Issued June 1961

SOIL SURVEY

Jackson County Oklahoma

OUR SOIL ★ OUR STRENGTH

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

HOW TO USE THE SOIL SURVEY REPORT

THIS SOIL SURVEY of Jackson County was made to find out the nature and extent of each kind of soil in the county. A soil scientist went into each part of the county. Wherever he went, he examined the surface soil and subsoil at many places; looked closely at the lay of the land; and watched for differences in the crops, weeds, brush, and trees that were growing on the different soils. He carried a photograph that was made from an airplane that flew directly overhead, and on it he plotted boundaries of the soils. He placed a symbol in each area to tell what kind of soil he saw there.

This report contains a description of each soil and statements about what that soil will do under different kinds of use and treatment. Soil maps of the entire county have been printed on the aerial photographs, which were pieced together to make a mosaic. Roads, towns, streams, and other important landmarks and places have been marked on the aerial mosaic.

Find your farm on the map

In using this survey, start with the soil map which is in the back of this report. To find your farm, use the index to map sheets at the back of the report. This is a small map of the county on which numbered rectangles have been drawn to show where each sheet of the soil map is located. The number will tell you the map sheet on which you will find your farm.

When you have found the map of your farm, you will find that boundaries of the soils have been outlined and that there is a symbol for each kind of soil. All areas marked with the same symbol, anywhere in the county, are the same kind of soil.

Suppose you have found on your farm an area marked with a symbol TaB. On the map legend, this symbol identifies Tillman clay loam, 1 to 3 percent slopes. The guide to mapping units, near the map legend, tells the page on which this soil is described, the pages on which it is mentioned in groupings of soils for dryland farming, and the page on which it is mentioned as part of a range site.

Finding information

Special sections of the report will interest different groups of readers. The introductory part, which mentions climate and physiography, relief, and drainage, and gives some statistics on agriculture, will be of interest mainly to those not familiar with the county.

Farmers and those who work with farmers can learn about the soils in the section, Descriptions of Soils, and then turn to the section, Use and Management of Soils. In this way they first identify the soils on their farm or ranch and then learn how these soils can be managed and what yields can be expected. The soils are grouped by capability units; that is, groups of soils that need similar management and respond in about the same way. For instance, Tillman clay loam, 1 to 3 percent slopes, is shown to be in capability unit IIIe-1 for dryland farming, and also in unit IIIe-1 for irrigation. The management this soil needs will be stated under capability unit IIIe-1, in the sections that deal with management of dryland and of irrigated soils.

Foresters and others interested in woodlands can refer to the section, Woodlands and Windbreaks. In that section the kinds of trees in the county are described and the factors affecting the management of woodlands are explained.

Engineers will want to refer to the section, Engineering Uses of Soils. Tables in that section show characteristics of the soils that affect engineering.

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

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

Newcomers and those who want general information about soils will be especially interested in the section, General Soil Areas, which describes the broad pattern of the soils. They may also wish to read the section, Additional Facts About the County.

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SOIL SURVEY OF JACKSON COUNTY, OKLAHOMA

BY ORAN F. BAILEY AND RICHARD D. GRAFT, SOIL CONSERVATION SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE

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

General Nature of the County

Jackson County is in the southwestern part of Oklahoma (fig. 1). Altus is the county seat and the largest city. The county contains approximately 499,200 acres, or 780 square miles.

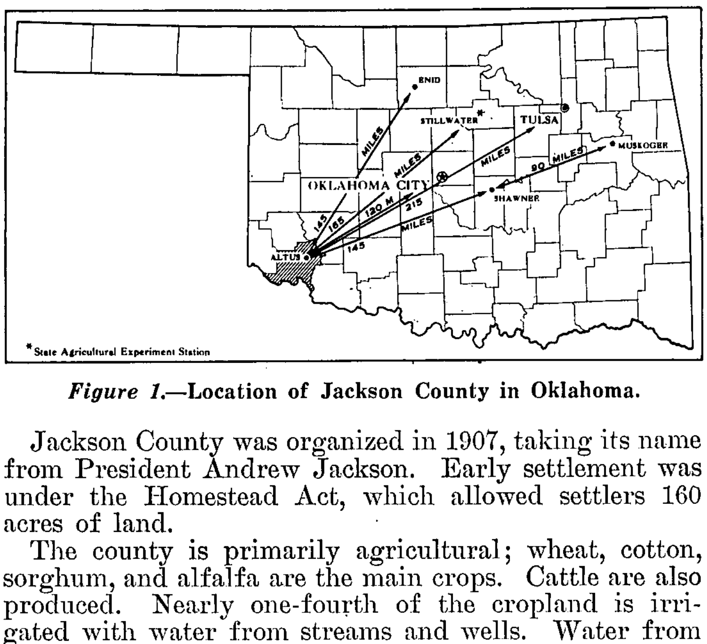

Figure 1.—**Location of Jackson County in Oklahoma.**

Jackson County was organized in 1907, taking its name from President Andrew Jackson. Early settlement was under the Homestead Act, which allowed settlers 160 acres of land.

The county is primarily agricultural; wheat, cotton, sorghum, and alfalfa are the main crops. Cattle are also produced. Nearly one-fourth of the cropland is irrigated with water from streams and wells. Water from the main streams is supplied to farmers by the W. C. Austin Irrigation Project.

The Jackson County Soil Conservation District was organized in 1938 under the Oklahoma Soil Conservation District Law of 1937. Under this law a district may be organized as a governmental subdivision of the State. The District is farmer governed by and operates under a board of supervisors elected by the farmers and landowners. The District maintains an office in Altus, Okla.

To provide a basis for good agricultural use of the land, this cooperative soil survey was made by the United States Department of Agriculture and the Oklahoma Agricultural Experiment Station. Fieldwork was completed in 1958, and statements in this report refer to conditions at that time.

General Soil Areas

This section gives general information for those who want a broad picture of the soils of Jackson County. A colored soil association map in the back part of the report shows the general soil areas that are described here.

As one travels over the county, it is easy to see differences in the landscape from place to place. Some of the differences are in shape, steepness, and length of slopes; in the course, depth, and speed of the streams; in the width of the bordering valleys; in the kinds of wild plants; and in the kinds of farming or ranching. With these obvious differences there are also differences, some of them less easily noticed, in the patterns of soils. The soils differ along with other parts of the environment.

By drawing lines around the different patterns of soils on a small map, one may obtain a general map of the soils. Each kind of pattern is sometimes called a soil association. The pattern, of course, is not strictly uniform in each association, but the same soils are present in somewhat the same arrangement. Such a map is useful to those who want a general idea of the soil, who want to compare different parts of a county, or who want to locate large areas suitable for some particular kind of farming or other broad land use. It does not show accurately the kinds of soils on a single farm or a small tract.

The general map shows eight soil associations. Each association contains several different soils that were formed from similar parent materials. Patterns of soils in two of the associations are shown in figures 2 and 3. Names of several soils are shown in these two figures. Each soil in the county is listed by name and is described in the section, Descriptions of Soils.

Each soil association is described briefly in this section and a few facts about some of the main soils in it are given. Some facts are also given about how the soils are used, and some of the problems that come up in taking care of them are discussed.

Nearly Level Soils That Have Clayey Subsoils, on Uplands: Tillman, Hollister

This association is on a large, broad plain that is nearly level to gently sloping. It is broken occasionally by narrow streams and in places by small areas of rough and broken land. The association covers about 40 percent of the county.

In the nearly level areas are the Tillman, Hollister, and Abilene soils. The gently sloping soils are mostly those of the Tillman series, with lesser amounts of Abilene and some Weymouth soils. The steep, broken areas are composed of Rough broken land. On the narrow stream bottoms are soils of the Spur and Port series.

The southern part of this association, in the Elmer and Hess communities, are areas of Dill soils. They are gently sloping to moderately sloping soils developed from soft sandstone of the red beds. Dill soils are in a landscape that is distinctly higher than the one of Tillman and Hollister soils.

Most of these soils are cultivated. A large part of the irrigated land in the county is in this association. Cotton, sorghum, and alfalfa are the principal crops grown under irrigation. These crops and wheat are also grown under dryland farming.

The conservation of water and protection against wind erosion are the major problems for continued use of these soils under dryland agriculture.

Moderately Sandy and Very Sandy Soils on Uplands: Miles, Nobscot

The Miles, Nobscot association is mainly in the northeastern part of the county. Minor areas of Miles soils are also in the western and southwestern parts. The chief soils in this association are moderately sandy to sandy, and their slope ranges from nearly level to steep. The association covers about 13 percent of the county.

The Miles soils, the most extensive soil series, have a surface soil that ranges in texture from fine sandy loam to loamy fine sand. They are nearly level to moderately sloping.

The Nobscot soils are more sandy and more undulating than Miles soils. The surface soil is fine sand. About three-fourths of the Nobscot soils are undulating, and their slope ranges up to 5 percent. Nobscot fine sand, 5 to 12 percent slopes, is a soil on long narrow ridges and dunes. The plants are sand sage, shinnery oak, and some tall grasses.

The Miles soils are suitable for irrigation and are almost all cultivated. The crops best suited are cotton, grain sorghum, wheat, rye, and alfalfa. About two-thirds of the Nobscot soils on the more level slopes are cultivated, and rye and grain sorghum are the crops best suited. The rest of the association is used for rangeland.

The severe risk of wind erosion and the low level of fertility on the coarse-textured soils are the main problems in using the soils of this association.

Deep, and Shallow, Moderately Sloping Soils on Uplands: La Casa, Weymouth

This association is in the western part of the county and makes up about 10 percent of the total area. The La Casa and Weymouth soils are gently to moderately sloping, but they are broken occasionally by shallow, stony soils or rock outcrops (fig. 2).

The La Casa soils are deep and gently sloping. Weymouth soils, which are not so deep, are gently to moderately sloping. Of less extent are the nearly level Till-

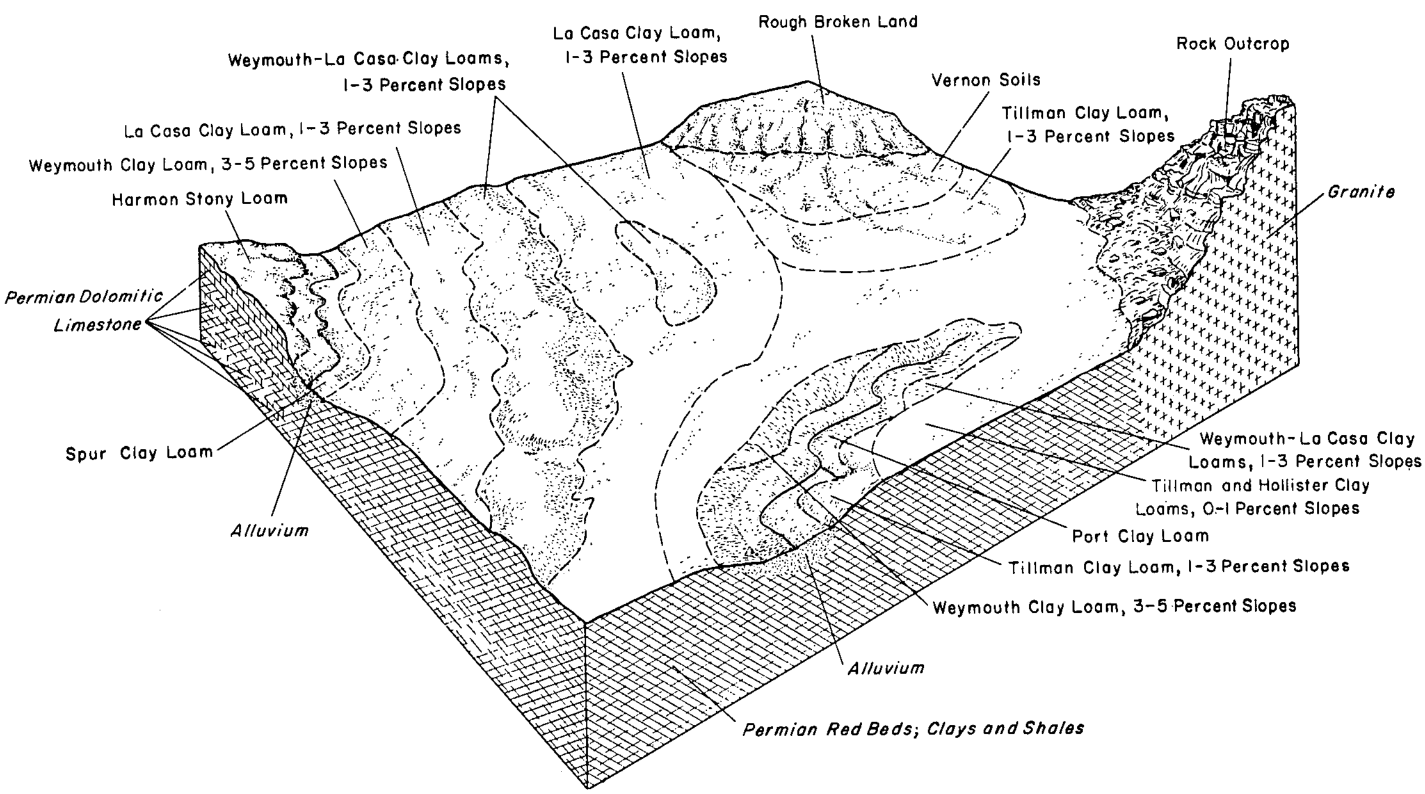

Figure 2.—**Typical pattern of La Casa and associated soils, Rough broken land, and Rock outcrop.**

man and Hollister soils. The shallow, steep soils are members of the Harmon and Vernon series.

Most of the soils are cultivated. They are generally friable below plow depth, and good yields can be obtained if moisture is adequate. Wheat is the major crop; grain sorghum, cotton, and alfalfa occupy smaller acreages.

Moisture conservation and erosion control are the major problems for continued production under dryland agriculture. The La Casa soils are suitable for irrigation; only small acreages, however, are irrigated.

Deep, Loamy, and Sandy Soils on Uplands: Tipton, Enterprise, Tivoli

This association lies along the rivers and covers about 15 percent of the county. The soils are mostly nearly level or gently sloping, but small bodies of steep Enterprise and Tivoli soils are located near the rivers.

The Tipton soils are in flat, terracelike areas. They were developed in loamy or silty alluvial or eolian material on uplands. The Enterprise soils are similar to the Tipton soils. They are formed in very fine sands and silts that were blown from channels of rivers. The Enterprise soils that are adjacent to the rivers are sloping, but those farther from the river are nearly level to gently sloping.

Tivoli soils consist of wind-drifted sands and are billowy or dunelike. Generally, they are near areas of Enterprise soils. In most areas the dunes are stationary; in a few places the soil is so unstable that the dunes are active.

Typical patterns of soils in this association and in the Miles, Nobscot association are shown in figure 3.

Tipton and Enterprise soils are fertile, are easy to cultivate, and are suitable for all crops grown in the county. These soils are well suited to irrigation, and a large acreage is irrigated. The Tivoli soil is used for range and produces only fair to poor grazing.

Smooth, and Steeply Sloping, Shallow, Clayey Soils on Uplands: Vernon, Rough Broken Land

This association is mostly in the western part of the county; minor areas are in other parts. It covers about 10 percent of the county.

The Vernon soils are in the smoother areas; they are on steep slopes adjacent to Tillman soils and also in slopes that border Rough broken land. Rough broken land consists of steep escarpments, canyons, and extremely gullied areas in which rocks of the red beds are exposed. Also included are areas in which layers of dolomitic limestone and beds of gypsum intermingled with clays of the red beds are exposed. The raw, compact, clayey alluvium below areas of Rough broken land is of the Treadway series.

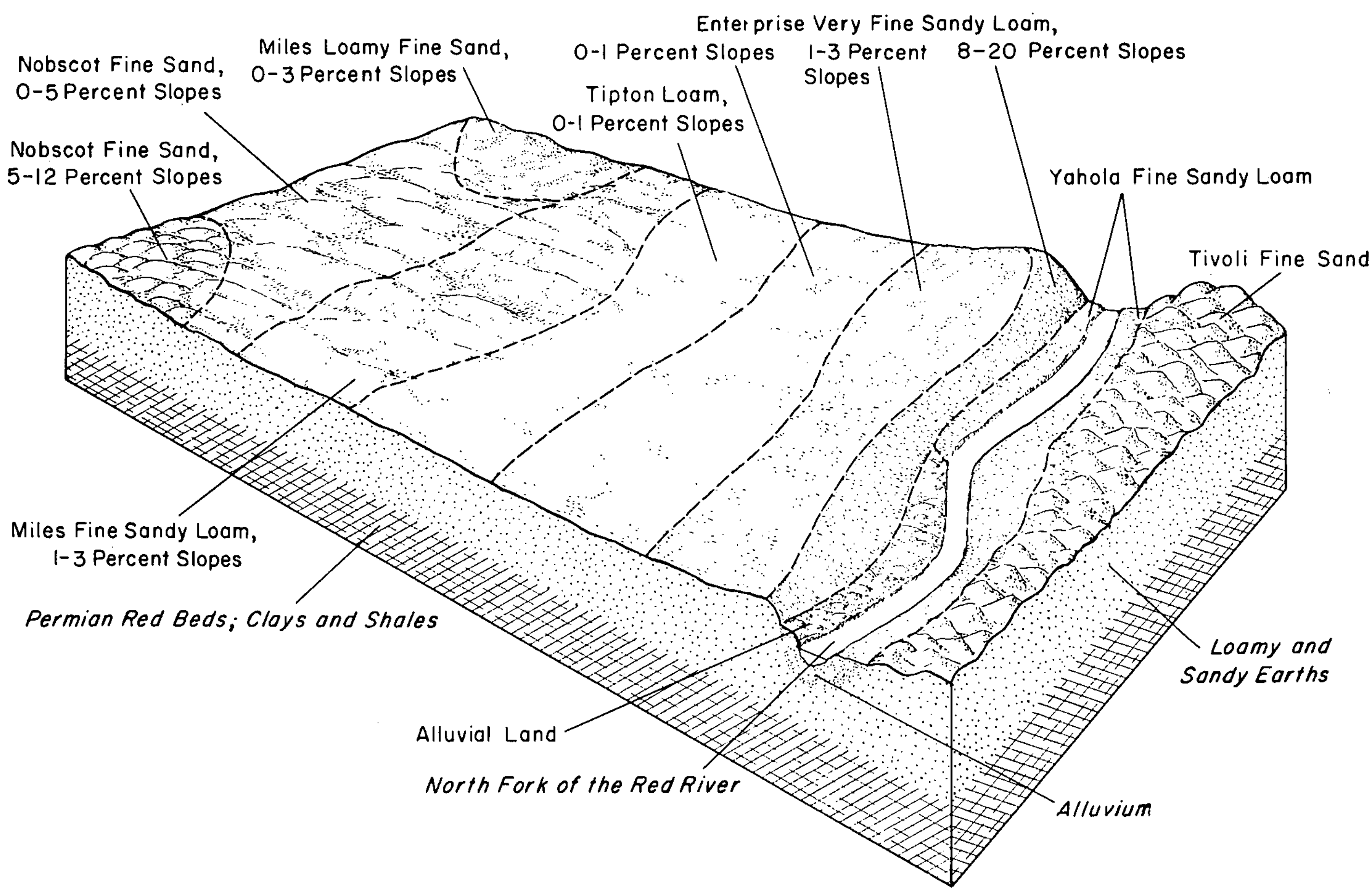

Figure 3.—**Typical pattern of Miles, Enterprise, Tivoli, and associated soils.**

Harmon soils make up about 10 percent of this association. They are shallow, stony soils that lie west of the Salt Fork of the Red River.

This association is unsuited for cultivation. The soils, in places, are so shallow and infertile that they support only scanty vegetation. Harmon and Vernon soils are the best grassland soils of this association, but good management is required to maintain grass on them.

Moderately Clayey Soils on Flood Plains: Spur, Port

This association lies along the major creeks and makes up about 6 percent of the county. The soils, formed in alluvium on flood plains, are nearly level. Rarely to occasionally they are flooded, but little damage is caused.

The Port soils are dark and reddish brown. They are along major creeks and usually occupy higher positions than Spur soils; consequently, they are less frequently flooded.

Minor parts of the association are Spur clay loam, wet phase, Spur clay loam, channeled, and Miller clay.

About three-fourths of this association is in cultivation and is used mainly for cotton, alfalfa, small grain, and sorghum.

Sandy Soils on Bottom Lands: Alluvial Land, Yahola

This association is on flood plains of the rivers. It covers about 6 percent of the county. The soils are subject to recurrent flooding and receive additions of fresh materials from time to time.

Alluvial land is made up mostly of sandy soils on the lower parts of the flood plains. These soils are susceptible to much sanding and scouring during floods and to cutting by the shifting river. They have a high water table and generally a very sandy subsoil.

Yahola soils as a rule are farther from the river channel than Alluvial land and are generally less sandy, are less frequently flooded, and have a somewhat deeper water table.

The Alluvial land is used mainly for range. It is choice rangeland and produces large and dependable amounts of forage. Yahola soils are suitable for both dryland and irrigation farming. Crops grown on them are cotton, small grain, and alfalfa.

Granitic Mountains: Rock Outcrop

This association consists of the stony granitic hills of the Wichita Mountains, in the eastern part of the county. Slopes are rough and steep, and there are patches of soil in some places.

Use and Management of Soils

This section consists of several parts. The first explains the system of land capability classification used by the Soil Conservation Service. Next there are three sections that deal with dryland farming: The general practices needed, the management of soils by dryland capability units, and the yields of crops that can be expected in dryland farming. Another group of sections deals with irrigation farming, general management of irrigated soils, capability groups of soils for irrigation, management of the irrigated capability units, and expected yields under irrigation. Then there is a section on range management, one on woodlands and windbreaks, and one on engineering uses of soils.

Capability Grouping

Capability grouping is a system of classification to show relative suitability of soils for crops, grazing, forestry, and wildlife, and particularly for the usual field crops. It is a practical grouping based on the needs and limitations of the soils, on the risk of damage to them, and also on their response to management. There are three levels above the soil mapping unit in this grouping. They are the capability unit, subclass, and class.

The capability unit, which can also be called a management group of soils, is the lowest level of the grouping of individual soils for this purpose. A capability unit is a group of soils that are similar in kind of management needed, in risk of damage, and in general suitability for use. It can also consist of a single soil. The capability unit is represented by a figure, for example 1, 2, or 3, in the classification symbols, such as IIIe-1, Vw-2, and VIs-3.

The next broader grouping, the subclass, is used to indicate the dominant kind of limitation. The letter symbol "e" indicates that the main limiting factor is risk of erosion if the plant cover is not maintained; "w" means excess water that retards plant growth or interferes with cultivation; and "s" shows that the soils are shallow, droughty, or unusually low in fertility. In some parts of the country, there is a subclass "c" for the soils that are limited chiefly by a climate that is too cold or too dry.

The broadest grouping, the land capability class, is identified by Roman numerals. All the soils in one class have limitations and management problems of about the same degree, but of different kinds, as shown by the subclass. All the land classes, except class I, may have one or more subclasses.

In classes I, II, and III are soils that are suitable for annual or periodic cultivation of annual or short-lived crops.

Class I soils are those that have the widest range of use and the least risk of damage. They are level or nearly level, productive, well drained, and easy to work. They can be cultivated with almost no risk of erosion and will remain productive if managed with normal care.

Class II soils can be cultivated regularly but do not have quite so wide a range of suitability as class I soils. Some class II soils are gently sloping; consequently, they need moderate care to prevent erosion. Other soils in class II may be slightly droughty, slightly wet, or somewhat limited in depth.

Class III soils can be cropped regularly but have a narrower range of use than those in classes I and II. These need even more careful management.

In class IV are soils that have greater natural limitations than those in class III, but they can be cultivated for some crops under very careful management.

In classes V, VI, and VII are soils that normally should not be cultivated for annual or short-lived crops but that can be used for pasture or range, as woodland, or for wildlife.

Class V soils are nearly level or gently sloping and are not likely to erode but are wet, low in supply of plant nutrients, or otherwise unsuitable for cultivation.

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, forage crops, orchard crops, or forest products. Some soils in class VI can, without damage, be cultivated enough so that some crops can be grown, fruit trees or forest trees can be set out, or special perennial crops or pastures can be seeded.

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

Class VIII (none in Jackson County) consists of soils that have practically no agricultural use. The soils have value as parts of watersheds, and some have value as wildlife habitats or for scenery.

The capability classes, subclasses, and units for dryland agriculture in Jackson County are given in the following list. The descriptive name gives the general nature of the principal soils in each unit. Soils in each unit are listed in the pages that follow.

Class I.—Soils that have few limitations that restrict their use.
- Unit I–1.—Deep, nearly level clay loams or loams on bottom lands or benches.

Class II.—Soils that can be used for tilled crops but with some risk of erosion or other limitation.
- Subclass IIc.—Soils that are limited in crop production by insufficient effective rainfall.
  - Unit IIc–1.—Deep, nearly level, clay loam soils with moderately heavy subsoils.
- Subclass IIe.—Soils that have moderate erosion hazard when used for tilled crops.
  - Unit IIe–1.—Deep, gently sloping, well-drained loams or clay loams on uplands.
  - Unit IIe–2.—Deep, nearly level to gently sloping, well-drained very fine sandy loams or fine sandy loams on uplands.
- Subclass IIs.—Soils moderately limited by low water-holding capacity or other soil properties.
  - Unit IIs–1.—Deep, nearly level, moderately well drained fine sandy loam on bottom lands.

Class III.—Soils that have severe limitations that reduce the choice of plants grown or that necessitate special conservation practices, or both.
- Subclass IIIe.—Soils subject to erosion if used for cultivated crops.
  - Unit IIIe–1.—Deep to moderately deep, gently sloping, well-drained clay loams on uplands.
  - Unit IIIe–2.—Deep, gently to moderately sloping, well-drained very fine sandy loams or fine sandy loams on uplands.
  - Unit IIIe–3.—Deep, gently undulating or gently sloping loamy fine sands on uplands.
  - Unit IIIe–4.—Deep, nearly level, somewhat slowly drained fine sandy loam on uplands.
- Subclass IIIs.—Soils with severe limitations of unfavorable tilth or lack of capacity for holding water that plants can use.
  - Unit IIIs–1.—Deep, nearly level, slowly drained clay on bottom lands.

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 very severe erosion.
  - Unit IVe–1.—Deep or moderately deep, sloping, well-drained fine sandy loam and very fine sandy loam on uplands.
  - Unit IVe–2.—Deep, gently sloping or undulating fine sand on uplands.
  - Unit IVe–3.—Shallow to moderately deep, moderately sloping clay loam on uplands.

Class V.—Soils that are too wet or frequently flooded for cultivation but may be used for grass.
- Subclass Vw.—Alluvial land subject to frequent overflow or excess water in the soil.
  - Unit Vw–1.—Deep, nearly level sandy soil on bottom lands.
  - Unit Vw–2.—Deep, nearly level clay loams on bottom lands.

Class VI.—Soils that have severe limitations that make them generally unsuitable for cultivation and limit their use largely to pasture or range.
- Subclass VIe.—Shallow or deep soils that are subject to severe erosion.
  - Unit VIe–1.—Deep, steep very fine sandy loam on uplands.
  - Unit VIe–2.—Deep, steep to duny, sandy soils on uplands.
- Subclass VIs.—Shallow, or stony, sloping upland soils and raw clayey alluvium.
  - Unit VIs–1.—Shallow, clayey soils on uplands.
  - Unit VIs–2.—Shallow, stony soils on uplands.
  - Unit VIs–3.—Raw, compact, clayey alluvium below outcrops of red beds.

Class VII.—Soils that have very severe limitations that make them unsuitable for cultivation and that restrict their use largely to grazing, woodland, or wildlife.
- Subclass VIIs.—Rough broken land or rock outcrops.
  - Unit VIIs–1.—Rough, steep, rock outcrops.
  - Unit VIIs–2.—Rough broken land.

General Management Practices for Dryland Farming

The chief problems in using and managing the soils are control of soil erosion, conservation of moisture, maintenance of an adequate level of fertility, use of suitable cropping systems, use of good methods of tillage, proper use of forage crops, and adequate control of weeds and insect pests. These principles of management, which are basic to good farming, are discussed briefly.

Erosion control and water conservation

Most farmers need to use one or more water-control devices on their farms, such as field terraces, diversion terraces, waterways, or farm ponds; and it is likely that they will also benefit by practicing contour farming.

Terraces.—A terrace is a ridge, or a combination of a ridge and channel, built across the slope to divert or stop the flow of water. Terraces are used to reduce erosion and conserve moisture. They also serve as guidelines for contour farming, and to help spread water that has been diverted into the system on slopes of 1 percent or less.

Terraces can be used on all soils suitable for crops in Jackson County except soils that are rocky, sandy, or subject to overflow.

Field terraces.—Three types of level field terraces—ridge, impounding, and channel—are used in this county. The ridge and impounding types are used on slopes of 3 percent or less. The ridge type of terrace is constructed by moving the soil from both the upper and lower sides to form the ridge of the terrace. The impounding type is constructed by moving all the soil up the slope from a wide area below the terrace ridge. The impounding type of terrace is built with closed ends to allow the maximum amount of moisture to be conserved; where necessary, provisions are made to drain off surplus impounded water.

Channel-type terraces are generally used to control erosion on slopes of more than 3 percent. They are built by moving all the soil downslope to form a channel and a ridge.

To work satisfactorily, terraces must be designed and built properly with respect to layout, cross section, height, protected spillways, and planned closures and outlets at the ends. They will need to be well maintained. The irregularity of slopes, variation in width of the strips between terraces, and the type of farming equipment used for various crops cause the methods of maintaining terraces to differ. Therefore, it is difficult to establish definite rules for farming terraced fields so that the terraces will be maintained properly. Among the best practices for protecting the terraces is to plow and plant crops parallel to the terrace. This practice protects the terrace, and it also helps to store moisture for the crops.

Diversion terraces.—Diversion terraces are built to carry more water than field terraces. They are used to protect cultivated fields from runoff from adjoining land, to increase or decrease the amount of runoff water entering a farm pond, to divert excess water from active gullies, and to divert water from points of concentration to places where a system of water-spreading or impounding-type terraces has been installed.

Diversion terraces can be used on all the soils in Jackson County, except on those that are rocky, sandy, subject to overflow, or that are too steep and rough to permit their construction.

Diversion terraces are laid either level or graded. Like the field terraces, there are three types—channel, ridge, and level impounding.

Diversion terraces are constructed so that farm machinery can be used to control undesirable vegetation in pastures, or to make cultivation easier in cropped fields. Where practical, a broad strip of permanent vegetation should be established above the diversion terrace in a cultivated field to protect the channel from sediment.

Each diversion terrace must be designed individually. The size is determined primarily by the extent, slope, and permeability of the soils that drain into it and by the cover on the drainage area. The outlet for the diversion terrace needs to be a pasture or other vegetated area with a stabilized grade capable of carrying the additional water.

In cropped fields, maintenance of diversion terraces is the same as that for field terraces. Mowing to control undesirable vegetation is the principal maintenance practice needed for terraces on pastures.

Grassed waterways.—Grassed waterways are built to safely carry away runoff that has collected in natural drainageways, terraces, drainage systems, or irrigation systems. Waterways are commonly used on all kinds of soils except those that are flooded from creeks, rivers, or very large drainageways.

Waterways consist of broad, grass-covered, flat-bottomed channels built at such a grade that runoff water does not erode. A retaining dike, if one is needed, can be built on each side of the channel to increase capacity. Bermudagrass or native grasses are commonly used for vegetative cover.

Each waterway needs to be especially designed and built. The size of the area drained, and the slope, erodibility, and permeability of the soil are important in the design of a waterway. So, also, are the erosion-control practices that are planned or in effect, and the kind and quality of vegetation on the watershed. All of these factors are considered to determine width, depth, grade of channel, and kind of vegetation needed. A waterway is shown in figure 4.

In tilled fields, waterways need to be maintained with care. Weeds can be controlled by mowing or spraying. Vigorous growth of grass can be promoted by applying fertilizers as needed. Some waterways will need protection from overgrazing and from excessive traffic. Size and shape can be maintained by lifting tillage implements when crossing waterways and by keeping the designed width when the rest of the field is tilled. It will be practical to protect some waterways by fence.

Technical assistance in design, construction, and main-

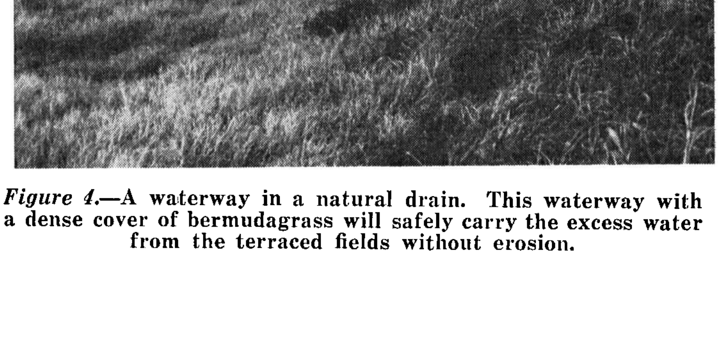

Figure 4.—**A waterway in a natural drain. This waterway with a dense cover of bermudagrass will safely carry the excess water from the terraced fields without erosion.**

tenance of waterways is available from the local representative of the Soil Conservation Service.

Farm ponds.—Farm ponds are useful to provide water for livestock, to distribute grazing, to furnish irrigation water, to aid in the stabilization of waterways or gullies, and to produce fish.

The two types of farm ponds used on the ranges of Jackson County are the impounding and the excavated, or pit, type.

An impounding pond is formed by placing an earth fill across a valley or drainageway. Excavated, or pit, type ponds are used in range areas where the topography is nearly level and where sites are not available to impound water behind an earth fill. An excavated pond consists of a square or rectangular hole dug below the surface, located so that runoff water will fill it.

To maintain capacity over long periods, locate every farm pond on a drain that is protected from erosion that will produce sediment. As a rule, a drainage area of 35 acres for each acre-foot of pond water storage will be needed.

Spillways should be designed to take care of a 50-year intensity rain. Wherever possible, ponds should be at least 12 feet deep, and water of that depth should cover at least 750 square feet.

To maintain a farm pond, cover the fill and spillway with bermudagrass sod, fence the pond and spillway, and keep good cover on the watershed. Where bermudagrass will not grow, or if you don't want it, seed a locally adapted or native grass and apply a cover of noncompetitive mulch.

Contour farming.—Contour farming, a practice that can be widely used in Jackson County, consists of planting and tilling across the slope. Many benefits result from contour farming (fig. 5). More rainwater soaks into the soil and is available to plants. Water erosion is reduced. It is easier to get a stand of plants, and crops tend to be more uniform in size. Farm equipment is easier and more economical to operate on the contour than up and downhill.

***Figure 5.*—Contour farming and terracing keep most of the water where it falls.**

***Figure 6.*—A field that has been plowed to a depth of 20 inches to help control wind erosion. Large chunks of the sandy clay loam subsoil cover the surface. The field will need to be tilled several times to break up the chunks before a crop can be planted.**

Practice contour farming on all terraced land. Practice it also on all sloping land that is not terraced, unless it is more beneficial to run rows in an east-west direction to control wind erosion.

Deep plowing.—Deep plowing is a practice for control of wind erosion. It is suitable only on soils that have moderately coarse or coarse textured surface soil and sandy clay loam subsoil (fig. 6). The depth of plowing varies from 16 to 24 inches. For good results, 1/4 to 1/3 of the furrow slice should be of the finer textured subsoil material.

Soils that are deep plowed should be properly fertilized and seeded to crops that produce large amounts of residue. If the soils are suitable, an entire field should be deep plowed at one time.

Deep plowing, properly done on suitable soils, will increase crop yields and decrease soil blowing. Without proper soil management, however, deep plowing is just another way to deplete the soil.

The expense of deep plowing increases the cost of farming. The practice may be useless and, in some places, harmful. Coarse-textured soils that are very shallow or shallow, and those with subsoils that are either very high or very low in clay, should not be deep plowed; nor should medium- or fine-textured soils, or those that have sandy surface soils of less than 4 to 7 inches in thickness. Soils of more than 4 percent slope are too erodible. Those with subsoil that is dispersed, or that for some other reason do not respond well under tillage, are not suitable for deep plowing.

Wind stripcropping.—Wind stripcropping is an effective means of reducing blowing on sandy soils. Peanuts and cotton are crops that do not protect the soil against blowing; they are commonly grown in strips separated by strips of sorghum, which is a crop that will protect the

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soil from blowing. A high stubble of sorghum should be left on the soil during winter and early spring.

The greatest allowable width of a tilled strip can be figured by a rule of thumb that has been found effective. This is: On fine sand, 1.5 rods; on loamy fine sand, 4 rods; on fine sandy loam and highly granular clay, 8 rods; and on loam, silt loam, or clay loam, 20 rods. Strips of clean-tilled crops and of erosion-resistant crops should be of the same width. Strips should be laid out as nearly as possible at right angles to the direction of prevailing winds during the blowing season. These precautions will tend to hold the movement of soil to less than the allowable limit of one-fourth ton per rod per hour.

Fertilizers and cropping systems

Practices for soil improvement are fertilization, growing of soil-improving crops, management of crop residues, stubble mulching, growing cover crops, selecting the rotation or sequence of crops, and emergency tillage.

Fertilization.—Since the average annual rainfall is only about 25 inches, fertilization of crops on dryland is questionable except on a few soils. The variation of rainfall in different years, from 13 to 50 inches, makes it difficult to determine the amount and kind of fertilizer to use.

Experiments on fertilizing cotton have been carried out at the Sandy Land Research Station at nearby Mangum, Okla. Results indicate that fertilization of this crop on sandy soils was profitable during 6 years. Experience of farmers has shown varying degrees of success.

On moderately sandy and sandy soils, it has been profitable to fertilize alfalfa, cotton, peanuts, and truck crops. Response to fertilizers on these crops has been best on soils of inherently low fertility.

Most of the current soil tests do not show that fertilizers are needed on the mixed soils or the clayey soils, although crops grown on these soils respond to fertilizers during years of high rainfall. Use of fertilizers should be based on recommendations issued by the Oklahoma Agricultural Experiment Station.

Applications of nitrogen and phosphorus are likely to give worthwhile returns of cotton, peanuts, and truck crops on most soils. Potassium is likely to give response on sandy soils in some places.

Soil-improving crops.—Crops that can be grown for improvement of soil include several legumes, several grasses, and a few others.

Legumes that are suited in the county are alfalfa, sweetclover, cowpeas, mungbeans, Austrian winter peas, hairy vetch, and guar. Of these, the best suited are alfalfa, sweetclover, and cowpeas.

In years of average or above-average rainfall, mungbeans, Austrian winter peas, vetch, and guar grow well. Rotations that contain legumes are used successfully throughout the county except on tight or shallow soils. On these soils, small grain is the best suited. If legumes are grown, a good growth should be turned under for soil improvement.

Mixtures of native or introduced grasses can be grown for pasture, and the sod can be turned under for soil improvement. Under dryland conditions native grasses require from 2 to 4 years to become established and should be used in a long-time rotation. Blue panic is one of the successfully introduced grasses.

Other crops that produce large amounts of residue can be grown to improve the soil. Improvement is obtained only if a good amount of residue is returned to the soil.

Management of crop residues.—Leaving crop residues on the surface or working them partly into the soil has a number of advantages. The residue protects the soil against wind and rain. The soil is kept somewhat cooler in summer and warmer in winter, since much of the surface is covered. Crusting of the surface is reduced, and stands of crops planted are better. The surface of the soil is protected, which permits more of the rain that falls to soak into the soil. Since the supply of organic matter is increased, pore space also is increased, tilth of the soil is improved, capacity for moisture is increased, and the food supply for micro-organisms is increased.

Stubble mulching.—The aim in stubble mulching is to farm so that a protective cover of crop residues is kept on the surface of the soil. Methods and equipment for tilling, planting, and harvesting are chosen to kill weeds but not to cover the residues completely. Sweeps, rod weeders, and blades are used to undercut the residues and leave them on the surface. Seeding equipment is needed that will drill through trashy cover.

Stubble mulching is not yet widely used in the county but is gaining acceptance. Many farmers, after harvest, now use sweeps and chisels to control weeds and prepare seedbeds. This method leaves most of the stubble on the surface at time of seeding. In some fields, stubble is worked into the surface soil by seeding time. This nullifies the benefits of stubble mulching. The most dangerous period for wind erosion is usually after the small grain is seeded in the fall and before it has made sufficient growth to protect the soil. A stubble-mulched field is shown in figure 7.

Stubble mulching is beneficial on all soils, especially where small grain is to be seeded. Benefits are about the same as those discussed under the heading, Management of Residues.

How much residue is required to control wind erosion? There are so many factors involved, such as wind speed, physical condition of the soil, and kind of soil, that only a general statement can be made. As a general estimate, from 1,000 to 3,000 pounds of residue, evenly distributed over the area and anchored on the surface of the soil at seeding time, can be expected to protect the soil and the crop until seedling wheat supplies adequate cover. Generally, about 100 pounds of straw is produced for each bushel of wheat.

The benefits of stubble mulching and the machinery and methods necessary for a good job are not yet widely understood. The work can be done well with any of several machines. In general, however, experience has shown that sweeps at least 2 feet wide manage the surface residues most efficiently. Secondary tillage tools are also needed, such as a rotary hoe or skew-treader, a chisel, and a one-way plow.

After a heavy crop, when a lot of stubble is present, the one-way plow can be used first to reduce the amount of residue on the surface to a more workable amount

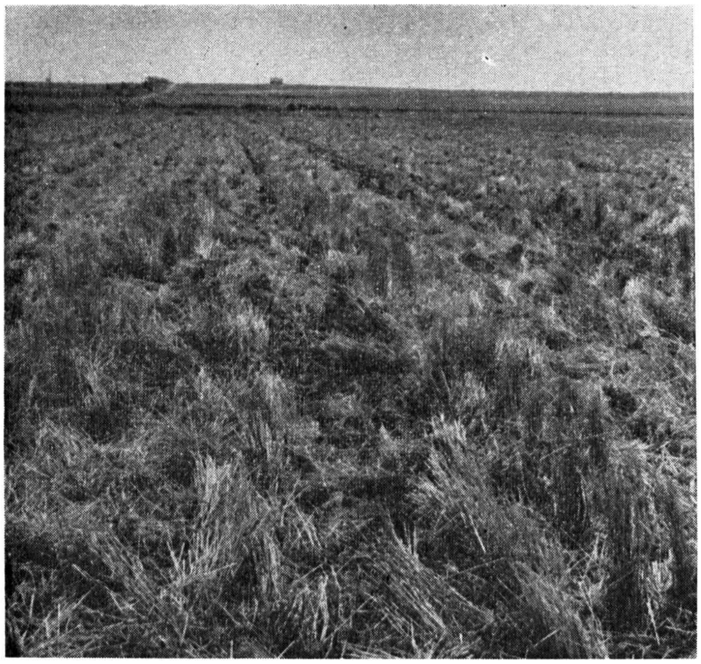

Figure 7.—**Stubble-mulch tillage can be done by using sweeps to undercut the stubble and leave it anchored and evenly distributed on the surface.**

Each operation of a one-way plow reduces by approximately 50 percent the amount of residue left on the surface.

Cover crops.—Cover crops, such as rye, can be grown on sandy soils to prevent wind and water erosion during winter and early spring. They are now grown extensively. One of the main objections to cover crops has been that they use up valuable moisture needed for growth of crops that follow. Experience of farmers in this county has shown, however, that benefits of the cover crop more than compensate for the soil moisture used. Crop yields have been increased when rye is grown as a cover crop. Other small grains are sometimes grown, but rye is the principal one for this purpose.

By the use of specially constructed drills, rye can be seeded in cotton early in September to protect the soil during winter.

Crop sequence and rotations.—On soils used chiefly for grain, if a legume is grown, it is usually seeded so that the small grain serves as a nurse crop. In some fields the nurse crop is volunteer small grain. The nurse crop is desirable because of the uncertainty of obtaining a stand of legumes on most soils. The entire growth should be plowed down about the middle of May.

Where small grain, cotton, and sorghum are grown, small grain is the best crop to seed for cover after cotton.

If alfalfa or sweetclover is grown in a rotation and left on the field for 2 years or longer, cotton is then the next crop grown. In a rotation with small grain, the legume crop is plowed down early in spring, and the field is summer fallowed until fall.

On sandy soils where wind erosion is a problem, the most dependable annual legumes in rotations are cowpeas and guar. The entire growth may be turned under in July or August or disked into the soil so the field can be seeded to rye for winter cover.

Crops, other than legumes, that can be used for soil improvement in rotations are small grain, sudangrass, sorghum, and grasses such as blue panic, weeping lovegrass, and others. To obtain the benefit of a soil-improving crop, the growth should be returned to the soil, and the residue should be managed to help save moisture and prevent blowing.

Emergency tillage.—The use of vegetative cover is the best method of controlling wind erosion; there are times, however, when tillage is necessary to create a rough, cloddy soil surface to resist blowing for a while.

Emergency tillage, as the name implies, should be done only in emergencies when the vegetation is not enough to protect the soil. The practice can be applied rapidly. Even though it serves to control wind erosion for a while, it should not become a normal operation because of detrimental effect on soil structure and the loss of soil moisture.

Factors that influence the effectiveness of emergency tillage are speed of the equipment, depth of tillage, spacing between chisels, and size of the chisel points.

For general conditions in Jackson County, medium speeds of 3 to 4 miles per hour are considered the most effective for increasing surface roughness. The depth of tillage is variable, but it should be enough to bring clods to the surface. Loose soils will have to be worked deeper than tight hardlands. Spacing will depend on the particular area being worked. Close spacing of 27 to 36 inches is generally effective, but to control moderate wind erosion, a spacing of 44 to 54 inches is usually adequate. The wider spacing is especially desirable if an attempt is being made to salvage a wheat crop.

Choice of the width of chisel points depends on soil texture and compactness. There is little or no difference at close spacing, but a narrow chisel is less effective at wide spacing. In compacted soils a narrow chisel of the heavy-duty type should be used. A lister plow should be used for ridging on loose, sandy soils. The direction of rows should be at right angles to the prevailing wind during the blowing season.

Facts that should be considered in emergency tillage are: (1) Chiseling is rarely successful on sandy soils; (2) effectiveness in chiseling soils low in organic matter is short lived because the soil runs rapidly together again when it becomes wet; (3) when soil moisture is low, emergency tillage contributes to further depletion of moisture; (4) the use of equipment tends to pulverize the surface soil; (5) emergency tillage is a costly extra operation that should be delayed as long as possible; and (6) emergency tillage should cover the entire area being treated, and should not be done in strips.

Control of weeds and insects

Weeds.—The weeds that are most difficult to control are johnsongrass, bindweed, and field dodder.

Johnsongrass is a noxious weed in Jackson County, and is prevalent in all sections. It grows on roadsides, along railroads, and on creek banks. The seed is spread to cultivated fields by wind, birds, overflow water, and tillage equipment. Spot treatment is practicable, and control may be done by using tillage methods or chemical sprays. Continuous pasturage through the growing season also is an effective control measure.

Bindweed grows in all sections of the county, but it is generally confined to small areas within any particular field. A combination of chemical and tillage measures can be used to control it. Soil sterilizers are practical only where the weed is present in a small area and the treatment will not contribute to the hazard of wind erosion. Bindweed is probably the most difficult of all weeds in the county to control without taking the land out of crop production for a while.

Field dodder is another noxious weed that is difficult to control. At present, clean cultivation is the only successful method.

Many other weeds grow in the county, but as a rule they can be controlled by proper cultivation and the use of weed-free seed.

Insects.—Soil insects and worms make up one group of troublesome pests. Nematodes are found in damaging numbers in the sandy soils. They cause damage to most vegetable plants and slight damage to cotton. Control is difficult and often too expensive to permit treatment of large fields. White grubworms and wireworms infest a small area in the western part of the county. These two pests generally do not cause enough damage to warrant special control of them.

A number of feeding insects cause damage to such cash crops as cotton, small grain, grain sorghum, and alfalfa.

Insects that do the most damage to cotton generally are the bollworm, boll weevil, cabbage looper, fleahopper, and thrip. A good insect-control program, carried out regularly, will control them.

Insects that cause the most damage to wheat are greenbugs and cutworms. They can be controlled with insecticides that are recommended by the Oklahoma Agricultural Experiment Station.

The spotted alfalfa aphid is the most damaging insect to alfalfa. This is the most difficult insect to control among those that now infest crops in Jackson County. However, with proper timing and the right insecticide, good control can be accomplished.

The chinchbug and corn earworm cause some damage to grain sorghum but seldom cause enough damage to make control measures profitable.

Management of Capability Units Suited to Dryland Crops

Capability unit I–1

The soils of capability unit I–1 are deep, dark-colored, nearly level clay loams and loams. They have moderately permeable or slowly permeable subsoil. They are on first and second bottoms and adjacent benches or old terraces. The soils are fertile and are the most productive of any in the county. The soils are:

Port clay loam.
Spur clay loam.
Tipton loam, 0 to 1 percent slopes.

These soils are well suited to all small grains, cotton, sorghum, and alfalfa. Well-suited legumes other than alfalfa are sweetclover, cowpeas, guar, vetch, and Austrian winter peas. Diversion terraces are needed in some places to break up concentrations of water and to protect against runoff from higher lying areas.

A cropping system that will conserve soil and moisture will include a soil-improving crop 1 year in 6, and another high-residue crop 1 year in the other 5. The formation of tillage pans can be reduced by varying the depth of tillage. Stubble mulching is a valuable practice to help increase intake of water.

Capability unit IIc–1

These are deep, dark-colored soils that have clay loam surface soil and slowly permeable subsoil. They are nearly level and on uplands. They take water fairly well and have only a slight hazard of runoff and erosion. Moisture conservation is the chief problem. The soils in this unit are:

Abilene clay loam, 0 to 1 percent slopes.
Tillman and Hollister clay loams, 0 to 1 percent slopes.

These soils are best suited to small grain. Cotton and sorghums are a little more uncertain during years of below-average rainfall. There are no specific erosion problems. Terraces for moisture conservation are now being used on a few farms. Farm on the contour if the soil is terraced. Diversion terraces are needed in places to break up concentrations of water on the long, nearly level slopes. Use stubble mulch tillage.

Use soil-improving crops 1 year in 6, and high-residue crops one-fifth of the remaining time. Stands of alfalfa or clover are difficult to obtain in years when rainfall is low. Annual legumes such as mungbeans and Austrian winter peas can be grown in such years.

Capability unit IIe–1

These deep, dark-colored soils have loam or clay loam surface soil. Some have moderately permeable subsoil, and others have slowly permeable subsoil. They are gently sloping and on uplands. Loss of moisture through runoff and a slight susceptibility to erosion are the main problems in use and management. The soils in this unit are:

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

These soils are highly productive, but the need for moisture conservation is increasing. The best suited crops are small grain, cotton, sorghum, and alfalfa. Small grain is the most dependable crop, except on the Tipton soil, where cotton and sorghum are likely to grow better. Stubble mulching on all the soils is beneficial, and crop residues should be properly used.

A cropping system that will conserve soil and moisture on terraced and contour-farmed land consists of a soil-improving crop 1 year in 6 and a high-residue crop 1 year in 5.

Without terraces, plant close-growing crops continuously; if erosion in drains cannot be controlled with crops in the regular cropping system, seed alfalfa and grass.

Capability unit IIe–2

These are deep soils that have very fine sandy loam or fine sandy loam surface soil and friable, moderately permeable subsoil. They are nearly level to gently sloping

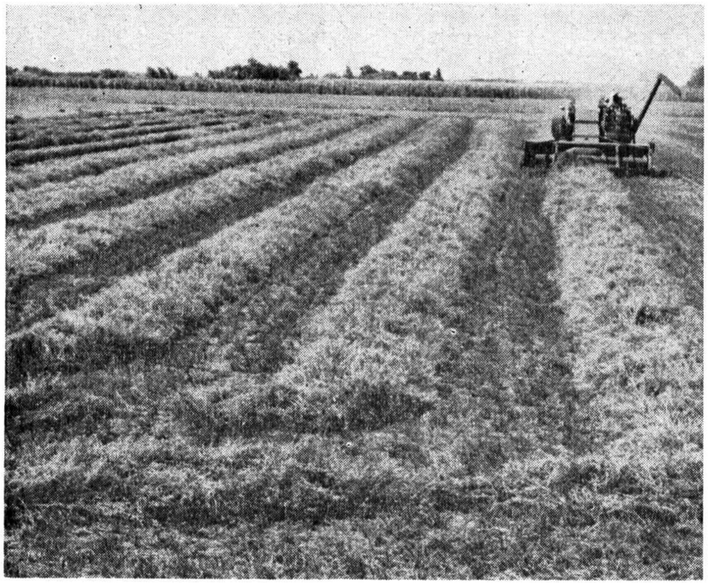

Figure 8.—**Threshing alfalfa seed with a combine harvester. One or two cuttings of hay are obtained before the alfalfa is allowed to seed.**

and are on uplands. Since they have a moderate tendency to blow, control of erosion is needed. The soils in this unit are:

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

Crops suited are cotton, small grain, sorghum, alfalfa, and peanuts. Legumes that can be grown successfully are alfalfa (fig. 8), sweetclover, cowpeas, guar, and vetch. The soils are suited to truck crops, such as watermelons, sweet corn, and okra. They are also good for fruit trees, such as peach, pear, and apple.

For protection from wind erosion, leave crop residues on the land and plant rye for winter cover. Plowing the Miles soil to a depth of 16 to 24 inches will reduce the problem of wind erosion. To conserve soil and moisture on Enterprise very fine sandy loam, 1 to 3 percent slopes, use a complete terrace system, contour farming, and stubble mulching; without terraces, use a cropping system that includes soil-improving crops 1 year in 4 and a close-growing crop 1 year in the other 3. Seed alfalfa and grass in drains if crops in the regular system do not control erosion.

In years of above-average rainfall, planting in low places is likely to be delayed and some crops may be drowned. Some of the low places can be filled or drained. Plantings for windbreaks do well on these soils. Depth of tillage in cropped fields can be varied to reduce formation of a tillage pan.

Capability unit IIs-1

This is a deep, moderately fertile soil on nearly level flood plains. In most places the soil is subject to overflow, but crops are seldom damaged. The soil has a moderately sandy subsoil that takes water rapidly but cannot hold large amounts of water for plant use. The unit consists of only one soil, Yahola fine sandy loam.

The most suitable crops are cotton and sorghum. Alfalfa is well suited, but it is likely to be drowned if the soil is flooded, and the stand is hard to maintain. Annual legumes like cowpeas and guar are most successful and can be grown in rotation.

Waterways to remove excess water are needed in some places. For control of wind erosion, leave crop residues on the surface and grow rye as a winter cover crop.

To conserve soil and moisture, use a cropping system that includes soil-improving crops 1 year in 6, and a close-growing crop 1 year in the remaining 5. Crops that leave a large amount of residue can be grown continuously. Depth of tillage can be varied to reduce formation of a tillage pan. Trees for windbreaks and posts can be grown.

Capability unit IIIe-1

These are deep to moderately deep, gently sloping soils on uplands. They take water well but lose a considerable part of the rainfall through runoff. The soils are subject to moderate erosion. They are:

Mansic clay loam, 1 to 3 percent slopes.
Tillman clay loam, 1 to 3 percent slopes.
Weymouth-La Casa clay loams, 1 to 3 percent slopes.

Wheat, oats, and barley are the crops best suited. Sorghums seldom are grown except in years of favorable rainfall. Cotton is a low-yielding crop on these soils.

Conserve moisture and prevent erosion with terraces, contour farming, and stubble mulching. Diversion terraces are needed in some places to prevent washing as a result of runoff from higher land. Use soil-improving crops 1 year in 4, and keep half the land in close-growing crops. Proper management of crop residues is especially important on the Mansic soil to prevent surface crusting.

To conserve soil and moisture without terraces, use a cropping system that contains a high-residue crop each year and one crop for soil improvement 1 year in 3.

Capability unit IIIe-2

These are deep, gently to moderately sloping, fine sandy loams or very fine sandy loams. They have friable subsoil that takes water well and makes moisture, even from small rains, available to crops. These soils have a tendency to blow and are moderately susceptible to water erosion. The soils are:

Dill fine sandy loam, 1 to 3 percent slopes.
Enterprise very fine sandy loam, 3 to 5 percent slopes.
Miles fine sandy loam, 1 to 3 percent slopes.
Miles fine sandy loam, 3 to 5 percent slopes.

Cotton, sorghum, and wheat are the crops best suited to these soils. Alfalfa is grown only on the nearly level or gentle slopes. Sweetclover, cowpeas, and guar are also dependable legumes. Peanuts are grown on these soils, but wind erosion is generally severe unless intensive conservation measures are applied.

Stripcropping, with alternate strips of cotton or peanuts and of feed crops in rows, will help control wind erosion. Plant rye for winter cover. Leave crop residues on the soil during winter. Windbreaks can be grown on these soils.

In a cropping system with terraces, farm on the contour, use stubble mulching, and grow legumes. Without terraces on 1 to 3 percent slopes, grow a soil-improving crop 1 year in 4 and a close-growing crop 1 year in the remaining 3. On slopes of 3 to 5 percent without terraces, a suitable cropping system is one that includes a soil-improving crop 1 year in 4 and a close-growing crop every year. Vary the depth of tillage to reduce formation of a tillage pan.

Capability unit IIIe-3

These are deep, gently undulating or gently sloping sandy soils. They take water well and have fair to good capacity to store moisture. The Miles loamy fine sand includes several areas that are naturally subirrigated. Wind erosion is the most serious hazard in farming these soils. The soils are:

Enterprise loamy fine sand, 0 to 3 percent slopes.
Miles loamy fine sand, 0 to 3 percent slopes.

The crops best suited are cotton and sorghum. Peanuts do well, but wind erosion is a problem if they are grown. Vetch is a good legume when the supply of moisture is above average. Cowpeas, an old standby, are also among the dependable legumes. Alfalfa can be established by seeding in sorghum. In the subirrigated areas, crops are sometimes delayed because the soil is too wet to work during seasons of above-normal rainfall. The soils in this unit are suitable for fruit trees, such as pear, peach, and apple.

To control erosion, plant cotton or peanuts in alternate strips with sorghum. Plant rye for winter cover and soil improvement. Leave crop residues on the land during winter. Successful windbreaks have been grown on these soils, and they help control wind erosion. Plowing the Miles soil to a depth of 16 to 24 inches will also reduce wind erosion. To keep cover on the surface, grow a soil-improving crop 1 year in 4 and a high-residue crop such as rye or sorghum at least 1 year in each 2.

Capability unit IIIe-4

This is a deep, nearly level soil that has, in most places, a moderately compact subsoil. The soil in several places is subirrigated, and in these areas, slick spots are present in varying degree and size. This soil is moderately productive but requires good management to prevent wind erosion. The subirrigated areas are somewhat limited by excess water during extremely rainy seasons. The soil is Altus fine sandy loam, 0 to 1 percent slopes.

Small grain, cotton, sorghum, and alfalfa are considered the crops best suited to these soils. Other crops can be grown when rainfall is not too great or when the season is extremely dry. On the wet spots, grasses for pasture or seed (fig. 9) are more likely to succeed than the other crops.

Stubble mulching and the management of crop residues on these soils will help prevent wind erosion and aid in the intake of water. To reduce formation of a tillage pan, vary the depth of tillage.

There are minor water problems; drainage, however, will improve production in the low places. A few trials indicate that the use of gypsum on slick spots will improve the physical condition and the intake of water.

Capability unit IIIs-1

This is a deep, nearly level, slowly drained, droughty clay on the flood plains. It takes water slowly and re-

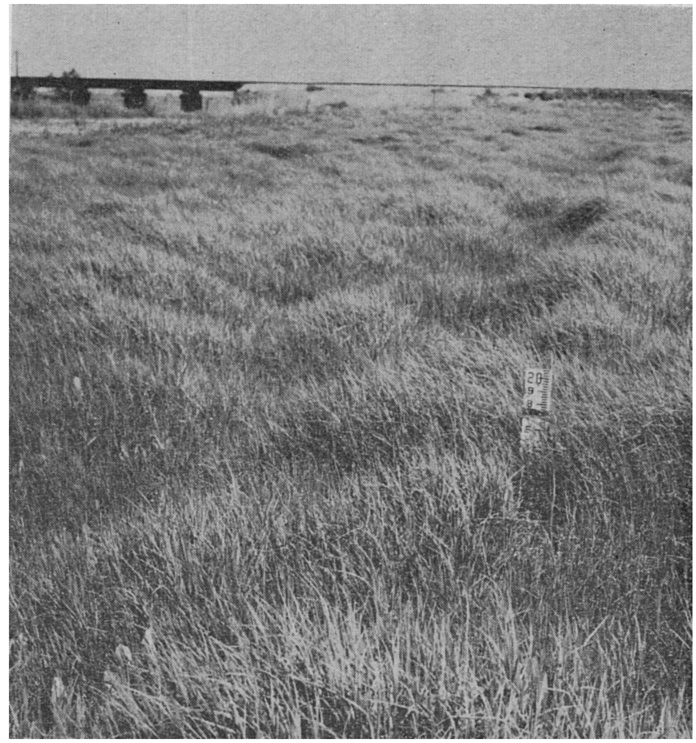

***Figure 9.*—The wet soil of unit IIIe-4 will produce good pastures of midland bermudagrass.**

leases only a moderate amount to plants. The surface soil has a tendency to run together when wet, and it crusts badly when it dries. Moisture conservation is the major problem. This unit consists of only one soil, Miller clay.

Wheat, oats, and barley are the main crops. Legumes are not grown much, because of the lack of moisture in dry weather and the difficulty in getting a stand. Grasses are the best soil-improving crops for this soil.

Tillage should be done with implements that open up the soil. Crop residues should be left on or near the surface as much as practicable to prevent crusting and aid the intake of water.

The best cropping system consists of continuous close-growing crops.

Capability unit IVe-1

In this unit are several sloping, deep soils that have permeable subsoil, and some moderately deep soils. They take water well but lose a considerable part of the rainfall through runoff. They are subject to severe erosion. The unit consists of:

Dill fine sandy loam, 3 to 5 percent slopes.
Enterprise very fine sandy loam, 5 to 8 percent slopes.

The crops usually grown are wheat, oats, barley, and sorghum. The best suited legumes are sweetclover and cowpeas when moisture conditions are favorable. Grasses are the close-growing crops best suited for a rotation.

A complete system of broad-base terraces or diversion terraces, along with contour farming and stubble mulching, may be needed for erosion control. Terrace outlets that are seeded to well-suited grasses or are sodded will safely dispose of runoff from terraced fields.

Without terraces, plant a close-growing crop every year continuously and a soil-improving crop 1 year in 4. The depth of tillage can be varied to reduce formation of a tillage pan.

Capability unit IVe-2

This is a deep, gently sloping or undulating, very sandy soil on uplands. It has friable subsoil that can store a moderate amount of moisture. Extra care is needed in handling this soil to prevent wind erosion. The one soil in the unit is Nobscot fine sand, 0 to 5 percent slopes.

The crops best suited to this soil are sorghum and rye; cotton and peanuts are planted in some places, however, and cause a serious erosion problem. Close-growing crops, cowpeas, or grass are best for soil improvement. Some farmers grow fruit trees successfully if the trees are protected by windbreaks.

Wind and water erosion are the main problems; the land is too sandy, however, for broad-base terraces or diversion terraces. Growing of rye for winter cover, use of crop residues, and practicing stubble-mulch tillage will help conserve soil and moisture. Windbreaks will help control wind erosion.

Capability unit IVe-3

This is a shallow to moderately deep, sloping clay loam on uplands. The subsoil is very limy, friable clay loam or light clay that does not store enough moisture for crops. Roots do not grow well in the limy subsoil. Water erosion is a severe problem if the soil is farmed. The one soil in the unit is Weymouth clay loam, 3 to 5 percent slopes.

Small grain is the crop best suited to this soil. Sweetclover grows better than other legumes; however, many failures have occurred. Best results are obtained if the sweetclover is seeded in the small grain. The best use of this soil is for grasses.

To conserve soil and moisture, use a complete system of terraces, contour farming, and stubble mulching; or, without terraces, use a cropping system that consists of high-residue crops half the time and deep-rooted legumes the other half.

Capability unit Vw-1

Only one land type, Alluvial land, occurs in this unit. It consists of the sandy alluvial soils on the lower parts of flood plains along the larger streams. The water table is shallow and generally within reach of deep-rooted plants. The land is not suitable for cultivation but when properly managed is choice rangeland.

Management is discussed under the Sandy bottomland range site in the section, Range Management.

Capability unit Vw-2

The soils of this unit comprise narrow flood plains of secondary streams. They are so wet or so broken by meandering channels that they are unsuited to cultivation, but they produce abundant grass. The soils are:

Spur clay loam, channeled.
Spur clay loam, wet.

Management of the channeled phase is discussed under the Loamy bottom-land range site, and that of the wet phase under the Subirrigated range site, in the section, Range Management.

Capability unit VIe-1

Enterprise very fine sandy loam, 8 to 20 percent slopes, is the only soil in this unit. This soil, in many places, forms a sloping bench along the rivers of the county. It is too steep for safe cultivation but produces good amounts of grass.

Management is discussed under the Loamy prairie range site in the section, Range Management.

Capability unit VIe-2

The soils in this unit are the sandiest in the county. Most areas are adjacent to the rivers and are so sandy that they are entirely unsuitable for cultivation. The soils are:

Nobscot fine sand, 5 to 12 percent slopes.
Tivoli fine sand.

Management is discussed under the Deep sand range site in the section, Range Management.

Capability unit VIs-1

The Vernon soils are the only soils in this unit. They are shallow, droughty, rather infertile, sloping, clayey soils that support moderate amounts of vegetation.

Management is discussed under the Red clay prairie range site in the section, Range Management.

Capability unit VIs-2

Harmon stony loam is the only soil in this unit. It is a shallow, stony soil over thin-bedded, dolomitic limestone. It is too stony and shallow for cultivation but can be used safely for range.

Management is discussed under the Shallow prairie range site in the section, Range Management.

Capability unit VIs-3

Treadway clay is the only soil in this unit. It consists of compact, reddish clayey alluvium on alluvial fans, aprons, and flood plains below outcrops of red beds. It is too infertile and droughty for tilled crops and is fairly poor for range.

Management is discussed under the Red clay flats range site in the section, Range Management.

Capability unit VIIs-1

Only one land type, Rock outcrop, occurs in this unit. It consists of the rough, stony, granitic mountains in the eastern part of the county. The soil is very thin, and bare granitic rock is exposed in most places. This land is suitable for only limited grazing.

Management is discussed under the Granite hills range site in the section, Range Management.

Capability unit VIIs-2

Only one land type, Rough broken land, is in this unit. It consists of steep, rough broken areas with, in places, more nearly level areas that are extremely cut and dissected by many narrow channels. This unit is suitable only for range and in that use requires careful management.

Management is discussed under the Breaks range site in the section, Range Management.

Yields of Crops in Dryland Farming

Estimated average yields per acre of principal crops to be expected in dryland farming on the soils of Jackson County are shown in table 1. These are average yields that can be expected over a period of years. In columns A are yields to be expected under management that does not include use of definite crop rotations, in which fertilizers are not applied, and without most soil conservation measures.

In columns B are yields to be expected under improved management. Improved management, as used for these estimates, includes use of a definite crop rotation that provides for a legume or a soil-improving crop; use of improved crop varieties; application of moderate amounts of fertilizer where needed; use of contour farming and terracing on suitable soils; and use of other applicable conservation measures. These practices are discussed in the subsection, General Management Practices for Dryland Farming.

Irrigation Farming

Irrigation farming was begun earlier in Jackson County than in most other counties of the State. Scattered patches along the creeks were irrigated shortly after 1900. The irrigated acreage was small, however, until about 1935.

Farmers became interested in irrigation in 1927, when the city of Altus built a water-supply dam near Lugert. A few farmers began to irrigate on a small scale from the city pipeline. In 1935, planning was begun for the W. C. Austin irrigation project. This project delivered its first irrigation water to a few farms in 1946. In the meantime, several wells for irrigation had been drilled in the Duke neighborhood.

From these beginnings, irrigation spread rapidly. By 1950, 21,880 acres were irrigated; in 1957, the total had increased to 51,000 acres. A greater acreage would have been irrigated in 1957 if weather had been less favorable. The importance of irrigation to the economy of the county is indicated by the 1954 U.S. Census of Agriculture, which shows that there is irrigated acreage on 23 percent of all farms in the county.

Nearly all of the irrigated land is watered by flood or furrow methods. Water was applied by sprinklers to only 1,000 acres of the 51,000 acres irrigated in 1957.

Supply and quality of water

The three main sources of irrigation water in the county are surface streams, underground caverns in the gypsum, and the unconsolidated sand and gravel formations along streams. Most of the irrigation from surface streams is included in the W. C. Austin irrigation project. Several intermittent streams are suitable for the construction of impounding dams. Water from many smaller drains can be impounded by building large farm ponds and can be used to irrigate small acreages of crops on individual farms. Generally, about 2½ to 3 acre-feet of water should be stored for each acre that is to be irrigated unless the pond is fed by the flow from springs. Spring-fed ponds can be smaller, and their size depends on the adequacy of the flow. The gyp cavern formations furnish most of the irrigation water in the Duke area, and the unconsolidated sands furnish most of the supply in the Eldorado and Elmer areas. Gyp caverns are large, water-filled, underground caves. The amount of water that can be pumped from one of them depends on its size and the extent of its connection with other caves. Isolated caverns are likely to be pumped dry in a short time.

Most of the water from the gyp caverns is pumped from a depth of 100 to 150 feet by pumps of the turbine type. The depth from which water in the unconsolidated sands must be pumped varies from as little as 15 feet along some of the stream channels to as much as 150 feet away from the streams. Most shallow wells are of low capacity. Enclosed storage reservoirs can be used to store the pumped water from low-producing wells for a period of 18 to 20 hours; then the water is released for a shorter period of irrigation. This saves labor and provides a large stream for efficient irrigation. In some places where water can be obtained at a depth of less than about 20 feet, a group of sand-point wells can be connected and pumped by a centrally located centrifugal pump.

Irrigation of the better soils of Jackson County can increase crop yields an average of two to four times. Thus, possibilities of obtaining good-quality irrigation water should not be overlooked.

The potential water supply probably will permit irrigation of 125,000 to 150,000 acres in the county.

The quality of water for irrigation generally ranges from fair to very poor. All of the water contains some detrimental salts; some of it contains such a high percentage that it is unfit for irrigation.

The water used in the irrigation district contains an average of about 1,000 to 1,200 parts per million of total salts; about 40 percent of the cations are sodium. Such water is fair for irrigation.

Analyses of water from the North Fork of the Red River, east of Humphreys, have shown as high as 5,000 parts per million of salts; of these, 82 percent are salts of sodium. Water for individual wells contains as much as 7,000 to 7,500 parts per million of salts, of which 43 to 55 percent are salts of sodium. Irrigating with water of unsuitable quality can result in crop failure, and (fig. 10) also can make the soil unsuitable for crops. A farmer should have the water analyzed, or know what is in it, before he irrigates.

Requirements for profitable irrigation

Farmers who want to irrigate can estimate fairly well their chances of success. They need to plan a good program and to follow it with care.

The soil is the first item to consider. Some soils respond to irrigated farming much better than others. A good soil is deep enough to provide space for roots and permeable enough to control the accumulation of harmful salts. It will take in and store enough water for the crops, it can be drained adequately, and it is nearly level

TABLE 1.—*Estimated average yields per acre of principal crops in dryland farming under two levels of management*

[Yields in columns A are those obtained under common management practices; yields in columns B may be expected under the best management practices. Dashes indicate crop is not grown at the management level indicated or the soil is unsuited to the crop]

Map symbol	Soil	Wheat		Oats		Barley		Cotton (lint)		Sorghum for grain		Sorghum for fodder		Alfalfa for hay [1]		Alfalfa for seed		Rye	
		A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
		Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Tons*	*Tons*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
AbA	Abilene clay loam, 0 to 1 percent slopes	15	20	27	37	18	28	165	225	700	1,000	----	----	1.0	1.3	2.0	2.5	----	----
AbB	Abilene clay loam, 1 to 3 percent slopes	14	17	25	34	17	27	175	225	700	900	----	----	.8	1.1	1.8	2.2	----	----
Ac	Alluvial land	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
AtA	Altus fine sandy loam, 0 to 1 percent slopes	12	14	19	25	14	22	150	175	750	900	1.4	2.4	.8	1.1	1.5	1.9	8	10
DaB	Dill fine sandy loam, 1 to 3 percent slopes	12	16	25	32	17	26	175	250	800	950	1.5	2.5	1.1	1.5	1.5	2.0	10	13
DaC	Dill fine sandy loam, 3 to 5 percent slopes	8	11	16	22	12	21	----	----	600	750	1.0	1.8	----	----	----	----	8	10
EnB	Enterprise loamy fine sand, 0 to 3 percent slopes	8	12	----	----	----	----	165	225	750	1,050	1.5	2.5	.8	1.1	1.5	1.9	8	10
ErA	Enterprise very fine sandy loam, 0 to 1 percent slopes	15	20	26	36	18	28	225	335	1,050	1,450	1.7	2.7	1.2	1.7	2.0	3.0	11	14
ErB	Enterprise very fine sandy loam, 1 to 3 percent slopes	13	17	25	33	17	25	200	300	875	1,250	1.6	2.6	1.0	1.3	1.6	2.6	10	13
ErC	Enterprise very fine sandy loam, 3 to 5 percent slopes	11	14	21	27	15	23	150	250	700	950	1.4	2.4	----	----	----	----	8	10
ErD	Enterprise very fine sandy loam, 5 to 8 percent slopes	8	12	20	25	13	22	----	----	650	850	1.2	2.0	----	----	----	----	7	10
ErE	Enterprise very fine sandy loam, 8 to 20 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Ha	Harmon stony loam	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
LaB	La Casa clay loam, 1 to 3 percent slopes	14	18	26	35	17	27	160	205	710	930	----	----	.8	1.1	1.8	2.2	----	----
MaB	Mansic clay loam, 1 to 3 percent slopes	9	11	16	22	13	20	----	----	----	----	----	----	----	----	----	----	----	----
MeA	Miles fine sandy loam, 0 to 1 percent slopes	15	20	28	38	20	30	225	335	1,050	1,450	1.7	2.7	1.2	1.7	2.0	3.0	12	15
MeB	Miles fine sandy loam, 1 to 3 percent slopes	12	16	25	32	17	26	175	250	800	1,100	1.6	2.6	1.1	1.5	1.5	2.0	10	13
MeC	Miles fine sandy loam, 3 to 5 percent slopes	11	14	21	27	15	23	150	230	700	950	1.4	2.4	----	----	----	----	8	10
MfB	Miles loamy fine sand, 0 to 3 percent slopes	----	----	----	----	----	----	165	225	750	1,050	1.5	2.5	.8	1.1	1.5	1.9	8	10
Mr	Miller clay	7	9	14	19	12	17	----	----	----	----	----	----	----	----	----	----	----	----
NoC	Nobscot fine sand, 0 to 5 percent slopes	----	----	----	----	----	----	----	----	600	800	1.0	2.0	----	----	----	----	7	9
NoD	Nobscot fine sand, 5 to 12 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Po	Port clay loam	16	22	30	40	22	32	210	315	1,000	1,400	----	----	1.3	1.7	2.2	3.1	----	----
Rc	Rock outcrop	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Rg	Rough broken land	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Sc	Spur clay loam	15	20	28	38	20	30	205	305	925	1,325	----	----	1.2	1.6	2.1	3.0	----	----
Sn	Spur clay loam, channeled	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Sw	Spur clay loam, wet	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
TaB	Tillman clay loam, 1 to 3 percent slopes	11	15	20	28	16	25	120	175	650	850	----	----	----	----	----	----	----	----
TcA	Tillman and Hollister clay loams, 0 to 1 percent slopes	15	20	27	37	18	28	165	225	700	1,000	----	----	1.0	1.3	2.0	2.5	----	----
TpA	Tipton loam, 0 to 1 percent slopes	18	25	35	45	25	35	250	375	1,100	1,600	----	----	1.5	2.0	2.5	3.5	----	----
TpB	Tipton loam, 1 to 3 percent slopes	15	19	27	37	18	28	200	250	840	1,100	----	----	1.0	1.3	1.9	2.3	----	----
Tv	Tivoli fine sand	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Ty	Treadway clay	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Ve	Vernon soils	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
WeC	Weymouth clay loam, 3 to 5 percent slopes	8	10	16	22	14	20	----	----	----	----	----	----	----	----	----	----	----	----
WmB	Weymouth-La Casa clay loams, 1 to 3 percent slopes	11	14	20	28	16	25	120	175	650	850	----	----	----	----	----	----	----	----
Ya	Yahola fine sandy loam	13	18	25	33	18	27	200	300	900	1,300	1.7	2.7	1.2	1.6	2.0	3.0	----	----

[1] Alfalfa—when seed crop is harvested it reduces yields of hay 30 percent.

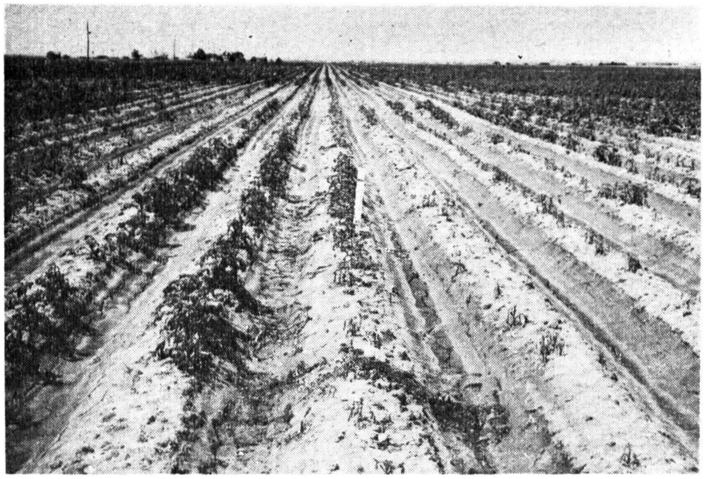

***Figure 10.*—Potato plants killed by irrigating with water containing a large amount of harmful salts.**

or gently sloping. It is productive or can be made to produce good yields.

Soils of the county suitable for irrigation are listed in table 2, and their suitability for irrigation by each of the three common methods is indicated. Irrigation of soils not listed in the table is not likely to be profitable.

A supply of water of good quality is needed for profitable irrigation. In most parts of the county the water supply is enough to irrigate only part of the suitable land. It is poor economy to spread the available water over too many acres. Quality of water is also important, as already stated.

The farmer who has good soil and a supply of water then needs to select his crops. Cotton is the principal irrigated cash crop. Alfalfa can be grown, and it supplies some nitrogen and improves the physical condition of the soil. Truck crops such as potatoes, onions, lettuce, and spinach have been grown successfully and might be produced if a market could be assured. Sorghums for grain and forage are highly productive if they are well managed. Some wheat is irrigated, but most of the crop is grown on dryland.

Methods of irrigation

Water is distributed over the land mainly by flooding, in furrows, or by sprinklers. The method to be used depends mostly on the soil. If a field is to be irrigated by flooding or by furrows, it should first be leveled to a satisfactory grade.

Flooding.—The general method of flooding includes irrigation by parallel borders, either level or graded; contour borders; and contour ditches.

Irrigation in parallel borders is done on nearly level fields. Water is applied between small parallel borders, or dikes, that divide the field into convenient units and control the direction of flow (fig. 11). The method is suitable for most soils of the county that are commonly irrigated, but not for a permeable soil. If a soil is too permeable, the run would need to be too short for efficient farming. Even on suitable soil a fairly large stream of water is needed to cover the area quickly. The border method is efficient, rapid, fairly easy, and has a low labor requirement.

Parallel borders can be level or graded. Each type has advantages and disadvantages. With level borders it is easy to obtain uniform distribution of water on the soil; erosion, either by rainfall or by the irrigation water, is prevented; the rain that falls is held on the field where crops can use it; drainage normally is not needed except to remove excess water from rainfall; the labor requirement is low since one irrigator can manage a large stream of water; leaching of excess salts is accomplished easily; and the system is simple and easy to operate.

Level border systems also have some disadvantages. In most fields major leveling and fine grade leveling are needed to obtain even distribution of water; a large

TABLE 2.—*Suitability of soils for three methods of applying water*

Map symbol	Soil	Suitability for applying water by—		
		Flooding	Furrows	Sprinklers
AbA	Abilene clay loam, 0 to 1 percent slopes	Good	Good	Not suitable.
AbB	Abilene clay loam, 1 to 3 percent slopes	Good	Fair	Not suitable.
AtA	Altus fine sandy loam, 0 to 1 percent slopes	Good	Good	Fair.
DaB	Dill fine sandy loam, 1 to 3 percent slopes	Good	Good	Good.
EnB	Enterprise loamy fine sand, 0 to 3 percent slopes	Not suitable	Good	Good.
ErA	Enterprise very fine sandy loam, 0 to 1 percent slopes	Good	Good	Good.
ErB	Enterprise very fine sandy loam, 1 to 3 percent slopes	Fair	Fair	Good.
ErC	Enterprise very fine sandy loam, 3 to 5 percent slopes	Not suitable	Not suitable	Good.
LaB	La Casa clay loam, 1 to 3 percent slopes	Good	Good	Not suitable.
MeA	Miles fine sandy loam, 0 to 1 percent slopes	Fair	Good	Good.
MeB	Miles fine sandy loam, 1 to 3 percent slopes	Fair	Fair	Good.
MeC	Miles fine sandy loam, 3 to 5 percent slopes	Not suitable	Not suitable	Good.
MfB	Miles loamy fine sand, 0 to 3 percent slopes	Not suitable	Not suitable	Good.
Po	Port clay loam	Good	Good	Not suitable.
Sc	Spur clay loam	Good	Good	Not suitable.
TcA	Tillman and Hollister clay loams, 0 to 1 percent slopes	Good	Good	Not suitable.
TaB	Tillman clay loam, 1 to 3 percent slopes	Good	Fair	Not suitable.
TpA	Tipton loam, 0 to 1 percent slopes	Good	Good	Fair.
TpB	Tipton loam, 1 to 3 percent slopes	Good	Good	Fair.
Ya	Yahola fine sandy loam	Good	Good	Good.

Figure 11.—**Irrigation in rows between parallel borders.**

stream of water is required to flood each strip quickly and evenly; tillage operations must be adjusted to fit the system and to maintain it; expensive permanent structures are needed in some places to control the necessary stream; a light application of water, less than 2 inches, is difficult to apply; and the system cannot be used efficiently on a soil that takes water rapidly.

Graded border systems, in which the land is leveled to a uniform, very gently sloping grade, have two advantages. Less leveling is required than for level borders, and a light application of water can be made more easily. Disadvantages of graded borders are that some rainfall is likely to run off and thus does not reach the crop; a high degree of skill is required to irrigate efficiently; erosion is likely to occur if the grade is enough to give runoff water much velocity; and a disposal system must be provided for runoff water from irrigation and from rainfall.

Contour borders can be built if the field has a gentle slope. They are laid out along the natural contour rather than straight or parallel. They have two advantages: Only minor leveling or smoothing ordinarily is required, and the system, therefore, can be applied on soils too shallow for parallel borders. Disadvantages are that crops cannot be harvested readily and pasture is about the only suitable crop; also, since the borders are irregular in shape, the acreage in each is difficult to measure.

Contour ditches are laid out on a grade so that the water in them will flow slowly. Then, from the ditch, a sheet of water is permitted to flow over a field without further control. Flooding from contour ditches is used to irrigate small grain, alfalfa, and clover. The method works well with a small head of water and is well suited to sloping fields, especially if the slope is irregular. The contour ditches are temporary, and, if the crop is small grain, they are filled before harvest. This method is inefficient and should not be used where any of the others can be applied.

Contour ditches require practically no leveling, and shallow soils and fairly steep slopes can be watered by means of them. They are inefficient, however, since it is difficult to control the water. Application of water almost always is uneven. As a result, the stand is uneven, the crop matures at different times, and the yield is likely to be low.

Furrows.—Irrigation can be done in furrows between rows of crops or in furrows of various sizes and spacing that are called corrugations. An example is shown in figure 12. Spacing of furrows between crop rows depends on the cropping system, and spacing of corrugations depends on the permeability of the soil. If the cross slope is more than one-half foot in 100 feet, a border generally should be built also. Rows and corrugations can be used on nearly all the soils except those that are too permeable. On a permeable soil the rows or corrugations need to be extremely short, unless water can be carried to the rows in gated surface pipe so that each row is irrigated in a segment of the proper length to prevent much loss by percolation.

Advantages of furrow methods are that good irrigation efficiency can be obtained, row crops are easily irrigated, and small amounts of water can be applied uniformly. Disadvantages are that furrows must be maintained through the irrigation season, and harvesting of drilled crops is difficult.

Sprinkler method.—Sprinkler irrigation consists of conveying water to the field in a pipeline and distributing it under pressure through a system of overhead nozzles or perforated pipe. Loss of water by seepage from ditches is eliminated, but added loss through evaporation balances part of this. Five systems of sprinkler irrigation are recognized. The one called the intermediate system will generally be used for most sprinkler irrigation in Jackson County. Only a small amount of the irrigated land of Jackson County is irrigated by sprinklers. Most of the irrigated soils are suitable for flood or furrow irrigation, and the expense

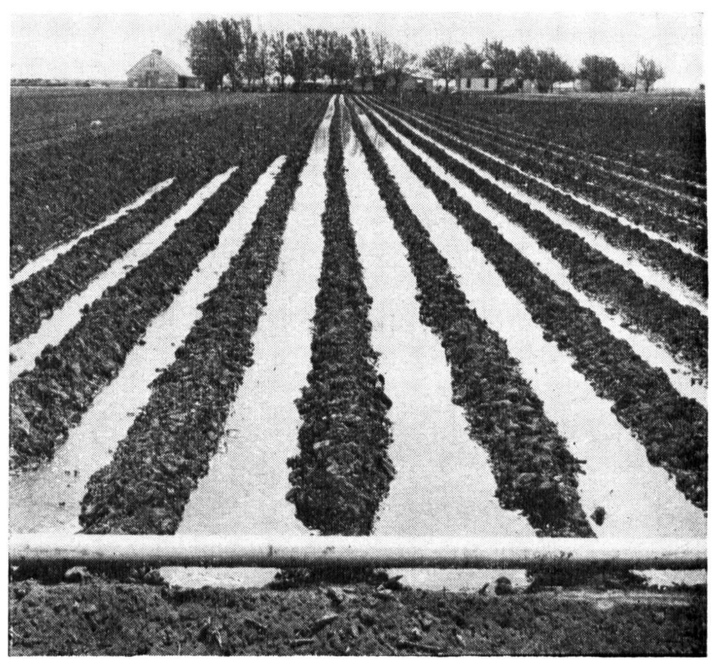

Figure 12.—**Irrigation in furrows.**

of installing and operating sprinkler systems is more than the cost of the surface methods.

Advantages of sprinkler systems are that little or no leveling is required; very light applications of water can be made efficiently; drainage is not required; portable systems can be removed from fields while tillage is done; most of the equipment can be moved from field to field, and it has resale value; and the system is well adapted to soils that take water rapidly.

Disadvantages of sprinkler systems are the high initial investment; high operating cost; difficulty of moving a portable system on a fine-textured, cultivated soil; the chance of increased fungus growths; the failure of some crops to fruit if blossoms are sprinkled; and the slow or very slow intake rate of some soils, especially some that are fine textured.

Conveyance of water

The water used in the irrigation district is carried to the farms in a series of earthen ditches. Nearly all the farm ditches are also of earth construction. Irrigation canals, laterals, and drains are shown on the soil map. Any water-conveyance system should not unduly obstruct farming operations, and it should not permit excess losses of water in transit.

Farmers who have their own irrigation wells are replacing earthen ditches with underground pipe. Elimination of surface ditches eliminates loss of water during conveyance. Underground pipe does not get in the way of farming operations and lessens the infestation of the fields by weeds and insects. Most of the underground pipe is made of plastic, concrete, or asbestos cement.

Farm structures

The early irrigation farmers generally used canvas checks in ditches and opened ditchbanks to allow water to run from the ditch to the field. The temporary checks are being replaced with permanent structures; and turnovers, gated pipe, or siphon tubes are being used to eliminate the need for cutting ditchbanks.

Pumping equipment

A dealer in irrigation equipment generally stocks all necessary parts for repair of pumps. Crop losses brought about by delays as a result of mechanical failure of an irrigation system during a critical period are usually far greater than the cost of stock-piled repair parts and materials. Therefore, unless the dealer has a supply of repair parts, the irrigation farmer should keep on hand enough parts to make emergency repairs.

To lessen the need for repairs and in this way avoid delay during a critical period of crop growth, the following maintenance practices should be followed: Operate a system within its designed capacity at all times; have engines checked periodically by a qualified mechanic; inspect impellers, seal rings, and other operating parts of a centrifugal pump and replace worn parts; inspect all sections of the entire suction line of a centrifugal pump for damaged or corroded parts where air leaks might develop; check turbine pumps periodically for loss of efficiency, noisy operation, or excessive vibration, and replace worn parts whenever the need is indicated; replace worn drive belts, or worn parts in other types of pump drives; provide a cover over power units for protection against the weather.

Capability Groups of Irrigated Soils

The capability classes, subclasses, and units for irrigation farming are given in the following list. Only the general nature of the principal soils in each unit is given in the descriptive name. Soils in each unit are given in the section, Management of Irrigated Capability Units.

Class I.—Soils suitable for intensive cultivation with ordinary farming methods. They need no special practices to control runoff or erosion.
- Unit I–1.—Deep, nearly level, moderately fine textured, well-drained bottom-land soils.
- Unit I–2.—Deep, nearly level, medium-textured, well-drained upland soils.
- Unit I–3.—Deep, nearly level, moderately fine textured upland soils with moderately heavy subsoils.

Class II.—Soils that can be used for tilled crops but with slight risk of erosion or other slight limitations.
- Subclass IIe.—Soils subject to moderate risk of erosion when used for tilled crops.
  - Unit IIe–1.—Deep, gently sloping, medium to moderately fine textured, well-drained upland soils.
  - Unit IIe–2.—Deep, nearly level to gently sloping, medium to moderately coarse textured, well-drained upland soils.
- Subclass IIs.—Soils that have moderate limitations because of soil properties.
  - Unit IIs–1.—Deep, nearly level, moderately coarse textured, excessively drained bottom-land soils.

Class III.—Soils that can be used for tilled crops but with moderate risk of damage or other moderate limitations.
- Subclass IIIe.—Soils subject to severe risk of erosion hazards if they are cultivated and not protected.
  - Unit IIIe–1.—Moderately deep, gently sloping, moderately fine textured upland soils with moderately heavy subsoils.
  - Unit IIIe–2.—Deep, gently sloping, moderately coarse textured, well-drained upland soils.
  - Unit IIIe–3.—Deep, moderately sloping, medium to moderately coarse textured, well-drained upland soils.
  - Unit IIIe–4.—Deep, gently sloping, coarse-textured, well-drained upland soils.
  - Unit IIIe–5.—Deep, nearly level, moderately coarse textured, somewhat slowly drained upland soils.

General Management Practices for Irrigation Farming

The successful farmer, on irrigated land or dryland, strives to build up and maintain productivity of his soils. In order to do this, a good system of management must be followed.

The chief problems of soil use and management in irrigation farming are those of land leveling and maintenance, water-delivery systems, tillage methods, crop-residue management, cropping systems, cover crops, legumes and grasses, and fertilization. Under irrigation, the methods used to control weeds and insect pests are similar to those used in dryland farming, and those problems are not discussed in this section.

Leveling

Irrigation farming generally requires that the land be leveled to permit uniform application of water. Leveling may consist only of rough grading if water is to be applied by sprinklers, contour ditches, or contour borders, or if the farmer wants to install a temporary system to serve until more exact leveling can be done. Even for a temporary system, and especially if the land surface is uneven because of mounds, knolls, gullies, or depressions, it is usually worth while to smooth the land by rough leveling. No depressions should remain that will cause drowning of the crop, and the grades should be established so that an irrigation system can be installed.

Conservation irrigation systems, except those of a temporary nature just mentioned, require rather precise leveling; this requires a detailed engineering plan.

After the land has been leveled, the soil needs to be conditioned. When a field is leveled, part of the topsoil, which contains more organic matter and is more fertile than the subsoil, is removed from the places where cuts are made. On these spots soil-improving crops should be grown the first year and all crop growth should be returned to the soil. Cutting and moving topsoil as a rule slicks over the surface and breaks down soil structure. The result is less intake of irrigation water and rainfall. Chiseling should be done immediately after leveling to open up the soil.

Moving heavy equipment over the soil packs the surface layer and cuts down the intake of irrigation water and rainfall. For this reason, heavy machinery should not be used when the soil is wet. Leveling leaves the surface soil bare, so that it seals over quickly during flash rains and takes water very slowly. A cover of plants should be obtained as soon as possible; organic matter such as barnyard manure should be added if available. When soil is moved from high areas and deposited in low areas, it is left in loose, pulverized condition and will later settle to form slight depressions. Cut areas, in contrast, will rise slightly when their surface layer is tilled. To correct the uneven surface that is thus produced, an annual crop should be planted the first year after a field is leveled and the field should be releveled after that crop is harvested.

Maintaining the system

An irrigation system functions best when all of its component parts are in good working condition. Any irrigation system should work nearly perfectly just after it is installed. It will not continue to do so unless a careful and systematic plan of maintenance is followed. The maintenance plan should provide for inspection to discover any obvious condition that might cause unsatisfactory operation. The inspection should be made between the time the last irrigation in the season is completed and before the system is again to be used. Be sure to allow ample time for any needed repairs. Repair any part of the system that is not in good working order. Observe the system while it is used, so that any part not working properly can be promptly located and repaired.

Delivery of water

To inspect the ditch system, fill the ditches full of water and check for cracks or holes through the ditchbank and for possible undermining of any structures. Underground pipe systems should be completely filled with water and observed to see if any leaks are present. If leaks are found, they should be repaired. Surface pipe should be inspected for damaged sections, and any that are found should be repaired or replaced. Steel pipe should be coated with asphalt if needed.

Ditches should be cleaned and repaired as needed, and all cracks and holes should be filled.

Tillage methods

Careful tillage of an irrigated field is needed. Most farmers have found that some implements used in dryland farming leave the field rough and irregular and thus make it difficult to irrigate the next year.

The best tools for most irrigated soils in the county are a two-way moldboard plow, a double disk, a chisel, and sweeps or a lister.

If the field has considerable grade, the farmer may want to use a one-way plow; after plowing, the field should then be floated twice, in different directions, before crops are planted.

Surface irregularities will develop in most irrigated fields. These should be observed during the irrigation period, and stakes should be set to mark the places that need more leveling. After the crop has been harvested, these places should be leveled, as needed, to obtain even distribution of water.

Management of residues

On most irrigated soils, crop residues are handled the same as on dryland. On sandy soils where wind erosion is a problem, stubble should be left standing or residues should remain on the surface until about 4 to 6 weeks before planting time.

If floating, planing, or more leveling is needed, residues are turned under after harvest. Grasses or legumes that are grown for soil improvement should be plowed under green.

Cropping systems

A cropping system on irrigated land should include a deep-rooted legume; alfalfa is the one most likely to be successful. Sweetclover is also grown, especially if the field is to be pastured. Most farmers plant cotton after one of these legumes. Cowpeas and guar grow well on the sandy soils. Grasses such as blue panic can also be used in the cropping system.

If small grain is grown in a system that does not include a perennial legume, an annual drilled crop can be plowed under for soil improvement.

Cover crops

Cover crops are needed to protect the sandy soils that are subject to wind erosion. Any small grain is suitable; rye is the best one for the very sandy soils. Rye should be seeded early in the fall to get sufficient growth. A cover crop should remain on the soil during winter, and should be plowed under about April 1 if cotton or sorghum is to be planted. Rye can be seeded in cotton in September by the use of a special drill.

Millet is a good cover crop for the fine-textured soils, and it will produce cover rapidly.

Soil-improving crops

Several legumes and grasses, and also some of the other crops, can be grown to improve the soil. Of the legumes, alfalfa and sweetclover are most commonly grown for this purpose. Both are well adapted to irrigation farming. Alfalfa is a good soil builder, provided a good growth of tops is turned under. It can be cut for hay as a cash crop and will provide a great deal of grazing. Grazing can best be done in the fall when the danger of poisoning is least. Alfalfa also will produce a valuable crop of seed.

Winter legumes suitable for soil improvement are Austrian winter peas, vetch, cowpeas, and guar. Austrian winter peas will grow well on moderately fine textured soils and can be seeded alone or with small grain. Vetch is well suited to the medium-textured and coarse-textured soils and grows best if it is seeded with small grain.

Grasses provide pasture and also can be harvested for seed. Side-oats grama, switchgrass, and blue panic can be grown. A good growth should be turned under for soil improvement.

Any small grain crop will produce a large amount of residue. It is a soil-improving crop if the grain only is removed and all the straw and stubble is returned to the soil and managed as residue. Fertilizer is generally needed to produce a worthwhile amount of small-grain residue on an irrigated field. The amount usually applied ranges from 20 to 40 pounds of actual nitrogen per acre.

Fertilizers

Soil tests show that the principal irrigated soils are medium to low in organic matter, medium to high in phosphate, and high in potash. Applications of nitrogen and phosphorus are necessary for high yields. Potash is applied also on the sandy soils.

Definite fertilizer recommendations need to be based on the previous cropping history, a test of the soil, and the farmer's production goals. Farmers who obtain high yields of cotton every year are fertilizing with 80 to 100 pounds of nitrogen and 70 to 80 pounds of phosphorus. Alfalfa is normally fertilized with 70 to 90 pounds of phosphorus and 10 to 20 pounds of nitrogen, in order to establish a stand. Very little fertilizer is used at present on wheat and grain sorghum, as these crops give a rather low return on irrigated land.

Fertilizers at present generally are not applied in the amounts needed for high yields of crops.

Management of Irrigated Capability Units

Capability unit I-1 (irrigated)

The soils of this capability unit are deep, fertile soils on nearly level flood plains. The Port soil lies above most overflow but is flooded occasionally. The Spur soil is flooded somewhat more often. Both soils have a slowly permeable subsoil, but the surface soil takes water reasonably well. The soils in this unit are:

Port clay loam.
Spur clay loam.

These soils are well suited to cotton, alfalfa, sorghum, small grain, and vegetable crops. Land leveling for uniform water application and surface drainage is desirable. A crop rotation including a deep-rooted legume, such as alfalfa or clover, will improve soil structure and return organic matter. Surface crusting is a problem, but crop residues can be used to reduce it. Proper fertilization and insect control are necessary for high yields.

Capability unit I-2 (irrigated)

These are deep, loamy soils on nearly level uplands. They have moderately permeable subsoil and take water well. They are easy to work and are productive. The soils in this unit are:

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

These soils will grow all crops that are well suited to Jackson County, such as cotton, alfalfa, sorghum, small grain, and many vegetable crops. Land leveling is commonly needed to properly distribute irrigation water; most of the land, however, can be irrigated satisfactorily after floating or planing. Alfalfa or clover is better suited than an annual legume in the crop rotation. Proper fertilization and insect control are necessary for high yields.

Capability unit I-3 (irrigated)

In this capability unit are deep, dark-colored, nearly level soils on uplands. They have clay loam surface soil and slowly permeable subsoil. The soils take water fairly well and are capable of storing large amounts of it for plant use. The soils in this unit are:

Abilene clay loam, 0 to 1 percent slopes.
Tillman and Hollister clay loams, 0 to 1 percent slopes.

Crops best suited are cotton, alfalfa, and small grain. Sorghum is not grown extensively, although it is well suited. The hardier vegetables are grown to some extent. Most of the soil irrigates fairly well with only minor leveling or floating. Deep-rooted legumes are needed to maintain a desirable water-intake rate. Proper fertilization and insect control are necessary for high yields.

Capability unit IIe-1 (irrigated)

These are deep, dark-colored, gently sloping soils on uplands. They have loam or clay loam surface soil and friable to moderately firm subsoil. They are slightly susceptible to water erosion. The soils in this unit are:

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

Cotton, small grain, sorghum, and alfalfa are the main crops grown. Unless the land is leveled, small grain and alfalfa are better suited on the steeper slopes than cotton or sorghum. Land leveling is needed in most fields to lessen the slope and to control erosion from rainfall and irrigation. Diversion terraces or dikes are needed in some places to divert runoff from higher areas. Many annual legumes are suited; alfalfa and clover, along with grasses, are needed to improve soil structure and aeration, and they add nitrogen. Proper fertilization and insect control are necessary for high yields.

Capability unit IIe-2 (irrigated)

These are deep soils that have very fine sandy loam or fine sandy loam surface soil and friable, moderately permeable subsoil. They are nearly level and gently sloping soils on uplands. They have a moderate tendency to blow if not protected. The soils in this unit are:

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

Crops best suited are cotton, alfalfa, and sorghum. Small grain is suited, but not much of it is grown under irrigation. Crop residues will help control wind erosion.

These soils can be irrigated by sprinklers without any leveling; leveling is needed in most places for flood irrigation. Deep-rooted legumes or grasses are desirable in a crop rotation. To obtain high yields, proper fertilization and insect control are necessary.

Capability unit IIs-1 (irrigated)

Only one soil, Yahola fine sandy loam, is in this capability unit. It is a deep, moderately fertile soil on nearly level flood plains. In most places, it is subject to overflow, but the field crops commonly grown are seldom damaged. The soil has a moderately sandy subsoil and cannot hold a large amount of water for plant use.

This soil is best suited to cotton, alfalfa, sorghum, and grass. Vegetable crops can be grown, but they are considered a high risk because of the danger of overflow. This soil may be irrigated either by sprinkling or by flooding. A drainage system needs to be worked out in connection with the land leveling in most fields.

In addition to legumes, such as alfalfa and clover, grasses are needed in the crop rotation. Use of fertilizers and the control of insects are necessary for high yields.

Capability unit IIIe-1 (irrigated)

This capability unit consists of only one soil, Tillman clay loam, 1 to 3 percent slopes. It is a deep, gently sloping soil on uplands. It takes water fairly well but loses a considerable amount through runoff. The soil is subject to moderate water erosion if it is not protected.

Cotton, small grain, and sorghum are the crops best suited. Drilled crops should be grown on the most sloping areas. Most of the fields can be surface-irrigated without much leveling; some leveling is needed, however, for proper distribution and use of water.

Diversion terraces or dikes are needed in some places to protect the soil against runoff from higher areas. Since penetration of water is a problem, the crop rotation should include deep-rooted legumes and grasses. Use of fertilizers and control of insects are needed to obtain high yields.

Capability unit IIIe-2 (irrigated)

These are deep, moderately sandy, gently sloping soils on uplands. They have friable subsoil and take water well. Wind erosion is the main hazard in cropping these soils. The soils in this unit are:

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

Cotton, sorghum, alfalfa, small grain, and peanuts will grow well. Sweetclover and grasses are well suited in rotations. Land leveling for proper utilization and distribution of water is needed on most of the land. These soils can be irrigated by sprinkling or by flooding. Cover crops and crop residues will help control wind erosion. Windbreaks are effective in helping to reduce wind erosion.

Grasses and legumes should be included in the rotation. Proper fertilization and the control of insects are necessary for high yields.

Capability unit IIIe-3 (irrigated)

These are deep, moderately sloping, sandy soils on uplands. They have friable subsoil and take water well. Wind and water erosion are the main hazards in using them. The soils in this unit are:

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

Cotton, sorghum, peanuts, alfalfa, and small grain are all suited. Cover crops of rye and vetch are needed to control wind erosion. Windbreaks are also helpful.

These soils can be irrigated by flooding, but they need extensive leveling. Irrigation by sprinkling is more desirable. Use of fertilizers and control of insects are necessary to obtain high yields.

Capability unit IIIe-4 (irrigated)

In this unit are gently sloping or gently undulating, sandy soils on uplands. They have a thick, sandy surface soil that soaks up water rapidly. They have friable subsoil that has fair to good moisture-storage capacity. Wind erosion is the most serious hazard in farming these soils. The soils are:

Enterprise loamy fine sand, 0 to 3 percent slopes.
Miles loamy fine sand, 0 to 3 percent slopes.

The crops best suited are cotton, sorghum, peanuts, rye, vetch, alfalfa, and truck crops. Sprinkling is the only practical method of irrigation. Windbreaks are important to help prevent wind erosion. The cropping system should include rye and vetch or other suitable cover crops. Fertilization and control of insects are necessary to obtain good yields.

Capability unit IIIe-5 (irrigated)

Only one soil, Altus fine sandy loam, 0 to 1 percent slopes, is in this capability unit. It is a deep soil that has moderately compact subsoil. The soil in several places is subirrigated. In those areas, slick spots of varying degree and size are present. This soil is moderately productive, but is subject to some damage from wind erosion. The subirrigated areas are somewhat limited by excess water during extremely rainy seasons.

Cotton, sorghum, and alfalfa are the best suited crops. On the wet spots, grasses for pasture and seed production are best. Land leveling for proper water distribution and surface drainage is necessary in most places. This soil can be irrigated by sprinkling. Crop rotations should include grasses or legumes. It is difficult to maintain a stand of deep-rooted legumes in the subirrigated areas. Proper fertilization and control of insects are necessary for high yields.

A few trials on the use of gypsum on slick spots indicate that it will improve the physical condition of the soil and the intake of water.

Yields of Crops Under Irrigation

Estimated average yields per acre of principal crops on the irrigated soils of Jackson County are shown in table 3. These are average yields that can be expected over a period of years. In columns A are yields to be expected under management that does not include use of definite crop rotations and in which fertilizers are not applied and efficient use is not made of irrigation water.

In columns B are yields to be expected under improved management. Improved management, as used for these estimates, includes use of a definite crop rotation that includes a legume or a soil-improving crop; use of improved crop varieties; application of fertilizer; control of insects; and efficient use of irrigation water.

Range Management

Rangeland amounts to about 107,400 acres, or one-fourth of the farm and ranch land. There are few if any true ranch units. Most of the cattle are on livestock farms that range in size from 320 to 480 acres. About one-fourth of the native grazing land is in pastures on small farms that average about 40 acres in size.

Rangelands are usually low in productivity. They produce little because of their low inherent fertility and the deterioration that has resulted from overgrazing. Many of the range soils are rough, broken, immature, or shallow, although there are still some productive ranges on hardlands, sandy bottom lands, and subirrigated soils. In 1955, the Soil Conservation Service estimated that 88 percent of the county's grazing lands were in fair or poor range condition classes, and only 12 percent were in good or excellent condition.

Livestock operations are largely production of cows and calves, although stocker and feeder operations have increased in recent years.

The number of cattle and calves in the county usually ranges from 22,000 to 24,000. The Agricultural Marketing Service of the United States Department of Agriculture estimated 23,233 cattle and calves on January 1, 1933, and 24,000 on January 1, 1958. During the drought of the 1930's the number dropped to a low of 11,800. Many stockmen sold cattle in the dry years of the 1950's, but the drop was not nearly so great.

Some deterioration of the ranges probably resulted from the large number of cattle and calves that grazed during the war years of 1941–45. The number reached

TABLE 3.—*Estimated average yields per acre of principal irrigated crops, on the soils best suited for irrigation, under two levels of management*

[Yields in columns A are those obtained under common management practices; yields in columns B may be expected under the best management practices. Dashes indicate that a crop is not grown at the management level indicated or the soil is unsuited to its production]

Map symbol	Soil	Wheat		Cotton (lint)		Alfalfa for hay [1]		Alfalfa for seed		Sorghum for grain	
		A	B	A	B	A	B	A	B	A	B
		Bu.	*Bu.*	*Lb.*	*Lb.*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Lb.*	*Lb.*
AbA	Abilene clay loam, 0 to 1 percent slopes	17	26	550	900	2. 5	3. 3	3. 4	4. 3	2, 500	3, 000
AbB	Abilene clay loam, 1 to 3 percent slopes	16	23	450	800	1. 7	2. 6	3. 1	3. 8	2, 300	2, 800
AtA	Altus fine sandy loam, 0 to 1 percent slopes	14	18	425	750	1. 8	2. 5	2. 5	3. 3	2, 400	2, 800
DaB	Dill fine sandy loam, 1 to 3 percent slopes	15	23	400	700	2. 2	2. 5	2. 7	3. 7	2, 600	3, 000
EnB	Enterprise loamy fine sand, 0 to 3 percent slopes	------	------	325	550	2. 1	2. 3	1. 5	2. 2	------	------
ErA	Enterprise very fine sandy loam, 0 to 1 percent slopes	18	28	550	850	2. 8	3. 2	3. 3	4. 3	3, 000	3, 450
ErB	Enterprise very fine sandy loam, 1 to 3 percent slopes	15	26	400	750	2. 2	2. 6	2. 9	3. 7	2, 600	3, 000
ErC	Enterprise very fine sandy loam, 3 to 5 percent slopes	------	------	350	650	------	------	------	------	------	------
LaB	La Casa clay loam, 1 to 3 percent slopes	17	24	465	825	1. 7	2. 6	3. 1	3. 8	2, 500	3, 000
MeA	Miles fine sandy loam, 0 to 1 percent slopes	18	28	500	900	2. 5	3. 0	3. 2	4. 2	3, 000	3, 500
MeB	Miles fine sandy loam, 1 to 3 percent slopes	15	23	400	700	2. 2	2. 5	2. 7	3. 7	2, 600	3, 000
MeC	Miles fine sandy loam, 3 to 5 percent slopes	------	------	325	625	------	------	------	------	------	------
MfB	Miles loamy fine sand, 0 to 3 percent slopes	------	------	325	550	2. 1	2. 3	1. 5	2. 2	------	------
Po	Port clay loam	18	29	500	900	2. 7	3. 3	3. 3	4. 3	2, 600	3, 000
Sc	Spur clay loam	17	27	465	800	2. 5	3. 0	3. 1	4. 1	2, 500	2, 800
TaB	Tillman clay loam, 1 to 3 percent slopes	14	18	375	675	1. 6	2. 5	2. 7	3. 5	------	------
TcA	Tillman and Hollister clay loams, 0 to 1 percent slopes	17	26	550	900	2. 5	3. 2	3. 4	4. 3	2, 500	3, 000
TpA	Tipton loam, 0 to 1 percent slopes	22	33	600	1, 000	3. 0	3. 5	3. 5	4. 5	3, 300	3, 900
TpB	Tipton loam, 1 to 3 percent slopes	18	25	480	850	1. 8	2. 7	3. 2	3. 9	2, 700	3, 200
Ya	Yahola fine sandy loam	17	27	400	750	2. 5	3. 0	3. 2	4. 2	2, 800	3, 300

[1] If a crop of alfalfa seed is harvested, the yield of hay is reduced 30 percent.

an alltime high of 38,200 in 1942 and never fell below 30,000 during the war. Other factors affected the ranges also. Many operators carry more cattle than the native range will support and hope to have enough wheat pasture during winter and early spring. There is also the hope for good spring and summer moisture to produce enough native grass and temporary pasture. It is estimated that under dryland farming, wheat normally produces good pasture only about 2 years out of 5. Some pasture of sudangrass or other sorghum generally can be grown for supplementary grazing.

The native pastures, when grazed closely, do not have enough mulch, and the soil is likely to be too hard to permit good water intake when the rains come. During years when supplemental and temporary pastures fail, and forage on the range is reduced by drought, the operator finds it difficult to reduce the number of livestock. He faces excessive feed costs unless he has an abundance of native grass and other feed reserves.

Principles of range management

Improvement of the native vegetation will assure the production of range forage and the conservation of soil, water, and plants. To improve the vegetation, manage grazing to encourage and increase the best native forage plants.

Successive, although overlapping, stages in growth of grass are the growth of leaves, growth of roots, formation of flower stalks, production of seed, regrowth of forage, and storage of food in the roots. Grazing must allow for these natural processes of growth if high yields of forage and gains in weight or numbers of animals are to be obtained.

Livestock graze selectively, and they seek out the palatable and nutritious plants. If grazing use is not carefully regulated, the better plants are weakened or eliminated. Less desirable plants will then increase. If grazing pressure is continued, even the second-choice plants are thinned out or eliminated and undesirable weeds or invaders take their places.

Experiences of stockmen and studies by research workers have shown that if only about half the yearly volume of grass produced is grazed, damage to the better plants is minimized and the range can improve up to its maximum production. The forage left on the ground serves as a mulch that encourages rapid intake of water; the more water stored in the soil, the better the growth of grass for grazing. Roots grow so they can reach deep moisture; overgrazed grass cannot reach deep moisture because not enough green shoots are left to provide the food needed for good root growth. A good growth of grass protects the soil from wind and water; grass is one of the best kinds of cover for preventing erosion. If grasses are vigorous, the better grasses can crowd out weeds, which means that range in a low state of productivity will improve. Plants that have plenty of tops are able to store food for quick and vigorous growth after droughts and in spring. Plenty of grass also provides a feed reserve for the dry spells that otherwise might force sale of livestock at a loss.

Sound range management requires that grazing use be adjusted from season to season to match the amount of forage produced. The range operator needs to provide reserve pastures or other feed for use during drought and at other times when production of forage is curtailed. This permits moderate grazing of forage at all times. Besides having reserves of forage and feed, the operator may want to have some readily salable stock such as stocker steers. Such flexibility allows the operator to balance his livestock with forage production without sacrificing breeding animals.

Range sites and condition classes

To make use of the best practices and improve his grassland, the range operator needs to know the range plants and the combinations in which they grow. He should be able to read the signs that show him whether his range is getting better or worse. Important changes in the kinds of grasses often take place gradually, and they can be overlooked by an operator who is not acquainted with his range plants and soils. Sometimes the extra plant growth resulting from favorable rainfall leads to a conclusion that the range is improving, when actually the longtime trend is toward poorer grasses and lower production. On the other hand, temporary close grazing that gives the appearance of degraded range may provide only a temporary setback to healthy grass in the care of a capable manager.

Different kinds of soil produce different kinds and amounts of grass. In order to manage the range properly, an operator should know the different kinds of soil in his holdings and the plants each kind is capable of growing. He is then able to manage the range to favor the best forage plants on each kind of soil.

Range sites are kinds of rangeland that differ from each other in their ability to produce a significantly different kind or amount of climax, or original, vegetation. A significant difference means one large enough to require different grazing use or management.

Climax vegetation is the combination of plants that grew originally on a given site. The most productive combination of forage plants on rangelands is generally the climax type of vegetation.

Range condition is the present state of the vegetation in relation to the climax conditions for the site. Four range condition classes are defined. A range in excellent condition has present from 76 to 100 percent of the vegetation that is characteristic of the climax vegetation on the same site; one in good condition, 51 to 75 percent; one in fair condition, 26 to 50 percent; and one in poor condition, less than 25 percent.

Ranchers want a range to be in excellent or good condition because such a range yields the most and has the most cover for soil and water conservation. Knowledge of the range site and range condition class helps a rancher tell how good his range is and how much better it can become under correct use. An inventory of range site and condition gives the operator an evaluation of his range and helps him determine what can be done to maintain or improve it.

Descriptions of range sites

There follows a description of each range site that gives the important soil characteristics, principal grasses, and other information about how to use and manage the vegetation.

HARDLAND

The Hardland site consists of clay loam soils that have moderately heavy, clayey subsoils. The following soils are in this site:

- (AbA) Abilene clay loam, 0 to 1 percent slopes.
- (AbB) Abilene clay loam, 1 to 3 percent slopes.
- (LaB) La Casa clay loam, 1 to 3 percent slopes.
- (MaB) Mansic clay loam, 1 to 3 percent slopes.
- (TaB) Tillman clay loam, 1 to 3 percent slopes.
- (TcA) Tillman and Hollister clay loams, 0 to 1 percent slopes.
- (WeC) Weymouth clay loam, 3 to 5 percent slopes.
- (WmB) Weymouth-La Casa clay loams, 1 to 3 percent slopes.

The site is considered droughty because the soils take water slowly and because much moisture taken in is not readily available to the grass. Moisture seldom penetrates deeper than 2 feet during the growing season. As a result, the site supports the short grasses of the western plains, mainly blue grama and buffalograss. The taller grasses such as vine-mesquite, side-oats grama, and sand bluestem may be found principally in the drainageways and in other areas that receive extra moisture.

SHALLOW PRAIRIE

Only one soil—(Ha) Harmon stony loam—is in this site. It is a shallow soil over dolomitic limestone interbedded with red clays (fig. 13). Its surface layer is shallow and loamy. The soil is droughty and restrictive to deep penetration of roots. There is some deep growth of roots through cracks and openings in the rock. In excellent condition the common grasses are side-oats grama, hairy grama, and little bluestem. An increase of hairy tridens is a sign of too much grazing and of a change to a lower condition class.

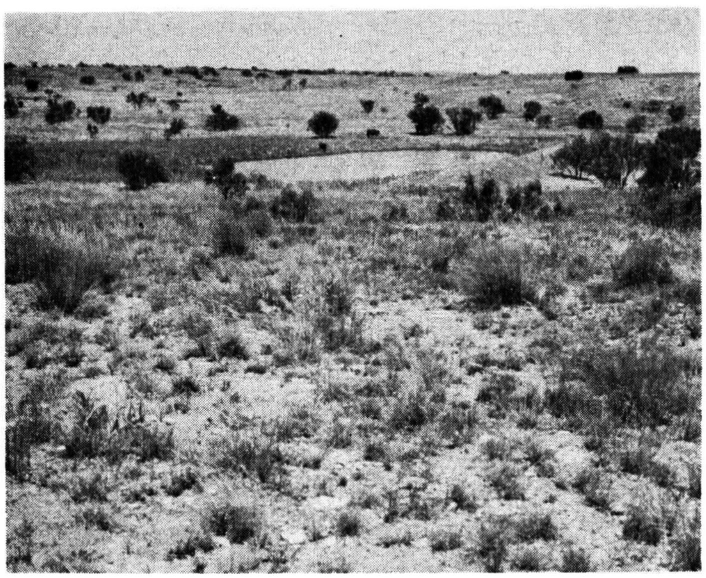

Figure 13.—**Shallow prairie range site in fair condition; note the lack of ground cover.**

RED CLAY PRAIRIE

Only one mapping unit—(Ve) Vernon soils—is in this site. The soils consist of dense, red clay on fairly smooth topography with some steep slopes (fig. 14). The surface soil is somewhat granular, but it is underlain by dense clay. The low fertility and dense clay subsoil make this site less productive than the more fertile Hardland site.

Side-oats grama, vine-mesquite, blue grama, and buffalograss are the common grasses. Under heavy grazing and drought, mesquite invades. Broom snakewood is a common unpalatable invader.

RED CLAY FLATS

Only one soil—(Ty) Treadway clay—is in this site. This soil consists of raw, compact, clayey soil materials spread out on fans and flood plains below outcrops of clayey red beds. It is extremely droughty and is low producing even in its best condition. Moisture seldom penetrates more than 10 inches. Vegetation is sparse and is principally found in areas where water concentrates. Common grasses are white tridens, buffalograss, vine-mesquite, and blue grama. Grazing abuse results in nearly complete loss of vegetation.

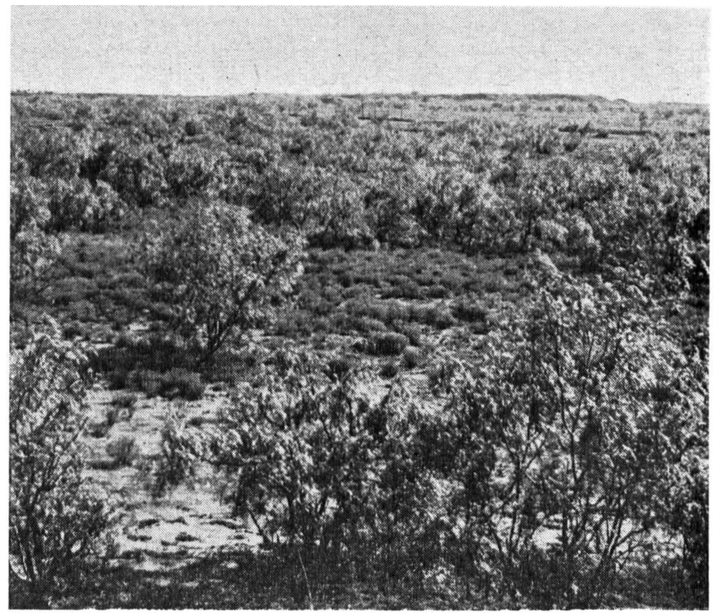

Figure 14.—**Red clay prairie range site in poor condition; note the invading mesquite and broom snakeweed.**

BREAKS

This site consists of one mapping unit—(Rg) Rough broken land. The areas are variable in productivity, but generally they furnish little forage. Common grasses are side-oats grama, little bluestem, and sand bluestem.

DEEP SAND

This site consists of deep, productive sands. The soils are low in water-holding capacity, but they support tall grasses and brush. Since they take water rapidly, there is little runoff, and they give up water readily to plants. The soils in this site are:

- (EnB) Enterprise loamy fine sand, 0 to 3 percent slopes.
- (MfB) Miles loamy fine sand, 0 to 3 percent slopes.
- (NoC) Nobscot fine sand, 0 to 5 percent slopes.
- (NoD) Nobscot fine sand, 5 to 12 percent slopes.
- (Tv) Tivoli fine sand.

If this site is in excellent condition, the principal grasses are sand bluestem, little bluestem, switchgrass, and Indian grass. Under abusive management woody plants, such as sagebrush and skunkbush, are likely to take over and production of grass can be reduced to almost nothing. On Nobscot soils, shinnery oak is the principal woody plant. Control of brush by herbicides, along with deferred grazing and good grazing management, will result in production of large amounts of forage.

SUBIRRIGATED

This site consists of only one soil—(Sw) Spur clay loam, wet. This soil is on narrow flood plains and has a water table within the reach of plant roots.

In excellent range condition the dominant grass on this site is usually switchgrass, with an understory of alkali sacaton and inland saltgrass. Grazing abuse generally favors increase of alkali sacaton, but if heavy use continues too long, it, in turn, may be largely replaced by inland saltgrass.

This site is of small extent, but it is the most productive one per acre in the county.

LOAMY PRAIRIE

This site consists of productive loams that take water well. Moisture penetrates these soils more deeply during the growing season than in soils of the Hardland site. As a result, the taller grasses were somewhat more abundant than short grasses on the native range of this site. The soils in this site are:

(ErA) Enterprise very fine sandy loam, 0 to 1 percent slopes.
(ErB) Enterprise very fine sandy loam, 1 to 3 percent slopes.
(ErC) Enterprise very fine sandy loam, 3 to 5 percent slopes.
(ErD) Enterprise very fine sandy loam, 5 to 8 percent slopes.
(ErE) Enterprise very fine sandy loam, 8 to 20 percent slopes.
(TpA) Tipton loam, 0 to 1 percent slopes.
(TpB) Tipton loam, 1 to 3 percent slopes.

Figure 15.—**Six-year-old range seeding on Sandy plains' range site; this shows a properly grazed range at the end of the grazing season.**

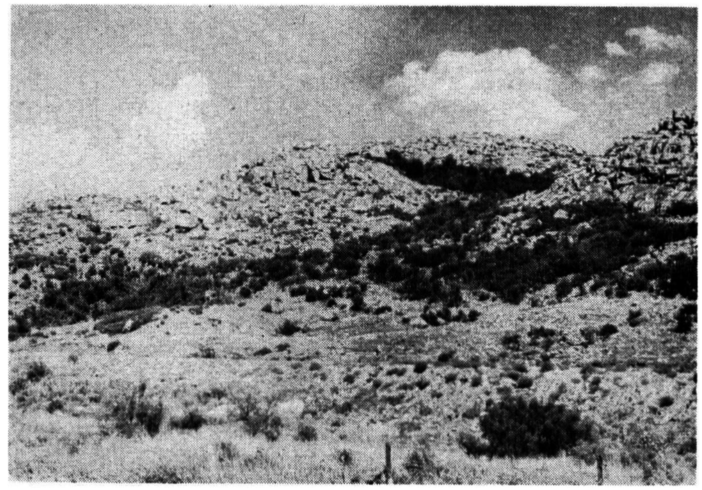

Figure 16.—**Granite hills range site.**

Under grazing abuse, blue grama increases at the expense of the higher producing sand bluestem and little bluestem. Side-oats grama is an important desirable grass on this site.

SANDY PLAINS

Most of this site is in cultivation. The soils in this site are:

(AtA) Altus fine sandy loam, 0 to 1 percent slopes.
(DaB) Dill fine sandy loam, 1 to 3 percent slopes.
(DaC) Dill fine sandy loam, 3 to 5 percent slopes.
(MeA) Miles fine sandy loam, 0 to 1 percent slopes.
(MeB) Miles fine sandy loam, 1 to 3 percent slopes.
(MeC) Miles fine sandy loam, 3 to 5 percent slopes.

These deep, friable soils encourage growth of sand bluestem and little bluestem on the range areas (fig. 15). Some invading skunkbush, shinnery oak, and sand sagebrush are likely to grow on this site, but they increase less rapidly and are not so common here as they are on the Deep sand site. Blue grama and hairy grama are the common short grasses that increase as the taller grasses are reduced by heavy grazing.

GRANITE HILLS

Only one mapping unit—(Rc) Rock outcrop—is in this site. The site is in the eastern part of the county, and most of it consists of exposed granite rock (fig. 16). There are some moderately productive grassland areas along drainageways and lower slopes where patches of soil are present. These areas are more accessible to livestock than the rocky land and are likely to be grazed too closely.

Kinds of vegetation vary greatly. Little bluestem, side-oats grama, and hairy grama are common on the better managed pastures. Native legumes are abundant.

LOAMY BOTTOM LAND

Most of the soils in this site are cultivated. The soils are principally clay loams that are somewhat droughty but receive overflow water. The soils in this site are:

(Po) Port clay loam.
(Sc) Spur clay loam.
(Sn) Spur clay loam, channeled.

Common grasses are vine-mesquite, western wheatgrass, sand bluestem, and side-oats grama. An increase of buffalograss is a sign of damage from grazing too closely.

HEAVY BOTTOM LAND

This site consists of one bottom-land soil—(Mr) Miller clay. The soil is a dense clay and is droughty. It is moderately productive, however, since the area is subject to overflow that benefits the vegetation.

Range grasses are vine-mesquite, western wheatgrass, white tridens, and buffalograss. Mesquite and cactus invade and increase under grazing abuse.

SANDY BOTTOM LAND

This site consists of productive, deep, sandy soils. Most of the soils are along the rivers, where they are subject to overflow, sanding, and streambank cutting. Some areas are subirrigated. The soils in this site are:

(Ac) Alluvial land.
(Ya) Yahola fine sandy loam.

Sand bluestem, Indian grass, and switchgrass are the dominant grasses on this site. Some trees and brush are generally present.

Practices for rangeland

Practices applicable on rangeland are proper grazing, proper stocking rate, deferred grazing, control of brush and weeds, proper development of watering places, and seeding of native grasses.

Proper grazing use.—Proper grazing is the most important of all range practices. Without this practice, all other practices fail.

The green leaves of plants convert air, water, and nutrients into plant materials, using the energy of the sun. The food thus formed is stored within plant tissues as starch, sugar, protein, fat, and other organic products. Because the manufacture of food takes place in the leaves, grazing or mowing needs to be limited so that enough leaf surface remains to keep this important process in operation. A general rule to follow is to graze not more than half of the total year's growth.

Plants that are grazed heavily are weakened because they cannot produce and store starch and other foods. Plants that are grazed least tend to grow the best because more light, water, and nutrients go to the plants that have the most leaf surface. Thus, without sound grazing management, the least palatable plants and those that best escape grazing through low or matted growth are the plants that tend to survive.

Stocking rate for proper use.—No specific guide for safe stocking rates can be given. The operator's pastures are likely to contain different range sites, and parts of any site may be in different range conditions. Local agricultural agencies have qualified technical people who can help to delineate the range sites and classify condition classes of the sites in each pasture. If the rancher wishes, these people can offer suggestions on changes in grazing practices or suggest a rate of grazing.

The operator who becomes familiar with his range sites and knows the signs of improving and declining ranges can use judgment in managing his rangeland. A proverb says that the eye of the feeder fattens his cattle. To a considerable degree, the eye of the good grassland manager can improve his native pastures. A good general rule is to remove no more than half the desirable range forage.

The relative productivity of the 13 range sites in Jackson County is given in the following list, which shows the estimated index of productivity by sites. The normally least productive range site, Red clay flats, is given an index of 1.0. The most productive site, Subirrigated, has an index of 7.0. Thus, the Subirrigated site is normally seven times as productive as the Red clay flats. Other sites are arranged between these two extremes in order of relative productivity.

Range site:	*Estimated index of productivity*
Red clay flats	1.0
Breaks	1.5
Granite hills	1.5
Shallow prairie	1.8
Red clay prairie	2.0
Hardland	2.5
Loamy prairie	3.0
Sandy plains	3.5
Sandy bottom land	3.5
Deep sand	3.7
Heavy bottom land	3.8
Loamy bottom land	4.0
Subirrigated	7.0

An index of 3.5 is given for the Sandy bottom-land site, but production on this site is highly variable because of the influence of meandering streams on the sandy soil.

Deferred grazing.—It has been said that extra grass is like money in the bank. Summer rest is a good way to hasten recovery of a seriously depleted range. If grazing of a pasture is to be deferred for the entire summer, the operator must consider the effect that the extra stock will have on his other pastures. The operator is fortunate who always has a deferred pasture in reserve and keeps all his other pastures moderately stocked. Temporary pastures and feed crops will help permit summer deferment.

Control of brush and weeds.—A rancher can expect a steady shift to good range plants if he carries out a conservation grazing program on weedy pastures. Generally, the best method of control for undesirable plants on rangeland is to allow the natural succession of native plants to crowd out the weeds. Unpalatable weeds have some value to condition the trampled and packed soil of a range that has been grazed too closely. They furnish protective litter for the surface of the soil and provide food and cover for wildlife. Their presence indicates a need for better cover on the land; therefore, it is often not advisable to mow or spray them.

On ranges that have a cover of shinnery oak, sand sage, skunkbush, and other woody plants, the rancher can profitably help nature control these undesirable plants. Control of brush is necessary to obtain a big improvement in grass cover within a reasonable time. Natural succession operates slowly after brush has invaded, since the woody plants have deep roots and live a long time. It is generally not safe, however, to destroy woody plant cover on steep, choppy sand dunes. Here, any kind of cover is of great benefit to prevent active blowing of the sand.

Rest for a full growing season is needed after brush and weeds are killed. Depleted stands of grass must be allowed to develop a vigorous growth and produce seed if the pasture is to improve. Moderate grazing in the winter following deferment is ordinarily desirable, since the livestock will aid in distributing seed and mulch, and removal of part of a dormant grass does not weaken the stand.

Development of water.—Water facilities for livestock should be located to encourage proper grazing use. Ponds and dug earthen reservoirs are the most common facilities used to provide water for stock. Wells are limited mainly to the sandier sites, as most of the county is underlain by red beds, which generally do not furnish a dependable supply of water. Furthermore, the quality of water taken from the red beds is generally poor.

Ponds and reservoirs should have enough storage capacity to provide water for the period the pasture is to be grazed, except possibly in periods of extreme drought. Ponds and reservoirs need to be designed so that they can store enough water to meet extreme drought, but at the present time the added cost of such construction is generally too great to be justified. Tanks built in conjunction with windmills should be large enough to store sufficient water to provide a supply for 1 week.

Seeding native grasses.—Revegetation of soils not suited for cultivation is one of the big conservation jobs to be done in Jackson County. To reseed a field, we need to select kinds of grasses best suited to the particular range sites that compose it.

Hardland should be seeded to a mixture that consists principally of blue grama, side-oats grama, and buffalograss. Western wheatgrass also is desirable, especially in draws and swales. Loamy and sandy sites should be seeded to a mixture made up largely of such grasses as little bluestem, side-oats grama, sand bluestem, switchgrass, and blue grama. Deep sand sites should be seeded to a mixture of such taller grasses as sand bluestem, switchgrass, Indian grass, little bluestem, sand lovegrass, and Canada wildrye.

It is best to leave the fence around a seeded field until the seeded area and the adjacent native range have similar plant cover. There is a tendency for cattle to concentrate grazing on the reseeded area at least for several years after a new stand is established, and better control can be maintained during that period if the field is fenced.

Woodlands and Windbreaks

Except on some 15,000 acres of Nobscot soils in northeastern Jackson County, trees are native only along the streams, on small areas that are subirrigated, and on pockets of soil within areas of Rock outcrop. Trees on the Nobscot soils and Rock outcrop are chiefly oaks with a few hackberry, cedar, and elm. They are scrubby and at present are of economic importance only for wildlife habitats. Along the stream courses are small stands of cottonwood, elm, and willow that have some commercial value. Stands of cottonwood and willow occurred naturally on subirrigated areas of Altus and Miles soils, but most of them have been cut.

Planting trees for windbreaks and in post lots will help to stabilize the sandy soils and to protect crops, farmsteads, and livestock (fig. 17). More than 200 miles of plantings have been made, with varying degrees

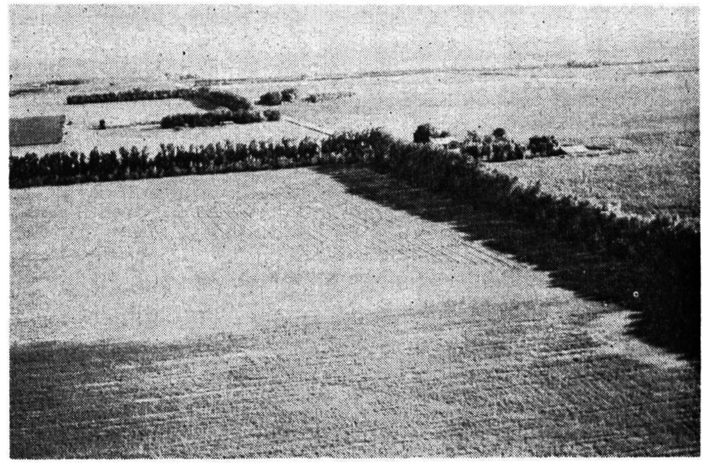

***Figure 17.*—Young trees in windbreaks on a deep Miles soil; the trees will check wind erosion and provide protection for crops and farmsteads.**

of success. Their success and effectiveness have been in proportion to the attention given to selecting the site and species and to the care and protection that the trees received.

Trees for field windbreaks will grow only on soils that are deep enough and of such texture and structure as to provide infiltration and retention of moisture. The suitable soils are listed in table 4. Broadleaf trees, suitable for windbreaks and post lots, that will grow best on these soils are such trees as cottonwood, sycamore, bois-d'arc, and black locust, which are native to Oklahoma between the 34th and 35th parallels. A few introduced species, such as Chinese (Siberian) elm and Russian mulberry, have proved valuable. Among the conifers, eastern redcedar has been planted almost exclusively, although Arizona cypress, certain strains of arborvitae, and such pines as Austrian, shortleaf, and loblolly are successful if intensive early care is provided.

Farmstead windbreaks are less exacting in their soil requirements than field windbreaks, because tall trees are not needed to protect buildings and feedlots. It is also generally possible to irrigate them during critical dry periods. The trees in field windbreaks, in contrast, need to survive without much assistance after the early cultivation period, and they are effective only if they grow to be tall and dense.

Field windbreaks may be placed at intervals up to 20 times the anticipated average height of the tall trees when they are fully grown. Windbreaks are most effective if they are planted in belts, and other conservation practices such as crop rotation, residue management, and stripcropping are followed. An effective pattern of belts requires sacrifice of considerable cropland unless the interval between belts is the maximum of 20 times the average height of the tall trees, the minimum number of rows required for protection is planted, and the trees and rows are spaced as closely as they will grow on that particular soil.

Although one row of vigorous evergreen trees could theoretically provide good protection, experience suggests at least one row of shrubs and two rows of tall trees are needed. Some trees are sure to be lost for one

TABLE 4.—*Suitability of soils for field windbreaks and farmstead windbreaks*

Map symbol	Soil	Suitability for—		
		Field windbreaks	Farmstead windbreaks	Approximate extent
				Acres
AbA	Abilene clay loam, 0 to 1 percent slopes	Not suitable	Fair	18, 400
DaB	Dill fine sandy loam, 1 to 3 percent slopes	Fair to excellent	Good to excellent	2, 700
EnB	Enterprise loamy fine sand, 0 to 3 percent slopes	Good	Good to excellent	6, 800
ErA	Enterprise very fine sandy loam, 0 to 1 percent slopes	Good to excellent	Good to excellent	4, 400
ErB	Enterprise very fine sandy loam, 1 to 3 percent slopes	Fair to excellent	Good to excellent	5, 600
ErC	Enterprise very fine sandy loam, 3 to 5 percent slopes	Not suitable to fair	Fair to good	3, 400
LaB	La Casa clay loam, 1 to 3 percent slopes	Not suitable	Fair	19, 300
MeA	Miles fine sandy loam, 0 to 1 percent slopes	Good to excellent	Good to excellent	18, 800
MeB	Miles fine sandy loam, 1 to 3 percent slopes	Fair to good	Good to excellent	7, 300
MeC	Miles fine sandy loam, 3 to 5 percent slopes	Not suitable	Fair to good	3, 850
MfB	Miles loamy fine sand, 0 to 3 percent slopes	Good to excellent	Good to excellent	15, 000
NoC	Nobscot fine sand, 0 to 5 percent slopes	Fair to good	Good to excellent	12, 150
Po	Port clay loam	Not suitable	Fair to good	9, 000
Sc	Spur clay loam	Not suitable	Fair to good	13, 800
TcA	Tillman and Hollister clay loams, 0 to 1 percent slopes	Not suitable	Fair	118, 400
TpA	Tipton loam, 0 to 1 percent slopes	Fair to good	Good to excellent	37, 550
TpB	Tipton loam, 1 to 3 percent slopes	Fair	Good	1, 700
Ya	Yahola fine sandy loam	Good to excellent	Excellent	7, 400
	Approximate acreage of soils on which windbreaks can be grown			305, 550

reason or another in any planting, and replacements cannot be made after the trees grow large. Several rows decrease the risk of a gap in the belt if a few trees die. The pattern of rainfall is such in Jackson County that each tree requires about 600 cubic feet of permeable soil to carry it through dry periods. This calls for a spacing of about 8 feet between trees in the row and 12 feet between the rows on a soil that is permeable to a depth of 6 feet. Shallow soils require a wider spacing between trees.

Cultivation of windbreaks is essential until crown closure renders it impractical.

Engineering Uses of Soils

This soil survey report for Jackson County, Okla., contains information that 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 estimates of runoff and erosion, for use in designing drainage structures, in planning dams, and in planning other structures for water and soil conservation.
3. Make preliminary evaluations of soil and ground conditions that will aid in selecting locations for highways and airports and in planning more detailed investigations of the selected locations.
4. Locate probable sources of gravel and other materials for use in construction.
5. Correlate performance of engineering structures with soil mapping units and thus develop information that will be useful in designing and maintaining the structures.
6. Determine the suitability of soils identified by mapping units for cross-country movements of vehicles and construction equipment.
7. Supplement information obtained from other published maps, reports, and aerial photographs for the purpose of making soil maps and reports that can be used readily by engineers.
8. Develop other preliminary estimates pertinent to the particular area for construction purposes.

The mapping and the descriptive report are somewhat generalized and should be used only in planning more detailed field surveys to determine the in-place condition of the soil at the site of the proposed engineering construction.

Soil science terminology

Some of the terms used by the agricultural soil scientist may be unfamiliar to the engineer, and some words may have different meanings in soil science from those used in engineering terminology. For example, soil is defined by an agricultural scientist as the natural medium for the growth of land plants on the surface of the earth; it is composed of organic and mineral materials. The soil profile is a vertical section of the soil through all its horizons and extending into the parent material. Unconsolidated material beneath the developed soil horizons would be called substratum by an agricultural soil scientist, although an engineer probably would call it soil.

Soil separates, soil textural classes, and other soil terms are defined in the Glossary.

Engineering classification systems

The United States Department of Agriculture system of classifying soil texture is used by agricultural scientists. In some ways this system of classifying soil texture is comparable to the two systems used by engineers for classifying soils. All three of these classification systems are described in the PCA Soil Primer;[1] the systems used by engineers are explained briefly as follows:

The American Association of State Highway Officials (AASHO) has developed a classification based on the field performance of soils.[2] In this system, soil materials are classified in seven principal groups. The groups range from A-1 (gravelly soils having high bearing capacity) to A-7 (clayey soils having low strength when wet). Within each group, the relative engineering value of the material is indicated by a group index number. Group indexes range from 0 for the best material to 20 for the poorest. The group index number is shown in parentheses, following the soil group symbol, if the classification is made from test data. It is not given in the estimated classification in table 5, where soils in Jackson County have been classified under this system.

The Unified system of soil classification was established by the United States Army, Corps of Engineers.[3] It is based on the identification of soils according to their texture and plasticity and on their performance as engineering construction materials. In the Unified system, SW and SP are clean sands, SM and SC are sands with fines of silt and clay, ML and CL are silts and clays of low liquid limit, and MH and CH are silts and clays of high liquid limit.

Engineering interpretations and soil test data

The engineer should know the physical properties of the soil materials and the in-place condition of the soil to enable him to make the best use of the soil maps and the soil survey reports. After he has made soil tests and observed behavior of the soils in structures and foundations, an engineer can estimate design requirements for the different soils shown on the map. Tables 5, 6, and 7 give a summary of the physical properties of the different soils and their suitability for engineering uses.

Table 5 gives a brief description of the site and internal characteristics of each soil in the county and its estimated physical properties. These properties are given for a typical profile, generally of each soil series. The soil profile is divided into the significant layers (horizons), and the depth is given in inches. More complete profile descriptions are given in the section, Descriptions of Soils. Also given are classifications by the textural classes of the United States Department of Agriculture, as well as estimates of the Unified classification of the material and the classification used by the American Association of State Highway Officials.

In table 5, the columns under "Percentage passing" show the separation between the coarse- and fine-grained soils and denote the percentage of soil material that is smaller in diameter than the openings of the given screen.

The column titled, Permeability, gives an estimate of the probable rate of water percolation; the rate is expressed in inches per hour.

The type of structure in the major horizons of each typical soil profile is also given in table 5. Structure is a term used to define the arrangement of primary soil particles into clusters that are separated from adjoining masses by surfaces of weakness. The terms used to denote structure, such as platy, blocky, subangular blocky, granular, massive, single grain, and prismatic, are defined in the Glossary.

The column headed, Available water capacity, gives the amount of water in inches per foot of soil depth that is held in the root zone and is available to a crop. The total water-holding capacity of a soil in inches per foot of depth is approximately twice the available water capacity.

In the column headed, Dispersion, the degree and rapidity with which the soil structure breaks down or slakes in water is given. Dispersion is expressed in terms of high, moderate, and low. High dispersion means that the soil slakes readily. In general, sandy soils would have high dispersion and clayey soils would have low dispersion.

The column titled, Shrink-swell potential, gives the volume change of soil when changes take place in its content of water. Shrink-swell potential is expressed as low, moderate, high, or very high. In general, soils classed as CH or A-7 have high or very high shrink-swell potential, and soils classed as SP or SM have low shrink-swell potential. Typical examples of soils that have high shrink-swell potential are Vernon soils and La Casa clay loam, 1 to 3 percent slopes; soils that have a low shrink-swell potential are Tivoli fine sand and Enterprise loamy fine sand, 0 to 3 percent slopes.

Table 6 describes specific characteristics within the soil profiles that affect the design and application of construction measures. These features have been evaluated from the estimated data in table 5, actual test data from table 7, other available test data, and field experience and performance.[4] Other engineering information, such as possible location of suitable road fill material near the proposed construction site, can be obtained from the soil map and the soil association map. It will often be desirable to refer to other sections of this report for additional information.

Only three of the soils are likely to have any need for agricultural drainage. Altus fine sandy loam is wet and naturally subirrigated in some places, and these areas might be improved by drainage. Miles loamy fine sand is generally well drained but includes some wet areas. Spur clay loam, wet, is too wet for cultivation but produces good grass.

Table 7 gives the engineering test data for soil samples from 15 profiles of 10 soil series. These samples were taken in the county. The modal profile of a series is the most typical for the soil as it occurs in the county. Nonmodal profiles are samples of significant variations within the concept of the series or of the mapping unit.

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[1] PORTLAND CEMENT ASSOCIATION. PCA SOIL PRIMER. 86 pp., illus. 1956.

[2] AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS. STANDARD SPECIFICATIONS FOR HIGHWAY MATERIALS AND METHODS OF SAMPLING AND TESTING. Designation: M 145-49, AASHO 7th ed., 2 pts., illus. Washington, D.C. 1955.

[3] UNITED STATES ARMY, CORPS OF ENGINEERS. THE UNIFIED SOIL CLASSIFICATION SYSTEM. Tech. Memo. 3-357. v.1. 1953.

[4] HELMER, R. A., research engineer, Oklahoma Department of Highways, helped make the estimates.

TABLE 5.—*Brief description of soils of Jackson County,*

Symbol on map	Soil	Brief description of site and soil	Depth from surface	Classification
				USDA texture
			Inches	
AbA	Abilene clay loam, 0 to 1 percent slopes.	3 to 4 feet of lean clay occurring on nearly level to gently sloping areas, mainly on old alluvial plains.	0 to 25	Clay loam
AbB	Abilene clay loam, 1 to 3 percent slopes.		25 to 54	Clay
Ac	Alluvial land	Deep, sandy soils on the lower parts of the flood plains of rivers; subject to considerable shifting and deposition by floods.	0 to 5	Loamy fine sand
			5 to 50	Loamy fine sand to fine sand.
AtA	Altus fine sandy loam, 0 to 1 percent slopes.	Deep, sandy upland soil with moderately compact subsoil, nearly level; includes subirrigated areas, characterized by scattered slick spots.	0 to 8	Fine sandy loam
			8 to 34	Sandy clay loam
			34 to 60	Sandy clay loam
DaB	Dill fine sandy loam, 1 to 3 percent slopes.	Deep to moderately deep, sandy upland soils developed from soft red-bed sandstone; upper 12 inches moderately sandy over about 24 inches of clayey sand, which grades to soft, red sandstone at about 4 feet.	0 to 12	Fine sandy loam
DaC	Dill fine sandy loam, 3 to 5 percent slopes.		12 to 50	Sandy clay loam to fine sandy loam.
EnB	Enterprise loamy fine sand, 0 to 3 percent slopes.	Deep, sandy upland soils developed from wind-deposited very fine sands and silts blown from river channels; occurs on uneven, gentle slopes and knolls.	0 to 45	Loamy fine sand
ErA	Enterprise very fine sandy loam, 0 to 1 percent slopes.	Deep, upland soils developed from wind-deposited, calcareous very fine sands and silts blown from river channels; no textural change, or very little, in the profile; some of the steeper soils are underlain with beds of waterworn gravel; on nearly level to steeply sloping areas adjacent to rivers.	0 to 18	Very fine sandy loam
ErB	Enterprise very fine sandy loam, 1 to 3 percent slopes.		18 to 60	Very fine sandy loam
ErC	Enterprise very fine sandy loam, 3 to 5 percent slopes.			
ErD	Enterprise very fine sandy loam, 5 to 8 percent slopes.			
ErE	Enterprise very fine sandy loam, 8 to 20 percent slopes.			
Ha	Harmon stony loam	Upland; very shallow, lean clay surface soils, 0 to 4 inches thick; the range of slope is from 2 to 15 percent; dolomitic limestone, 2 to 10 feet thick, outcrops or lies within a few inches of the surface; the limestone beds are underlain with heavy red-bed clays.	0 to 4	Stony loam
			4 to 30	Bedrock
			30+	Clay
		Inclusions are present of shallow, lean clay; friable surface soil on some of the slopes between 2 and 15 percent; the surface soil in these areas rests abruptly on nearly pure gypsum; gyp sinks and caves are common.	0 to 6	Clay loam or loam
			6+	Gypsum
LaB	La Casa clay loam, 1 to 3 percent slopes.	Deep, upland, lean clay soils, 3 feet or more in depth; friable, granular surface soil and moderately heavy, slowly permeable subsoil; developed from moderately clayey, mostly highly calcareous red beds that in most places contain thin layers of dolomitic limestone.	0 to 12	Clay loam
			12 to 30	Clay loam
			30 to 52	Clay loam
MaB	Mansic clay loam, 1 to 3 percent slopes.	8 feet of lean clay; content of the clay fraction is greatest in the lower part; gently sloping.	0 to 100	Clay loam
MeA	Miles fine sandy loam, 0 to 1 percent slopes.	Deep, upland soils; friable, sandy surface soil and clayey sand subsoil; developed on sandy, calcareous earths of plains outwash or old alluvium.	0 to 10	Fine sandy loam
MeB	Miles fine sandy loam, 1 to 3 percent slopes.		10 to 36	Sandy clay loam
MeC	Miles fine sandy loam, 3 to 5 percent slopes.		36 to 72	Sandy clay loam to fine sandy loam.

Okla., and their estimated physical properties

Classification		Percentage passing—			Permeability	Structure	Available water capacity	Dispersion	Shrink-swell potential
Unified	AASHO	No. 200 sieve	No. 10 sieve	No. 4 sieve					
					Inches per hour		*Inches per foot of soil*		
CL	A-6	60 to 75	100	100	0. 20 to 0. 80	Granular to subangular blocky.	2. 0	Moderate to low.	Moderate.
CL or CH	A-7	80 to 90	100	100	. 05 to . 20	Blocky to massive	2. 0	Moderate to low.	Moderate.
SM	A-2-4	15 to 25	100	------	2. 5 to 5. 0	Single grain	. 5 to 0. 8	High	Low.
SM	A-2-4	15 to 25	100	------	2. 5 to 10. 0	Single grain	. 5	High	Low.
SM	A-4	30 to 40	100	------	. 8 to 2. 5	Granular	1. 7	Moderate to high.	Low.
CL	A-6	40 to 50	100	------	. 2 to . 8	Blocky	2. 0	Moderate	Low to moderate.
CL	A-6	55 to 65	100	------	. 2 to . 8	Blocky	2. 0	Moderate	Low to moderate.
ML	A-4	55 to 65	100	------	. 80 to 2. 5	Granular	1. 4	Moderate to high.	Low to moderate.
ML	A-4	55 to 70	100	------	. 80 to 2. 5	Prismatic and granular.	1. 7	Moderate	Low to moderate.
SM	A-3	15 to 25	100	------	2. 5 to 5. 0	Granular	. 8 to 1. 1	High	Low.
ML	A-4(5)	55 to 65	100	------	. 8 to 2. 5	Granular	1. 7	Moderate to high.	Moderate to low.
SM or SC	A-2-4(0)	25 to 40	100	------	. 8 to 2. 5	Granular	1. 7	Moderate to high.	Low.
CL	A-4 or A-6.	40 to 50	80	85	. 2 to 0. 8	Granular	1. 4	Moderate to high.	Moderate.
------	------	(1)	(1)	(1)	------	Level bedded	------	------	
CH	A-7-6	60 to 80	100	100	Less than 0.05	Massive	2. 0	Low	High to very high.
CL	A-4 or A-6.	50 to 70	100	100	. 2 to 0. 8	Granular	1. 7	High to moderate.	Moderate.
------	------	------	------	------	------	------	------	High	Low.
CL	A-6(9)	90 to 95	100	------	. 2 to 0. 8	Granular	2. 0	Moderate to low.	High to moderate.
CL or CH	A-7-6 (13).	90 to 98	100	------	. 2 to 0. 8	Subangular blocky	2. 0	Moderate to low.	High to very high.
CL or CH	A-7-6 (16).	85 to 95	100	------	. 2 to 0. 8	Almost structureless	2. 0	Moderate to low.	High to very high.
CL	A-6 or A-7-6.	70 to 80	100	------	. 20 to 0. 80	Granular to subangular blocky.	2. 0	Moderate to low.	Moderate to low.
SM	A-2-4	25 to 40	100	------	. 8 to 2. 5	Granular	1. 7	Moderate to high.	Low.
SM-SC	A-6	40 to 50	100	------	. 8 to 2. 5	Prismatic and granular.	1. 7	Moderate	Low to moderate.
SM or SC	A-6	35 to 55	100	------	. 8 to 2. 5	Prismatic and granular.	1. 7	Moderate	Low to moderate.

See footnote at end of table.

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TABLE 5.—*Brief description of soils of Jackson County,*

Symbol on map	Soil	Brief description of site and soil	Depth from surface	Classification: USDA texture
			Inches	
MfB	Miles loamy fine sand, 0 to 3 percent slopes.	Sandy upland soil; similar to Miles fine sandy loam, except somewhat more sandy in all soil layers.	0 to 12 12 to 38 38 to 61	Loamy fine sand Sandy clay loam Sandy loam or sandy clay loam.
Mr	Miller clay	Deep, nearly level, heavy clay on flood plains; very tight and compact; developed in sediments that came from areas with exposed red beds.	0 to 60	Clay
NoC NoD	Nobscot fine sand, 0 to 5 percent slopes. Nobscot fine sand, 5 to 12 percent slopes.	Deep, very sandy upland soils, gently to steeply sloping, undulating to dunelike; thick, sandy surface soil with increasing amount of clay in the subsoil; developed from sandy earths that are commonly less than 50 feet thick.	0 to 25 25 to 40 40 to 84	Fine sand Fine sandy loam Fine sandy loam
Po	Port clay loam	Deep, nearly level, lean clay soil on bottom land; well drained and occurs in the higher, seldom overflowed parts of flood plains along creeks; developed from sediments that came from adjacent uplands.	0 to 72	Clay loam
Rc	Rock outcrop	Stony, granitic hills of the Wichita Mountains; the slopes are rough and steep; large, solid granitic masses and boulders with minor amounts of coarse gravel, sand, silt, and clay.		
Rg	Rough broken land	Steep escarpments, canyons, and extremely dissected or gullied areas of exposed red beds; also areas of eroded, raw, red clay and shale that are not extremely broken.		Clay
Sc Sn	Spur clay loam. Spur clay loam, channeled.	Deep, calcareous, lean clay alluvial soils; on frequently overflowed bottom lands along major creeks and their tributaries; developed from sediments that came from adjacent uplands.	0 to 36 36 to 60	Clay loam Clay loam
Sw	Spur clay loam, wet.	Deep, lean clay alluvial soils; water table within 6 feet of surface; a few slick spots are present; the soils occur as narrow, frequently flooded flood plains on the tributaries of the major creeks.	0 to 36 36 to 60	Clay loam Clay loam
TaB TcA	Tillman clay loam, 1 to 3 percent slopes. Tillman and Hollister clay loams, 0 to 1 percent slopes.	Deep, upland, lean clay surface soil that grades to slowly permeable clay; developed from calcareous clays of the red beds and are nearly level or gently sloping.	0 to 10 10 to 28 28 to 60	Clay loam Clay Clay
TpA TpB	Tipton loam, 0 to 1 percent slopes. Tipton loam, 1 to 3 percent slopes.	Deep, upland, lean clay soils developed in silty alluvial or eolian materials; in nearly level to gentle sloping, terracelike areas.	0 to 18 18 to 42 42 to 64	Loam Clay loam Clay loam
Tv	Tivoli fine sand.	Deep, very sandy soil developed from wind-drifted sands; the surface relief is billowy to duny; the soil occurs adjacent to the rivers.	0 to 54	Fine sand
Ty	Treadway clay.	Compact, clayey alluvium on alluvial fans, aprons, and flood plains below outcrops of clayey red beds.	0 to 50+	Clay or clay loam
Ve	Vernon soils.	Shallow, compact, clayey soils on moderate or steep slopes.	0 to 6 6 to 15 15+	Clay loam or clay Clay Clay

Okla., and their estimated physical properties—Continued

Classification		Percentage passing—			Permeability	Structure	Available water capacity	Dispersion	Shrink-swell potential
Unified	AASHO	No. 200 sieve	No. 10 sieve	No. 4 sieve					
					Inches per hour		*Inches per foot of soil*		
SM	A-2-4	15 to 25	100		2.5 to 5.0	Granular	0.8 to 1.4	High	Low.
SM-SC	A-6	35 to 45	100		.8 to 2.5	Prismatic and granular.	1.0 to 1.6	Moderate	Low to moderate.
SM-SC	A-6	30 to 35	100		.8 to 2.5	Prismatic and granular.	1.1 to 1.7	Moderate to high.	Low.
CL	A-6	80 to 95	100		.5 to 0.20	Massive	2.0	Low	High.
SM	A-2-4	15 to 25	100		2.5 to 5.0	Single grain	.8	High	Low.
SM-SC or SC.	A-2-4	30 to 40	100		2.5 to 5.0	Porous, massive	.8	High to moderate.	Low.
SM	A-2-4	15 to 25	100		2.5 to 5.0	Almost structureless	.8	High	Low.
CL	A-4	65 to 80	100		.2 to 0.8	Granular to subangular blocky.	2.0	Moderate to low.	High to moderate.
CL or ML.	A-7-5 or A-7-6.	75 to 95	100		.05 to 0.2	Massive	2.0	Low	High to very high.
CL	A-6	70 to 80	100		.2 to 0.8	Granular	2.0	Moderate to low.	High.
CL	A-6	70 to 80	100		.2 to 0.8	Subangular blocky	2.0	Moderate to low.	High.
CL	A-6	70 to 80	100		.2 to 0.8	Granular	2.0	Moderate to high.	Low to moderate.
CL	A-6	70 to 80	100		.2 to 0.8	Subangular blocky	2.0	Moderate	Moderate.
CL	A-4	80 to 90	100		.2 to 0.8	Granular	2.0	Low	Moderate to high.
CL or CH	A-7-6	80 to 90	100		.05 to 0.2	Blocky	2.0	Low	High.
CL or CH	A-6	70 to 85	100		.05 to 0.2	Massive	2.0	Low to moderate.	High to moderate.
CL	A-4	70 to 85	100		.8 to 2.5	Granular	1.7	Low to moderate.	Low to moderate.
CL	A-4	70 to 85	100		.8 to 2.5	Granular	1.7	Low	Moderate.
CL	A-6	75 to 90	100		.8 to 2.5	Subangular blocky	1.8	Low	Moderate.
SP-SW	A-2-4	5 to 10	100		5 to 10.0+	Single grain	.5 to 0.8	High	Low.
CL or CH	A-7-5 or A-7-6.	80 to 90	100		.05 to 0.1	Platy to massive	1.1	Moderate to low.	High.
CL	A-6 or A-7-6.	80 to 90	100		.05 to 0.2	Granular	1.7	Low	High.
CL	A-6 or A-7-6.	65 to 75	100		.05 to 0.2	Massive	1.7	Low to moderate.	High to moderate.
CL	A-6 or A-7-6.	75 to 85	100		.05 to 0.2	Massive	1.7	Low to moderate.	High to moderate.

TABLE 5.—*Brief description of soils of Jackson County*

Symbol on map	Soil	Brief description of site and soil	Depth from surface	Classification
				USDA texture
			Inches	
WeC	Weymouth clay loam, 3 to 5 percent slopes.	Moderately deep to shallow, lean clay upland soils that are high in lime; developed in strongly calcareous, clayey red beds; the Weymouth soils are on gentle to moderate, convex slopes.	0 to 12	Clay loam
			12 to 18	Clay loam
			18 to 50	Clay loam
WmB	Weymouth-La Casa clay loams, 1 to 3 percent slopes.	In most places these two soils are so intermingled that they are mapped together; the Weymouth soils make up about 50 to 80 percent of the map unit; they occupy gentle slopes on rounded knolls or ridges and side slopes of natural drains; La Casa soils are deeper and occur in the slightly lower areas between the knolls and ridges.		See descriptions of
Ya	Yahola fine sandy loam.	Deep, nearly level, rapidly drained, moderately sandy soil on bottom lands along the major streams; stratified profile of silty sand and lean clay.	0 to 60	Fine sandy loam

[1] None.

TABLE 6.—*Engineering*

Soil and map symbol	Suitability of soil material for—		Suitability as source of—		Soil features affecting—	
					Farm ponds	
	Road subgrade	Road fill	Topsoil	Sand and gravel	Permeability of reservoir	Stability of embankment
Abilene clay loam (AbA, AbB).	Poor to fair	Poor to fair	Upper 25 inches good; 25 to 48 inches, fair.	None	Slow	Stable fill with good compaction and erosion control.
Alluvial land (Ac)	Good to fair	Fair to good	Good	None	Very rapid	Fairly stable; not suited to shells; use for cores and dikes.
Altus fine sandy loam (AtA)	Good to fair	Good to fair	Good	None	Moderately rapid.	Stable fill with good compaction and erosion control.
Dill fine sandy loam (DaB, DaC).	Poor	Fair to poor	Good	None	Moderate	Poor stability; will need good compaction.
Enterprise loamy fine sand (EnB).	Fair to good	Good	Fair	None	Rapid	Fairly stable; not particularly suited to shells; good for cores or dikes.
Enterprise very fine sandy loam (ErA, ErB, ErC, ErD, ErE).	Fair to good	Good	Good	None	Moderately rapid.	Fairly stable; not particularly suited to shells; good for cores or dikes.
Harmon stony loam (Ha)	Poor to fair	Poor to fair	Poor	Fair source of gravel.	Slow	Stable; nonpermeable fill.
Harmon stony loam, inclusions of gypsum (Ha).	Poor	Poor	Poor	None		

See footnotes at end of table.

Okla., and their estimated physical properties—Continued

Classification		Percentage passing—			Permeability	Structure	Available water capacity	Dispersion	Shrink-swell potential
Unified	AASHO	No. 200 sieve	No. 10 sieve	No. 4 sieve					
					Inches per hour		*Inches per foot of soil*		
CL	A-4	80 to 90	100		0.8 to 2.5	Granular	1.7	Low to moderate.	Moderate.
CL	A-4	75 to 85	100		.8 to 2.5	Granular	1.7	Low to moderate.	Moderate.
CL	A-4	80 to 90	100		.8 to 2.5	Subangular blocky to nearly massive.	1.7	Moderate to low.	Moderate to high.
Weymouth and of La Casa soils.									
SM	A-2-4	25 to 35	100		2.5 to 5.0	Granular	1.4	Low to moderate.	Moderate.

interpretations of soils

Soil features affecting—Continued					
Irrigation			Application of water	Terraces and diversions	Waterways
Permissible depth of cut	Ditches	Borders			
Inches					
2 to 6	Slow permeability; easily compacted.	Moderate shrink-swell potential.	Slow intake rate, 0.45 inch per hour; sticky when wet; erosion resistant.	Stable fill; no hazard of wind erosion.	Fertile; slight susceptibility to erosion.
(2)	Very rapid permeability; unstable; erodible soil.	Low shrink-swell potential.	Very high intake rate, 2.5 inches per hour; subject to wind erosion.	Unstable; subject to wind erosion.	Erodible soil; unstable.
8 to 20	Moderately rapid permeability; erodible soil; unstable.	Low to moderate shrink-swell potential.	Intake rate, 0.9 inch per hour; susceptible to wind erosion.	Stable fill	Fertile; erodible soil; susceptible to wind erosion.
12 to 16 [1]	Moderate permeability; may lose stability.	Low to moderate shrink-swell potential.	Moderate intake rate, 0.9 inch per hour.	Moderately stable fill; susceptible to wind erosion.	Fertile; susceptible to wind and water erosion.
(2)	Rapid permeability; unstable; erodible.	Low shrink-swell potential; subject to wind erosion; too sandy.	Very high intake rate, 1.6 inches per hour; subject to wind erosion.	Too sandy and unstable; highly susceptible to wind erosion.	Low fertility; subject to wind accumulations.
12 to 40 [1]	Moderately rapid permeability; may lose stability.	Low shrink-swell potential; fair stability.	Intake rate, 0.9 inch per hour; susceptible to wind erosion.	Stable fill	Fertile, erodible soil.

TABLE 6.—*Engineering*

Soil and map symbol	Suitability of soil material for—		Suitability as source of—		Soil features affecting—	
					Farm ponds	
	Road subgrade	Road fill	Topsoil	Sand and gravel	Permeability of reservoir	Stability of embankment
La Casa clay loam (LaB)	Poor to fair	Fair	Good	None	Moderately slow.	Stable fill; easily compacted.
Mansic clay loam (MaB)	Poor to fair	Fair	Good	None	Moderately slow.	Stable fill; easily compacted.
Miles fine sandy loam (MeA, MeB, MeC).	Good to fair	Good to fair	Good	None	Moderately rapid.	Stable fill with good compaction and erosion control.
Miles loamy fine sand (MfB)	Fair to good	Good to fair	Good	None	Rapid	Stable fill with good compaction and erosion control.
Miller clay (Mr)	Poor to fair	Poor to fair	Fair	None	Slow	Stable; impervious cores and dikes.
Nobscot fine sand (NoC, NoD).	Good	Good	Poor to fair	None	Rapid	Fairly stable; not particularly suited to shells; may be used for cores and dikes.
Port clay loam (Po)	Poor	Poor	Fair to good	None	Moderately slow.	Stable fill; low permeability.
Rock outcrop (Rc)	Excellent	Good	Very poor	Good source of gravel.		
Rough broken land (Rg)	Poor	Fair to poor	Poor	None	Slow	Stable fill; impervious cores and blankets.
Spur clay loam (Sc, Sn, Sw)	Fair to poor	Good to fair	Good	None	Moderate	Stable fill; also good for blankets or cores.
Tillman clay loam (TaB)	Poor	Good to fair	Good	None	Slow	Stable; impervious cores and blankets.
Tillman and Hollister clay loams (TcA)						
Tipton loam (TpA, TpB)	Poor	Good	Very good	None	Moderate	Stable; impervious cores and blankets.
Tivoli fine sand (Tv)	Fair	Good to fair	Poor	None	Very rapid	Stable fill with flat slopes and sodding; erodible.
Treadway clay (Ty)	Poor	Fair to good	Poor	None	Very slow	Stable fill; high shrink-swell potential.
Vernon soils (Ve)	Poor	Fair to poor	Poor	None	Slow	Stable fill; high to moderate shrink-swell potential.
Weymouth clay loam (WeC, WmB).	Poor	Fair	Fair	None	Moderately slow.	Stable fill; moderate to high shrink-swell potential; impervious cores and blankets.
Yahola fine sandy loam (Ya)	Fair to good	Good	Fair to good	None	Rapid	Fairly stable; not suited to shells; may be used for impervious cores or dikes.

[1] Slopes of 3 percent or more are not suitable for surface irrigation. [2] Not suitable for surface irrigation.

interpretations of soils—Continued

Soil features affecting—Continued					
Irrigation			Application of water	Terraces and diversions	Waterways
Permissible depth of cut	Ditches	Borders			
5 to 15	Moderately slow permeability; easily compacted.	High to moderately high shrink-swell potential.	Intake rate, 0.45 inch per hour; sticky when wet.	Stable fill; resistant to erosion.	Fertile; resistant to erosion.
([2])	Moderately slow permeability; easily compacted.	Moderate to low shrink-swell potential.	Intake rate, 0.65 inch per hour; sticky when wet.	Stable fill; resistant to erosion.	Fertile; moderately resistant to erosion.
15 to 34 [1]	Moderately rapid permeability; unstable.	Low to moderate shrink-swell potential.	Intake rate, 0.9 inch per hour; susceptible to wind erosion.	Stable fill	Fertile, erodible soil; susceptible to wind erosion.
([2])	Rapid permeability; very unstable; erodible.	Low shrink-swell potential.	Intake rate, 1.2 inches per hour; wind erosion hazard.	Unstable fill; hazard of wind erosion; fill erodible.	Hazard of wind erosion.
([2])	Slow permeability; stable.	High shrink-swell potential.	Low intake rate, 0.05 inch per hour; sticky when wet.	Stable fill; high shrink-swell potential.	High shrink-swell potential; droughty.
([2])	Rapid permeability	Low shrink-swell potential; subject to wind erosion.	Very high intake rate, 2.5 inches per hour; hazard of wind erosion; low water-holding capacity.	Unstable fill; hazard of wind erosion; no soil binder.	Very low fertility; hazard of wind erosion.
18 to 36	Moderately slow permeability; stable.	High to moderate shrink-swell potential.	Moderate intake rate, 0.45 inch per hour; slightly sticky when wet.	Stable fill	Good fertility; not subject to erosion.
([2])	Rapid to slow permeability; stable; resistant to erosion.	Not suitable for irrigation.	Not suitable for irrigation.	Fairly stable fill	Poor fertility; erodible; excessive cracking.
18 to 36 [3]	Moderately slow permeability; stable fill; resistant to erosion.	High shrink-swell potential.	Moderately slow intake rate, 0.45 inch per hour.	Stable fill	Fertile; resistant to erosion.
2 to 6	Slow permeability; stable fill; resistant to erosion.	Stable; high to moderate shrink-swell potential.	Slow intake rate, 0.3 inch per hour; sticky when wet.	Stable fill	Resistant to erosion.
18 to 36	Moderate permeability; may lose stability.	Stable; moderate to low shrink-swell potential.	Moderate intake rate, 0.65 inch per hour; slightly sticky when wet.	Stable fill	Fertile; moderately resistant to erosion.
([2])	Very rapid permeability; erodible; unstable.	Low shrink-swell potential; subject to wind erosion.	High intake rate, 5.0+ inches per hour; duny; subject to wind erosion; low fertility; low water-holding capacity.	Unstable; subject to wind erosion.	Low fertility; subject to severe wind erosion.
([2])	Very slow permeability; stable; resistant to erosion.	High shrink-swell potential; stable.	Very low intake rate, 0.01 to 0.5 inch per hour; sticky when wet.	Stable fill; high shrink-swell potential.	Low fertility; high shrink-swell potential.
([2])	Moderately slow permeability; stable; resistant to erosion.	High shrink-swell potential; stable fill.	Low intake rate, 0.05 to 0.2 inch per hour; sticky when wet.	Stable fill; high to moderate shrink-swell potential.	Low fertility; high to moderate shrink-swell potential.
([2])	Moderately slow permeability; resistant to erosion; may lose stability.	Moderate to high shrink-swell potential.	Moderately low intake rate, 0.45 inch per hour; sticky when wet.	Stable fill; moderate to high shrink-swell potential.	Moderate fertility; resistant to erosion.
12 to 24	Rapid permeability; erodible; unstable.	Moderate shrink-swell potential; fairly stable.	Moderately high intake rate, 0.9 inch per hour; subject to wind erosion.	Fairly stable; subject to wind erosion.	Moderate fertility; subject to wind erosion.

[3] Spur clay loam, channeled, and Spur clay loam, wet, are not suitable for surface irrigation.

TABLE 7.—*Engineering test data [1] for soil samples*

Soil name	Depth	Classification			Liquid limit	Plastic limit	Plasticity index	Shrinkage limit
		Textural, USDA	Unified	AASHO				
	Inches				*Percent*	*Percent*		*Percent*
Enterprise very fine sandy loam, 1 to 3 percent slopes.	0 to 11	Very fine sandy loam.	CL	A-4(5)	23	17	6	19
	14 to 29	Very fine sandy loam.	SM-SC	A-2-4(0)	22	16	6	20
	34 to 53	Very fine sandy loam.	SM-SC	A-2-4(0)	22	17	5	20
La Casa clay loam, 1 to 3 percent slopes.	0 to 10	Clay loam	ML	A-6(9)	36	24	12	16
	11 to 27	Clay loam	CL or ML	A-7-6(13)	46	26	20	13
	38 to 68	Clay loam	CH	A-7-6(16)	51	25	26	12
Miles fine sandy loam, 0 to 1 percent slopes.	0 to 8	Fine sandy loam	SM	A-2-4(0)	18	16	2	17
	10 to 28	Sandy clay loam	SC	A-6(2)	29	17	12	16
	38 to 61	Sandy clay loam	SC	A-6(2)	30	17	13	18
Miles fine sandy loam, 0 to 1 percent slopes (not a modal profile; light-textured subsoil).	0 to 13	Fine sandy loam	SM-SC	A-4(3)	20	14	5	15
	17 to 26	Fine sandy loam	SC	A-4(1)	25	17	8	16
	32 to 48	Fine sandy loam	SM-SC	A-4(0)	24	18	6	18
Miles fine sandy loam, 1 to 3 percent slopes (not a modal profile; mottled at 36 inches).	0 to 12	Fine sandy loam	SM-SC	A-4(1)	19	14	5	16
	16 to 27	Sandy clay loam	SC	A-6(3)	32	19	13	17
	36 to 49	Sandy clay loam	CL	A-6(8)	36	18	18	12
Nobscot fine sand, 0 to 5 percent slopes.	0 to 14	Fine sand	SM	A-2-4(0)	(3)	(3)	0	16
	20 to 26	Fine sandy loam	SM-SC	A-2-4(0)	22	17	5	20
	32 to 48	Fine sandy loam	SM	A-2-4(0)	21	19	2	20
Nobscot fine sand, 0 to 5 percent slopes.	0 to 30	Fine sand	SM	A-2-4(0)	(3)	(3)	0	16
	30 to 39	Fine sand	SM-SC	A-2-4(0)	21	16	5	23
	45 to 84	Fine sand	SM-SC	A-2-4(0)	23	16	7	21
Tillman clay loam, 0 to 1 percent slopes (mapping unit is Tillman and Hollister clay loams, 0 to 1 percent slopes).	0 to 8	Clay loam	SL or ML	A-6(9)	34	22	12	16
	8 to 20	Clay	CL	A-7-5(11)	46	23	23	12
	38 to 50	Clay	ML	A-7-6(16)	49	23	11	12
Tillman clay loam, 0 to 1 percent slopes (mapping unit is Tillman and Hollister clay loams, 0 to 1 percent slopes).	0 to 8	Clay loam	CL	A-4(8)	27	18	9	19
	10 to 26	Clay	CL	A-7-6(12)	42	22	20	12
	28 to 42	Clay	CL	A-6(12)	40	20	20	13
Tipton loam, 0 to 1 percent slopes.	0 to 18	Loam	CL-ML	A-4(8)	27	20	7	18
	18 to 38	Clay loam	ML	A-4(8)	34	26	8	17
	48 to 61	Clay loam	CL	A-6(10)	36	21	15	15
Tipton loam, 0 to 1 percent slopes (not a modal profile; light subsoil).	0 to 21	Loam	CL-ML	A-4(8)	25	19	6	20
	21 to 32	Clay loam	CL	A-4(8)	28	18	10	19
	33 to 50	Clay loam	CL	A-4(8)	27	19	8	20
Tipton loam, 0 to 1 percent slopes (not a modal profile; heavy subsoil).	0 to 18	Loam	CL-ML	A-4(3)	20	15	5	13
	22 to 36	Clay loam	CL	A-6(7)	33	19	14	14
	40 to 73	Clay loam	CL	A-6(10)	38	19	19	14
Tivoli fine sand	0 to 72	Fine sand	SW-SM	A-2-4(0)	(3)	(3)	0	19
Vernon soils	0 to 8	Clay loam	CL	A-7-6(8)	28	18	10	13
	11 to 22	Clay loam	CL	A-6(6)	36	22	14	18
	36 to 43	Clay loam	CL or ML	A-6(5)	34	23	11	17
Weymouth-La Casa clay loams, 1 to 3 percent slopes.	0 to 7	Clay loam	CL	A-6(8)	31	19	12	16
	8 to 16	Clay loam	CL	A-6(11)	39	22	17	20
	32 to 44	Clay loam	CL	A-6(10)	33	18	15	12

[1] Tests performed by State of Oklahoma, Department of Highways, Materials and Research Department in accordance with standard procedures of the American Association of State Highway Officials (AASHO).

[2] Mechanical analyses by procedure of the AASHO. Results by this procedure are likely to differ somewhat from results that would have been obtained by the procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is

from 15 profiles in Jackson County, Okla.

Shrinkage ratio	Volume change from FME	Mechanical analyses [2]									
		Percentage passing sieve—				Percentage smaller than—			Soil classes		
		No. 10 (2.0mm.)	No. 40 (0.42mm.)	No. 60 (0.25mm.)	No. 200 (0.074mm.)	0.05 mm.	0.005 mm.	0.002 mm.	Sand (2.0–0.074mm.)	Silt (0.074–0.005mm.)	Clay (less than 0.005mm.)
	Percent								*Percent*	*Percent*	*Percent*
1. 73	5	100	98	92	59	35	12	9	41	47	12
1. 72	0. 3	100	98	89	35	23	13	11	65	22	13
1. 71	2	100	97	84	28	18	12	10	72	16	12
1. 84	30	100	99	98	94	78	32	24	6	62	32
1. 98	60	100	99	99	97	89	50	41	3	47	50
2. 02	63	100	98	95	88	83	55	47	12	33	55
1. 82	1	100	91	64	26	19	9	7	74	17	9
1. 83	19	100	93	74	42	31	14	15	58	25	17
1. 78	16	100	94	74	39	28	19	17	61	20	19
1. 85	9	100	95	78	49	37	14	12	51	35	14
1. 89	13	100	95	77	42	32	16	15	58	26	16
1. 75	10	100	96	79	37	26	14	13	63	23	14
1. 84	3	100	93	72	38	30	11	10	62	27	11
1. 72	25	100	92	74	46	37	23	21	54	23	23
1. 98	42	100	94	80	58	49	30	28	42	28	30
1. 75	2	100	91	64	14	8	4	3	86	10	4
1. 69	3	100	95	75	33	15	12	12	67	21	12
1. 68	8	100	96	76	16	10	9	9	84	7	9
2. 16	4	100	86	60	15	8	3	3	85	12	3
1. 63	6	100	82	53	15	12	10	10	85	5	10
1. 69	2	100	87	64	23	17	12	12	77	11	12
1. 85	28	100	98	96	82	68	31	25	18	51	31
1. 97	53	100	99	97	88	76	42	36	12	46	42
2. 03	62	100	97	96	90	76	45	40	10	45	45
1. 72	13	100	99	98	82	64	26	20	18	56	26
1. 99	54	100	99	99	85	70	44	40	15	41	44
2. 00	44	100	97	95	78	68	44	38	22	34	44
1. 76	16	100	99	98	83	58	23	19	17	60	23
1. 80	23	100	100	99	85	65	26	21	15	59	26
1. 89	34	100	100	99	87	70	31	25	13	56	31
1. 74	5	100	100	99	82	58	16	12	18	66	16
1. 76	13	100	100	99	79	55	19	17	21	60	19
1. 66	11	100	100	99	78	50	19	15	22	59	19
1. 82	11	100	97	86	51	40	16	12	49	35	16
1. 92	33	100	96	86	60	47	24	22	40	36	24
1. 93	35	100	96	87	67	57	29	26	33	38	29
1. 70	2	100	100	83	8	5	3	1	92	5	3
1. 93	25	100	99	97	86	71	39	30	14	47	39
1. 83	25	100	94	89	71	63	36	30	29	35	36
1. 83	26	100	95	91	79	72	42	33	21	37	42
1. 75	22	100	97	95	86	65	28	20	14	58	28
1. 92	28	100	95	90	82	76	41	35	18	41	41
2. 01	36	100	92	89	82	74	46	35	18	36	46

determined 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 procedure of the SCS, the fine material is determined by the pipette method and material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table, therefore, are not suitable for naming textural classes of soils in the USDA system.

[3] Nonplastic.

555888—61——4

Laboratory tests given in this table were made by the State of Oklahoma Department of Highways, Materials and Research Department, in accordance with standard procedures of the American Association of State Highway Officials.

The engineering soil classifications in table 7 are based on data obtained by mechanical analyses and by tests to determine liquid limits and plastic limits. Mechanical analyses were made by combined sieve and hydrometer methods. Percentages of clay, obtained in this test by the hydrometer, are not suitable for determining USDA soil textural classes.

The liquid-limit and plastic-limit tests measure the effect of water on the consistence of the soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from a semisolid to a plastic state. As the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content, on a dry basis, at which the soil material changes from a semisolid to a plastic state. The liquid limit is the moisture content at which the material changes from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and plastic limit. It indicates the range of moisture content within which a soil material is in a plastic condition.

As moisture leaves a soil, the soil shrinks and decreases in volume in proportion to the loss in moisture until a condition of equilibrium is reached. At that point, shrinkage stops although additional moisture is removed. This point of moisture content where shrinkage stops is called the shrinkage limit of the soil and is reported as the moisture content in relation to ovendry weight of soil at the time when shrinkage stops.

Since clay is the major soil fraction that causes shrinkage, the shrinkage limit of a soil is a general index of clay content, and will, in general, be a low number for soils that contain a great deal of clay. The shrinkage limit of a sand that contains little or no clay is close to the liquid limit, and is called insignificant. Sands containing some silt and clay have a shrinkage limit of about 14 to 25, and the shrinkage limit of clays ranges from about 9 to 14. The load-carrying capacity of a soil is at a maximum when the moisture content is at or below the shrinkage limit. Sands do not follow this rule since they will have a uniform load-carrying capacity with a considerable range in moisture content, providing they are confined.

The shrinkage ratio of a soil is the ratio between its volume change and the corresponding change in water content above the shrinkage limits. Theoretically, the shrinkage ratio is also the apparent specific gravity of the dried soil pat.

Volume change from FME (field moisture equivalent) is defined as the volume change, expressed as a percentage of the dry volume of the soil mass when the moisture content is reduced from the FME to the shrinkage limit. The field moisture equivalent is the minimum moisture content at which a smooth surface of soil in its natural state will absorb no more water in 30 seconds when the water is added in individual drops. It is the moisture content required to fill all the pores in sands and to approach saturation in cohesive soils in their natural state.

The mechanical analysis gives the soil components by particle-size classes. All soils can be divided into coarse-grained soils and fine-grained soils. The No. 200 sieve is used to make this division. In the AASHO classification, coarse-grained soils are those in which more than 35 percent of the soil particles are larger than the openings in a No. 200 sieve. Fine-grained soils are those in which more than 35 percent of the soil particles are smaller than the openings in a No. 200 sieve. The fine materials are further subdivided into size classes by the hydrometer test, and limits of the size classes are stated in millimeters. Sand and coarse material are retained on the No. 200 sieve. Clay, as reported in the last column of table 7, is the fraction smaller than 0.005 millimeter in diameter. The material in size between that held on the No. 200 sieve and the diameter of 0.005 millimeter is called silt.

Descriptions of Soils

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

Then, they described the various soils and drew boundaries on aerial photographs to separate them. The soils are described in the following pages. Their acreage and proportionate extent are shown in table 8, and their location can be seen on the detailed map at the back of this report.

The soil series (groups of soils) and the single soils (mapping units) are described in alphabetic order. A soil series is a group of soils that are much alike except for possible differences in texture of surface soil. A series is given a place name; for example, the Altus soils make up a soil series.

An important part of each series description is the typical soil profile, a record of what the soil scientist saw and learned when he dug into the ground. It is to be assumed that all soils of one series have essentially the same kind of profile. The differences, if any, are explained in the description of the soil or are indicated in the soil name. To illustrate, a detailed profile is described for the Miles series, and the reader is to conclude that all soils in the Miles series have essentially this kind of profile.

Following the name of each soil, there is a set of symbols in parentheses. These identify the soil on the detailed map. The capability grouping and range site are given for each mapping unit. The capability units and range sites are described in the section, Use and Management of Soils.

In describing the soils, the scientist frequently assigns a letter symbol, for example, "A_1" to each of the various layers. These letter symbols have special meanings that concern scientists and others who desire to make a special study of soils. Most readers will need to remember only that all letter symbols beginning with "A" are surface soil; those beginning with "B" are subsoil; and those beginning with "C" are substratum, or parent material.

TABLE 8.—*Approximate acreage and proportionate extent of soils*

Soil	Acres	Percent
Abilene clay loam, 0 to 1 percent slopes	18, 403	3. 7
Abilene clay loam, 1 to 3 percent slopes	1, 100	. 2
Alluvial land	22, 809	4. 5
Altus fine sandy loam, 0 to 1 percent slopes	8, 213	1. 6
Dill fine sandy loam, 1 to 3 percent slopes	2, 696	. 5
Dill fine sandy loam, 3 to 5 percent slopes	1, 678	. 3
Enterprise loamy fine sand, 0 to 3 percent slopes	6, 779	1. 3
Enterprise very fine sandy loam, 0 to 1 percent slopes	4, 438	. 9
Enterprise very fine sandy loam, 1 to 3 percent slopes	5, 608	1. 1
Enterprise very fine sandy loam, 3 to 5 percent slopes	3, 374	. 7
Enterprise very fine sandy loam, 5 to 8 percent slopes	1, 832	. 4
Enterprise very fine sandy loam, 8 to 20 percent slopes	1, 366	. 3
Harmon stony loam	7, 328	1. 5
La Casa clay loam, 1 to 3 percent slopes	19, 307	3. 9
Mansic clay loam, 1 to 3 percent slopes	860	. 2
Miles fine sandy loam, 0 to 1 percent slopes	18, 836	3. 8
Miles fine sandy loam, 1 to 3 percent slopes	7, 343	1. 5
Miles fine sandy loam, 3 to 5 percent slopes	3, 851	. 8
Miles loamy fine sand, 0 to 3 percent slopes	15, 035	3. 0
Miller clay	515	. 1
Nobscot fine sand, 0 to 5 percent slopes	12, 154	2. 4
Nobscot fine sand, 5 to 12 percent slopes	2, 922	. 6
Port clay loam	9, 009	1. 8
Rock outcrop	1, 373	. 3
Rough broken land	17, 155	3. 4
Spur clay loam	13, 830	2. 8
Spur clay loam, channeled	3, 889	. 8
Spur clay loam, wet	3, 000	. 6
Tillman clay loam, 1 to 3 percent slopes	31, 889	6. 4
Tillman and Hollister clay loams, 0 to 1 percent slopes	118, 365	23. 7
Tipton loam, 0 to 1 percent slopes	37, 550	7. 5
Tipton loam, 1 to 3 percent slopes	1, 700	. 3
Tivoli fine sand	14, 018	2. 8
Treadway clay	2, 410	. 5
Vernon soils	23, 270	4. 7
Weymouth clay loam, 3 to 5 percent slopes	7, 851	1. 6
Weymouth-La Casa clay loams, 1 to 3 percent slopes	19, 485	3. 9
Yahola fine sandy loam	7, 393	1. 5
River channel	20, 566	4. 1
Total	499, 200	100. 0

The boundaries between horizons are described so as to indicate their thickness and shape. The terms for thickness are (1) *abrupt*, if less than 1 inch thick; (2) *clear*, if about 1 to 2½ inches thick; (3) *gradual*, if 2½ to 5 inches thick; and (4) *diffuse*, if more than 5 inches thick. The shape of the boundary is described as *smooth*, *wavy*, *irregular*, or *broken*.

The color of a soil can be described in words, such as reddish brown, or can be indicated by symbols for the hue, value, and chroma, such as 2.5YR 4/4. These symbols, called Munsell color notations, are used by soil scientists to evaluate soil colors precisely.

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

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

For definitions of other terms used in describing soils, refer to the Glossary in the back part of the report.

Abilene Series

The Abilene series consists of deep soils that have a dark-brown, friable, clay loam surface layer. The subsoil, of about the same color but slightly more clayey in texture, is tight and compact in the lower part. The thickness of the surface layer is about 8 inches, and that of the subsoil, about 17 inches. Below a depth of 25 inches, the soil material, similar to that from which the soil formed, is a brownish, calcareous clay.

These soils formed on uplands under a cover of native grasses. The main species is buffalograss, but gramas and some taller growing grasses are included.

Abilene soils are nearly level or gently sloping. The largest areas are in the vicinity of Martha and Blair. Near these towns, Abilene soils comprise a marginal belt between higher lying, sandy soils to the east and the areas of Tillman and Hollister clay loams to the west. There are some smaller areas of Abilene soils elsewhere in the county.

Abilene soils are darker and more friable than the Tillman soils; they are less compact and tight in the subsoil, but otherwise closely resemble the Hollister soils. They are less sandy and friable than the Tipton soils.

Typical profile of Abilene clay loam, in a nearly level, cultivated field, about 200 feet east and 50 feet south of the north quarter corner of sec. 28, T. 3 N., R. 19 W.:

A_{1p} 0 to 8 inches, dark-brown (7.5YR 4/2, dry; 3/2, moist) clay loam; weak, fine, granular structure; hard when dry, friable when moist; noncalcareous (pH 7.0); gradual boundary.

B_1 8 to 12 inches, dark-brown (7.5YR 4/2, dry; 3/2, moist), heavy clay loam; moderate, medium, subangular blocky structure; hard when dry, firm when moist; noncalcareous (pH 7.5); gradual boundary.

B_2 12 to 25 inches, dark-brown (7.5YR 4/2, dry; 3/2, moist) clay that is slightly lighter when crushed (7.5YR 4/4, moist); moderate, medium, subangular blocky structure; very hard when dry, firm to very firm when moist; moderate clay skins; few perdigons; occasional concretions of calcium carbonate; noncalcareous (pH 7.5); gradual boundary.

C 25 to 54 inches +, strong-brown (7.5YR 5/6, dry; 4/6, moist) clay that is slightly redder as depth increases; weak, blocky structure to massive (structureless); very hard when dry, very firm when moist; many concretions of calcium carbonate; calcareous.

The texture of the surface layer is clay loam or loam, but clay loam is dominant. The characteristic color of both surface soil and upper subsoil is dark grayish brown or dark brown. The structure in the subsoil is generally subangular blocky. In most of the soils, a zone of calcium carbonate has accumulated at depths of 25 to 35 inches. Below a depth of 25 inches the parent material is very slowly permeable to air and water.

Abilene soils are fertile and productive. Most areas are cultivated. Cotton, small grains, alfalfa, and grain sorghum are the principal crops. The soils are well suited to irrigation, and about half of the total acreage is irrigated.

These soils have a friable, granular surface layer. If not too dry or too wet, they are easy to work. Permeability of the subsoil to air and water is slow; in the underlying material it is very slow.

Abilene clay loam, 0 to 1 percent slopes (AbA).—This is the most extensive of the Abilene soils. It is on a broad, flat plain that extends north and east of Martha and in smaller areas in other places. A typical profile is described under the Abilene series.

This is an excellent soil. It is fertile, fairly drought resistant, and productive. It grows excellent crops of wheat and good crops of cotton, grain sorghum, and alfalfa. High yields are obtained if these crops are produced under irrigation and if the soils are well managed. The lack of moisture that plants can use is the main problem in farming this soil. Capability unit IIc–1 (dryland), I–3 (irrigated); range site, Hardland.

Abilene clay loam, 1 to 3 percent slopes (AbB).—Most areas of this gently sloping soil border Abilene clay loam, 0 to 1 percent slopes, or the natural drainageways that pass through the nearly level areas. Most areas are farmed with Abilene clay loam, 0 to 1 percent slopes. Except for a surface soil that is only 6 to 8 inches thick, Abilene clay loam, 1 to 3 percent slopes, has a profile like that described for the series.

Wheat, cotton, alfalfa, and grain sorghum are the main crops. This soil is suitable for irrigation, but only a small part is irrigated. It is subject to slight water erosion. Capability unit IIe–1 (dryland and irrigated); range site, Hardland.

Alluvial Land

This miscellaneous land type consists of a mixture of sandy soils that formed on recent alluvium. It occurs on the relatively unstable flood plains of the Red River and on the North Fork and the Salt Fork of the Red River. In these areas the water table is high, generally within reach of deep-rooted plants. In places, it is so high that salt accumulates in the surface layer.

Although subject to change by periodic overflow, Alluvial land has remained stable long enough for plants to become established. The main grasses are sand bluestem, switchgrass, Indian grass, and bermudagrass. Brushy plants include tamarix, willow, and cottonwood.

Alluvial land (Ac).—This is the only unit of this miscellaneous land type mapped in the county. Most of this land type consists of soils of the Lincoln series, which are mapped in several other Oklahoma counties. The Lincoln soils have a loose, very sandy subsoil. In this land type, the Lincoln soils are intermingled with other soils, chiefly those of the Yahola series. Yahola soils are mapped separately in other parts of the county and are described in the latter part of this section of the report. The surface layer varies considerably in texture, but the substratum is rather uniformly coarse textured. Loamy fine sand is the dominant texture in the surface layer, but there is some fine sandy loam and fine sand. Also, in some low places, the surface layer is clay loam or clay, 8 to 14 inches thick. In most areas, the surface soil is likely to be covered by sand or is otherwise modified when flooded.

Very little, if any, Alluvial land is cropped; it is best suited to range. It is considered choice for this use and is a dependable producer of large quantities of forage. Capability unit Vw–1 (dryland), not suited to irrigation; range site, Sandy bottom land.

Altus Series

Soils of the Altus series have a dark grayish-brown, friable fine sandy loam surface layer about 8 inches in thickness. The subsoil, about 34 inches thick, is moderately tight. The upper 16 inches of the subsoil is brown sandy clay loam that grades into reddish-brown, heavy sandy clay loam in the lower part. The underlying parent material is light reddish-brown, friable, calcareous sandy clay loam outwash or old alluvium.

These soils formed under a cover of native grasses that consisted chiefly of sand bluestem, little bluestem, and switchgrass.

The Altus soils in Jackson County are on nearly level, slightly concave slopes. Most areas are within larger areas of the Miles soils. In other places, Altus soils form a marginal belt between the Miles soils and the Abilene, Tillman, or Hollister soils.

Altus soils have a darker colored surface soil than the Miles soils; they contain more clay in the subsoil and are somewhat more slowly drained. Also, Altus soils are more sandy and are less compact in the subsoil than the Abilene, Tillman, or Hollister soils.

Typical profile of Altus fine sandy loam, 0 to 1 percent slopes, in a cultivated field, about 500 feet south and 50 feet west of the east quarter corner sec. 6, T. 2 N., R. 19 W.:

A_1 0 to 8 inches, dark grayish-brown (10YR 4/2, dry; 3/2, moist) fine sandy loam; weak, granular structure; friable; noncalcareous (pH 6.5); clear boundary.

B_{21} 8 to 34 inches, brown (7.5YR 4/2, dry; 3/2, moist) sandy clay loam that is slightly lighter in color when crushed; weak, medium, blocky structure; friable to firm when moist; distinct but patchy clay skins; many open pores on faces of peds; numerous worm-casts; noncalcareous (pH 7.5); gradual boundary.

B_{22} 34 to 42 inches, reddish-brown (5YR 5/4, dry; 4/4, moist), heavy sandy clay loam; similar to above layer but more reddish; some sides of peds are darker in color, apparently from topsoil sifting into cracks when dry; noncalcareous (pH 8.0); gradual boundary.

C 42 to 60 inches, light reddish-brown (5YR 6/4, dry; 5/4, moist) sandy clay loam; friable when moist; few small concretions of calcium carbonate; calcareous.

The color of the surface soil varies from very dark brown to dark grayish brown. The structure of the subsoil varies from coarse prismatic and granular to medium blocky. In places, this soil is subirrigated in wet seasons. The subirrigated soil differs from the normal soil in that it is more clayey throughout the profile and is mottled in the lower part of the subsoil. The depth to red beds is between 4 and 10 feet in most places. A typical area of this subirrigated soil is in a cultivated field about 500 feet south and 200 feet west of the northwest corner of sec. 20, T. 2 N., R. 19 W.

Altus fine sandy loam, 0 to 1 percent slopes (AtA).—This is the only soil of the Altus series mapped in the county. A profile of it is described for the series.

The dominant texture of the surface layer of this soil is fine sandy loam, but areas of loam are included. Also included are areas where the soil is subirrigated in wet seasons. These areas are characterized by scattered slick spots, and during wet years the water table is generally within 5 feet of the surface. During dry periods, when the water table is below 5 feet, the slick spots decrease in size or disappear. This subirrigated inclusion comprises less than 12 percent of the mapping unit.

The surface soil of Altus fine sandy loam, 0 to 1 percent slopes, is friable, granular, and easy to work. The subsoil, though moderately tight, is readily penetrated by plant roots.

Small grain, cotton, sorghum, and alfalfa are the crops best suited to Altus fine sandy loam, 0 to 1 percent slopes. On the subirrigated areas, grasses for pasture or seed production are best. The soil is suitable for irrigation, but very few of the subirrigated areas are irrigated, especially during wet years. Capability unit IIIe-4 (dryland), IIIe-5 (irrigated); range site, Sandy plains.

Dill Series

In the Dill series are deep to moderately deep soils that developed from soft, red-bed sandstone on the uplands. The surface soil, a reddish-brown, granular fine sandy loam, is about 12 inches thick. The subsoil, a reddish-brown, friable sandy clay loam, is about 24 inches thick. Below a depth of 24 inches, the color is more reddish as the depth increases. At a depth of about 50 inches, the soil material grades to soft, red sandstone. The profile does not contain free lime.

Dill soils formed under a cover of native grasses; the principal kinds were sand bluestem, little bluestem, and side-oats grama.

In Jackson County, the Dill soils make up a landscape that is higher than the surrounding soils. Most areas of these gently sloping or moderately sloping soils are in the southern part of the county, in the Hess and Elmer communities.

In general, the Dill soils are redder and contain less clay in the subsoil than the Miles soils. They are sandier and more red than the Tipton soils and have developed from different parent material.

Typical profile of Dill fine sandy loam, in a cultivated field, slope of about 2 percent, 600 feet west and 50 feet north of the southeast corner of sec. 31, T. 1 N., R. 20 W.:

A_{1p} 0 to 6 inches, reddish-brown (5YR 5/4, dry; 4/4, moist) fine sandy loam; structureless; slightly hard when dry, friable when moist; noncalcareous (pH 6.7); abrupt boundary.

A_1 6 to 12 inches, reddish-brown (5YR 4/3, dry; 3/3, moist) fine sandy loam; weak, granular structure; slightly hard when dry, friable when moist; many wormcasts and open pores; noncalcareous (pH 7.0); gradual boundary.

B_2 12 to 36 inches, reddish-brown (2.5YR 4/4, dry; 3/4, moist) sandy clay loam; compound, moderate, coarse prismatic and moderate, medium, granular structure; hard when dry, friable when moist; many wormcasts and open pores; noncalcareous (pH 7.0); gradual boundary.

C 36 to 50 inches, red (2.5YR 4/8, dry or moist) fine sandy loam that is slightly sticky; hard when dry, friable when moist; noncalcareous (pH 7.0).

D_r 50 to 54 inches +, red, soft, earthy, noncalcareous sandstone.

The surface soil ranges in thickness from 4 to 15 inches, but in most places it is 8 to 12 inches in thickness. The texture of the subsoil ranges from heavy fine sandy loam to sandy clay loam; the color ranges from red to dark reddish brown. The soil has a compound structure of long prisms that break into friable, granular pieces. The depth to sandstone ranges from 20 to 60 inches.

The friable, granular surface soil is easy to till, but a tillage pan commonly forms in or just beneath it. Permeability to air and water in the subsoil is moderate. In many respects, the Dill soils are similar to the Miles soils but are developed from sandstone parent material, instead of from Plains outwash, or old alluvium.

About four-fifths of the Dill soils are cultivated. Small grain, cotton, and sorghum are the main crops. The soils are fairly resistant to drought, and at least fair yields are almost always certain.

Dill fine sandy loam, 1 to 3 percent slopes (DaB).—This soil is inextensive but is the most extensive of the Dill soils in the county. It is on gentle, convex slopes. A profile of this soil is described as typical of the series.

Most of this soil is used for crops. The main ones grown are cotton and wheat, but all of the other principal crops grown in the county are suited. The soil is well suited to irrigation, but only a small acreage is irrigated.

If it is to be used for tilled crops, this soil needs practices to control wind erosion. In tilled fields that have been eroded by wind, the texture of the surface layer is somewhat sandier than that in uneroded areas because many of the finer particles have been blown out. Capability unit IIIe-2 (dryland and irrigated); range site, Sandy plains.

Dill fine sandy loam, 3 to 5 percent slopes (DaC).—This is the least extensive of the Dill soils in the county. It is on gentle, convex slopes that border Dill fine sandy loam, 1 to 3 percent slopes.

The profile of this soil differs from that described for the series in that the thickness of the surface layer ranges from 4 to 10 inches. The color is redder than that of Dill fine sandy loam, 1 to 3 percent slopes, because, in many places, part of the upper subsoil has been mixed with the surface layer by tillage. The texture of the subsoil ranges from fine sandy loam to light sandy clay loam. The depth to the soft, red sandstone differs considerably within short distances; the average depth is around 24 inches. A few areas that contain crossable gullies are included with this soil. Also included are thin or rocky spots where the soil is shallow or where most of it has been removed by erosion. In places, lime concretions are scattered over the surface of the rocky areas and throughout the profile. These inclusions comprise less than 10 percent of the mapping unit.

Small grain and sorghum are the main crops grown on this soil. Yields are low, however, as compared to those of other soils in the county. The soil is well suited to the native grasses of the county, and many fields that were used for tilled crops have been seeded to grass. Water erosion and wind erosion are the main problems in use and management. The soil is not well suited to irrigation. Capability unit IVe-1 (dryland); range site, Sandy plains.

Enterprise Series

The soils of the Enterprise series formed in deep, calcareous very fine sands and silts that were blown by wind from the flood plains of streams to the uplands. The surface soil is brown very fine sandy loam, about 18 inches thick. This layer grades rather indistinctly into a subsoil that is, in most places, several feet thick. The subsoil is much like the surface soil, except that it is redder. Whitish threads of calcium carbonate are distributed throughout the profile in many places.

These soils formed under a cover of native grasses, principally little bluestem, sand bluestem, and side-oats grama. They are nearly level to steeply sloping soils that do not extend farther than 3 miles from the rivers in Jackson County.

Enterprise soils are similar to Miles soils, except that the surface soil is less sandy and the subsoil does not contain accumulated clay. Enterprise soils do not have the clayey subsoil that is characteristic of the Tipton soils, and, in addition, they are lighter colored and less granular in the surface soil. Enterprise soils are not so sandy as the Tivoli soils, and they are smoother and do not have their typical duny relief.

Typical profile of Enterprise very fine sandy loam, in a nearly level, cultivated cottonfield, about 100 feet north of the south quarter corner of sec. 32, T. 1 S., R. 22 W.:

A_1 0 to 18 inches, brown (7.5YR 5/4, dry; 4/4 moist) very fine sandy loam; plow layer is slightly sandier; weak, granular structure; friable when moist; many wormcasts and insect holes; calcareous; gradual boundary.

C_1 18 to 60 inches, reddish-brown (5YR 5/4, dry; 4/4, moist) very fine sandy loam; weak, granular structure; friable when moist; several wormcasts and insect holes; many whitish threads of calcium carbonate; strongly calcareous.

In many cultivated fields of the Enterprise soils, enough of the fine soil particles have been blown away by wind erosion to leave the surface soil sandier than it was originally. The color of the surface soil ranges from brown to reddish brown; that of the subsoil, from reddish brown to yellowish red. In most places, the very fine sandy loam type is calcareous at or near the surface, but the loamy fine sand type is generally noncalcareous to depths of 50 inches or more.

The Enterprise soils are easily tilled and are friable in the surface layer when moist. A tillage pan forms in the plow layer in some places. The subsoil takes water well.

About four-fifths of the area of the Enterprise soils in Jackson County is cultivated. Crops that are best suited are small grain, cotton, alfalfa, and sorghum. Except for Enterprise very fine sandy loam, 8 to 20 percent slopes, the soils in this series are suitable for irrigation.

Enterprise loamy fine sand, 0 to 3 percent slopes (EnB).—This is one of the most extensive of the Enterprise soils in the county. It has uneven topography and gentle knolls but does not have well-defined natural drains.

The profile of this soil is sandier throughout than that described as typical for the series; otherwise, it is similar. The thickness of the surface soil averages about 16 inches. The texture is heavy loamy fine sand in most places, but minor areas of fine sandy loam are included. The texture of the subsoil is fine sandy loam or loamy fine sand. In areas that are farthest from the rivers, the surface soil is slightly darker in color and is heavier in texture. Calcareous material generally does not occur above 50 inches. In many areas of this soil, the surface soil has been winnowed, or wind erosion has gradually removed fine soil particles. In places, sand has drifted along roadsides and fences.

The soil is drought resistant and grows cotton and grain sorghum successfully. Rye is well suited as a cover crop to prevent wind erosion. The soil is suitable for irrigation by sprinkler, but only a small acreage is irrigated. Wind erosion is the most serious hazard if this soil is used for tilled crops. Capability unit IIIe–3 (dryland), IIIe–4 (irrigated); range site, Deep sand.

Enterprise very fine sandy loam, 0 to 1 percent slopes (ErA).—This soil is on nearly level benches that are commonly 6 to 8 feet above overflow, but range to as much as 100 feet above the flood plain. A profile of this soil is described under the series. The soil is calcareous at or near the surface in most places. The texture of the surface soil is a very fine sandy loam that is high in content of silt. Included with this soil are some cultivated fields in which enough of the fine soil particles have been blown away to change the texture of the surface soil to fine sandy loam.

This is a good soil and is one of the most productive in the county for cotton and alfalfa under dryland farming. If irrigated, it is considered choice soil for and produces good yields of the crops commonly grown in the county. Wind erosion is the most serious hazard to cropping this soil. Capability unit IIe–2 (dryland), I–2 (irrigated); range site, Loamy prairie.

Enterprise very fine sandy loam, 1 to 3 percent slopes (ErB).—This soil covers a greater acreage than Enterprise very fine sandy loam, 0 to 1 percent slopes, but, like that soil, is comprised of large areas. It occupies gentle slopes that border areas of Enterprise very fine sandy loam, 0 to 1 percent slopes, and is on ridges or in gentle depressions in hilly areas. The surface layer of this soil averages about 14 inches in thickness. Other characteristics of the profile are about the same as those of the profile described for the series. Included with this soil are cultivated fields in which enough of the fine soil particles have been blown away to leave the remaining surface soil more sandy than it was originally.

Cotton, small grains, and grain sorghum are the main crops grown. This soil is suitable for irrigation and, in places, irrigated, generally along with the neighboring, more nearly level soils. Wind erosion is the most serious hazard in using this soil. Capability unit IIe–2 (dryland and irrigated); range site, Loamy prairie.

Enterprise very fine sandy loam, 3 to 5 percent slopes (ErC).—This gently rolling soil is in areas adjacent to other Enterprise soils. The surface soil averages about 10 inches in thickness and is more reddish than the more nearly level Enterprise very fine sandy loams. In many areas, this soil is underlain by beds of waterworn gravel at depths ranging from 3 to 20 feet. Some of these are used as a source of gravel for construction. A few gullies occur in areas of this soil, but most of them are crossable with farm machinery.

Wheat, cotton, and grain sorghum are the main crops. The soil is suitable for sprinkler irrigation, but only a small acreage is irrigated.

Water erosion is the most serious hazard in cropping this soil. Capability unit IIIe-2 (dryland), IIIe-3 (irrigated); range site, Loamy prairie.

Enterprise very fine sandy loam, 5 to 8 percent slopes (ErD).—This soil occupies the next to the smallest acreage of the Enterprise soils in the county. It is on the moderately steep side slopes of valleys or on sloping benches that parallel streams. The average thickness of the surface layer is about 8 inches. This layer is generally reddish brown. The depth to red beds or to layers of waterworn gravel, in most places, ranges from 3 to 15 feet. Noncrossable gullies occur in places where large volumes of water concentrate.

If the soil is cultivated and good management is used, fair yields of wheat and grain sorghum are obtained. The safest use, however, is for grass. Water erosion is the most serious problem in using this soil for tilled crops. Capability unit IVe-1 (dryland), not well suited to irrigation; range site, Loamy prairie.

Enterprise very fine sandy loam, 8 to 20 percent slopes (ErE).—This is the steepest Enterprise soil in the county. It forms a sloping escarpment between the river bottoms and uplands in many places. The thickness of the surface soil is quite variable, but the average is about 7 inches. The soil ranges from shallow to deep over red beds or gravel beds. In a few places, running water has cut deep gullies. This soil is too steep for safe cultivation but is well suited to native grasses. Capability unit VIe-1 (dryland), not suited to irrigation; range site, Loamy prairie.

Harmon Series

The Harmon series is made up of very shallow, undulating to rolling soils on uplands where dolomitic limestone outcrops or lies within a few inches of the surface. The soil is brown or dark-brown stony loam about 4 inches thick. Many small fragments of limestone are on the surface. Beneath the surface soil are beds of dolomitic limestone, averaging about 26 inches in thickness, that are interbedded with red and gray calcareous clays of the red beds.

The vegetation on Harmon soils consists chiefly of sideoats grama, blue grama, buffalograss, and some little bluestem. Also, a few shrubby mesquites dot the landscape.

The Harmon soils formed chiefly on convex slopes. The principal soils near or adjacent are those of the Weymouth and Vernon series. Harmon soils are not so deep as either the Weymouth or the Vernon soils; those soils formed in clayey red beds that do not contain thick layers of dolomitic limestone.

Typical profile of Harmon stony loam, in a virgin area, 400 feet east of the south quarter corner of sec. 9, T. 1 N., R. 23 W.:

A_1 0 to 4 inches, brown; 10YR 5/3, dry; 4/3, moist) stony loam; the stone consists of fragments of dolomitic limestone ranging up to 8 inches in diameter and comprising 10 to 30 percent of the layer; granular structure; friable when moist; strongly calcareous; abrupt boundary.

D_r 4 to 30 inches, level-bedded dolomitic limestone, with beds ranging in thickness from ½ to 3 inches.

C 30 inches +, beds of red and grayish calcareous clay.

The depth to parent rock varies from 2 to 12 inches. The level-bedded dolomitic limestone, of the Permian system, ranges from 2 to 10 feet in thickness.

Harmon stony loam (Ha).—This undulating to rolling soil ranges in slope from 2 to 15 percent. The profile described as typical of the series is on a convex surface. This is the only soil of the Harmon series that is mapped in Jackson County.

In places, small pockets of deeper soils lie within large areas of Harmon stony loam. Also included are areas of a very shallow soil developed over deposits of gypsum. The surface layer of the gypsiferous soil is dark-brown, friable, granular, calcareous clay loam or loam that ranges from ½ to 12 inches in thickness. This layer rests abruptly on white, nearly pure gypsum. This soil is used for grazing but at one time was a source of gypsum for industrial uses. Gyp sinks, or caves, are common where the soil occurs. The soil is not extensive; principal areas are north of Eldorado.

Almost all of Harmon stony loam is used for range and is suited only to that use. It affords good grazing when properly managed. The main problems in using the soil are to maintain stands of the more desirable grasses under pressure of grazing and to get uniform use. Capability unit VIs-2 (dryland), not suited to irrigation; range site, Shallow prairie.

Hollister Series

The Hollister series is comprised of deep, clayey soils that have grayish-brown, granular, clay loam surface soil. The subsoil is very dark gray to gray clay that has blocky structure below about 16 inches. The thickness of the surface soil is about 9 inches, and that of the subsoil, about 27 inches. Below a depth of about 36 inches, the underlying material is gray, calcareous clay that grades at about 60 inches to reddish-brown clay.

These soils formed under a cover of native grasses. The main species were buffalograss and blue grama, together with some taller grasses.

Soils of the Hollister series are not mapped separately but are mapped extensively in a unit of Tillman and Hollister clay loams.

Hollister soils resemble the Tillman soils, but they are darker in the surface layer and have a dark-gray to gray subsoil instead of the reddish subsoil that is typical of the Tillman soils.

Typical profile of Hollister clay loam, in a cultivated field of wheat on a broad, nearly level upland plain, about 200 feet west and 100 feet north of the southeast corner of sec. 22, T. 3 N., R. 22 W.:

A_{1p} 0 to 5 inches, grayish-brown (10YR 5/2, dry; 3/2, moist) clay loam; weak, granular structure; hard when dry, firm when moist; noncalcareous (pH 7.5); abrupt boundary.

A_1 5 to 9 inches, very dark gray (10YR 3/2, dry; 2/2, moist) clay loam; weak, granular structure; hard when dry, firm when moist; many fine pores; peds have a weak shine; noncalcareous (pH 7.5); gradual boundary.

B_2 9 to 28 inches, very dark gray (10YR 3/1, dry; 2/2, moist) clay; moderate, medium, subangular blocky structure becoming blocky at 16 inches; very hard when dry, firm to very firm when moist; clay skins apparent; noncalcareous to 20 inches (pH 7.5); gradual boundary.

B_3 28 to 36 inches, gray (10YR 5/1, dry; 4/1, moist) clay; weak, blocky structure; very hard when dry, very firm when moist; few whitish spots of soft calcium carbonate; calcareous; gradual boundary.

C_{ca} 36 to 44 inches, gray (10YR 5/1, dry; 4/1, moist) clay; weak, blocky structure; very hard when dry, very firm when moist; more compact than layer above; mixture of soft and hard concretions of calcium carbonate; strongly calcareous; gradual boundary.

C 44 to 60 inches +, gray (10YR 5/1, dry; 5/2, moist) clay, grading to reddish-brown clay. This is apparently red-bed residuum.

In most places, the Hollister and the Tillman soils are so intermingled that they cannot feasibly be mapped separately.

La Casa Series

In this series are deep soils that have a dark-brown surface layer about 12 inches thick. The subsoil, about 26 inches thick, is reddish-brown, light clay or heavy clay loam. The parent material, below about 38 inches, is light reddish-brown to red clay that contains a considerable amount of free lime.

The La Casa soils have formed on uplands from moderately clayey red beds, which are mostly highly calcareous. In most places, the parent material contains thin layers of dolomitic limestone.

The native vegetative cover for the soils consisted principally of blue grama, buffalograss, side-oats grama, and some taller grasses.

Commonly mapped near or adjacent to the La Casa soils are the Weymouth, Tillman, and Hollister soils. La Casa soils are deeper, less friable, and not so limy as the Weymouth soils. Also, they contain a B horizon, which the Weymouth soils do not have. La Casa soils have a less pronounced, less firm, less clayey, and more permeable B horizon than the Tillman soils. Compared to the Hollister soils, the La Casa soils are calcareous at shallower depths, are less compact, and are more permeable in the lower part of the B horizon.

Typical profile of La Casa clay loam, in a gently sloping, cultivated field, three-tenths of a mile north and 100 feet east of the southwest corner of sec. 3, T. 2 N., R. 22 W.:

A_1 0 to 12 inches, dark-brown (7.5YR 4/2, dry; 3/2, moist) clay loam; brown (7.5YR 4/3, dry; 3/3, moist) throughout the plowed layer to 5 inches, or when crushed; strong, medium, granular structure below the plowed layer; friable when moist; noncalcareous (pH 7.5); gradual boundary.

B_2 12 to 30 inches, reddish-brown (5YR 4/3, dry; 3/3, moist), light clay or heavy clay loam; moderate, medium, subangular blocky structure; distinct, continuous clay skins; firm when moist; calcareous; gradual boundary.

B_{ca} 30 to 38 inches, reddish-brown (5YR 5/4, dry; 4/4, moist), light clay or heavy clay loam; weak, blocky structure; thin, patchy clay skins; firm when moist; highly calcareous; contains a few friable concretions of segregated calcium carbonate; gradual boundary.

C_{ca} 38 to 52 inches, light reddish-brown (5YR 6/4, dry; 4/4, moist), light clay or heavy clay loam; contains numerous friable masses of segregated calcium carbonate; almost structureless; friable when moist; relatively porous and permeable; calcareous; estimated 30 percent content of calcium carbonate; grades through a transition layer more than a foot thick to the layer below.

C 52 to 72 inches, red, strongly calcareous, light clay or heavy clay loam that contains a few masses of segregated calcium carbonate and shows obscure bedding planes. This is little altered parent material of Permian sediments, here presumably marine.

In color, the A horizon ranges from brown to grayish brown, and the B horizon, from reddish brown to very dark brown. In thickness, the A horizon ranges from 7 to 15 inches, and the B horizon, from 8 to 20 inches. In some places, calcareous material is on the surface; in others, it is 24 inches deep. Apparently the calcareous areas on the surface have been covered by material dug up by prairie dogs. In places, a few fragments of dolomitic limestone as much as 6 inches in length are on the surface.

La Casa clay loam, 1 to 3 percent slopes (LaB).—This soil is on convex surfaces to plane surfaces in undulating, eroded uplands. It occurs west of the Salt Fork of the Red River in the western part of the county. A profile of the soil is described for the series.

Within areas of this soil or in areas of adjacent soils, large, round holes, many feet deep, form. These are called gyp sinks and result from the soil slipping into underground caverns (figs. 18 and 19). The sinks are most likely to form during wet periods. Gypsum deposits at one time occupied the spaces now taken by the

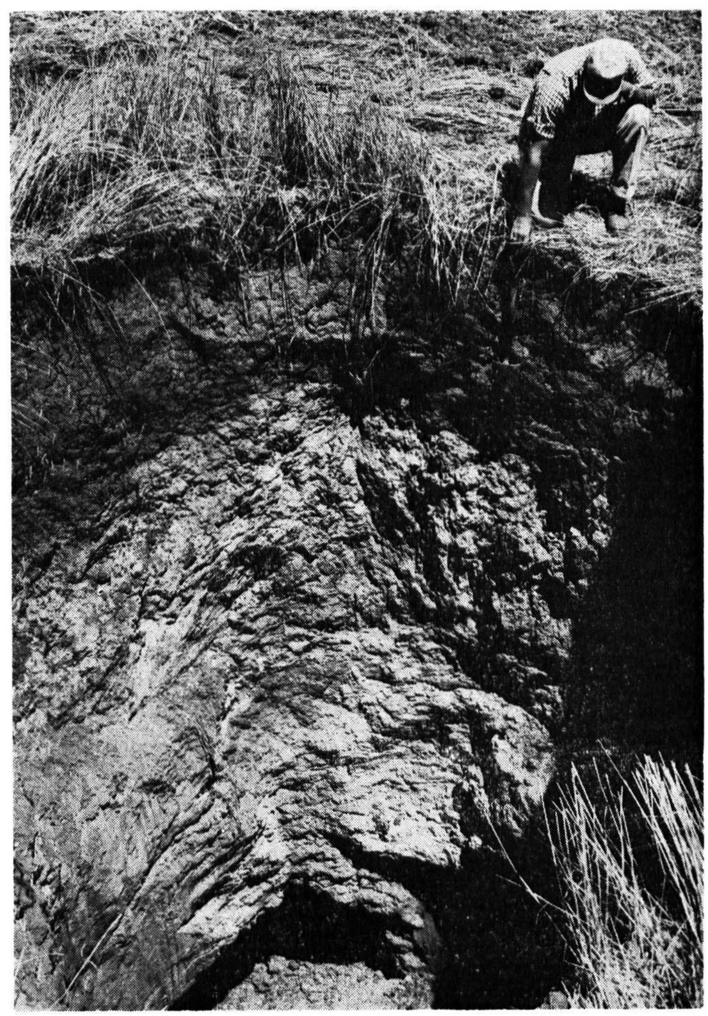

Figure 18.—**A profile of La Casa clay loam in a recently formed gyp sink. The hole is about 15 feet wide and at least 50 feet deep.**

Figure 19.—**A landscape of La Casa clay loam, 1 to 3 percent slopes. The hole is the same one shown in figure 18.**

underground caverns. The gypsum dissolved gradually and was carried away in the underground water, leaving a deep cavity beneath the surface.

Included with La Casa clay loam, 1 to 3 percent slopes, are small areas of Weymouth and Tillman soils. These inclusions, however, comprise less than 5 percent of the area. The Weymouth soils are in small areas, less than 5 acres in size. The La Casa soil occurs in areas that are gradational toward the Tillman soils, and accurate delineation is difficult.

Most of the La Casa soils are used for crops, of which wheat is the main one. Cotton, grain sorghum, and alfalfa are suitable, but good yields of these crops are less certain because of the limited supply of moisture. The soil is suitable for irrigation, and a small acreage is irrigated. Under irrigation, very good yields are obtained. Controlling water erosion, maintaining good surface tilth, and conserving moisture are the main problems in using this soil for tilled crops. Capability unit IIe-1 (dryland and irrigated); range site, Hardland.

Mansic Series

The Mansic series consists of deep, calcareous soils that have a grayish-brown clay loam surface soil, about 5 inches in thickness. Below the surface layer, from 5 to 15 inches, is dark grayish-brown clay loam that overlies a layer of brown clay loam in which carbonates have accumulated. This zone of carbonates extends to a depth of about 24 inches and is underlain by a brownish, heavy clay loam that contains slightly less accumulated carbonates than the layer above and extends to a depth of about 100 inches.

These soils formed in the High Plains from outwash sediments on gentle, convex slopes. They are distinctly higher than the soils on the surrounding areas.

The native vegetation consists chiefly of buffalograss, hairy grama, and some little bluestem.

Commonly associated with the Mansic soils are the Tillman, Hollister, and Abilene soils. The Mansic soils contain more carbonates, they do not have a B horizon, and they are generally more sloping than the Tillman, Hollister, and Abilene soils. Also, the Mansic soils formed from different parent materials.

Typical profile of Mansic clay loam, in a gently sloping, cultivated field, about 300 feet south and 250 feet east of the northwest corner of sec. 15, T. 2 N., R. 20 W.:

A_{1p} 0 to 5 inches, grayish-brown (10YR 5/2, dry; 3/2, moist) clay loam; glazed, thin surface crust of light grayish brown (10YR 3/2, dry); weak, granular structure; hard when dry, and friable when moist; calcareous; abrupt boundary.

AC 5 to 15 inches, dark grayish-brown (10YR 4/2, dry; 3/2, moist) clay loam; strong to moderate, medium, subangular blocky structure; hard when dry, firm when moist; few small concretions of calcium carbonate; strongly calcareous; gradual boundary.

C_{ca} 15 to 24 inches, brown (10YR 5/3, dry; 4/3, moist) clay loam; moderate, medium, subangular blocky structure; hard to very hard when dry, firm to very firm when moist; some concretions of calcium carbonate, up to 1 inch in diameter; strongly calcareous; gradual boundary.

C 24 to 100 inches, strong-brown (7.5YR 5/6, dry; 4/6, moist), heavy clay loam; very hard when dry, firm when moist; contains slightly less calcium carbonate than layer above; strongly calcareous.

Mansic clay loam, 1 to 3 percent slopes (MaB).—This soil is not extensive and occupies only a few areas in the county. One of the larger areas is west of Blair. Included in the total area are the Altus and the Blair Cemeteries. Most of the remaining acreage is used for small grain.

The profile of this soil is the one described as typical of the series. The surface soil has a tendency to crust badly after rains, making good stands of crops difficult to obtain. The subsoil, at depths of 5 to 24 inches, is moderately compact and is slowly permeable to air and water.

This soil is known for its low production, but crops have been good in years of abundant rainfall. Water erosion, surface crusting, and lack of moisture that plants can use are the main problems where this soil is planted to tilled crops. Capability unit IIIe-1 (dryland), not well suited to irrigation; range site, Hardland.

Miles Series

The Miles series consists of deep, well-drained soils that have a brown fine sandy loam surface soil and a reddish-brown sandy clay loam subsoil. The surface soil is about 10 inches thick; the subsoil, about 44 inches. Both layers are friable, are noncalcareous, and are neutral to mildly alkaline in reaction. The parent material is a yellowish-red, friable fine sandy loam that is several feet thick.

The soils formed under a cover of native grasses that consisted chiefly of sand bluestem, little bluestem, and switchgrass.

Miles soils are nearly level to moderately sloping and were formed in sandy, calcareous plains outwash or old alluvium. They are darker and less sandy in the surface soil than the Nobscot soils and have a thicker sandy clay loam subsoil.

Typical profile of Miles fine sandy loam, on a slope of about ½ percent, in a cultivated field, 800 feet north and 100 feet east of the west quarter corner sec. 2, T. 2 N., R. 19 W.:

A_{1p} 0 to 6 inches, brown (7.5YR 5/4, dry; 4/4, moist) fine sandy loam; friable when moist; noncalcareous (pH 6.7); abrupt boundary.

A_1 6 to 10 inches, dark-brown (7.5YR 4/2, dry; 3/2, moist) fine sandy loam; moderate, medium, granular structure; friable when moist; many wormcasts; noncalcareous (pH 6.7); gradual boundary.

B_2 10 to 36 inches, reddish-brown (5YR 4/4, dry; 3/4, moist) sandy clay loam; compound, coarse prismatic, and moderate, medium, granular structure; hard when dry, friable when moist; outside of peds have slight, dark coating; many open pores and wormcasts; moderately permeable; noncalcareous (pH 7.0); gradual boundary.

B_3 36 to 54 inches, yellowish-red (5YR 5/6, dry; 4/6, moist) sandy clay loam that contains less clay and is slightly more friable than the horizon above; same structure as overlying horizon; hard when dry; noncalcareous (pH 7.0); gradual boundary.

C 54 to 72 inches +, yellowish-red (5YR 5/8, dry; 4/8, moist) fine sandy loam; soft when dry, very friable when moist; noncalcareous (pH 7.5).

Miles soils are nearly level to moderately sloping. The color of the A horizon ranges from reddish brown to dark brown. In cultivated fields, deep plowing to depths of as much as 20 inches has mixed the subsoil with the surface soil. Horizons below the subsoil are calcareous in some places. A dark grayish-brown, clayey layer at depths of about 5 feet is evident in some places. This deep, clayey layer grades into material that is typical of the red beds. A profile of this variation can be seen in an area near Friendship, in sections 19 and 30, T. 3 N., R. 19 W.

The surface layer in soils of the Miles series has a friable, granular structure that is easily tilled. The subsoil, when moist, breaks into large prisms that crumble easily. It is moderately permeable to air and water. Miles soils are well drained, but they can store large amounts of moisture that plants can use.

Almost all of the Miles soils are cultivated. The crops best suited are cotton, grain sorghum, wheat, rye, and alfalfa. Truck crops also grow well. Under good soil management, yields of crops that are well suited are high. Many cultivated areas of Miles soils have been damaged to some extent by winnowing of the surface soil. Wind erosion has not been severe enough to warrant mapping wind-eroded phases in this soil survey. In places, however, sand drifts in fence rows or along roads show that wind erosion has been active. The Miles soils are suitable for irrigation, but very few of the more sloping areas are irrigated.

Miles fine sandy loam, 0 to 1 percent slopes (MeA).—This is the most extensive soil of the Miles series in the county. A profile of this soil is described for the series.

The crops commonly grown in the county are well suited to this soil, and yields of these crops are good.

The most serious hazard to use of this soil for tilled crops is wind erosion. Practices to control wind erosion and conserve moisture are needed if this soil is used for tilled crops. Of the Miles soils, irrigation is most extensive on this one. Capability unit IIe–2 (dryland and irrigated); range site, Sandy plains.

Miles fine sandy loam, 1 to 3 percent slopes (MeB).—This soil lies along natural drains and on gently sloping knolls or ridges within areas of other Miles soils. Although slopes range from 1 to 3 percent, those of 2 to 3 percent are dominant.

The surface layer of this soil ranges from 6 to 10 inches in thickness. In other respects, the profile is similar to that described for the series. All the crops common to the area can be grown.

Soil losses by wind and water erosion are the chief problems where this soil is planted to tilled crops. During rainy periods, runoff is greater and storage of moisture that plants can use is less than for Miles fine sandy loam, 0 to 1 percent slopes. Terracing, stubble mulching, and other suitable practices that will conserve moisture and control wind and water erosion are needed. Miles fine sandy loam, 1 to 3 percent slopes, is suitable for surface irrigation, but sprinkler irrigation is more practical. Capability unit IIIe–2 (dryland and irrigated); range site, Sandy plains.

Miles fine sandy loam, 3 to 5 percent slopes (MeC).—This is the most sloping of the soils in the Miles series in the county. The surface soil ranges from 4 to 10 inches in thickness. In places, the B horizon has been brought to the surface and mixed with the A horizon by plowing. In these areas, the surface layer is redder than it is in the less sloping Miles soils. There are crossable gullies in some areas.

Also included with Miles fine sandy loam, 3 to 5 percent slopes, are small areas of gravelly soil. These areas are on knolls or ridges within fields of good soils. They are under cultivation but give crop yields that are generally low. This gravelly soil, to a depth ranging from 10 to 18 inches, consists of reddish-brown fine sandy loam or loam that contains much waterworn gravel. This material grades downward into waterworn gravel that is embedded either in red clay or in hard, white carbonate of lime. The principal areas of this inclusion are south of Eldorado, in and around sec. 26, T. 1 S., R. 24 W.

Sheet and gully erosion as well as wind erosion are serious problems in the use and management of this soil. The soil is suitable for sprinkler irrigation, but only a small acreage is irrigated. Capability unit IIIe–2 (dryland), IIIe–3 (irrigated); range site, Sandy plains.

Miles loamy fine sand, 0 to 3 percent slopes (MfB).—This soil is slightly less dark in the surface than the Miles fine sandy loams and is somewhat sandy throughout. In other respects, it has a profile similar to that of Miles fine sandy loam, 0 to 1 percent slopes. In general, the surface soil ranges from 10 to 18 inches in thickness. In places, however, there are small spots that have lost all of the surface soil through wind erosion, leaving the bare subsoil exposed. Sandy drifts in fence rows are common but rarely exceed 2 feet in thickness.

This soil is not so productive as Miles fine sandy loam, 0 to 1 percent slopes, since it is less rich in plant nutrients. It is more subject to wind erosion, but it is fully as resistant to drought.

Included in this soil are minor areas that are subirrigated. These are in the lowest parts of the landscape or along drainageways, and huge cottonwood trees commonly grow on them. In these subirrigated soils, the water table is near the surface and the subsoil is somewhat mottled. A typical area of this inclusion is in a pasture, about 600 feet west of the south quarter corner of sec. 34, T. 4 N., R. 20 W.

Miles loamy fine sand, 0 to 3 percent slopes, is a fairly good soil. It is generally well suited to tilled crops, but it requires careful management to prevent excessive soil blowing. The soil is suitable for sprinkler irrigation, but only a small acreage is irrigated. Capability unit IIIe–3 (dryland), IIIe–4 (irrigated); range site, Deep sand.

Miller Series

In the Miller series are deep soils on bottom lands. They have a tough, plastic, reddish-brown clay surface soil about 7 inches thick. The subsoil is tight, compact, and hard when dry. The profile is fairly uniform, and, to a depth of 60 inches, few differences are obvious. In this county, Miller soils formed chiefly on sediments washed from exposed red beds.

The principal native vegetation is a moderate cover of grasses that consists chiefly of western wheatgrass, alkali sacaton, vine-mesquite, and buffalograss.

Miller soils resemble the Treadway soils in color, texture, and reaction, but they formed in more highly weathered alluvium. They differ from the Port and Spur soils in having thinner, lighter colored surface soils and more clayey subsoils. They are more compact and less friable throughout the profile.

Typical profile of Miller clay, in a nearly level field of wheat, 1,320 feet north and 50 feet west of the southeast corner of sec. 31, T. 1 N., R. 19 W.:

A_1 0 to 7 inches, reddish-brown (5YR 4.5/3, dry; 4/3, moist) clay; firm when moist, plastic when wet; noncalcareous (pH 8.0); gradual boundary.

AC 7 to 33 inches, reddish-brown (5YR 4/3, dry; 3/3, moist) clay; massive (structureless); very firm when moist, very hard when dry; very few pores; calcareous; gradual boundary.

C 33 to 60 inches +, reddish-brown (2.5YR 4/4, dry; 3/4, moist) clay; similar to above layer except redder in color and few pockets of whitish crystals that effervesce with acid; calcareous.

The surface soil varies in texture from clay to clay loam. In some areas the soil is calcareous at the surface; in others it is calcareous near the surface.

Miller clay (Mr).—This soil is of minor extent in Jackson County, but it is very extensive in some other counties of Oklahoma.

A typical profile is described for the series. This soil is tight, compact, and slow to drain. It is not so fertile as the typical Miller clay that is in other parts of the State. It is very slowly permeable to air and water and is droughty. It is not well suited to crops that make most of their growth in summer. The soil will support a moderate growth of native grasses. Capability unit IIIs–1 (dryland), not well suited to irrigation; range site, Heavy bottom land.

Nobscot Series

This series consists of light-colored soils that formed in deep sands on choppy-surfaced uplands that are undulating to dunelike in places. The upper 4 inches of the surface—a loose, grayish-brown fine sand—is underlain by about 21 inches of light-brown, loose fine sand. In tilled fields, the thin, dark layer is not evident because it either has been mixed with the horizon below or has been removed by wind erosion. The subsoil, from depths of about 25 to 40 inches, is red fine sandy loam that is hard when dry, but friable when moist. The parent material, below 40 inches, is light-red fine sandy loam of the Quaternary formations. In places, this material contains thin layers of light-colored fine sand.

Nobscot soils formed under a cover of shinnery oak and some tall grasses that include sand bluestem, little bluestem, and switchgrass.

The principal soils that are near or adjacent to the Nobscot soils are the Miles soils. Nobscot soils are more sandy, lighter colored in the surface layer, and lack the thicker, more uniform sandy clay loam subsoil that is typical of the Miles soils.

Typical profile of Nobscot fine sand, in a shinnery oak pasture on a slope of about 3 percent, 100 feet north and 1,320 feet east of the southwest corner of sec. 25, T. 4 N., R. 20 W.:

A_1 0 to 4 inches, grayish-brown (10YR 5/2, dry; 4/2, moist) fine sand; single grain (structureless); loose when dry; noncalcareous (pH 6.0); wavy boundary.

A_2 4 to 25 inches, light-brown (7.5YR 6.5/4, dry; 6/4, moist) fine sand; single grain (structureless); loose when wet or dry; noncalcareous (pH 6.0).

B_2 25 to 40 inches, red (2.5YR 5/6, dry; 4/6, moist) fine sandy loam; porous, massive (structureless); hard when dry, friable when moist; noncalcareous (pH 6.5); gradual boundary.

C_1 40 to 84 inches, light-red (2.5YR 6/6, dry; 5/6, moist) fine sandy loam with thin lenses of fine sand; hard when dry, friable when moist; noncalcareous (pH 6.5).

The texture of the surface soil is fine sand in most areas, but some areas of loamy fine sand are included. The surface soil ranges from 12 to 36 inches in thickness but is generally between 15 and 25 inches thick. The texture of the subsoil varies from heavy loamy fine sand to light sandy clay loam; the color, from reddish brown to red.

The Nobscot soils are so loose, sandy, and low in fertility that they have very limited use for cultivated crops. Only the more nearly level slopes are cultivated. Grain sorghum and rye are the best suited crops. Yields are fairly low, even with the best soil management practices. Under cultivation, wind erosion is a constant threat. Many areas of Nobscot soils that were once cultivated have been severely damaged by wind erosion. Since much of the soil profile is fine sand, it is difficult to estimate the amount of soil removed by wind erosion.

Nobscot fine sand, 0 to 5 percent slopes (NoC).—This undulating soil is in the northeastern part of the county. The largest areas are north of Friendship and are within a few miles of that town. This is one of the sandiest soils in the county. A typical profile is described under the Nobscot series.

About two-thirds of this soil is cultivated; sorghum and rye are the best suited crops. The rest is in range and has a variable cover of shinnery oak or sand sage and some tall grasses.

The severe risk of wind erosion and the low level of fertility are the main problems in using this soil. Wind erosion has been active in almost all places where the soil has been cultivated. Sand drifts in fence rows and roads are common. Many fields have been deep plowed, but the benefits from deep plowing on this soil are low. Capability unit IVe–2 (dryland), not well suited to irrigation; range site, Deep sand.

Nobscot fine sand, 5 to 12 percent slopes (NoD).—This soil is less extensive than Nobscot fine sand, 0 to 5 percent slopes. It occurs on long, narrow ridges or on duny areas.

The profile of this soil is like that described as typical for the series except that it shows more effects of wind erosion. Included are some severely eroded areas of Nobscot soils. On some of these, wind erosion has removed most or all of the surface soil. In other places, holes have been blown out and sand has drifted in from other parts of the field. Thus, fields are left choppy and hummocky. Most of the severely eroded areas are now idle or have been reseeded to native grasses. This inclusion, however, comprises no more than 5 percent of the area of the mapping unit.

The majority of this soil is in range or pasture. It supports a thick growth of shinnery oak or sand sage, and some tall grasses. Capability unit VIe–2 (dryland), not well suited to irrigation; range site, Deep sand.

Port Series

Soils of the Port series are deep, fertile, clayey, and well drained. They are on bottom lands that are seldom flooded. The surface soil is dark reddish brown to a depth of about 18 inches. This friable layer has a granular structure. From 18 inches to about 45 inches, the color grades to reddish brown, and the structure, to weak, subangular blocky. The underlying layer, from 45 to 72 inches, is calcareous, reddish-brown clay loam that contains lime concretions. This deepest layer is very firm when moist and very hard when dry. The soils formed on sediments deposited from floodwaters of adjacent streams. In most places, the sediments are only weakly stratified, and the clay loam texture of the surface layer extends to a depth of 6 feet or more. These sediments are neutral to mildly alkaline but are noncalcareous in the surface soil. At lower depths, they are mildly alkaline and, in some places, they are calcareous.

The Port soils formed under native vegetation of grasses, principally sand bluestem, little bluestem, western wheatgrass, and vine-mesquite. Native elm and hackberry trees are common along the creek channels. Most of the soils are along the creeks, in the central and eastern parts of the county.

The Port soils are similar to the Spur soils, but they differ from them in having a noncalcareous A horizon. Also, Port soils generally occupy higher flood plains that are less frequently flooded.

Typical profile of Port clay loam, on a nearly level flood plain in a cultivated field, 1,000 feet north and 100 feet west of the east quarter corner of sec. 19, T. 1 N., R. 19 W.:

A_1 0 to 18 inches, dark reddish-brown (5YR 3/3, dry; 2/3, moist) clay loam; moderate, medium, granular structure; hard when dry, friable when moist; many worm and insect casts; noncalcareous (pH 7.0); gradual boundary.

AC 18 to 45 inches, reddish-brown (5YR 4/4, dry; 3/4, moist) clay loam; contains slightly more clay than layer above; weak, subangular blocky structure; hard when dry, moderately firm when moist; many open rootlet channels; noncalcareous (pH 7.5); gradual boundary.

C 45 to 72 inches, reddish-brown (5YR 5/4, dry; 4/4, moist) clay loam; very hard when dry, very firm when moist; several calcium carbonate concretions; calcareous.

The color of the surface soil varies from dark brown to dark reddish brown, and that of the subsoil, from brown or reddish brown to yellowish red. The surface soil is easily tilled when it contains the right amount of moisture. From 18 to 45 inches deep, the structure of the soil is weak, subangular blocky. This layer is easily penetrated by roots, and it contains many open channels where roots have decayed. Port soils are fertile and adequately drained and have a good capacity for holding moisture that plants can use.

Port clay loam (Po).—This is the only soil of the Port series mapped in the county. A profile of it is described in the series. The texture of the surface soil is mostly clay loam, but small areas of loam are included. The color of the surface soil varies from dark brown to dark reddish brown, and that of the subsoil, from brown or reddish brown to yellowish red. The soil is noncalcareous to a depth of 20 inches or more.

About four-fifths of Port clay loam is cultivated; the rest, in pasture or woods, is inaccessible or is in inconveniently shaped small areas. These are isolated from cropped areas by property lines or by stream channels. Small grain, cotton, alfalfa, and grain sorghum are the main crops. The soil is fertile and adequately drained for good yields. It has a good water-holding capacity and is well suited to irrigation. Capability unit I–1 (dryland and irrigated); range site, Loamy bottom land.

Rock Outcrop

Rock outcrop is a miscellaneous land type that comprises the stony, granitic hills of the Wichita Mountains, in the eastern part of Jackson County. The slopes are rough and steep with only patches of soil in places. Natural vegetation in these areas varies, including a scattered growth of small hackberry, cedar, and mesquite trees with some grasses, principally little bluestem, sideoats grama, tall hairy grama, and sand bluestem.

A typical area is 1,300 feet north of the east quarter corner of sec. 20, T. 2 N., R. 18 W.

Rock outcrop (Rc).—This miscellaneous land type contains rough, steep areas where there are only patches of soil in places. The areas are unsuited to cultivation and are good for only limited grazing. Capability unit VIIs–1 (dryland); range site, Granite hills.

Rough Broken Land

In this miscellaneous land type are steep escarpments, canyons, and extremely dissected or gullied areas in which mostly red beds are exposed. These areas support a scant growth of native vegetation, but they have very low value for grazing. A typical area is in the southwest quarter of sec. 18, T. 1 N., R. 23 W. Layers of limestone are exposed in an area at the north quarter corner of sec. 31, T. 1 N., R. 22 W.

Rough broken land (Rg).—This is the only unit of this miscellaneous land type mapped in the county. Included are some areas of eroded, raw, red clay. Also exposed in some areas is shale that is not extremely broken. In the southwestern part of the county, Rough broken land includes areas in which are exposed layers of dolomitic limestone and beds of gypsum that are intermingled to a lesser extent with clays of the red beds. Capability unit VIIs-2 (dryland), not suited to cultivation or irrigation; range site, Breaks.

Spur Series

In the Spur series are deep, dark-brown, clayey soils on flood plains of the major creeks and their tributaries. The surface soil is friable, granular clay loam about 10 inches thick. From 10 to about 36 inches, the soil grades to a reddish color and has a less friable consistence that becomes firm at about 36 inches. Below 36 inches, the soil is reddish-brown, very firm clay loam. This layer contains carbonate concretions and, in a few places, whitish crystals. The entire profile is calcareous. Spur soils have formed in recently deposited alluvium. The character of the alluvium depends on the soils of the watersheds that are drained by the streams.

These soils developed under native grasses, principally vine-mesquite, western wheatgrass, buffalograss, and some bluestem. Trees, consisting chiefly of native elm, hackberry, and mesquite, are scattered along creek channels in most places.

Spur soils are similar to the Port soils, but they differ in being calcareous in the A horizon. They generally occupy slightly lower positions that are more frequently flooded. Spur soils differ from Miller soils in being more friable and less clayey throughout the profile.

Typical profile of Spur clay loam, in a nearly level wheatfield, about 800 feet south and 900 feet west of the east quarter corner of sec. 24, T. 1 S., R. 22 W.:

A_1 0 to 10 inches, dark-brown (7.5YR 4/2, dry; 3/2, moist) clay loam; moderate, medium, granular structure below plow depth; friable when moist; many roots; calcareous; gradual boundary.

AC 10 to 36 inches, reddish-brown (5YR 4/3, dry; 3/3, moist) clay loam; weak, subangular blocky structure; firm when moist; fewer roots than in layer above; calcareous; gradual boundary.

C 36 to 60 inches, reddish-brown (5YR 4/4, dry; 3/4, moist), heavy clay loam; very firm when moist; calcareous, with many calcium carbonate concretions; a few pockets of whitish crystals below 42 inches.

Clay loam is the dominant texture of the surface layer, but minor areas of loam occur. The color of the surface soil varies from dark brown to reddish brown. Spur soils are calcareous on or near the surface.

About half of the Spur soils are cultivated. Cotton, alfalfa, wheat, and grain sorghum are the main crops. The remaining areas are used for grass and, when in that use, the carrying capacity is very high.

Spur clay loam (Sc).—This is the most extensive Spur soil. A typical profile is described for the series.

This is a valuable soil for both dryland and irrigated crops. Most of the areas that are not cultivated are those made inaccessible by meandering stream channels or those in slightly lower, broken areas near stream channels. Only a small acreage of this soil is irrigated because there is not enough water in the streams. Capability unit I-1 (dryland and irrigated); range site, Loamy bottom land.

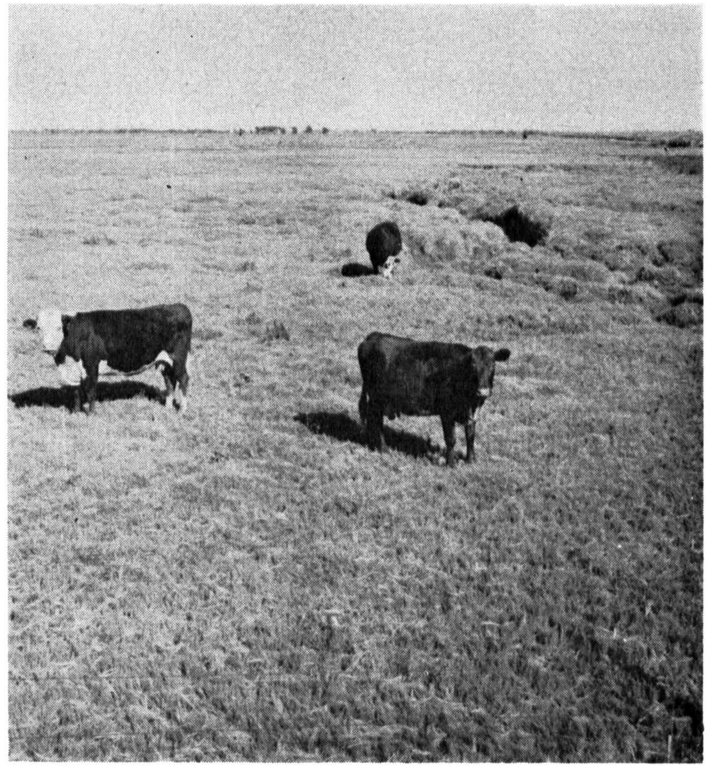

Figure 20.—Cattle grazing on Spur clay loam, wet.

Spur clay loam, channeled (Sn).—This soil consists of narrow bottom lands that flood frequently and that are cut up by meandering stream channels. The soil has a profile like that described for the Spur series.

Many areas are inaccessible to farm machinery. The soil is best suited to grass, and almost all is in that use. Capability unit Vw-2 (dryland), not well suited to irrigation; range site, Loamy bottom land.

Spur clay loam, wet (Sw).—Most areas of this soil are on narrow flood plains of the tributaries of large streams. There are some areas in both the eastern and the western parts of the county. In a few places, the soil is in narrow drainageways in irrigated areas.

This soil differs from other Spur soils in having a water table that is nearer the surface, generally within 6 feet. Salinity occurs in varying degrees. Slick spots or scabby patches are characteristic of the area.

This soil is not suitable for cultivation, but it produces good yields of grass (fig. 20). Capability unit Vw-2 (dryland), not suited to cultivation or irrigation; range site, Subirrigated.

Tillman Series

In the Tillman series are deep soils on uplands. These soils have a reddish-brown, granular, clay loam surface layer. The subsoil, of about the same color, is more clayey than the surface soil and has blocky structure in the lower part. The thickness of the surface layer is about 10 inches, and that of the subsoil, about 18 inches. The lower subsoil is blocky in structure. Below 28 inches is material similar to that from which the soil formed, a stiff, calcareous, clay that contains many soft carbonate concretions.

Tillman soils formed on nearly level or gentle slopes under native grasses, mainly buffalograss and blue grama, with some taller grasses.

The soils are lighter colored and have a reddish subsoil, in contrast to soils of the Hollister series that have a grayish-brown surface soil and a very dark gray to gray subsoil; they have a more compact and less friable subsoil than either the Weymouth or the La Casa soils.

Typical profile of Tillman clay loam, in a cultivated wheatfield, ½ percent slope, about 150 feet west and 100 feet south of the north quarter corner sec. 29, T. 2 N., R. 20 W.:

A_1 0 to 10 inches, reddish-brown (5YR 4/3, dry; 3/3.5, moist) clay loam becoming slightly darker in color below plow depth; slightly crusted surface; weak granular structure; hard when dry, firm when moist; noncalcareous (pH 7.5); clear boundary.

B_2 10 to 28 inches, reddish-brown (5YR 4/3, dry; 3/2, moist) light clay that is slightly lighter in color when crushed; moderate, very fine, blocky structure; very hard when dry, very firm when moist; clay skins apparent, but not pronounced; few small, black concretions; noncalcareous (pH 8.0); gradual boundary.

C_{ca} 28 to 50 inches, reddish-brown (5YR 3/4, dry; 3/6, moist) clay; massive (structureless); very hard when dry, very firm when moist; many soft concretions of calcium carbonate; soil mass calcareous; gradual boundary.

C 50 to 60 inches, yellowish-red (5YR 4/6, dry; 3/6, moist) clay containing less calcium carbonate concretions than above.

The dominant texture of the A horizon is clay loam, but texture varies from loam to silty clay loam. The color of the surface soil ranges from brown to dark reddish brown. The B horizon is reddish brown to dark reddish brown. In most places, the A horizon is 8 to 10 inches thick, but thickness ranges from 5 to 12 inches. In most profiles a zone of calcium carbonate has accumulated at depths between 24 and 30 inches.

The surface soil is easily tilled when not too wet or too dry. The lower part of the subsoil is slowly permeable to water and air.

Four-fifths or more of the Tillman acreage is cultivated. Under dryland farming, the soils are best suited to small grain. Yields of cotton, alfalfa, and grain sorghum are more uncertain because of the droughty nature of these soils. When these crops are irrigated, however, they yield well.

Tillman clay loam, 1 to 3 percent slopes (TaB).—This gently undulating soil is along the natural drains that pass through or border nearly level Tillman and Hollister clay loams, 0 to 1 percent slopes.

Tillman clay loam, 1 to 3 percent slopes, differs from the profile described for the Tillman series mostly in thickness of the surface soil and subsoil. The surface soil generally is 5 to 8 inches thick, but included are a few small, eroded areas in which the surface soil is less than 5 inches thick. The B_2 horizon is generally 8 to 12 inches thick and, in most places, is calcareous.

This soil includes up to 5 percent of Weymouth clay loam. The areas of the Weymouth soil are so closely intermingled that accurate distinction is difficult. The Weymouth soil has a friable, calcareous surface soil and a strong granular subsoil. It contains an abundance of soft calcium carbonate.

A small acreage of Tillman clay loam, 1 to 3 percent slopes, is irrigated, mostly in connection with the more level Tillman and Hollister clay loams. The principal problem in using this soil is the susceptibility to water erosion. Capability unit IIIe-1 (dryland and irrigated); range site, Hardland.

Tillman and Hollister clay loams, 0 to 1 percent slopes (TcA).—This is the most extensive mapping unit in the county. The soils are on a broad flat that surrounds the town of Altus and are also in smaller, nearly level areas in other parts of the county.

The Tillman soil makes up about 60 percent of the unit, and the Hollister soil makes up the rest. These two soils occur in such an intermingled pattern that it is impractical to show them separately on a map of the scale used. A typical profile is described for each of the series.

Tillman and Hollister clay loams, 0 to 1 percent slopes, grow excellent crops of wheat and fairly good crops of cotton, grain sorghum, and alfalfa. The soils are suitable for irrigation and comprise the largest irrigated acreage in the county. Practically all of the unit is cultivated; the irrigated areas produce very good yields.

The lack of moisture that plants can use is the main problem in farming Tillman and Hollister clay loams, 0 to 1 percent slopes. Erosion is not particularly a hazard. During prolonged dry periods, however, the fine particles of clay and silt are detached from the soil mass and are blown about. Blowing occurs mainly on poorly managed, cultivated fields. Capability unit IIc-1 (dryland), I-3 (irrigated); range site, Hardland.

Tipton Series

The Tipton series consists of deep soils formed in loamy or silty water-laid or wind-laid materials on uplands. These nearly level or gently sloping soils are in broad, terracelike areas. Both surface soil and subsoil are dark-brown granular material. The surface soil is loam and about 18 inches thick; the clay loam subsoil extends to a depth of several feet. A buried soil, at a depth of about 64 inches, is much older than the overlying soil.

The soils formed under native grasses, principally little bluestem, sand bluestem, Indian grass, and side-oats grama.

Tipton soils are similar to Enterprise soils but are darker, less reddish, and contain at least some accumulated clay in the subsoil.

Typical profile of Tipton loam, in a nearly level cottonfield, 1,600 feet north of the southeast corner sec. 24, T. 1 S., R. 20 W.:

A_{1p} 0 to 8 inches, dark-brown (7.5YR 4/2, dry; 3/2, moist) loam; weak granular structure; friable when moist; noncalcareous (pH 7.0); abrupt boundary.

A_1 8 to 18 inches, dark-brown (7.5YR 4/2, dry; 3/2, moist) loam; moderate, medium, granular structure; friable when moist; many wormcasts and insect holes; noncalcareous (pH 7.0); gradual boundary.

B_{21} 18 to 42 inches, dark-brown (7.5YR 4/4, dry; 3/4, moist) light clay loam; moderate, medium, granular structure; friable when moist; many wormcasts, insect holes, and open rootlet channels; moderately permeable; noncalcareous (pH 7.5); gradual boundary.

B_{22} 42 to 64 inches, dark-brown (7.5YR 4/2, dry; 3/2, moist) light clay loam; weak, fine to medium, subangular blocky structure; friable when moist; weak clay skins; calcareous with some soft splotches of lime; clear boundary.

64 inches +, grayish-brown (10YR 5/2, dry; 4/2, moist) clay loam; weak, blocky structure; firm when moist; calcareous.

The color of the surface soil ranges from brown to very dark brown; the thickness, from 8 to 18 inches. The color of the subsoil ranges from dark brown to reddish brown; the texture, from heavy loam to medium clay loam. Buried soils that are much older than Tipton soils are not uncommon at depths below 5 feet.

The Tipton soils have a friable, granular surface soil that is easily tilled and a subsoil that is moderately permeable to air and water. The Tipton soils are the most productive of the soils in the county, and most areas are used for tilled crops. They are fertile and are well suited to all of the crops commonly grown. Tipton soils are well suited to irrigation, and a large acreage is irrigated.

Tipton loam, 0 to 1 percent slopes (TpA).—This soil is the most extensive Tipton soil in the county. The largest area is on a flat, high terrace east and south of Hess. Smaller areas occur other places, generally adjacent to major streams.

The profile of this soil is like the one described as typical of the series. The dominant texture of the A horizon is loam, but included in some places are minor areas of silt loam and fine sandy loam. The fine sandy loam texture is probably in areas that have gradually lost some of the finer particles by winnowing.

This is an excellent soil. Most of it is used to grow cotton. Smaller areas are used to grow small grain, alfalfa, and grain sorghum. The highest yields in the county for these crops, under either dryland or irrigation, are obtained on this soil.

If tillage is improper or untimely, a tillage pan may develop. Capability unit I–1 (dryland), I–2 (irrigated); range site, Loamy prairie.

Tipton loam, 1 to 3 percent slopes (TpB).—This gently sloping soil borders areas of the more nearly level Tipton loam or extends along natural drainageways through the more nearly level areas. The surface soil averages about 10 inches in thickness. Otherwise, it has a profile that is about the same as the one described for the Tipton series.

The dominant texture of the A horizon is loam, but included in some places are minor areas of silt loam or fine sandy loam. The fine sandy loam texture is probably in areas that have gradually lost some of the finer particles by winnowing.

Most of the soil is cultivated in connection with Tipton loam, 0 to 1 percent slopes, or with some other soil. Cotton, small grain, alfalfa, and grain sorghum are the main crops. The soil is suitable for irrigation.

If tillage is improper or untimely, a tillage pan is likely to form. Capability unit IIe–1 (dryland and irrigated); range site, Loamy prairie.

Tivoli Series

These light-colored soils are formed in deep, wind-drifted sands that are adjacent to the larger streams on billowy or duny landscapes. The surface soil, 4 to 7 inches thick, contains a slight accumulation of organic matter that darkens the upper few inches. The underlying material is reddish-yellow, loose, fine sand that is uniform to depths of many feet.

In most places, Tivoli soils support a brushy growth of sand sage, wild plum, shinnery oak, and some grasses. This vegetation stabilizes the dunes that are typical of the area.

In some respects, the Tivoli soils are similar to the Nobscot soils, but they are lighter in color, more sandy, and less cohesive in the subsoil.

Typical profile of Tivoli fine sand in a duny, virgin area adjacent to the Red River, about 1,320 feet south and 300 feet east of the northwest corner of sec. 12, T. 2 S., R. 20 W.:

A_1 0 to 4 inches, brown (7.5YR 5/4, dry; 4/4, moist) fine sand; single grain (structureless); loose when moist or dry; roots plentiful; noncalcareous; clear boundary.

C 4 to 54 inches +, reddish-yellow (7.5YR 7/6, dry; 6 6, moist) fine sand; single grain (structureless); loose when moist or dry; few roots below 12 inches; weakly calcareous at 54 inches. This material extends to depths of several feet without differences.

Tivoli soils are so sandy and loose that they generally are unsuitable for cultivation.

Tivoli fine sand (Tv).—The texture of the surface soil ranges from loamy fine sand to fine sand. A profile of this soil is described for the Tivoli series. Included with this soil are areas of Enterprise loamy fine sand that range from 4 to 10 acres in size. These areas are in the more nearly level places between dunes. There are some active dunes in Tivoli fine sand, but most of these are only a few acres in size and not many of them exceed 20 acres. One of the largest active dunes in the county is in sec. 31, T. 1 S., R. 24 W.

Because of the extremely low fertility and the severe wind-erosion hazard, very few acres of this soil are cultivated. Some areas of the Enterprise loamy fine sand that are included have been cultivated, but now most of them are abandoned or have been planted to native grass.

Tivoli fine sand is fair to poor for grazing. Capability unit VIe–2 (dryland), not suited to irrigation for crops; range site, Deep sand.

Treadway Series

In the Treadway series are reddish-brown, light clay or heavy clay loam soils that are compact and sticky when wet. Treadway soils do not have the A and B horizons that are common to many soils. The upper 8 inches of the soil is underlain by massive, yellowish-red, light clay that extends to a depth of 50 inches or more. These soils formed in compact, raw, reddish, mostly calcareous, clayey alluvium, chiefly on fans, aprons, and flood plains, below outcrops of clayey red beds.

The principal vegetation on these soils is a sparse to moderate cover of short grasses and various thorny shrubs, such as mesquite and lotebush.

Vernon and Tillman soils are commonly on nearby or adjacent uplands. In color, texture, and reaction, Treadway soils are much like Miller soils that are also on the flood plains. But the Treadway soils are distinguished from Miller and associated soils by their low content of organic matter, raw soil material, droughtiness, low fertility, sparse vegetation, weak structure, and very low porosity and permeability.

Typical profile of Treadway clay, in a nearly level virgin area, about 1,000 feet south of the east quarter corner of sec. 30, T. 3 N., R. 20 W.:

C_1 0 to 8 inches, reddish-brown (5YR 4/4, dry; 3/4, moist), light clay or heavy clay loam; weak, platy structure and noncalcareous in the upper 3 inches, massive (structureless) and mildly calcareous below; very hard when dry, firm to very firm when moist; compact with few visible pores or root channels; gradual boundary.

C_2 8 to 50 inches +, yellowish-red (5YR 4/6, dry; 3/6, moist), light clay; massive (structureless); very hard when dry, very firm and compact when moist with almost no visible pores, root channels, or roots; obscure bedding planes can be seen; calcareous.

The texture of the Treadway soils commonly ranges from heavy clay to heavy clay loam. In a few places, there is a loamy deposit, 2 to 5 inches thick, on the surface. The soil is slightly saline in some places.

Below a depth of 8 inches, the structure is massive and the soil is almost impervious to water and plant roots.

The Treadway soils are not well suited to cultivation. Most areas are in grass, but attempts have been made to cultivate some areas. Also, Treadway soils are relatively unproductive for range.

Treadway clay (Ty).—This nearly level soil is not extensive in Jackson County. A profile of the soil is described for the series. Included are a few areas that have a loamy deposit, 2 to 5 inches thick, on the surface. Treadway clay is saline in a few places, but nowhere is it more than slightly saline.

Since Treadway clay is low in content of organic matter and fertility, is droughty, and is very slowly permeable, it is not well suited to tilled crops. Attempts have been made to cultivate some areas of this soil. But most areas are in grass, and the soil is relatively unproductive for that use. Capability unit VIs-3 (dryland), not suited to tilled crops and irrigation; range site, Red clay flats.

Vernon Series

The Vernon series consists of shallow, undulating to sloping soils on uplands. They are locally described as "red, tight land." The surface soil is compact, reddish-brown, calcareous clay loam or clay that is only about 6 inches thick. The underlying material, from 6 to 15 inches, grades into red, very compact, calcareous clay that contains a few white spots or concretions of lime. Below the surface layer, the soil breaks into very hard, intractable clods that have slick, glistening surfaces when moist. The parent material is residuum from red, calcareous shales or clays of the red beds.

The soils formed under a cover of native grasses that consisted chiefly of buffalograss, side-oats grama, blue grama, and some little bluestem.

Typical profile of Vernon soils on sloping, native range about 300 feet west of the south quarter corner of sec. 20, T. 3 N., R. 23 W.:

A_1 0 to 6 inches, reddish-brown (2.5YR 5/4, dry; 4/4, moist) clay loam or clay; weak, granular structure; firm when moist; calcareous; gradual boundary.

C 6 to 15 inches, red (10R 4/6, dry; 3/6, moist) clay; massive (structureless); very firm; calcareous with few concretions of calcium carbonate.

15 inches +, similar to layer above but less weathered; contains a few small, round spots of bluish-gray material.

The surface soil varies in texture from clay loam to clay; in thickness, from 3 to 12 inches. In some areas in the western part of the county, thin layers of dolomitic limestone are interbedded with the parent material. Because they are shallow, droughty, and susceptible to erosion, Vernon soils are not suited to crops.

Vernon soils (Ve).—Vernon soils are mostly on slopes of more than 3 percent and range from gently sloping to steep. A typical profile is described for the series. The surface texture ranges from clay loam to clay, and the thickness, from 3 to 12 inches. In some places in the western part of the county, thin layers of dolomitic limestone are interbedded in the parent material. Also included in this mapping unit are minor areas of severely eroded, clayey soils that are cultivated or have been previously cropped. This inclusion comprises less than 2 percent of the Vernon soils.

These soils are not suited to crops. Most areas are used for range. They are only fair for this use and require careful management. Capability unit VIs-1 (dryland), not suited to tillage and irrigation; range site, Red clay prairie.

Weymouth Series

In the Weymouth series are moderately deep to shallow, gently sloping to moderately sloping soils on uplands. The surface soil consists of 18 inches of granular clay loam that is friable when moist. The color of this layer grades from brown in the upper 12 inches to reddish brown in the lower 6 inches. The underlying material, from 18 to 30 inches, is a whitish mixture of lime and reddish-yellow, friable clay loam. In most places, concretions of calcium carbonate are on the surface and scattered throughout the profile. The soils developed in strongly calcareous, clayey red beds.

Weymouth soils formed under a cover of native grasses that consisted mainly of side-oats grama, buffalograss, hairy grama, and some little bluestem. In grassland areas, scattered, dwarfed mesquite shrubs are common, but they are less abundant than on the deeper associated soils.

Also formed in clayey red beds are soils of the La Casa, Vernon, Tillman, and Hollister series. Weymouth soils are commonly associated with the La Casa soils in the western part of the county. They are not so deep as the La Casa soils, are more granular, more limy, and do not have a B horizon; they are not so clayey, are more granular, and more limy than the Vernon soils. Weymouth soils are distinguished from the Tillman and Hollister soils by lack of the distinct, blocky B horizon that is typical of those soils.

Typical profile of Weymouth clay loam, on a slope of about 2 percent in a cultivated field, 1,150 feet east and 250 feet north of the southwest corner of sec. 28, T. 3 N., R. 19 W.:

A_{11} 0 to 12 inches, brown (7.5YR 4/3, dry; 3/3, moist) clay loam; strong, medium, granular structure; friable when moist; highly calcareous; gradual boundary.

A_{12} 12 to 18 inches, reddish-brown (5YR 5/4, dry; 4/4, moist) clay loam; strong, medium, granular structure; friable when moist; highly calcareous; nearly abrupt, irregular to wavy boundary.

C_{ca} 18 to 30 inches, whitish mixture of about two parts of reddish-yellow, friable clay loam and one part of friable to partly indurated concretions or other masses of segregated calcium carbonate; the proportion of the latter decreases below 27 inches; weak, subangular blocky structure; friable when moist; relatively porous and permeable; content of calcium carbonate probably is between 30 and 60 percent; gradual boundary.

C 30 to 50 inches +, yellowish-red (5YR 5/6, dry; 4/6, moist) clay loam; contains a few whitish masses of segregated calcium carbonate, which decrease with depth; nearly massive (structureless); friable when moist; relatively porous and permeable; highly calcareous.

The color of the surface soil ranges from brown to reddish brown; the soil is slightly to very strongly calcareous. The texture of the surface soil is loam or clay loam. In many places, the second horizon is yellowish red or strong brown and is more nearly an AC than an A_1 horizon. Depth to the C_{ca} horizon ranges between about 10 and 24 inches. This horizon varies from a nearly white, marly layer of as much as 18 inches in thickness to a strongly calcareous, reddish-yellow or light-brown clay loam that contains some 5 percent of calcium carbonate concretions. Thin layers of dolomitic limestone outcrop in many places on the steeper slopes. Where the soil is cultivated, the limestone layer is broken with tillage implements. Many farmers have removed larger, flat pieces of rock from their fields.

Two-thirds or more of the Weymouth soils are cultivated, and wheat is the principal crop. Yields are fair to poor even with the use of the best management practices.

Weymouth clay loam, 3 to 5 percent slopes (WeC).—The profile of this soil is more shallow than that described as typical of the series. The surface soil is thinner, averaging about 4 inches in thickness. In many places, the soil is gradational toward Vernon soils or Harmon stony loam, and about 10 percent of these two soils is included in the mapping unit. About 60 percent of the cultivated area of this soil is moderately eroded, and some small bodies of severely eroded soils are included. There are many rock outcrops. Also included are a few places of less than 3 percent slope where the soil is extremely thin or rocky.

Small grains are the main crops grown on this soil. But the choice of crops is limited, and the best use is for grass.

This soil is hard to manage because much of the water that falls on it runs off and is lost. Also, it is very erodible and needs protection from runoff to control erosion. Capability unit IVe–3 (dryland), not suited to irrigation; range site, Hardland.

Weymouth-La Casa clay loams, 1 to 3 percent slopes (WmB).—In most areas, this mapping unit is a complex of two soils. The soils occur in such an intricate pattern that they are farmed together and it is impractical to show them separately on a map. Typical profiles of both of these soils are described for the two series. Some areas that are wholly Weymouth clay loam are in this mapping unit, especially in the eastern half of the county. The Weymouth soil comprises 50 to 80 percent of the mapping unit. It is on rounded knolls or ridges and in areas that slope into natural drains. The La Casa soil is deeper than the Weymouth soil, and is in the slightly lower areas between the knolls and ridges.

Small grains are the crops best suited to Weymouth-La Casa clay loams, 1 to 3 percent slopes. Capability unit IIIe–1 (dryland), not well suited to irrigation for crops; range site, Hardland.

Yahola Series

The Yahola series consists of deep, nearly level, somewhat rapidly drained soils on bottom lands of major streams. The surface soil, about 15 inches thick, is brown fine sandy loam in the upper half but grades into dark-brown silt loam in the lower half. The second layer, from 15 to 31 inches in depth, is reddish-yellow fine sandy loam. This layer is very friable, rapidly drained, and less fertile than the surface soil. Below a depth of about 31 inches, the content of sand increases with depth. The soils are formed in materials deposited by floodwaters, and most areas are subject to overflow.

These are among the most youthful soils in the county. They are generally calcareous at or near the surface. In most areas the water table is at depths of less than 10 feet.

The native vegetation consisted of tall grasses, principally sand bluestem, switchgrass, and Indian grass.

Yahola soils are commonly mapped in the same general areas as Alluvial land; in most areas, they are not so sandy, are less frequently flooded, and have a somewhat deeper water table.

Typical profile of Yahola fine sandy loam, in a nearly level, native grass pasture, about 100 feet east of the north quarter corner of sec. 20, T. 3 N., R. 21 W.:

A_{11} 0 to 8 inches, brown (7.5YR 5/4, dry; 4/4, moist) fine sandy loam; weak, fine, granular structure; very friable when moist; calcareous; abrupt boundary.

A_{12} 8 to 15 inches, dark-brown (7.5YR 4/2, dry; 3/2, moist) silt loam; weak, medium, granular structure; friable when moist; calcareous; abrupt boundary.

C_{11} 15 to 31 inches, reddish-yellow (7.5YR 6/6, dry; 5/6, moist) fine sandy loam; very friable when moist; calcareous; gradual boundary.

C_{12} 31 to 60 inches, reddish-yellow (7.5YR 7/6, dry; 6/6, moist) loamy fine sand; loose; calcareous with several calcium carbonate concretions.

Yahola soils are extremely variable and are underlain by sand or thin strata of clay at various depths. In a few places, during dry seasons, a thin crust of salt or "white alkali" forms on the surface. The color of the surface soil varies from light brown to reddish brown. The degree of stratification in the substratum varies widely. Most of the Yahola soils are used for cultivated crops, and yields are good if the soils are properly managed. Areas that are grazed have a very high carrying capacity.

Yahola fine sandy loam (Ya).—A profile of this soil is described for the series. The texture of the surface soil commonly is fine sandy loam, but in minor areas the texture varies widely in short distances. In a few sloughs or depressions of old stream channels, the texture of the surface soil is clay loam, and the rest of the profile contains more clay than the typical Yahola soil. The color of the surface soil is light brown in some places and reddish brown in others. The soil is easily worked, takes water fast, and is fairly fertile.

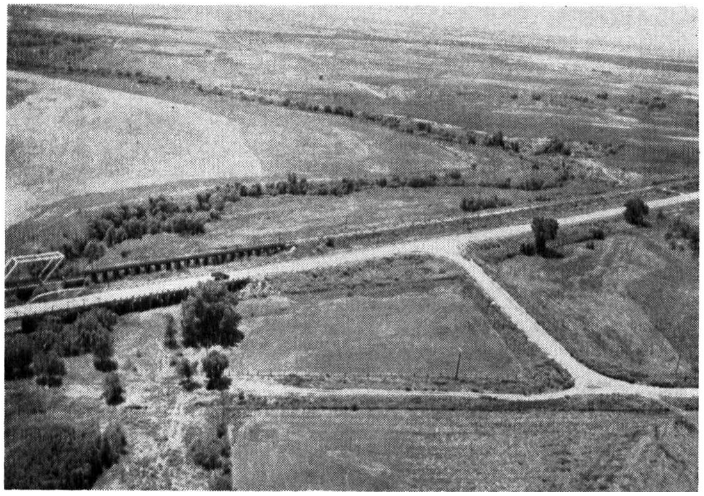

Figure 21.—**Aerial view of Yahola fine sandy loam on the flood plain of Sandy Creek near Eldorado, Okla.**

About three-fourths of Yahola fine sandy loam is cultivated. The principal crops are cotton, grain sorghum, alfalfa, and wheat. If the soils are well managed, yields are good. Areas that are grazed have a high carrying capacity. The soil is suitable for irrigation, and several farmers irrigate, pumping the water from sand-point wells.

Most areas of this soil are in positions where the possibility of destruction through shifting of the adjacent stream channel is ever present; an aerial view is shown in figure 21. Capability unit IIs-1 (dryland and irrigated); range site, Sandy bottom land.

Formation and Classification of Soils

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 (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 the processes of soil development have acted on the soil material.

Climate and vegetation are active factors of soil formation. They act on the parent material accumulated through the weathering of rocks and slowly change it into a natural body with 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 profile. It may be much or little, but some time is always required for differentiation of horizons. Generally a long time is required for the development of distinct horizons.

Factors of Soil Formation

The interrelationships among the factors of soil formation are complex, and therefore the effects of any one factor are hard to isolate with certainty. It is convenient to discuss the individual factors and their effects in soil formation, but the reader should remember that it is the interaction of these factors rather than their simple sum that determines the nature of any soil profile.

The purpose of this section is to present the outstanding characteristics of the soils of Jackson County and to relate them to the factors of soil formation. Only a few physical and chemical data are available for these soils, and the discussion of soil genesis and morphology is correspondingly incomplete. This subsection deals with the environment under which the soils exist; the next, with classification of the soils and the part environment has played in determining the morphology of the soils comprising the different series.

Parent materials

The surface rocks of Jackson County belong to four geologic systems (fig. 22). These are Recent, the youngest; Quaternary and Permian, which are older; and Precambrian, the oldest.

Recent.—The Recent formations are the alluvium of flood plains along the major streams that are subject to overflow. These deposits are mostly loamy and sandy sediments that vary considerably in thickness but are commonly less than 30 feet thick. The main soils in sediments of this age that occur on flood plains are those of the Port, Spur, and Yahola series.

Quaternary.—The Quaternary deposits in the county are loamy and sandy materials that commonly are less than 50 feet thick. The largest area occurs in the northeastern part of the county. Dune sand and alluvial or eolian terraces comprise smaller areas along the streams. The main soils that have developed from Quaternary deposits are members of the Abilene, Enterprise, Miles, Nobscot, Tipton, and Tivoli series.

Permian.—About two-thirds of the surface area of the county is underlain by rocks of Permian age. Four formations of this period are represented in the county. They are Dog Creek shale, Blaine gypsum, Flower-pot shale, and Hennessey shale.

Dog Creek shale, the youngest of the Permian group of rocks in the county, is exposed along the western boundary. It is 100 to 150 feet thick and consists of red clay-shales and some whitish dolomite. In some places, the dolomite layers are exposed or are near the surface. They are as much as 10 feet thick.

Under the Dog Creek shale is Blaine gypsum, the second youngest member of the Permian rocks in the county. The Blaine gypsum formation extends across the county from north to south in a narrow band that is only a few miles wide. This formation consists of alternating beds of red and bluish clay-shale and of numerous deposits of gray to white gypsum. In some places, dolomite or gypsum forms a hard caprock on the hilltops or outcrops in ledges. The Blaine gypsum is considered by several geologists to be the most consistent of any Permian formation in this part of Oklahoma. The entire Blaine gypsum formation averages 200 feet in thickness. A typical section of the upper part of the Blaine gypsum formation, which also applies to this formation in Jackson, Greer, and Beckham Counties, is given by Gouin [5] as follows:

[5] GOUIN, FRANK. GEOLOGY OF BECKHAM COUNTY. Okla. Geol. Survey Bul. No. 40, v. II, pp. 165–177, illus. 1930.

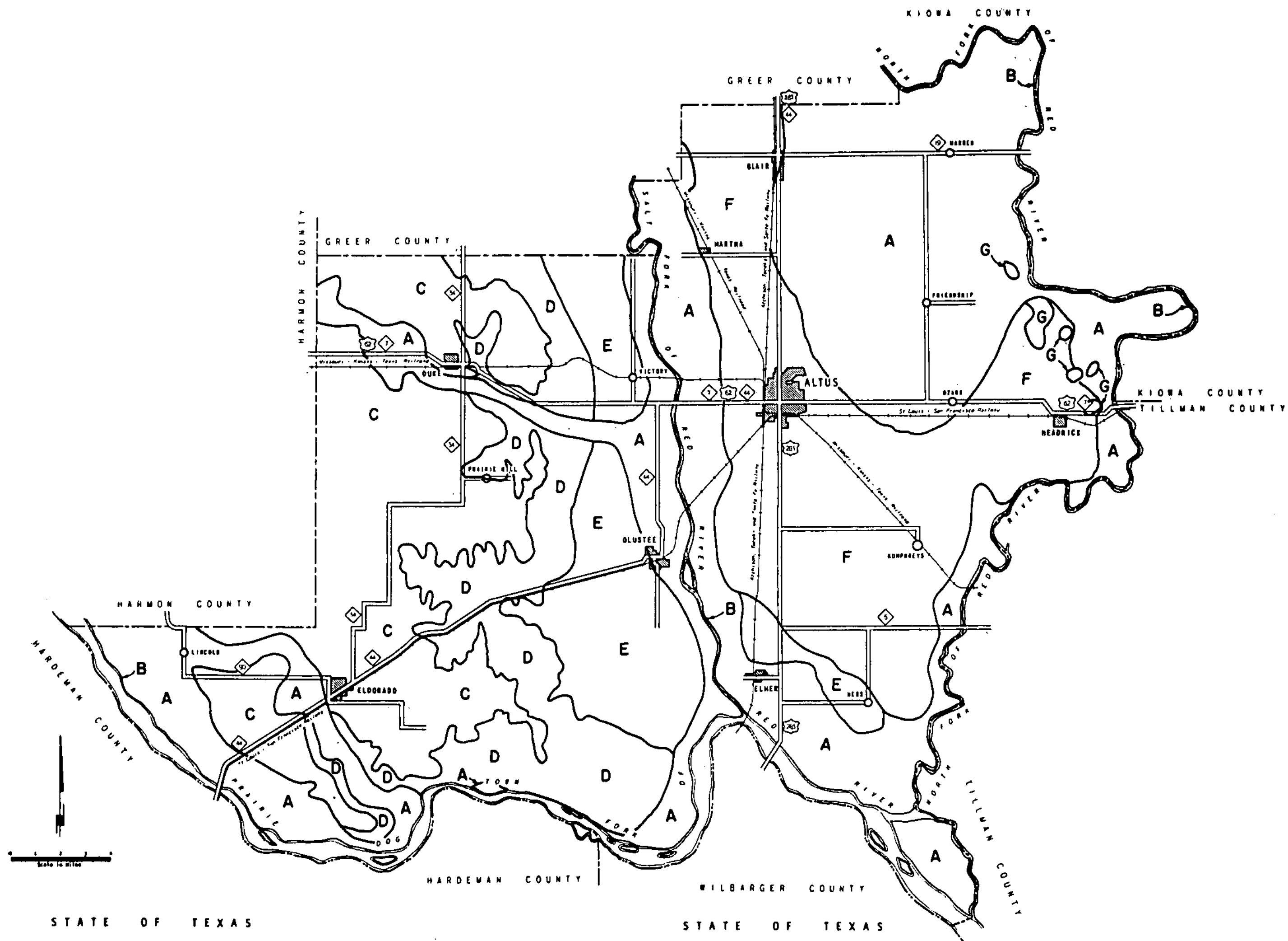

Figure 22.—**Generalized geologic map of Jackson County, Okla.—A, Recent and Quaternary deposits; B, river channel; C, Dog Creek shale; D, Blaine gypsum; E, Flower-pot shale; F, Hennessey shale; G, Precambrian granitic rocks.**

	Feet
Dolomite, honeycombed	3
Shale, red and blue	20
Gypsum, massive, white	18
Shale, red	5
Gypsum, massive, white	15

The Flower-pot shale borders the Blaine gypsum to the east and extends in a belt north and south through the central part of the county. This formation, next older than the Blaine gypsum, consists of red, silty shales with some clay and a little red sandstone that is in the vicinities of Elmer and Hess. The Flower-pot shale formation is about 100 to 150 feet thick.

The Hennessey shale is the oldest of the Permian formations in Jackson County, and it is the largest in the area. This formation consists of red, silty shales and clays and of some siltstone. Its outcrop occupies the eastern half of the county and is bordered mostly by the Quaternary deposits, except in the southwest where it joins the Flower-pot shale.

The main soils that have developed on rocks of the Permian formation are: On Dog Creek shale, soils of the Harmon, La Casa, Tillman, Vernon, and Weymouth series; on Blaine gypsum, soils of the Harmon, Vernon, and Weymouth series; on Flower-pot shale, soils of the Dill, Hollister, and Tillman series; and on Hennessey shale, soils of the Hollister and Tillman series.

Precambrian rocks.—The oldest rocks in the county are the granites, which are of Precambrian age. The granite in the extreme eastern part of the county is part of the western extremity of the Wichita Mountains. These mountains were formed during the Wichita uplift in early Pennsylvanian time.[6]

Rocks of Quaternary and Permian age have been deposited abruptly against the granite rocks. Consequently, the soils have not been influenced to any great degree by the granitic material. In this county, no true soils are developed on the granite. The land type, Rock outcrop, includes all material on rocks of Precambrian age.

Climate

The climate of Jackson County is continental. Rainfall is greatest in spring; summers are hot and generally

[6] GOUIN, FRANK. GEOLOGY OF COMANCHE COUNTY. Okla. Geol. Survey Bul. No. 40, v. II, pp. 203–223, illus. 1930.

are dry; only a little rain comes in fall and winter. One result, of interest in relation to formation of soils, has been spotted and rather shallow soil leaching. Because of the wind and heat, evaporation is high and water moves through the soil profile only occasionally. Thus, basic elements are not depleted by leaching. The presence of a lime zone in many soils suggests the average depth to which water moves. The depth to a lime zone ranges from a few inches in sloping, clayey soils to several feet on flat, permeable soils. The very sandy soils do not have a distinct lime zone at any depth, and the soils on extremely limy materials are, in some places, calcareous at the surface.

Climate is directly or indirectly the cause of many variations in plant and animal life. Thus, climate affects the changes in soils that are brought about by plant and animal life.

Plants and animals

Trees and shrubs, grasses, and other herbaceous plants, micro-organisms, earthworms, and various other forms of plant and animal life live on and in the soil and are active agencies in the soil-forming processes. The nature of the changes that these various biological forces bring about depends, among other things, on the kinds of life and the life processes peculiar to each. The kinds of plants and animals that live on and in the soil are determined by environmental factors, including climate, parent material, relief, age of the soil, and the associated organisms. The influence of climate is most apparent, though not always most important, as a determinant of the kinds of microflora that grow on the well-drained, well-developed soils. In this way, climate exerts a powerful, indirect influence on the morphology of soils.

A cover of short and mid grasses grew on the moderately fine textured soils on rocks of the Permian formations. On most of the soils on alluvial or Quaternary deposits, a cover of mid grasses was probably dominant and tall grasses subdominant. On some of the sandier soils of the Quaternary deposits, a shinnery oak or sand sage cover was dominant, with medium and tall grasses subdominant. The presence of a distinct A_2 horizon in the sandy soils indicates the presence of a cover of brush over a long period of time.

Most of the native grasses of the virgin prairies were deep rooted and were moderately deep or deep feeders. Thus, through decay of the plants, nutrients that came from the lower part of the soil were returned to the upper part.

Organic material is added to the soil in the form of dead leaves, roots, and entire plants. Most of it is added to the A horizon, where it is acted upon by micro-organisms, earthworms, and other forms of life. These factors are important in the development of the soils, but little is known about them in this area.

Relief

The relief of the soils of this county ranges from almost level to very steep. Relief modifies the effects of climate and vegetation. On some steep areas much water runs off, and consequently geologic erosion keeps almost even pace with rock weathering and soil formation. In such steep areas, soil materials are constantly removed or shifted so that they do not remain in place long enough for a profile of genetically related horizons to be formed.

Differences in slope usually affect temperature and the amount of moisture and air within the soil. The amount of runoff generally is greater, and its velocity is more rapid, on a steep slope than on a gentle one. The amount of runoff is influenced greatly, however, by the amount and kind of vegetation and by texture of the soil. The soils that have strongly developed horizons in this county are on nearly level or gentle slopes. In the soils on steep slopes there has been little clay movement to develop a prominent B horizon.

Time

Time is important in formation of the parent material of soils and is necessary for development of soils from the parent material. The length of time required for development of a soil depends on the other factors involved. The degree of profile development depends on intensity of the different soil-forming factors, on the length of time they have been active, and on the nature of the materials from which the soils have been developed. If the factors of soil formation have not operated long enough to form a soil that contains definite horizons, the soil is considered young, or immature. Soils that have been in place for a long time and have approached equilibrium with their environment tend to have well-expressed horizons and are considered mature.

Classification of Soils

Soils may be classified several ways to bring out their relation to one another. The classification units commonly used in the field are the soil series, type, and phase. Soil series may be grouped into higher categories that are called soil orders and great soil groups.

Soils are classified in three soil orders—zonal, azonal, and intrazonal. In places where the parent materials have been in place a long time and there are no extremes of relief or of kind of parent material, the soils have the characteristics of zonal soils. Zonal soils have characteristics that reflect the influence of the active factors of soil genesis, climate, and living organisms.

The well-drained, well-developed soils in the county have been formed under somewhat similar conditions of climate and vegetation and are zonal soils. It is on these soils that climate and vegetation have had the most influence, and relief the least. As a result, the soils developed from various kinds of parent materials have many properties in common.

The zonal soils of Jackson County are in the Reddish Chestnut, Chestnut, and Reddish Brown great soil groups.

In parts of the county where the parent materials have been in place only a short time, as have been the recently transported alluvial materials, the soils have poorly defined horizons or no genetic horizons. These soils are young; they have few or none of the properties of zonal soils and are therefore called azonal soils. Azonal soils are members of a second class in the highest category of soil classification and are defined as soils that do not have well-developed soil characteristics because their youth, their parent material, or their relief prevents the development of normal soil profiles.

The azonal soils have an A_1 horizon that is moderately dark colored and has a moderately high content of organic matter. They lack a zone of illuviation (accumulation), called a B horizon, and their parent material is generally lighter in color than the A_1 horizon. Because they have no B horizon, they are sometimes designated AC soils.

On some steep areas where the quantity of water that percolates through the soil is small and where runoff causes rapid removal of soil materials, the soils are young. Because the materials are constantly renewed or mixed and the changes brought about by vegetation and climate are so slight, the soils are essentially AC soils. These soils are also azonal soils.

On some nearly level areas where both internal and external drainage are restricted or where geological erosion is very slow, soils whose materials have been in place a long time have certain well-developed profile characteristics that zonal soils do not have. Such soils are associated geographically with the zonal soils and are called intrazonal soils. Intrazonal soils are those that have more or less well-developed soil characteristics that reflect the dominating influence of some local factor of relief or parent material over the normal effects of climate and vegetation.

The soil series of Jackson County are classified in table 9 by soil orders and great soil groups, and some of the factors that have influenced soil formation are given.

TABLE 9.—*Characteristics and*

Soil series	Slope		Characteristics of horizons		
	Description	Range	Depth	Color	Texture
		Percent	*Inches*		
Abilene	Nearly level to gently sloping	0–3	0–8	Dark brown	Clay loam
			8–12	Dark brown	Clay loam
			12–25	Dark brown	Clay
Altus	Nearly level; concave	0–3	0–8	Dark grayish brown	Fine sandy loam
			8–34	Brown	Sandy clay loam
			34–42	Reddish brown	Sandy clay loam
Dill	Gently sloping or undulating; complex.	1–5	0–12	Reddish brown	Fine sandy loam
			12–36	Reddish brown	Sandy clay loam
			36–50	Red	Fine sandy loam
Enterprise	Nearly level to steep	0–20	0–18	Brown	Very fine sandy loam
Harmon	Gently sloping to steep	2–15	0–4	Brown	Stony loam
Hollister	Nearly level	0–1	0–9	Grayish brown to very dark gray.	Clay loam
			9–28	Very dark gray	Clay
			28–36	Gray	Clay
			36–44	Gray	Clay
			44–60	Gray	Clay
La Casa	Gently sloping	1–3	0–12	Dark brown	Clay loam
			12–30	Reddish brown	Heavy clay loam or light clay.
			30–38	Reddish brown	Heavy clay loam or light clay.
			38–52	Light reddish brown	Heavy clay loam or light clay.
Mansic	Gently sloping; convex	1–3	0–5	Grayish brown	Clay loam
			5–15	Dark grayish brown	Clay loam
			15–24	Brown	Clay loam
			24–100	Strong brown	Heavy clay loam
Miles	Nearly level to undulating; convex.	0–5	0–10	Brown to dark brown	Fine sandy loam
			10–36	Reddish brown	Sandy clay loam
			36–54	Yellowish red	Sandy clay loam
			54–72	Yellowish red	Fine sandy loam
Miller	Nearly level	0–1	0–7	Reddish brown	Clay
			7–33	Reddish brown	Clay
			33–60	Reddish brown	Clay
Nobscot	Gently to strongly sloping; some dunelike.	0–5	0–4	Grayish brown	Fine sand
Port	Nearly level	0–1	0–18	Dark reddish brown	Clay loam
			18–45	Reddish brown	Clay loam
			45–72	Reddish brown	Clay loam
Spur	Nearly level	0–1	0–10	Dark brown	Clay loam
			10–36	Reddish brown	Clay loam
			36–60	Reddish brown	Heavy clay loam
Tillman	Nearly level and gently sloping	0–3	0–10	Reddish brown	Clay loam
			10–28	Reddish brown	Light clay
			28–50	Reddish brown	Clay
			50–60	Yellowish red	Clay

classification of soil series

in typical profile				
Structure	Parent material	Soil order	Great soil group	Associated soil series
Weak granular. Moderate subangular blocky. Moderate subangular blocky.	Calcareous, moderately clayey sediments.	Zonal	Chestnut	Tipton, Tillman, Hollister.
Weak granular. Weak medium blocky. Weak medium blocky.	Calcareous old alluvium.	Zonal	Chestnut	Miles.
Weak granular. Prismatic and granular. None.	Residuum from weathered red, very soft, earthy, noncalcareous Permian sandstone.	Zonal	Reddish Chestnut	Tipton.
Weak granular.	Eolian very fine sand and silt; Quaternary.	Azonal	Regosol	Tipton, Tivoli.
Granular.	Residuum from weathered dolomitic limestone.	Azonal	Lithosol	Weymouth, Vernon.
Weak granular. Moderate subangular blocky to blocky. Weak blocky. Weak blocky. Massive.	Clayey Permian red beds.	Zonal	Chestnut	Tillman.
Strong granular. Moderate subangular blocky. Weak blocky. Almost structureless (massive).	Clayey Permian red beds.	Zonal	Reddish Chestnut	Weymouth, Tillman.
Weak granular. Strong to moderate subangular blocky. Moderate subangular blocky. Massive.	Weakly consolidated, calcareous clay loam.	Azonal	Regosol	Tillman, Hollister.
Granular. Prismatic and granular. Prismatic and granular. Single grain.	Sandy earths of Quaternary deposits.	Zonal	Reddish Chestnut	Nobscot.
Massive. Massive. Massive.	Alluvium, mostly from red beds	Azonal	Alluvial	Port, Spur.
Single grain.	Sandy earths of Quaternary deposits.	Zonal	Reddish Brown	Miles.
Moderate granular. Weak subangular blocky. Massive.	Loamy alluvium, mostly from Permian red beds.	Azonal	Alluvial	Spur.
Moderate granular. Weak subangular blocky. Massive.	Loamy alluvium, mostly from Permian red beds.	Azonal	Alluvial	Port.
Weak granular. Moderate blocky. Massive. Massive.	Clayey Permian red beds	Zonal	Reddish Chestnut	Vernon, Hollister, Weymouth.

TABLE 9.—*Characteristics and*

Soil series	Slope		Characteristics of horizons in		
	Description	Range	Depth	Color	Texture
		Percent	*Inches*		
Tipton	Nearly level and gently sloping	0–3	0–18	Dark brown	Loam
			18–42	Dark brown	Light clay loam
			42–64	Dark brown	Light clay loam
			64+	Grayish brown	Clay loam
Tivoli	Billowy and duny	3–15	0–4	Brown	Fine sand
Treadway	Nearly level	0–2	0–8	Reddish brown	Light clay or heavy clay loam.
			8–50	Yellowish red	Light clay
Vernon	Gently sloping to steep	3–15	0–6	Reddish brown	Clay loam or clay
Weymouth	Gently and moderately sloping	1–5	0–12	Brown	Clay loam
Yahola	Nearly level	0–1	0–8	Brown	Fine sandy loam
			8–15	Dark brown	Silt loam
			15–31	Reddish yellow	Fine sandy loam
			31–60	Reddish yellow	Loamy fine sand

Additional Facts About the County

This section contains facts about the county, including some of its history, types of farming, water supply, climate, and wildlife.

History and Population

Jackson County was part of the large county of Greer, which was claimed by the State of Texas until 1896. The Supreme Court in a decision that year declared Greer County to be in the Oklahoma Territory. On January 18, 1897, Congress passed an act opening Greer County for settlement. Settlers were allowed 160-acre homesteads and those who had an additional 160 acres in their possession at the time of the decision had the opportunity to purchase it. The first residents lived in dugouts until lumber could be hauled in for building houses.

In 1907, after the Oklahoma Constitutional Convention, Jackson County was organized. When Oklahoma was admitted to the Union in 1907, the county was already fairly well settled.

In the first 3 years of statehood, the population increased by about 3,000. For many years, the rural population was evenly distributed over the county and exceeded the urban population. Now, there are many empty houses and remnants of old farmsteads throughout the county. Many of the present farmers, however, live in attractive homes.

The number of farms and the rural population are still decreasing. In 1930, there were 2,849 farms, and in 1954, there were 1,572 farms. The trend is for more farmers to live in town.

In 1930, the population numbered 28,910. It decreased gradually to 20,082 in 1950. Since 1956, after reactivation of the Altus Air Force Base, the population increased, especially in the city of Altus. Altus, the county seat and principal city, now has an estimated population of 18,000; the population of the county in 1958 was estimated to be 26,000.

Land Use and Types of Farming

When the county was first settled, cotton was the principal cash crop. It was reported that 200 bales were ginned in 1897. In the early 1920's, Jackson County produced more cotton than any other county in the Nation. Now, wheat and cotton are the most extensive, and grain sorghum and alfalfa are next. In 1958, the county had 131,982 acres of wheat, 57,831 acres of cotton, and about 10,000 acres each of alfalfa and grain sorghum. Other crops grown are sweetclover, cowpeas, and sudangrass. Alfalfa is grown for seed as well as for hay.

There are about 107,480 acres of native grassland and many temporary pastures. When wheat is available for pasture, many cattle are brought into the county to graze on it.

Jackson County is the leading irrigation county in Oklahoma. In 1950, about 21,880 acres were irrigated; in 1957, more than 51,000 acres were irrigated. Irrigation has done much to stabilize income of the farmers who practice it. The Lugert-Altus Irrigation District first delivered water to farmers in 1946.

Mineral Resources

The mineral resources in the county are petroleum, sand, gravel, and gypsum. Petroleum is the leading product among these four, but it does not now contribute to the income of many people.

classification of soil series—Continued

in typical profile—Continued: Structure	Parent material	Soil order	Great soil group	Associated soil series
Weak granular. Weak subangular blocky. Moderate granular. Weak blocky.	Loamy and silty alluvial or eolian earths of Quaternary deposits.	Zonal	Chestnut	Enterprise.
Single grain.	Eolian siliceous sands of Quaternary deposits.	Azonal	Regosol	Enterprise.
Weak platy. Massive.	Clayey alluvium from exposed Permian red beds.	Azonal	Alluvial	Vernon, Miller, Tillman.
Weak granular.	Clayey Permian red beds	Azonal	Lithosol	Weymouth, Tillman.
Strong granular.	Highly calcareous, clayey Permian red beds.	Intrazonal	Regosol	Vernon, La Casa, Tillman, Hollister.
Weak granular. Weak granular. Single grain. Single grain.	Loamy to moderately sandy alluvium.	Azonal	Alluvial	Alluvial land.

Schools and Community Activities

Schools have been consolidated and are well equipped. High schools and grade schools are located at Altus, Duke, Friendship, Warren, Martha, Eldorado, Olustee, Blair, and Southside; there is a grade school at Humphrey. A junior college is located in Altus.

Altus has a large auditorium where plays, concerts, and other activities can be held. The public library at Altus offers facilities for reading and research.

A county fair is held each fall, and a 4–H and FFA Livestock Show is presented each spring.

There are numerous churches in the county, and they represent most denominations.

Water Supply

When the county was first settled, water was scarce except in sandy places and near the streams. There were few ponds. Well water can generally be obtained in the sandy land areas, but only in isolated areas elsewhere. Much of the well water is not suitable for human consumption because of its high mineral content.

Since 1950, several irrigation wells have been drilled in the Duke and Eldorado areas. These are generally in the gypsum formation.

Where well water is not available or is not suitable for household use, many farmers collect water in cisterns; some of them haul water from towns.

Ponds now supply water for livestock in nearly all 750 adequate ponds, and about 50 more are being constructed each year.

The town of Altus gets water from the Lugert-Altus Irrigation Reservoir. Other towns in the county get their water from wells.

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Climate

Jackson County has a continental, warm-temperate, subhumid climate. Summers are decidedly warm, and winters are fairly mild and open. The climate is neither excessively wet nor dry. Cooling breezes moderate the high summer temperature. Bright sunshine makes the winter temperature seem less severe. Table 10, compiled from records of the weather station at Altus, gives important climatic data representative of the county. The major climatic hazards for farming are those of drought, high winds, and erratic rainfall.

The average rainfall, based on records for 38 years, is about 25 inches. The months of greatest rainfall, as shown in figure 23, are April through October. The PE index is (after Thornthwaite) about 38. Summer rains are spotty and undependable. Dry spells that last from 4 to 6 weeks are fairly common. Occasional crop failures result from the hot, dry spells. Cotton and grain sorghum are the crops most frequently damaged. Irrigation has greatly reduced the number of crop failures.

The soils are driest in late July and in August when high temperatures and hot, dry winds remove moisture rapidly. Moisture is evaporated from leaves faster than it can be supplied by the roots, and occasionally the wind parches the leaves to such an extent that they are unable to recover. Because of the hot summer winds, crop yields are often curtailed.

The dry spells are most damaging to crops on the soils that have moderately clayey or clayey subsoils. Part of the damage results from shrinkage and cracking of the clay on drying. The cracks speed the rate of drying and also break roots of plants. There is less damage from drought on the more friable soils that have sandy clay loam or clay loam subsoil.

TABLE 10.—*Monthly, seasonal, and annual temperature and precipitation at Altus, Jackson County, Okla.*

[Elevation, 1,410 feet]

Month	Temperature [1]			Precipitation [2]			
	Average	Absolute maximum	Absolute minimum	Average	Driest year (1917)	Wettest year (1941)	Average snowfall
	° F.	° F.	° F.	Inches	Inches	Inches	Inches
December	43. 2	83	0	1. 19	(3)	1. 25	1. 4
January	41. 1	85	−11	. 91	0. 30	1. 08	2. 4
February	44. 7	88	−6	. 88	. 50	2. 66	1. 3
Winter	43. 0	88	−11	2. 98	. 80	4. 99	5. 1
March	52. 4	97	0	1. 43	. 18	. 71	1. 2
April	62. 4	98	22	2. 68	3. 05	4. 72	. 3
May	70. 8	105	37	3. 54	2. 06	10. 60	(3)
Spring	61. 9	105	0	7. 65	5. 29	16. 03	1. 5
June	80. 3	112	50	3. 40	. 30	10. 84	(3)
July	84. 2	120	56	2. 09	1. 47	1. 18	0
August	84. 0	120	53	2. 37	4. 56	3. 90	0
Summer	82. 9	120	50	7. 86	6. 33	15. 92	0
September	75. 6	112	38	2. 72	1. 11	2. 75	0
October	65. 6	100	27	2. 93	. 25	8. 57	(3)
November	51. 3	91	13	1. 17	. 14	1. 04	. 1
Fall	64. 2	112	13	6. 82	1. 50	12. 36	. 1
Year	63. 0	120	−11	25. 31	13. 92	49. 30	6. 7

[1] Average temperature based on a 20-year record, through 1951; highest and lowest temperatures on a 20-year record, through 1951.
[2] Average precipitation based on a 38-year record, through 1952; wettest and driest years based on a 38-year record, in the period 1914–1952; snowfall based on a 20-year record, through 1951.
[3] Trace or no record.

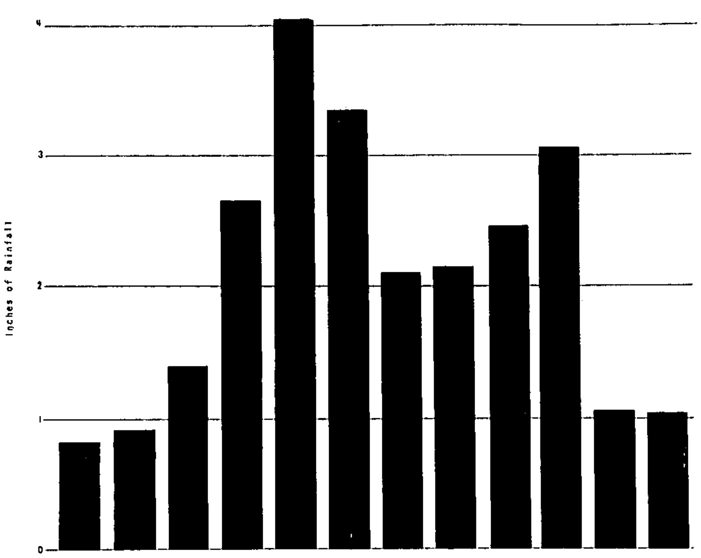

Figure 23.—**Average monthly rainfall at Altus, Okla., for 1914 through 1957.**

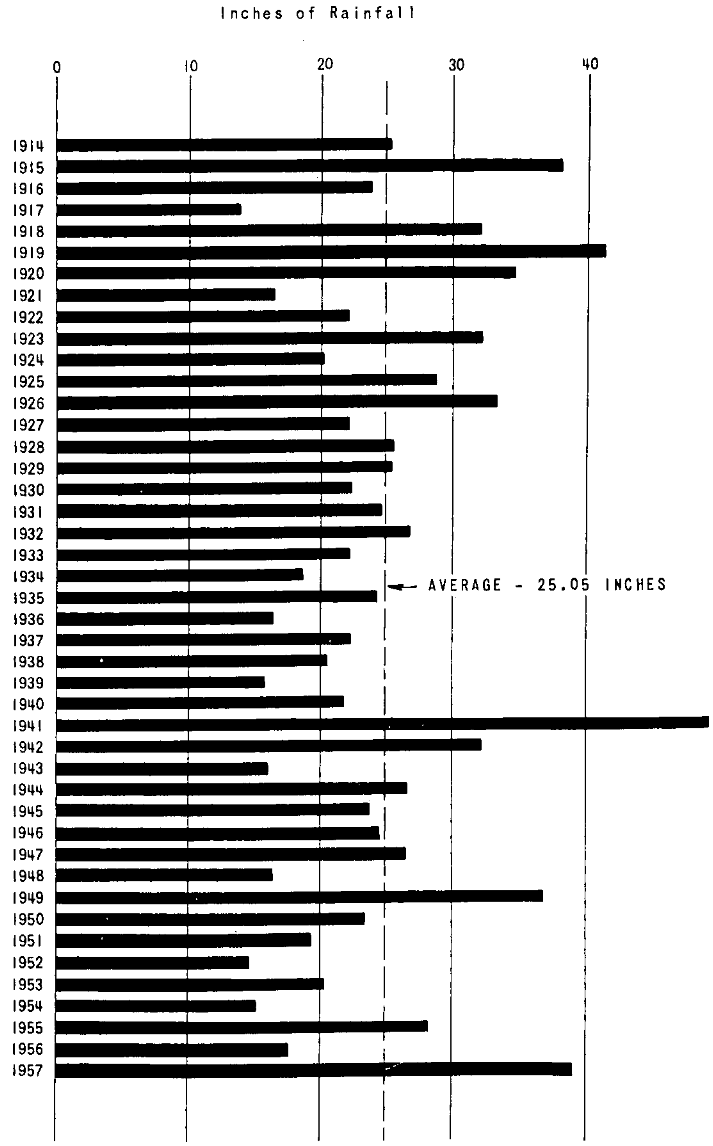

Figure 24.—**The annual rainfall at Altus, Okla., for 1914 through 1957.**

The amount, intensity, and distribution of precipitation have a direct bearing on the agriculture in the county. The low annual rainfall, especially that experienced during most of the thirties, makes the conservation and proper utilization of moisture important factors in crop production. Annual rainfall, 1914 through 1957, is shown in figure 24.

Rains late in spring, in summer, and early in fall often come as hard showers. Winter rains are fairly gentle and steady. Wet spells are rare, but they occasionally delay harvest, and they may delay planting of crops on some soils. Severe hailstorms generally occur somewhere in the county each year; small grain is the crop most frequently damaged.

The average date of the last killing frost in spring is March 28, and that of the first in fall is November 7. Frost has occurred as late as April 18 and as early as September 29. The frost-free season is 224 days. The long growing season is favorable for cotton. Early frost in fall sometimes reduces yields of cotton; late frost in spring sometimes reduces yields of wheat and damages buds on fruit trees. Winter wheat matures before the hot, dry weather of midsummer.

The prevailing winds are from the south. Shifts in the wind during the winter cause wide variations in temperature. "Northers" in winter bring a rapid drop in the temperature; generally, they last 2 or 3 days until the southerly winds and moderate temperatures return. The highest wind velocities, often from 25 to 45 miles per hour, occur late in February through the early part of May. Windstorms are of two types. Some originate during afternoon and evening thunderstorms; they are local in extent and usually of short duration. Others, usually more intense and of longer duration, originate in large, low-pressure areas. Their turbulent winds that move northeastward at a velocity of 25 miles an hour or more into low-pressure cells are capable of moving great quantities of soil. Many duststorms have taken place during short periods of strong winds. If the soil is not well protected by a growing crop or crop residues, wind erosion is likely to occur during the windy season.

Tornadoes pass through the county from time to time, and several towns and communities have received serious damage. Many people have storm cellars or other shelters to provide protection.

The average annual snowfall in Jackson County is 6.7 inches. Most of the snow occurs in winter, but snow may occur as late as April. The snow rarely covers the ground for a period longer than 2 weeks and generally remains for only 2 to 4 days.

Except for a few days following rain or snow, it is possible to do farm work almost any time during the year.

Wildlife

Game birds and animals in Jackson County are bobwhite quail, dove, waterfowl, squirrel, and cottontail rabbit. Scaled quail are sometimes observed, but it is not known whether they exist as a remnant population or were introduced by stocking.

Quail are the most important game; they are found to some extent over the entire county. They are abundant in areas of Nobscot soils where sand sage and clumps of brush are present and farming is done in small fields. Tivoli soils also furnish an excellent native habitat of sand sage, brush, and desirable grasses. Locally, quail are numerous near stream courses, depending upon the kind and intensity of land use. Weather and food factors are reflected in peaks and ebbs of population. Even after there have been several years that were bad for quail, however, there are generally enough birds left to restock the land.

Doves are common under all types of habitat, and the nesting population has been enhanced locally where windbreaks have been planted. Windbreaks also favor the insect-eating birds and songbirds.

Ducks and geese feed in fields of grain sorghum and in wheatfields during their migration and provide good shooting in occasional years. Lack of water is a limiting factor in holding them for any length of time, although there are always a few birds on farm ponds, reservoirs, and streams during the hunting season.

Squirrels are common in a few places, but the lack of suitable timber generally makes them rare. There are considerable numbers of squirrels in the windbreaks, but their numbers fluctuate with the abundance of crops that furnish them food.

Cottontail rabbits are generally numerous. They are not subject to any great hunting pressure. Locally, they are sometimes considered a pest because they destroy some crops and tree plantings. Jackrabbits are prevalent. They are generally unwelcome, except by those who are interested in the sport of coursing.

Other fur bearers are represented by a sparse and spotty population of badger, coyote, civet, opossum, mink, muskrat, raccoon, and skunk. There are a few colonies of beaver, and kit foxes are occasionally reported. There is little professional trapping in the county, but there is some farm trapping. Skunks and coyotes account for the bulk of the pelts marketed. Coyotes are regularly hunted with hounds for control and for the sport of coursing. Raccoon are also taken with dogs.

Fishing is largely limited to farm ponds, although there are occasional influxes of fish into the streams and irrigation canals during high water. About 750 farm ponds have been built, and about 400 of them support populations of largemouthed bass, sunfish, and catfish. Perhaps one-fourth of these are naturally suited to the production of bass, bluegill, and channel catfish. Under good management they may yield up to 400 pounds of pan fish per year.

Glossary

Alluvial soil. A soil developing from transported and relatively recently deposited material (alluvium) with little or no modification of the original materials by soil-forming processes.

Alluvium. Sediments deposited on land by streams. The sediments may be homogeneous and of local origin or of mixed origin, as along the courses of major streams.

Alkaline. High in exchangeable bases. (See also Reaction.)

Alkaline soil. Generally, a soil that is alkaline throughout most or all of the parts occupied by plant roots, although the term is commonly applied to only a specific layer or horizon of soil. Precisely, any soil horizon having a pH value greater than 7.0; practically, a soil having a pH value above 7.3.

Calcareous soil. A soil containing calcium carbonate, or a soil alkaline in reaction because of the presence of calcium carbonate. A soil containing enough calcium carbonate to effervesce (fizz) when treated with dilute hydrochloric acid.

Concave. The term applied to land surfaces that are curved like the interior of a hollow sphere. In level areas concave spots may be dished or swalelike.

Concretions. Rounded and hardened concentrations of chemical compounds, such as calcium carbonate or iron oxides, often formed as concentric rings about a central particle, in the form of hard grains, pellets, or nodules of various sizes, shapes, and colors.

Consistence, soil. The combination of properties of soil material that determine its resistance to crushing and its ability to be molded or changed in shape. Consistence varies with differences in moisture content; thus, a soil aggregate or clod may be hard when dry and plastic when wet. Terms used to describe consistence are:

Friable. Crushes easily under moderate pressure, when moist, and coheres when pressed together.

Very friable. Crushes easily under very gentle pressure but coheres slightly when pressed together.

Firm. Crushes under moderate pressure, when moist, but resistance is distinctly noticeable.

Very firm. Requires strong pressure to crush.

Extremely firm. Cannot be crushed between thumb and forefinger but must be broken apart bit by bit.

Hard. Moderately resistant to pressure when dry; can be broken in the hands without difficulty but is barely breakable between thumb and forefinger.

Loose. Noncoherent when slightly moist, but material is coherent if pressed together.

Convex. The term applied to land surfaces that are rounded and resemble a segment of a sphere when viewed from without.

Neutral. Exchangeable hydrogen and bases are about equal. (See also Reaction.)

Peds. An individual natural soil aggregate, such as a crumb, prism, or block.

Permeable. Easily penetrated, as by water or air.

Phase, soil. The subdivision of a soil type covering variations within the type not great enough to justify establishing a new type but significant to the use and management of the soil. Examples of the variations recognized by phases of soil types include differences in slope, stoniness, and thickness as the result of accelerated erosion.

Reaction. The degree of acidity of the soil mass expressed in pH values or in words as follows:

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

Series, soil. A group of soils having the same profile characteristics and the same general range in color, structure, consistence, and sequence of horizons; the same general conditions of relief and drainage; and, usually, a common or similar origin and mode of formation. A group of soil types closely similar in all respects except for the texture of the surface soil.

Soil separates. The individual size groups of mineral soil particles, as sand, silt, and clay.

Soil textural class. A classification based on the relative proportion of soil separates. The principal classes, in increasing order of the content of finer separates, are sand, loamy sand, sandy loam, loam, silt loam, silt, silty clay loam, clay loam, and clay.

Sand. (1) As a soil separate, particles ranging in diameter from 0.05 mm. to 2.0 mm. (2) As a textural class, soil material that is 85 percent or more sand and not more than 10 percent clay.

Loamy sand. Soil material that contains 25 percent or more of very coarse, coarse, and medium sand, and less than 50 percent fine or very fine sand.

Sandy loam. Soil material that contains 30 percent or more of very coarse, coarse, and medium sand, but less than 25 percent of very coarse sand, and less than 30 percent of very fine or fine sand.

Loam. Soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand.

Silt loam. Soil material that contains 50 percent or more silt and 12 to 27 percent clay, or 50 to 80 percent silt and less than 12 percent clay.

Silt. (1) Individual mineral particles of soil that range in diameter between the upper size of clay, 0.002 mm., and the lower size of very fine sand, 0.05 mm. (2) Soil of the textural class called silt contains 80 percent or more of silt and less than 12 percent of clay.

Clay loam. Soil material that contains 27 to 40 percent clay and 20 to 45 percent sand.

Silty clay loam. Soil material that contains 27 to 40 percent clay and less than 20 percent sand.

Clay. (1) As a soil separate, the mineral soil particles less than 0.002 mm. in diameter. (2) As a soil textural class, soil material that contains 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from the adjoining aggregates. The principal forms of soil structure are *platy, prismatic, columnar, blocky,* and *granular.* Structure is defined in terms of distinctness, size, and shape of the soil aggregates. For example, "moderate, medium, subangular blocky" means moderately distinct, medium-sized aggregates of subangular blocky shape.

Blocky. Aggregates are block shaped; they may have flat or rounded surfaces that join at sharp angles.

Columnar. Aggregates are prismatic and are rounded at the upper ends.

Granular. Roughly spherical, or rounded, firm, small peds that may be either hard or soft but are usually more firm than crumb and without the distinct faces of blocky peds.

Platy. Soil particles are arranged in thin, horizontal plates like wood shingles on a roof.

Prismatic. A prismlike soil structure, the vertical axis longer than the horizontal; peds have rounded tops, and vertical faces are well defined.

Massive. Soil has no observable structure, but material is coherent when pressed together.

Single grain. Soil has no observable structure, and each particle exists separately and does not cohere to others, as in dune sand.

Subangular blocky. Aggregates have mixed rounded and plane faces with vertices mostly rounded.

Subsoil. The B horizon of soils with distinct profiles. In soils with weak profile development, the soil below the plow layer (or its equivalent of surface soil), in which roots normally grow. In normal soils the subsoil is the zone of maximum clay accumulation. Where the soils are young (steeply sloping or alluvial soils), it is a layer similar in appearance to the plow layer but generally lighter in color.

Subsurface soil. That part of the dark upper part of the soil profile (A horizon) below the surface soil.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil. Usually, the darkened upper part of the soil (A horizon) to depths of about 5 to 8 inches.

Texture, soil. The relative proportions of sand, silt, and clay particles in the soil. (See also Soil separates; Soil textural class.)

Type, soil. A group of soils having genetic horizons similar as to differentiating characteristics, including texture and arrangement in the soil profile, and developed from a particular kind of parent material.

GUIDE TO MAPPING UNITS, CAPABILITY UNITS, AND RANGE SITES[1]

[Dashes indicate the soil has not been placed in an irrigated capability unit]

Map symbol	*Mapping unit*	*Page*	*Dryland capability unit*	*Page*	*Irrigated capability unit*	*Page*	*Range site*	*Page*
AbA	Abilene clay loam, 0 to 1 percent slopes	42	IIc-1	10	I-3	20	Hardland	24
AbB	Abilene clay loam, 1 to 3 percent slopes	42	IIe-1	10	IIe-1	20	Hardland	24
Ac	Alluvial land	42	Vw-1	13	--------		Sandy bottom land	26
AtA	Altus fine sandy loam, 0 to 1 percent slopes	42	IIIe-4	12	IIIe-5	21	Sandy plains	25
DaB	Dill fine sandy loam, 1 to 3 percent slopes	43	IIIe-2	11	IIIe-2	21	Sandy plains	25
DaC	Dill fine sandy loam, 3 to 5 percent slopes	43	IVe-1	12	--------		Sandy plains	25
EnB	Enterprise loamy fine sand, 0 to 3 percent slopes	44	IIIe-3	12	IIIe-4	21	Deep sand	24
ErA	Enterprise very fine sandy loam, 0 to 1 percent slopes.	44	IIe-2	10	I-2	20	Loamy prairie	25
ErB	Enterprise very fine sandy loam, 1 to 3 percent slopes.	44	IIe-2	10	IIe-2	21	Loamy prairie	25
ErC	Enterprise very fine sandy loam, 3 to 5 percent slopes.	44	IIIe-2	11	IIIe-3	21	Loamy prairie	25
ErD	Enterprise very fine sandy loam, 5 to 8 percent slopes.	45	IVe-1	12	--------		Loamy prairie	25
ErE	Enterprise very fine sandy loam, 8 to 20 percent slopes.	45	VIe-1	13	--------		Loamy prairie	25
Ha	Harmon stony loam	45	VIs-2	13	--------		Shallow prairie	24
LaB	La Casa clay loam, 1 to 3 percent slopes	46	IIe-1	10	IIe-1	20	Hardland	24
MaB	Mansic clay loam, 1 to 3 percent slopes	47	IIIe-1	11	--------		Hardland	24
MeA	Miles fine sandy loam, 0 to 1 percent slopes	48	IIe-2	10	IIe-2	21	Sandy plains	25
MeB	Miles fine sandy loam, 1 to 3 percent slopes	48	IIIe-2	11	IIIe-2	21	Sandy plains	25
MeC	Miles fine sandy loam, 3 to 5 percent slopes	48	IIIe-2	11	IIIe-3	21	Sandy plains	25
MfB	Miles loamy fine sand, 0 to 3 percent slopes	48	IIIe-3	12	IIIe-4	21	Deep sand	24
Mr	Miller clay	49	IIIs-1	12	--------		Heavy bottom land	26
NoC	Nobscot fine sand, 0 to 5 percent slopes	49	IVe-2	13	--------		Deep sand	24
NoD	Nobscot fine sand, 5 to 12 percent slopes	50	VIe-2	13	--------		Deep sand	24
Po	Port clay loam	50	I-1	10	I-1	20	Loamy bottom land	25
Rc	Rock outcrop	50	VIIs-1	13	--------		Granite hills	25
Rg	Rough broken land	50	VIIs-2	13	--------		Breaks	24
Sc	Spur clay loam	51	I-1	10	I-1	20	Loamy bottom land	25
Sn	Spur clay loam, channeled	51	Vw-2	13	--------		Loamy bottom land	25
Sw	Spur clay loam, wet	51	Vw-2	13	--------		Subirrigated	25
TaB	Tillman clay loam, 1 to 3 percent slopes	52	IIIe-1	11	IIIe-1	21	Hardland	24
TcA	Tillman and Hollister clay loams, 0 to 1 percent slopes.	52	IIc-1	10	I-3	20	Hardland	24
TpA	Tipton loam, 0 to 1 percent slopes	53	I-1	10	I-2	20	Loamy prairie	25
TpB	Tipton loam, 1 to 3 percent slopes	53	IIe-1	10	IIe-1	20	Loamy prairie	25
Tv	Tivoli fine sand	53	VIe-2	13	--------		Deep sand	24
Ty	Treadway clay	54	VIs-3	13	--------		Red clay flats	24
Ve	Vernon soils	54	VIs-1	13	--------		Red clay prairie	24
WeC	Weymouth clay loam, 3 to 5 percent slopes	55	IVe-3	13	--------		Hardland	24
WmB	Weymouth-La Casa clay loams, 1 to 3 percent slopes.	55	IIIe-1	11	--------		Hardland	24
Ya	Yahola fine sandy loam	55	IIs-1	11	IIs-1	21	Sandy bottom land	26

[1] Table 1, p. 15, gives estimated average yields of principal crops, dryland farming, on soils of Jackson County, Okla., under two levels of management. Table 3, p. 22, gives estimated average yields per acre of principal irrigated crops on the soils best suited to irrigation under two levels of management. Table 8, p. 41, gives approximate acreage and proportionate extent of soils.

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