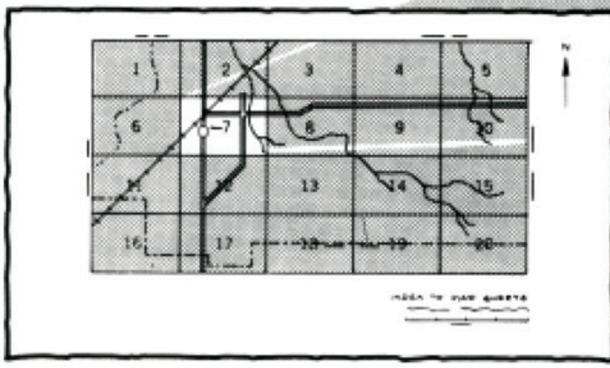
Soil survey of

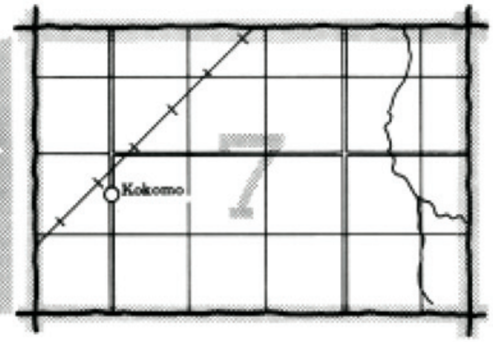
BECKHAM COUNTY OKLAHOMA

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

HOW TO USE

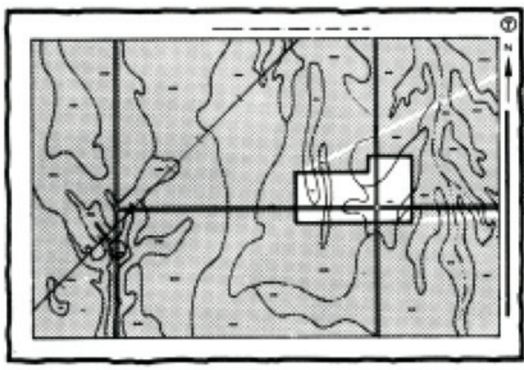
1. Locate your area of interest on the "Index to Map Sheets"

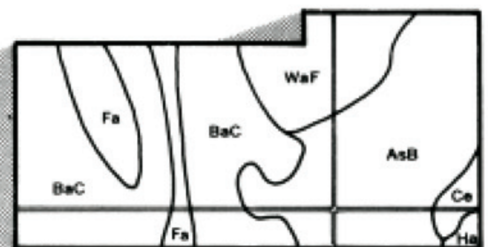




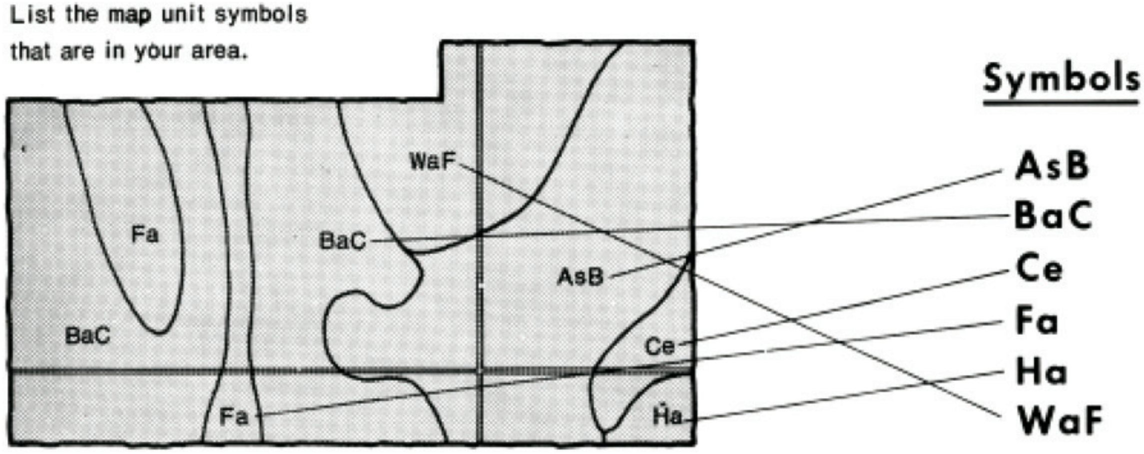
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



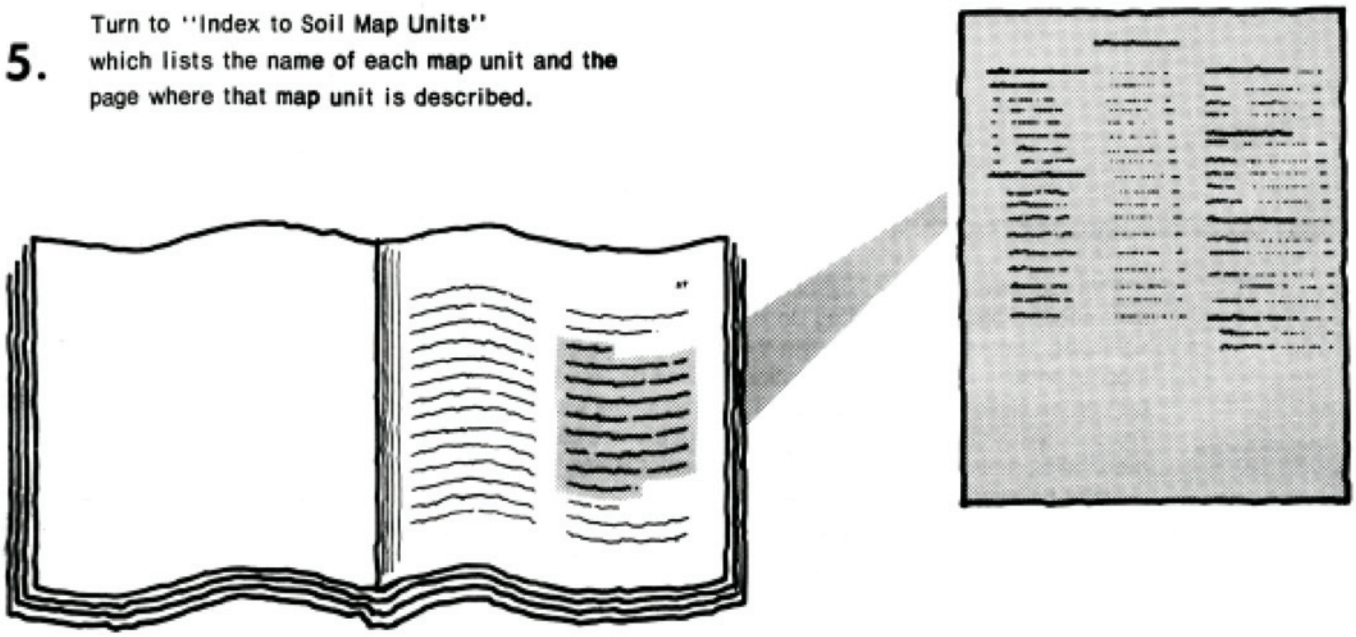


4. List the map unit symbols that are in your area.

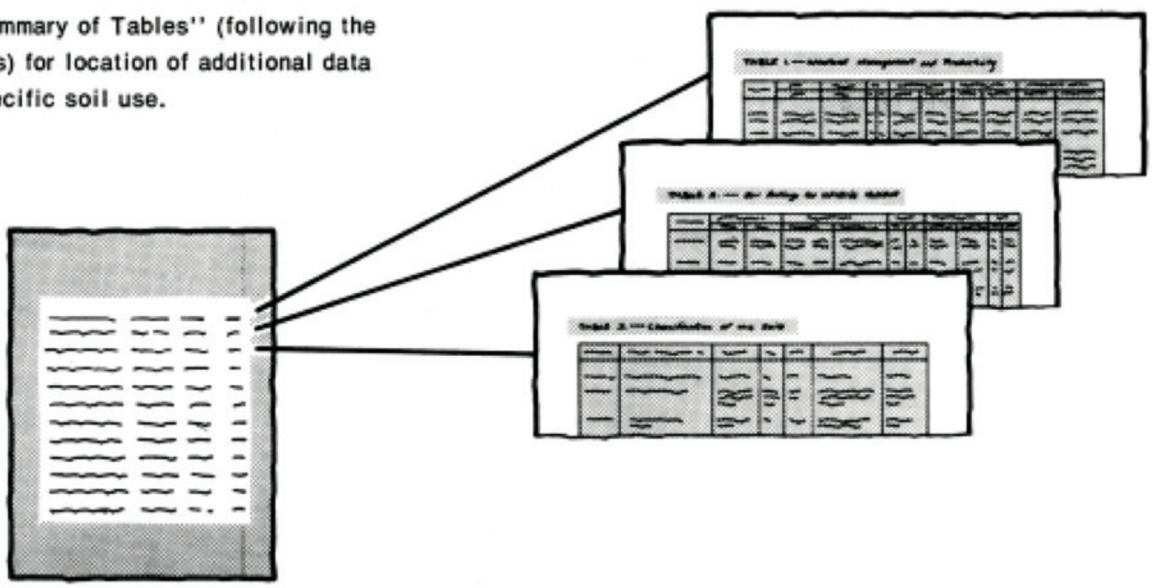


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was performed in the period 1961 to 1977. Soil names and descriptions were approved in 1978. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1978. This survey was made cooperatively by the Soil Conservation Service and the Oklahoma Agricultural Experiment Station. It is part of the technical assistance furnished to the North Fork of Red River Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: Cotton on Carey loam, 1 to 3 percent slopes.

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soil series

Issued September 1980

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foreword

This soil survey contains information that can be used in land-planning programs in Beckham County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

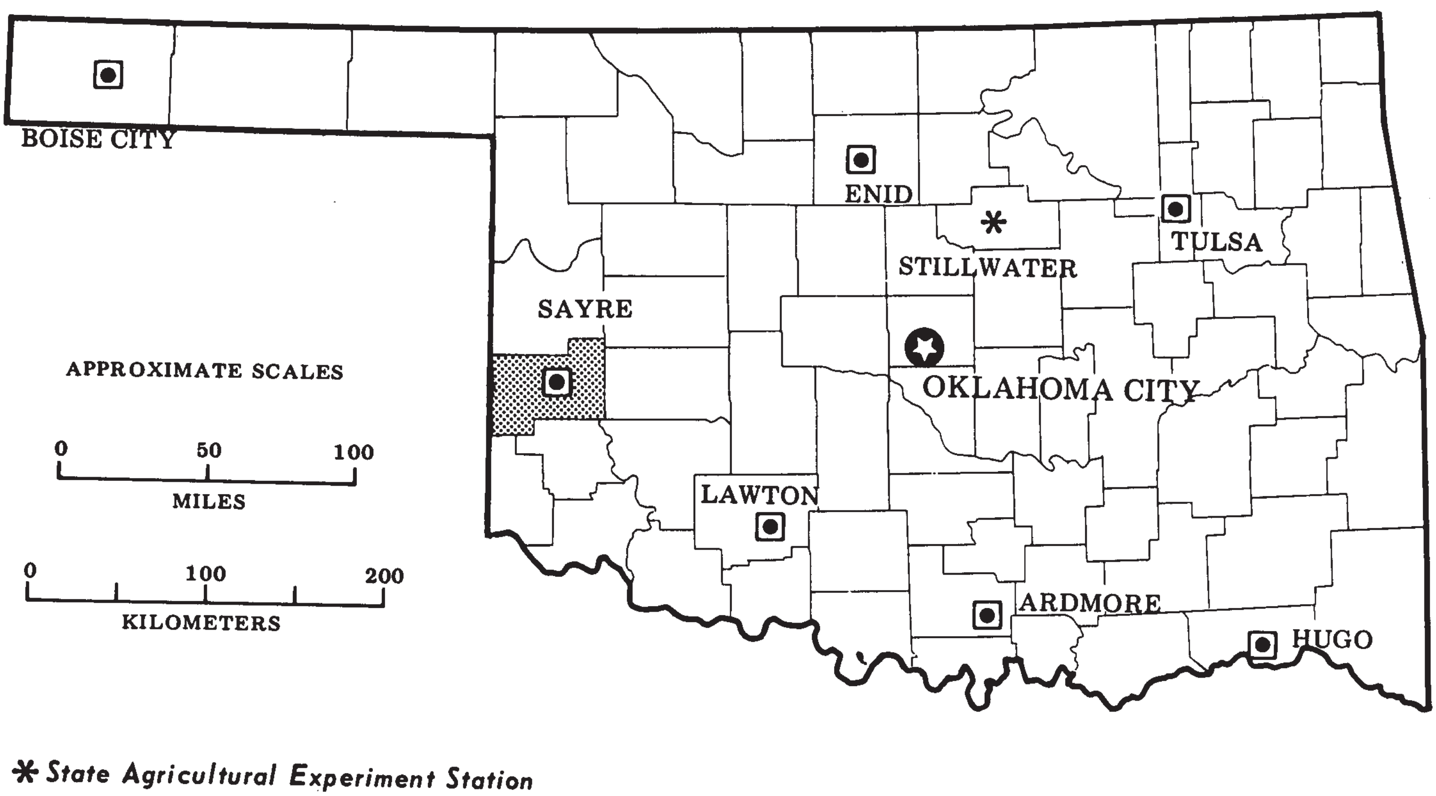
This soil survey is designed for many different users. Farmers, ranchers, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Roland R. Willis

Roland R. Willis
State Conservationist
Soil Conservation Service



Location of Beckham County in Oklahoma.

soil survey of
Beckham County, Oklahoma

By Jimmy G. Ford, Gregory F. Scott, and Jimmie W. Frie
Soil Conservation Service

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

BECKHAM COUNTY is in the southwestern part of Oklahoma. It has a population of 15,754, and Sayre, the county seat, has a population of 2,750. The county covers an area of 580,480 acres, or 907 square miles.

general nature of the county

This section discusses the climate, settlement and development, relief and drainage, and natural resources of Beckham County.

climate

Prepared by the National Climatic Center, Asheville, North Carolina.

In Beckham County, winter weather is alternately mild and very cool. Cold fronts repeatedly sweep over the area, causing sharp drops in temperature, but the cold air behind these fronts moderates quickly. Summers are hot. Winter precipitation, often snowfall, is light. Total annual precipitation is usually adequate for wheat, sorghum, and range grasses.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Elk City, Oklahoma, in the period 1951 to 1976. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 40 degrees F, and the average daily minimum temperature is 27 degrees. The lowest temperature on record, which occurred at Elk City on January 4, 1959, is -6 degrees. In summer the average temperature is 80 degrees, and the average daily maximum temperature is 93 degrees. The highest recorded temperature, which occurred on July 25, 1954, is 111 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

Of the total annual precipitation, 17 inches, or 70 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 13 inches. The heaviest 1-day rainfall during the period of record was 5.58 inches at Elk City on July 22, 1960. Thunderstorms occur on about 50 days each year, and most occur in summer.

Average seasonal snowfall is 6 inches. The greatest snow depth at any one time during the period of record was 8 inches. On an average of 3 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 40 percent. Humidity is higher at night, and the average at dawn is about 70 percent. The sun shines 80 percent of the time possible in summer and 70 percent in winter. The prevailing wind is from the southwest. Average windspeed is highest, 16 miles per hour, in April.

Duststorms occur in an occasional spring, when strong dry winds blow over unprotected soils. Tornadoes and severe thunderstorms, some with hail, occur occasionally. These storms are local and of short duration, and the pattern of damage is variable and spotty.

settlement and development

Beckham County was included in the Louisiana Purchase when the United States acquired the area from France in 1803. In 1803, the county was included in the Indian Territory and set aside as a place to relocate Indians. Although the area south of the North Fork of the Red River was claimed by Texas, it was later included in the Indian Territory by a ruling of the Supreme Court. Originally, the county was part of the land given to the Choctaw and Chickasaw Tribes. In 1875, it became part of the Cheyenne-Arapaho Reservation and was part of the Indians' grazing land. The county was leased to Texas cattlemen, and the Western Cattle Trail followed the path that is now known as Oklahoma Highway 34.

On April 19, 1892, the "Cherokee Run" opened the county for settlement. Elk City was founded in March 1901; Sayre, in September 1901; and Erick, in 1902. In 1907, at the time of statehood, the population of the county was about 17,000, and it grew steadily until the 1930's when the population was almost 30,000. The drought and depression of the 1930's and the drought of the 1950's caused many people to move to other areas. The population continued to decline until 1970 when there remained only about 15,000 people in the county.

Major use of the area for agriculture began in the 1880's when Texas ranchers leased the land from the Indians for grazing. After the "Cherokee Run," farmers began to plow the land for clean-tilled crops. Cotton, corn, grain sorghum, and wheat were the main crops. After the drought of the 1930's, much of the less productive cropland was reseeded or reverted naturally to native grass. That trend continues at present as some of the cropland is sown to native grass, bermudagrass, or weeping lovegrass.

As climatic and economic conditions permit, some of the sandy rangeland is being seeded or sodded to improved pasture grasses in order to expand the cow-calf industry. Cattle raising is an important part of the agricultural economy and has good potential for expansion in the future.

About 48 percent of the county is rangeland and the other 52 percent is used as cropland and pasture and for urban development. The major crops are wheat and cotton. Grain sorghum and alfalfa are also important. Improved pastures make up about 4 percent of the county.

relief and drainage

The county is in the Central Rolling Red Plains major land resource area. The North Fork of the Red River crosses the county from northwest to southeast, and its broad, sandy terraces cover a large part of the county.

The southwest corner of the county consists of steep rocky uplands cut by numerous canyons and gullies. The north, central, and eastern parts of the county consist of gently sloping or sloping uplands. The flood plain of Elk Creek runs along the eastern boundary of the county, and the northeast corner of the county consists of strongly sloping uplands that make up part of the Sandstone Creek watershed. Elevation ranges from 1,620 feet where the North Fork of the Red River leaves the county to 2,260 feet in the northwest corner of the county.

natural resources

Productive soils, available water for irrigation, and large reserves of natural gas are the most important natural resources in the county.

A large acreage in the county is productive and has a high potential for native grasses and introduced grasses such as bermudagrass and weeping lovegrass and for crops such as cotton, wheat, and grain sorghum. Rangeland makes up about half the area of the county. Although much of the rangeland and cropland has been damaged by erosion and overgrazing in the past, proper management can increase production of native grass and crops.

The sandy area lying immediately south of the North Fork of the Red River has a good underground water supply that is being used as a municipal water source for Elk City, Sayre, Erick, and other towns in the area. This water is also used for sprinkler irrigation, and in some areas it has sufficient volume to support intensive agricultural use.

Oil and natural gas production is important in most parts of the county. The Anadarko Basin is one of the largest natural gas fields in the United States. Gas wells in the northern part of Beckham County are commonly 15,000 to 20,000 feet deep, and reserves of gas extend to depths of 50,000 feet. This industry is becoming increasingly important to the county's economy.

Other resources include beds of gypsum that are mainly south of Carter. Although these deposits are large enough to be worked, it is not economical to do so at this time. Beds of gravel that are used mainly for road surfacing occur randomly throughout the southern part of the county.

how this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map units" and "Detailed soil map units."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, rangeland managers, engineers, planners, developers and builders, home buyers, and others.

general soil map units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The map units shown on the general soil map are described on the pages that follow.

deep, well drained to somewhat excessively drained sandy, loamy, and clayey soils; on flood plains

The three map units in this group make up about 10 percent of Beckham County. The soils are used mainly for range, tame pasture, and hay, but some areas are used for cultivated crops.

1. Lincoln-Yahola

Nearly level, well drained to somewhat excessively drained sandy and loamy soils that formed in sandy or loamy alluvium

This map unit is made up of nearly level soils on flood plains along the North Fork of the Red River and along some of the major drainageways within the county. Slope ranges from 0 to about 1 percent.

This map unit covers about 6 percent of the county. About 28 percent of the map unit is Lincoln soils, 22 percent is Yahola soils, and the remaining 50 percent is soils of minor extent.

Lincoln soils are at the lowest elevations on the flood plains adjacent to the stream channels. These soils are deep, nearly level, and somewhat excessively drained. Flooding is frequent and lasts for brief periods. Typically, the Lincoln soils have a surface layer of light brown loamy fine sand. The underlying material is very pale brown fine sand that has thin strata of fine sandy loam.

Yahola soils are at slightly higher elevations on the flood plain than the Lincoln soils. They are occasionally flooded for very brief periods. Yahola soils are deep, nearly level, and well drained. Typically, the Yahola soils have a surface layer of red fine sandy loam. The underlying material is red fine sandy loam that has thin strata of loam and silt loam.

The minor soils in this map unit are the well drained Cyril and Clairemont soils and the somewhat poorly drained Gracemont and Gracemore soils. The Gracemont and Gracemore soils have a water table within 40 inches of the soil surface most of the year.

The soils of this map unit are used mainly for pasture and hay, but in some areas along the small tributaries they are used for cultivated crops. The crops are mainly wheat and cotton. The major management concerns are flooding, soil blowing, and maintaining soil structure and fertility.

These soils have high potential for tame pasture and hay. Potential is medium for cultivated crops and low for sanitary facilities and building sites. Potential is medium for recreational development. Flooding and the sandy surface layer of the Lincoln soils are the main limitations.

2. Clairemont-Port

Nearly level, well drained loamy soils that formed in loamy alluvium

This map unit is made up of nearly level soils on flood plains that are scattered throughout the county. The largest area is along Elk Creek and its tributaries. Slope ranges from 0 to 1 percent.

This map unit covers about 3 percent of the county. About 70 percent of the map unit is Clairemont soils, 10 percent is Port soils, and the remaining 20 percent is soils of minor extent.

Clairemont soils are at the lower elevations on the flood plains and are in narrow areas adjacent and parallel to the stream channels. These soils are occasionally or frequently flooded for very brief periods. Clairemont soils are deep, nearly level, and well drained. Typically, they have a surface layer of reddish brown silt loam. The underlying material is red and reddish brown silt loam with thin strata of very fine sandy loam and sandy loam.

Port soils are at slightly higher elevations on the flood plains than the Clairemont soils. They are occasionally flooded for very brief periods. Port soils are deep, nearly level, and well drained. Typically, they have a surface layer and subsoil of reddish brown silty clay loam. The underlying material is red silt loam that has a few thin strata of fine sandy loam.

The minor soils in this map unit are the somewhat poorly drained Gracemont soils, which have a water table within 40 inches of the soil surface most of the year, and the well drained Spur and Yahola soils.

The soils of this map unit are used mainly for cultivated crops, but in some areas they are used for hay and pasture. The crops are mainly wheat and cotton. The major management concerns are maintaining soil structure and fertility. Flooding is a major problem in the lower lying areas of the Clairemont soils.

These soils have high potential for cultivated crops, hay, and pasture. Potential is low for sanitary facilities and building sites. Potential is medium for recreational development. Flooding is the main limitation.

3. Spur-Mangum

Nearly level, well drained loamy and clayey soils that formed in loamy or clayey alluvium

This map unit is made up of nearly level soils on flood plains in the southern part of the county, mainly along North Elm Creek and Haystack Creek and their tributaries. Slope ranges from 0 to 1 percent.

This map unit covers about 2 percent of the county. About 52 percent of the map unit is Spur soils, 13 percent is Mangum soils, and the remaining 35 percent is soils of minor extent.

Spur soils are at the lower elevations of the flood plains and are in narrow areas adjacent and parallel to the stream channels. These soils are frequently or occasionally flooded for very brief periods. Spur soils are deep, nearly level, and well drained. Typically, they have a surface layer of brown loam or clay loam. The subsoil is dark brown loam. The underlying material is reddish brown loam.

Mangum soils are generally at slightly higher elevations on the flood plains than the Spur soils. Flooding is rare and lasts for very brief periods. Mangum soils are deep, nearly level, and well drained. Typically, they have a surface layer of brown clay. The subsoil and underlying material are reddish brown clay.

The minor soils in this map unit are the well drained Clairemont, Beckman, Treadway, and Yahola soils.

The soils in about 80 percent of this map unit are used for range, and those in 20 percent are used for cultivated crops. Small grain, cotton, and grain sorguhum are the major crops. The major management concerns are controlling grazing and maintaining soil structure and fertility.

These soils have high potential for range. Potential is low for cultivated crops and for sanitary facilities and building sites. Potential is low for recreational development. Flooding and the clayey texture, shrinking and swelling, and the very slow permeability of the Mangum soils are the main limitations.

deep to shallow, well drained loamy soils; on uplands

The three map units in this group make up about 34 percent of Beckham County. The soils are used mainly for cropland, but some areas are used for tame pasture, hay, and range.

4. Woodward-St. Paul-Carey

Deep and moderately deep, nearly level to strongly sloping soils that formed in loamy materials weathered from sandstone

This map unit is made up of nearly level to strongly sloping soils on smooth uplands. The areas are scattered throughout the county. Slope ranges from 0 to 12 percent.

This map unit covers about 13 percent of the county. About 36 percent of the map unit is Woodward soils, 30 percent is St. Paul soils, and 15 percent is Carey soils (fig. 1). The remaining 19 percent is soils of minor extent.

Woodward soils are on convex uplands. These soils are moderately deep, very gently sloping to strongly sloping, and well drained. Typically, the Woodward soils have a surface layer of yellowish red and reddish brown loam. The subsoil is red and light red loam. Below a depth of about 27 inches is weakly cemented sandstone.

St. Paul soils are on broad, smooth, convex uplands. These soils are deep, nearly level or very gently sloping, and well drained. Typically, the St. Paul soils have a surface layer of dark grayish brown silt loam. The subsoil is reddish brown silty clay loam, and the underlying material is yellowish red silt loam.

Carey soils are on smooth, convex uplands. These soils are mainly on crests of ridges and the upper side slopes. The Carey soils are deep, very gently sloping, and well drained. Typically, they have a surface layer that is brown and dark brown silt loam. The subsoil is reddish brown clay loam in the upper part and yellowish red loam in the lower part. Weakly consolidated sandstone is at a depth of about 45 inches.

The minor soils in this map unit are mainly the well drained Clairemont and Yahola soils that are on flood plains of narrow streams that dissect the area. Minor soils of lesser extent are the Abilene, Aspermont, Dill, Hardeman, Obaro, Quinlan, and Tipton soils on the adjacent uplands.

The soils of this map unit are used mainly for cultivated crops, hay, or tame pasture. Other areas are in native range. The main crops are small grain, grain sorghum, cotton, and alfalfa. The major management concerns are maintaining soil structure and fertility and controlling erosion.

These soils have high potential for cultivated crops and medium potential for hay and tame pasture. Potential is medium for building sites and low for most

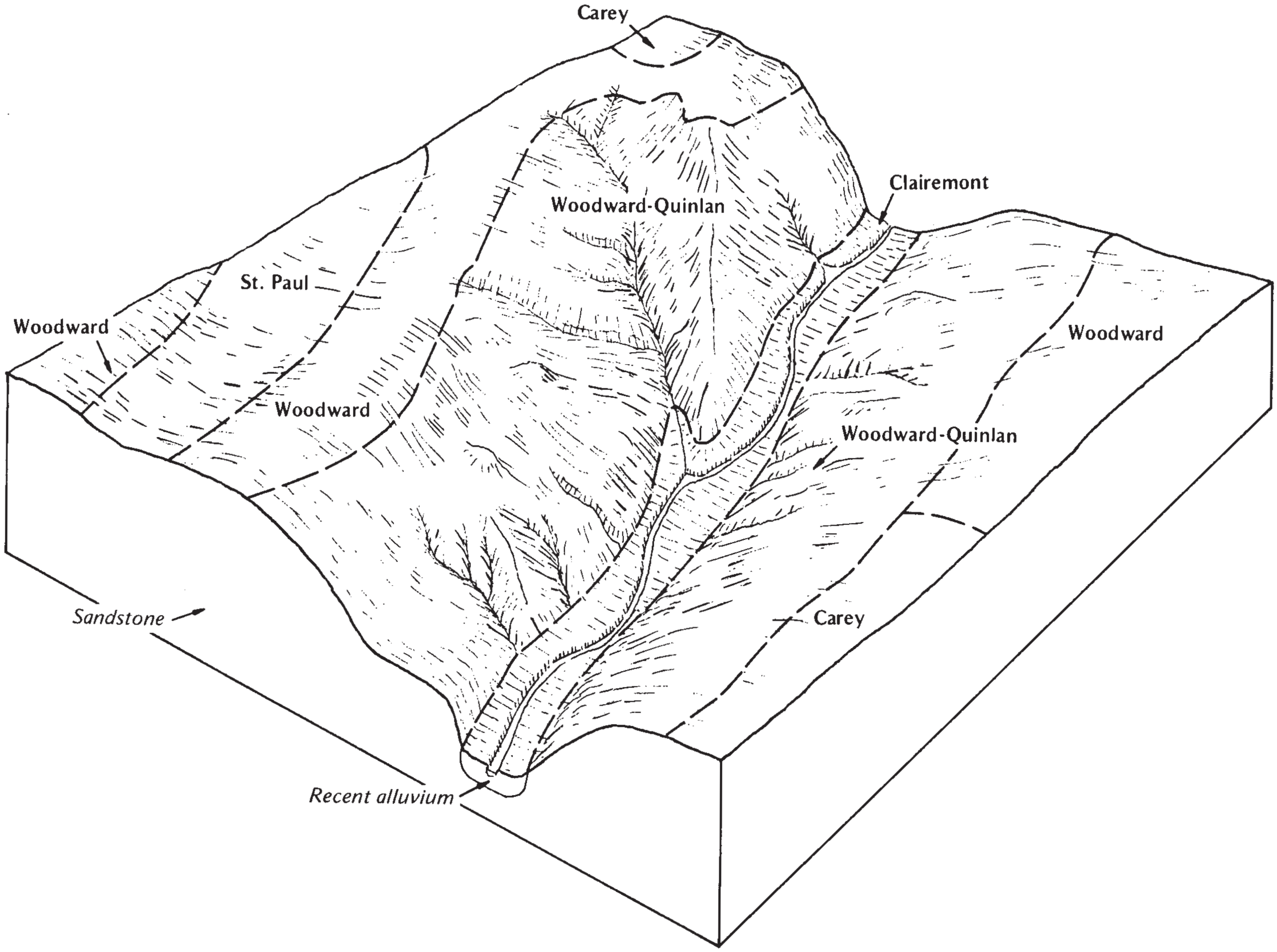


Figure 1.—Typical pattern of soils and underlying material in the Woodward-St. Paul-Carey map unit.

sanitary facilities. Potential is high for recreational development. Low strength and the moderate depth to bedrock are the main limitations.

5. Dill-Quinlan

Moderately deep and shallow, very gently sloping to strongly sloping soils that formed in loamy materials weathered from sandstone

This map unit is made up of very gently sloping to strongly sloping soils on ridges and knolls scattered throughout the county, but the most extensive area is in the northeast and north-central part of the county. Slope ranges from 1 to 12 percent.

This map unit covers about 14 percent of the county. About 40 percent of the map unit is Dill soils, 28 percent is Quinlan soils, and the remaining 32 percent is soils of minor extent (fig. 2).

Dill soils are generally on flat ridgetops and in low lying areas between the higher knolls on the landscape. These soils are moderately deep, very gently sloping to strongly sloping, and well drained. Typically, the Dill soils have a surface layer of reddish brown fine sandy loam. The subsoil is reddish brown fine sandy loam. Weakly cemented sandstone is at a depth of about 30 inches.

Quinlan soils are on all positions on the landscape, but they are most commonly on small knolls and side slopes. These soils are shallow, very gently sloping to strongly sloping, and well drained. Typically the Quinlan soils have a surface layer of red fine sandy loam. The subsoil is red fine sandy loam. Sandstone is at a depth of about 12 inches.

The minor soils are the well drained Cordell, Clark, Devol, Hardeman, Obaro, Owens, Woodward, and Woodward Variant soils on uplands and the Clairemont

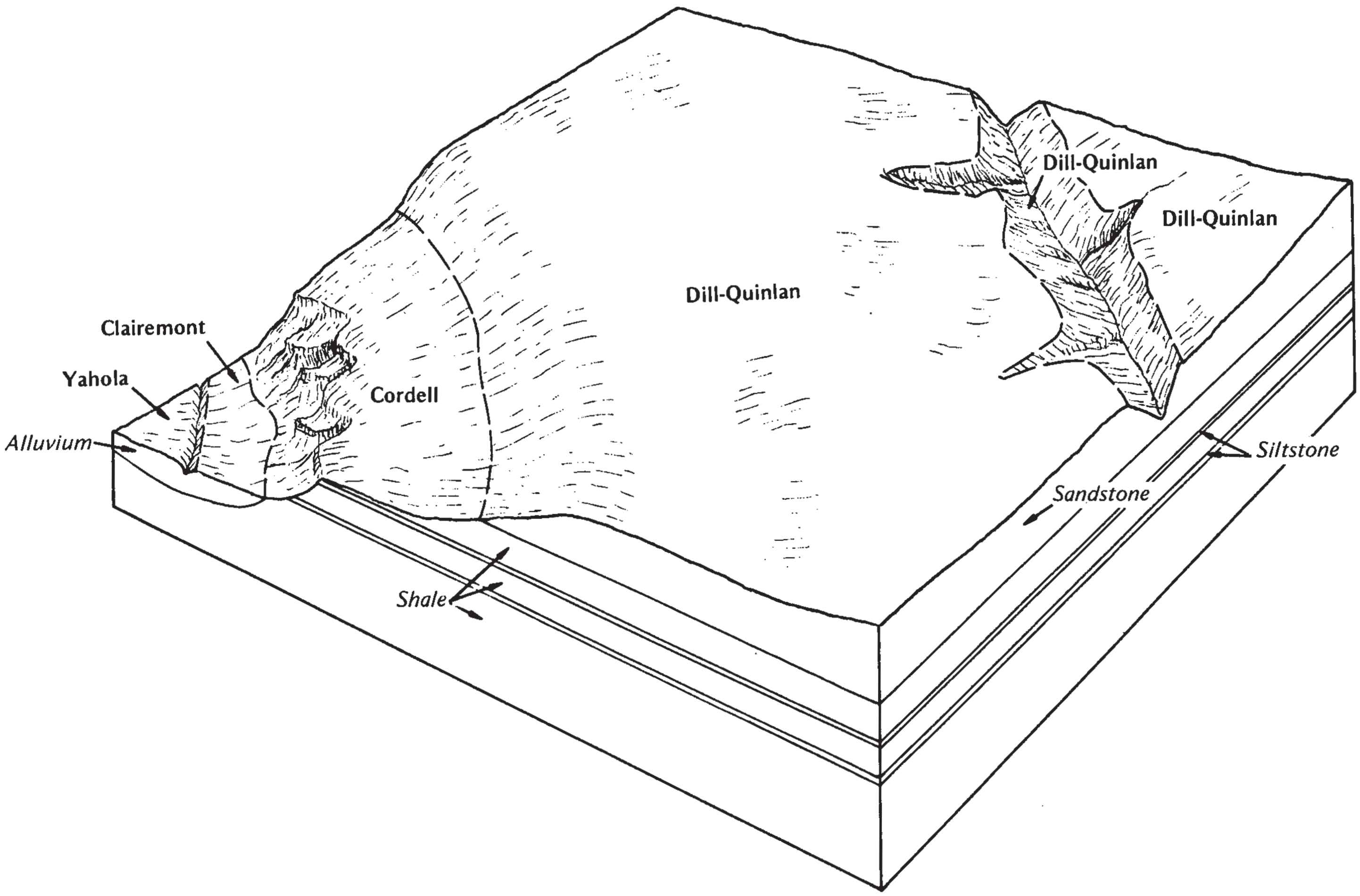


Figure 2.—Typical pattern of soils and underlying material in the Dill-Quinlan map unit.

and Yahola soils on flood plains of narrow streams throughout this map unit.

The soils of this map unit are used mainly for cultivated crops, but in some areas they are used for tame pasture and hay. The main crops are small grain, cotton, and grain sorghum. The major management concerns are controlling soil blowing and erosion and maintaining soil structure and fertility.

These soils have medium potential for cultivated crops. Potential is medium for building sites and low for sanitary facilities. Potential is medium for recreational development. Slope and the moderate to shallow depth to bedrock are the main limitations.

6. Obaro-Quinlan

Moderately deep and shallow, very gently sloping to strongly sloping soils that formed in loamy materials weathered from sandstone or siltstone

This map unit is made up of very gently sloping to strongly sloping soils on knolls and ridges that are scattered throughout the county. The main area is in a narrow band that passes through the central part of the county. Slope ranges from 1 to 12 percent.

This map unit covers about 6 percent of the county. About 60 percent of the map unit is Obaro soils, 15 percent is Quinlan soils, and the remaining 25 percent is soils of minor extent.

Obaro soils generally are slightly lower in elevation than the Quinlan soils. These soils are moderately deep, very gently sloping to strongly sloping, and well drained. Typically, the Obaro soils have a surface layer of reddish brown silt loam. The subsoil is reddish brown and red silt loam. Weakly cemented sandstone is at a depth of about 36 inches.

Quinlan soils are on small knolls and side slopes. These soils are shallow, very gently sloping to strongly sloping, and well drained. Typically, the Quinlan soils have a surface layer of red silty clay loam. The subsoil is red silty clay loam. Sandstone or siltstone bedrock is at a depth of about 12 inches.

The minor soils in this map unit are the well drained

Carey, Cordell, Dill, and Woodward soils on uplands and Clairemont and Yahola soils on the flood plains of narrow streams that dissect this map unit.

About 50 percent of the acreage is used for cultivated crops such as small grain, grain sorghum, and cotton. Some areas of the soils are used for tame pasture and hay and the remaining areas are used for native range. The major management concerns in cropland are maintaining soil structure and fertility and controlling erosion.

These soils have medium potential for cultivated crops. Potential is medium for building sites and low for sanitary facilities. This map unit has medium potential for recreational development. Slope and the moderate to shallow depth to bedrock are the main limitations.

deep, well drained loamy and sandy soils; on uplands

The two map units in this group make up about 32 percent of Beckham County. The soils are used mainly for cropland, but significant acreages are used for range, tame pasture, and hay.

7. Grandfield-Devol

Nearly level to strongly sloping loamy and sandy soils that formed in sandy and loamy deposits

This map unit is made up of nearly level to strongly sloping soils on smooth to hummocky uplands that are scattered throughout the county. These soils formed in old alluvial or eolian sediments that mantle the higher lying parts in the uplands. Slope ranges from 0 to 12 percent.

This map unit covers about 14 percent of the county. About 56 percent of the map unit is Grandfield soils, 29 percent is Devol soils, and the remaining 15 percent is soils of minor extent.

Grandfield soils generally are at a higher elevation than the Devol soils. These soils are deep, very gently sloping to sloping, and well drained. Typically, they have a surface layer of brown and dark brown loamy fine sand or fine sandy loam. The subsoil is reddish brown sandy clay loam, and the underlying material is yellowish red fine sandy loam.

Devol soils are on convex, hummocky uplands and side slopes along a narrow band parallel to the North Fork of the Red River. These soils are deep, nearly level to strongly sloping, and well drained. Typically, the Devol soils have a surface layer of brown loamy fine sand. The subsoil is reddish brown fine sandy loam, and the underlying material is yellowish red loamy fine sand.

The minor soils in this map unit are the well drained Altus and Hardeman soils on uplands and the Yahola and Cyril soils on the flood plains of the streams that dissect the map unit.

Most of the soils of this map unit are used for cultivated crops such as wheat, cotton, grain sorghum, peanuts, and other specialty crops. Some areas of the soil are used for tame pasture and hay and a small part of the unit is used for native range. The major concerns of cropland management are controlling water erosion and soil blowing and maintaining soil fertility and structure.

These soils have medium potential for cultivated crops and tame pasture. Potential is high for building sites and medium for sanitary facilities.

8. Nobscot-Delwin

Nearly level to strongly sloping sandy soils that formed in sandy and loamy deposits

This map unit is made up of nearly level to strongly sloping soils on uplands that are mainly in a band south of the North Fork of the Red River and in the northwest part of the county. These areas have an uneven, hummocky dune topography. Slope ranges from 0 to 12 percent.

This map unit covers about 18 percent of the county. About 67 percent of the map unit is Nobscot soils, 20 percent is Delwin soils, and the remaining 13 percent is soils of minor extent (fig. 3).

Nobscot soils are generally slightly higher in elevation than the Delwin soils and are on a more uneven, hummocky topography. These soils are deep, nearly level to strongly sloping, and well drained. Typically, the Nobscot soils have a surface layer of brown fine sand. The subsurface layer is pink fine sand. The subsoil is red sandy loam and loamy sand that grades to reddish yellow fine sand at a depth of 71 inches.

Delwin soils are in valleys between an uneven topography of low dunes and smooth broad flat areas. These soils are deep, nearly level or very gently sloping, and well drained. Typically, the Delwin soils have a surface layer of grayish brown loamy fine sand. The subsurface layer is light brown fine sand. The subsoil is yellowish red sandy clay loam that grades to reddish yellow fine sandy loam at a depth of 33 inches.

The minor soils in this map unit are the well drained Yahola and Cyril soils on the narrow flood plains of streams that dissect the area. Minor soils also include the well drained Devol and Hardeman soils on uplands. These soils are mainly parallel to narrow streams.

The soils in more than half of this map unit are in native range and are used for grazing. About 40 percent of the acreage is used for cultivated crops such as wheat, rye, cotton, and grain sorghum. A few areas are used for tame pasture and hay. The major concerns of management are controlling soil blowing and maintaining soil fertility.

These soils have medium potential for cultivated farm crops and tame pasture and high potential for native range. Potential is high for building sites and low for sanitary facilities. The potential is medium for most recreational development. The sandy surface texture and slope are the main limitations.

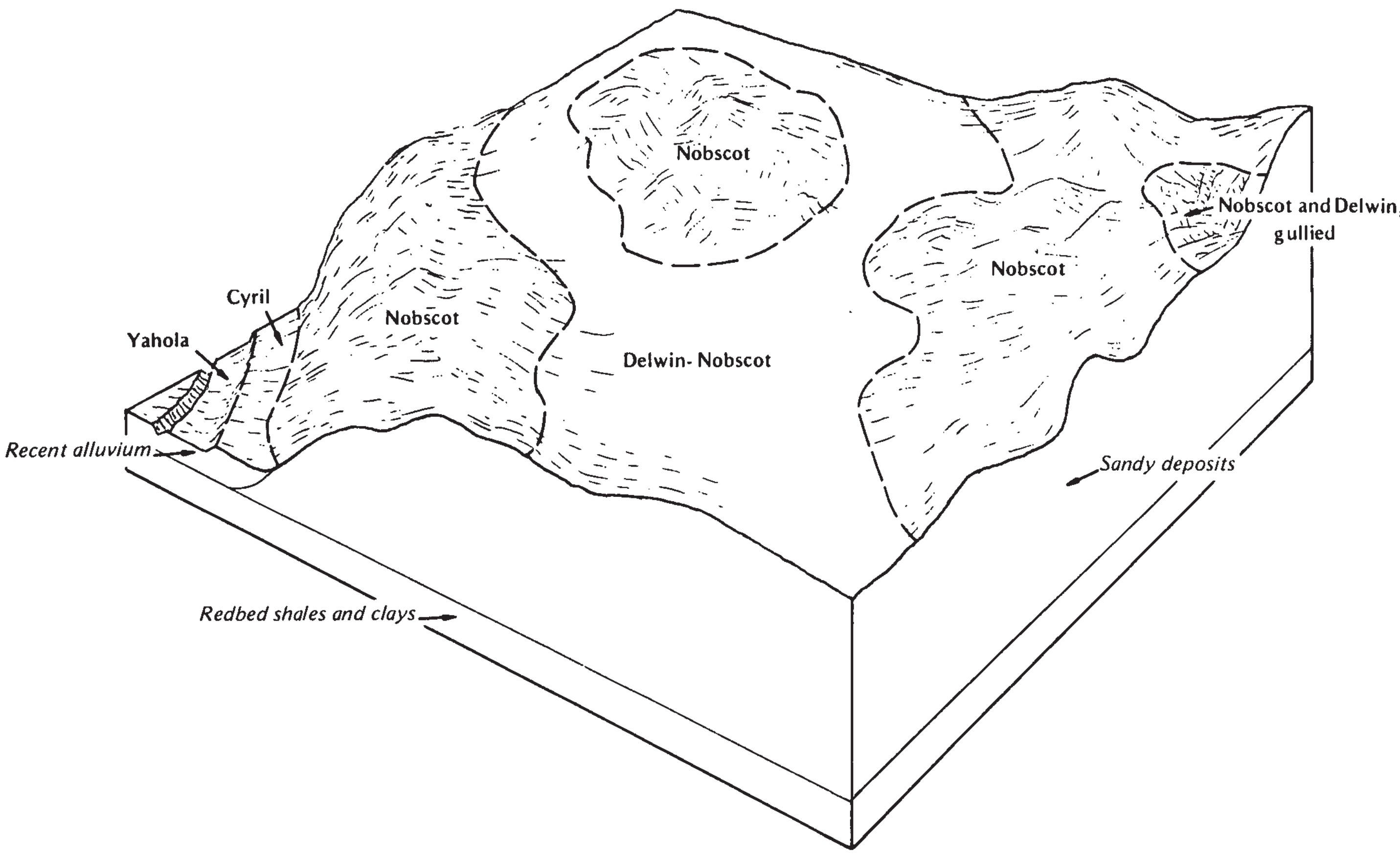


Figure 3.—Typical pattern of soils and underlying material in the Nobscot-Delwin map unit.

very shallow, shallow, and deep, excessively drained to well drained clayey and loamy soils; on uplands

The two map units in this group make up about 24 percent of Beckham County. The soils are mainly in native range that is used for grazing.

9. Cordell-Rock outcrop

Rock outcrop and shallow, very gently sloping to moderately steep, somewhat excessively drained loamy soils that formed in materials weathered from sandstone or siltstone

This map unit is made up of Rock outcrop and very gently sloping to moderately steep soils that are scattered throughout the northeast and north-central parts of the county. Slope ranges from 1 to 15 percent.

This map unit covers about 10 percent of the county. About 64 percent of the map unit is Cordell soils, 20 percent is Rock outcrop, and the remaining 16 percent is soils of minor extent.

Cordell soils are in smooth rolling areas and on side slopes along narrow drainageways. These soils are shallow, very gently sloping to moderately steep, and somewhat excessively drained. Typically, the Cordell soils have a surface layer and a subsoil of reddish brown silty clay loam. Red, hard siltsone is at a depth of 18 inches.

The rock outcrops are on small knolls and escarpments where the siltstone beds are tilted, and the outcrops are also on side slopes along drainageways.

The minor soils in this map unit are the well drained Clairemont soils on flood plains of narrow streams that dissect the unit and the Dill, Obaro, and Quinlan soils on uplands.

Most of the soils of this map unit are used for native range, but in some areas they are used for cultivated crops. Wheat and grain sorghum are the main crops. The major management concerns are controlling grazing and controlling erosion in cultivated areas.

These soils have low potential for cultivated crops and for native range. Potential is low for building sites and for sanitary facilities. Potential is medium for recreational development. Slope and the shallow depth to bedrock are the main limitations.

10. Knoco-Cornick-Quanah-Rock outcrop

Rock outcrop and very shallow and deep, very gently sloping to steep, well drained and excessively drained loamy and clayey soils that formed in loamy and clayey materials weathered from shale and gypsum

This map unit is made up of Rock outcrop and very gently sloping to steep soils on uplands in the south part of the county. Slope ranges from 1 to 40 percent.

This map unit covers about 14 percent of the county. About 16 percent of the map unit is Knoco soils, 12 percent is Cornick soils, 11 percent is Quanah soils, and 11 percent is Rock outcrop (fig. 4). The remaining 50 percent is soils of minor extent.

Knoco soils are generally slightly lower in elevation than the Cornick soils. Knoco soils are very shallow, strongly sloping to steep, and well drained to excessively drained. Typically, the Knoco soils have a surface layer of reddish brown clay. Red clayey shale is at a depth of 6 inches.

Cornick soils are on ridges and in the more nearly flat areas of the landscape. These soils are very shallow, very gently sloping to strongly sloping, and well drained. Typically, the Cornick soils have a surface layer of dark brown silt loam. Hard, white gypsum is at a depth of 10 inches.

Quanah soils are on convex ridges and concave foot slopes and depressions on the landscape. These soils

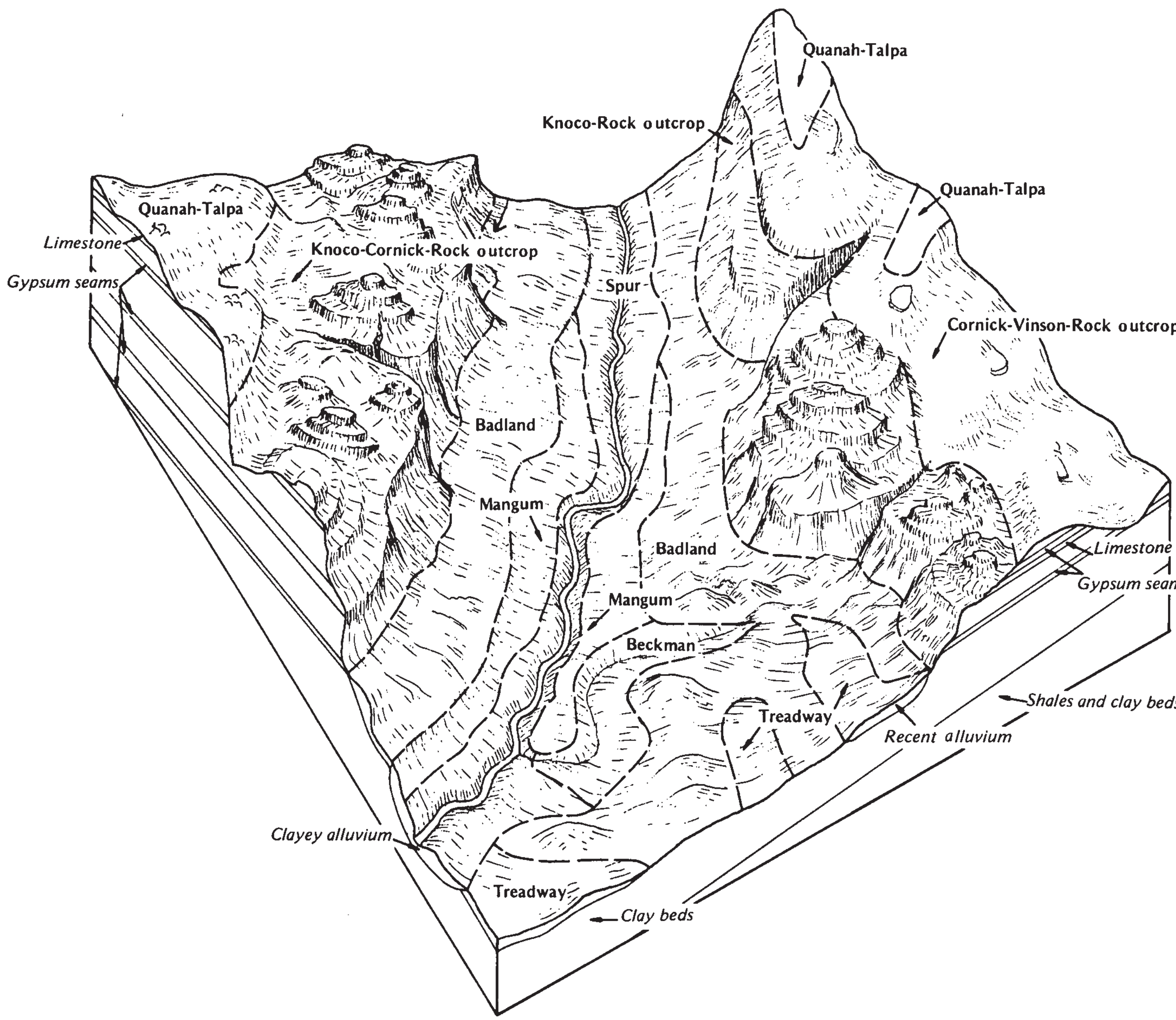


Figure 4.—Typical pattern of soils and underlying material in the Knoco-Cornick-Quanah-Rock outcrop map unit.

are deep, very gently sloping to gently sloping, and well drained. Typically, the Quanah soils have a surface layer of brown clay loam. The subsoil is reddish brown clay loam that grades to yellowish red clay loam underlying material at a depth of 24 inches.

Rock outcrop occurs throughout the map unit as geologically eroded shales and clays and as exposed beds of gypsum and dolomitic limestone bedrock.

The minor soils in this map unit are the well drained Aspermont, Talpa, Tillman, Treadway, Vinson, and Vernon soils on uplands and Beckman, Mangum, and Spur soils that are on the flood plains of narrow streams that dissect the area. Also, minor areas of Badland are included.

The soils of this map unit are used mainly for native range. The major management concerns are controlling grazing and providing an adequate water supply for livestock.

These soils have low potential for range but are best suited for this use. Potential is low for building sites and sanitary facilities. Potential is also low for recreational development. Slope, very shallow depth to bedrock, shrinking and swelling, and clayey surface texture are the main limitations.

detailed soil map units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and management of the soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Grandfield loamy fine sand, 2 to 5 percent slopes, eroded, is one of several phases in the Grandfield series.

Some map units are made up of two or more major soils. These map units are called soil complexes or undifferentiated groups.

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Dill-Quinlan complex, 1 to 3 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils in a mapped area are not uniform. An area can be made up of only one of the major soils, or it can be made up of all of them. Quinlan and Dill soils, 2 to 12 percent slopes, severely eroded, is an undifferentiated group in this survey area.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Badland is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

soil descriptions

1—Abilene clay loam, 0 to 1 percent slopes. This nearly level loamy soil is deep and well drained. It is on brown flat uplands. Slopes are smooth and convex. Areas are 10 to 200 acres.

Typically, the surface layer is dark grayish brown and dark brown clay loam about 11 inches thick. The subsoil extends to a depth of about 46 inches. It is dark brown clay loam to a depth of about 19 inches, dark brown clay to a depth of about 25 inches, and brown clay to a depth of about 46 inches. The underlying material is brown clay to a depth of 60 inches or more.

This soil is high in natural fertility and organic matter content. Reaction is neutral to moderately alkaline in the surface layer and subsoil and moderately alkaline in the underlying material. Permeability is moderately slow. Available water capacity is high, and runoff is slow. This soil has good tilth and can be worked throughout a fairly wide range in moisture content. The root zone is deep and fairly easily penetrated by plant roots. The shrink-swell potential is moderate.

Included with this soil in mapping are small areas of Aspermont and Tipton soils. These soils are in convex areas. The included soils make up about 15 percent of this unit, but individual areas are generally less than 5 acres.

Most areas of this Abilene soil are cultivated. The potential is high for growing wheat, grain sorghum, cotton, and legumes and grasses for hay and pasture. The hazard of water erosion is slight if cultivated crops are grown. Minimum tillage, winter cover crops, and residue management help prevent soil loss, improve fertility, reduce surface crusting, and increase water infiltration.

This soil has medium potential for tame pasture and hay. The potential is medium for rangeland, although very little of this soil is used for this purpose. Under good management it will produce a moderate amount of native grass. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during excessively wet and dry periods help keep the grass cover and soil in good condition.

This soil has low potential for trees for windbreaks and post lots. Low summer rainfall is the main limitation for trees.

The potential is high for openland wildlife habitat and medium for rangeland wildlife habitat.

This soil has medium potential for building sites. Low strength and shrinking and swelling are the main limitations for dwellings. These limitations can be overcome by good design and careful installation procedures. Low strength is a limitation for roads and streets, but this can be overcome by strengthening or replacing the base material. The potential for sanitary facilities is low. The clayey subsoil has moderately slow permeability, which is a limitation for septic tank absorption fields. This can be overcome by increasing the size of the absorption area. The clayey texture of the subsoil and underlying material is the main limitation for use of this soil as trench type sanitary landfill.

This soil has medium potential for most recreational uses. The high content of clay in the surface layer and moderately slow permeability are the main limitations. The surface layer is sticky when wet. Water may stand on the surface for short periods after heavy rains. Onsite investigation is necessary to evaluate and plan the development of specific sites.

This soil is in capability subclass IIc; Hardland range site.

2—Altus fine sandy loam, 1 to 3 percent slopes. This very gently sloping loamy soil is deep and well drained. It is on broad, smooth, convex uplands. Areas are irregular in shape and range from 10 to 500 acres.

Typically, the surface layer is grayish brown fine sandy loam about 8 inches thick. The subsoil extends to a depth of 80 inches. It is dark grayish brown fine sandy loam and sandy clay loam to a depth of about 25 inches, brown sandy clay loam to a depth of about 40 inches, and reddish brown sandy clay loam that has a few rounded pebbles to a depth of 80 inches.

This soil is high in natural fertility and organic matter content. Permeability is moderate, and surface runoff from cultivated areas is medium. The available water capacity is medium. Reaction of the surface layer is slightly acid or neutral. Below that, reaction is mostly neutral to moderately alkaline. The surface layer is friable and easily tilled throughout a wide range in moisture content. The root zone is deep and easily penetrated by plant roots. The shrink-swell potential is low.

Included with this soil in mapping are areas of Grandfield soils on low knolls. These soils make up about 10 percent of this map unit, but individual areas are generally less than 3 acres.

Most areas of this Altus soil are cultivated. The potential is high for growing wheat, cotton, and grain sorghum. The hazard of water erosion is moderate. Contour farming and terracing help to control water erosion. The hazard of wind erosion is moderate where cultivated crops are grown, and careful management is required to prevent damage from soil blowing. Wind erosion can be reduced by windbreaks and stubble mulching. Stubble mulching, use of cover crops, and minimum tillage all reduce runoff and help to control erosion, maintain tilth, and increase water infiltration.

This soil has high potential for tame pasture and hay. It is suited to bermudagrass, lovegrass (fig. 5), alfalfa, and other adapted grasses and legumes. The use of this soil for pasture or hay is also effective in controlling erosion.

The potential is high for rangeland, although very little of this soil is used for this purpose. With good management, this soil will produce high yields of native grass. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during dry periods help to keep the grass cover and soil in good condition.

This soil has high potential for trees in windbreaks. There are no serious limitations for trees on this soil.

The potential is high for openland wildlife habitat and rangeland wildlife habitat. Very little of the area is used for this purpose.

This soil has high potential for building sites and sanitary facilities. Excessive seepage is a limitation for sewage lagoons and sanitary landfills. This can be corrected by treatment to seal the bottom of the lagoon or landfill.

The potential is medium for most recreational uses. Soil blowing is the main limitation. This can be overcome by maintaining a good cover of grass. Onsite investigation is necessary to evaluate and plan the development of specific sites.

This soil is in capability subclass IIIe; Sandy Prairie range site.

3—Aspermont silt loam, 3 to 5 percent slopes. This gently sloping loamy soil is well drained and deep. It is

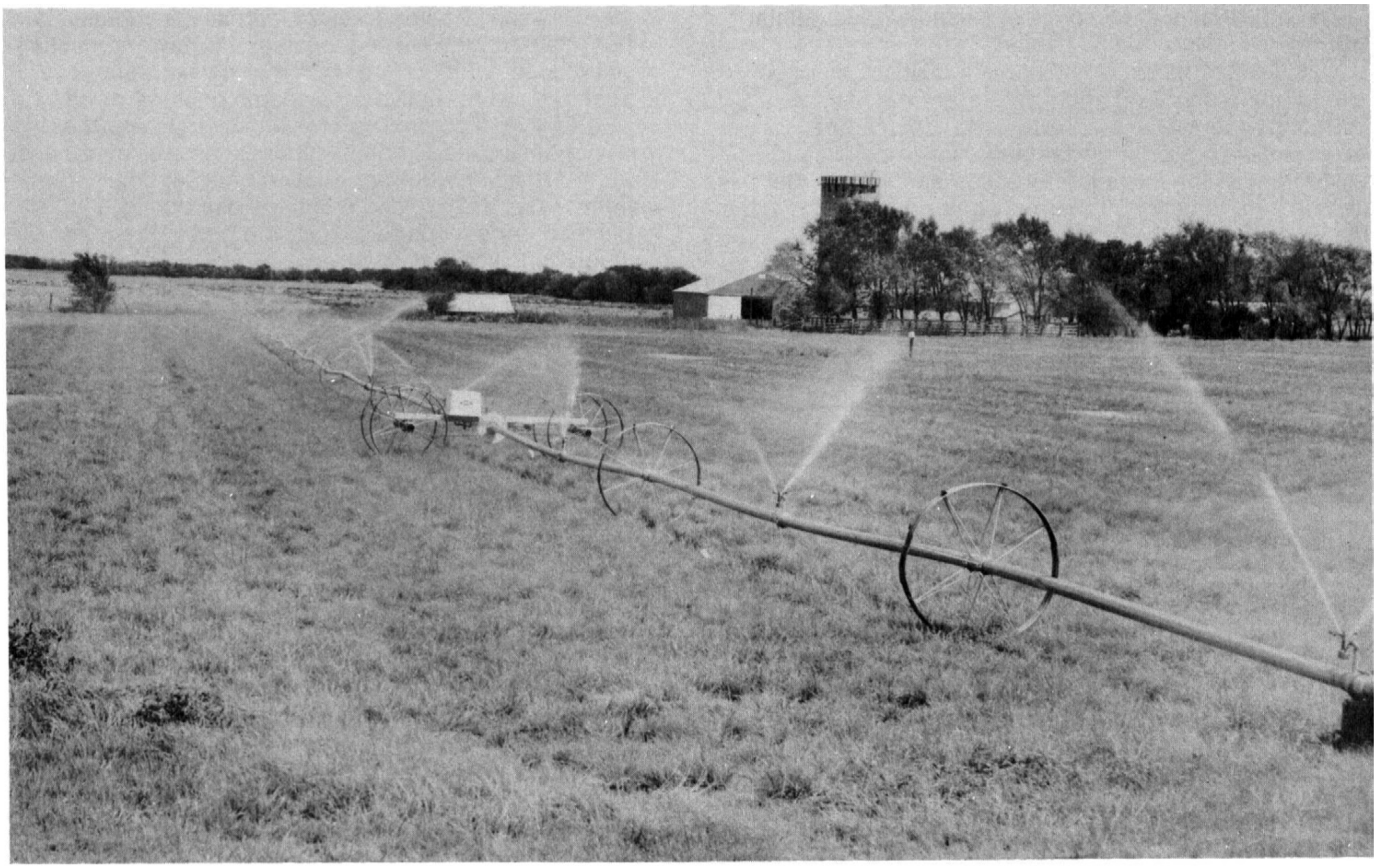


Figure 5.—Lovegrass on Altus fine sandy loam, 1 to 3 percent slopes.

on uplands that have broad convex slopes. Areas are irregular in shape and range from 10 to 100 acres.

Typically, the surface layer is reddish brown silt loam about 14 inches thick. The subsoil extends to a depth of 39 inches. It is reddish brown silt loam to a depth of 22 inches, yellowish red silt loam to a depth of about 31 inches, and yellowish red silt loam with an accumulation of calcium carbonate to a depth of about 39 inches. The underlying material to a depth of 60 inches is yellowish red silty clay loam that has thin strata of greenish siltstone and reddish sandstone in the lower part.

Natural fertility and organic matter content are medium. Reaction is moderately alkaline throughout the profile. This soil is calcareous throughout the profile. Permeability is moderate, and available water capacity is medium. Runoff is rapid. The root zone is deep and is easily penetrated by plant roots. The shrink-swell potential is moderate.

Included with this soil in mapping are a few small areas of Cornick, Quanah, and Talpa soils. The included soils make up about 5 percent of this map unit, but individual areas generally are less than 3 acres.

Most areas of this Aspermont soil are cultivated. Potential is medium for cultivated crops such as wheat, cotton, and grain sorghum. If cultivated crops are grown, water erosion is a moderate hazard. Minimum tillage, winter cover crops, terracing, contour farming, and grassed waterways reduce runoff and erosion. Returning crop residue to the soil helps to maintain organic matter content, improve fertility, reduce crusting, and increase water infiltration.

Potential is low for native grass, tame pasture, and hay. This soil is suited to bermudagrass, lovegrass, and other adapted grasses and legumes. It will produce a moderate amount of native grass. Using this soil for native grass, tame pasture, or hay is effective in controlling erosion. Overgrazing causes surface compaction, excessive runoff, and poor tilth. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during prolonged dry periods help keep the grass and soil in good condition.

This soil has medium potential for trees in windbreaks and post lots. Low summer rainfall is the main limitation.

The potential is medium for openland wildlife habitat and for rangeland wildlife habitat.

This soil has medium potential for building sites. Low strength and shrinking and swelling are the main limitations for dwellings. These limitations can be overcome with proper design and careful installation. Low strength is a limitation for roads and streets, but this can be overcome by strengthening or replacing the base material. This soil has medium potential for sanitary facilities. The moderate permeability is a limitation for septic tank absorption fields, but this can be overcome by increasing the size of the absorption area.

This soil has high potential for most recreational uses. Slope is a limiting factor for playgrounds. Onsite investigation is essential to evaluate and plan the development of specific sites.

This soil is in capability subclass IVe; Hardland range site.

4—Aspermont silt loam, 2 to 5 percent slopes, eroded. This gently sloping, eroded loamy soil is well drained and deep. It is on broad convex side slopes on uplands. The surface layer has been thinned by erosion and the subsoil has been exposed by plowing over about 60 percent of the area. Many rills and a few small gullies are in most areas. Areas are irregular in shape and range from 10 to 200 acres.

Typically, the surface layer is reddish brown silt loam about 6 inches thick. The subsoil extends to a depth of 32 inches. It is red silty clay loam to a depth of 23 inches, and it is red silty clay loam that has an accumulation of calcium carbonate to a depth of about 32 inches. The underlying material to a depth of 60 inches is red silty clay loam that has a few thin beds of weakly cemented shale and sandstone in the lower part.

Natural fertility is medium, and organic matter content is low. Permeability is moderate, and available water capacity is medium. Runoff is rapid. Reaction is moderately alkaline throughout. This soil is calcareous throughout the profile. The root zone is deep and is easily penetrated by plant roots. The shrink-swell potential is moderate.

Included with this soil in mapping are a few small areas of Cornick soils which are on knobs. Also included are a few small areas of Quanah and Talpa soils. These soils make up about 15 percent of the map unit, but individual areas are generally less than 5 acres.

Most areas of this Aspermont soil are cultivated. Potential is low for cultivated crops such as wheat, cotton, and grain sorghum. This soil is best suited to grass. The hazard of erosion is severe if cultivated crops are grown. Minimum tillage, winter cover crops, terracing, contour farming, and grassed waterways reduce runoff and erosion. Returning crop residue to the soil helps to maintain or improve organic matter content and fertility, reduces crusting, and increases water infiltration.

This soil has low potential for growing native grass, tame pasture, and hay, but it is best suited to these uses. This soil is suited to bermudagrass, lovegrass, and other adapted grasses and legumes for hay and pasture. It will produce moderate amounts of native grass. The use of this soil for native grass, tame pasture, or hay is also effective in controlling erosion. Overgrazing the grass causes surface compaction, excessive runoff, and poor tilth. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during prolonged dry periods help keep the grass cover and soil in good condition.

This soil has medium potential for trees in windbreaks and post lots. Lack of summer rainfall is the main limitation.

The potential is medium for openland wildlife habitat and rangeland wildlife habitat.

This soil has medium potential for building sites. Low strength and shrinking and swelling are the main limitations for dwellings. These limitations can be overcome by proper design and careful installation procedures. Low strength is a limitation for local roads and streets, but this can be overcome by strengthening or replacing the base material. This soil has medium potential for sanitary facilities. Moderate permeability is a limitation for septic tank absorption fields, but this can be overcome by increasing the size of the filter field.

This soil has high potential for most recreational uses. Slope is a limiting factor for playgrounds. Onsite investigation is essential to evaluate and plan the development of specific sites.

This soil is in capability subclass IVe; Hardland range site.

5—Badland. This map unit consists of large areas of very gently sloping to steep barren land. Geologic erosion is active. Areas consist of red clay beds, shales, and gypsiferous shales of Permian age that are dissected by entrenched channels of intermittent streams. Individual areas of Badland range from 10 to 1,500 acres. Most of the Badland is in the south-central and southwest part of the county.

The geologic materials that make up Badland have very slow permeability and high shrink-swell potential. Runoff is very rapid, and these areas are a source of large amounts of silty sediment. Organic matter and natural fertility are low. Root penetration is very restricted.

Badland is not suitable for cultivation or for pasture and hay. The potential is very low for native grass, but most Badland is within areas that are used as rangeland (fig. 6). The hazard of water erosion is very severe. It is very difficult to stabilize and establish a grass cover. Farm ponds can be constructed in some areas. Potential is very low for openland wildlife habitat or rangeland wildlife habitat.

Badland is not suited to most urban or recreational development.

This map unit is in capability subclass VIIs; Eroded Red Clay range site.

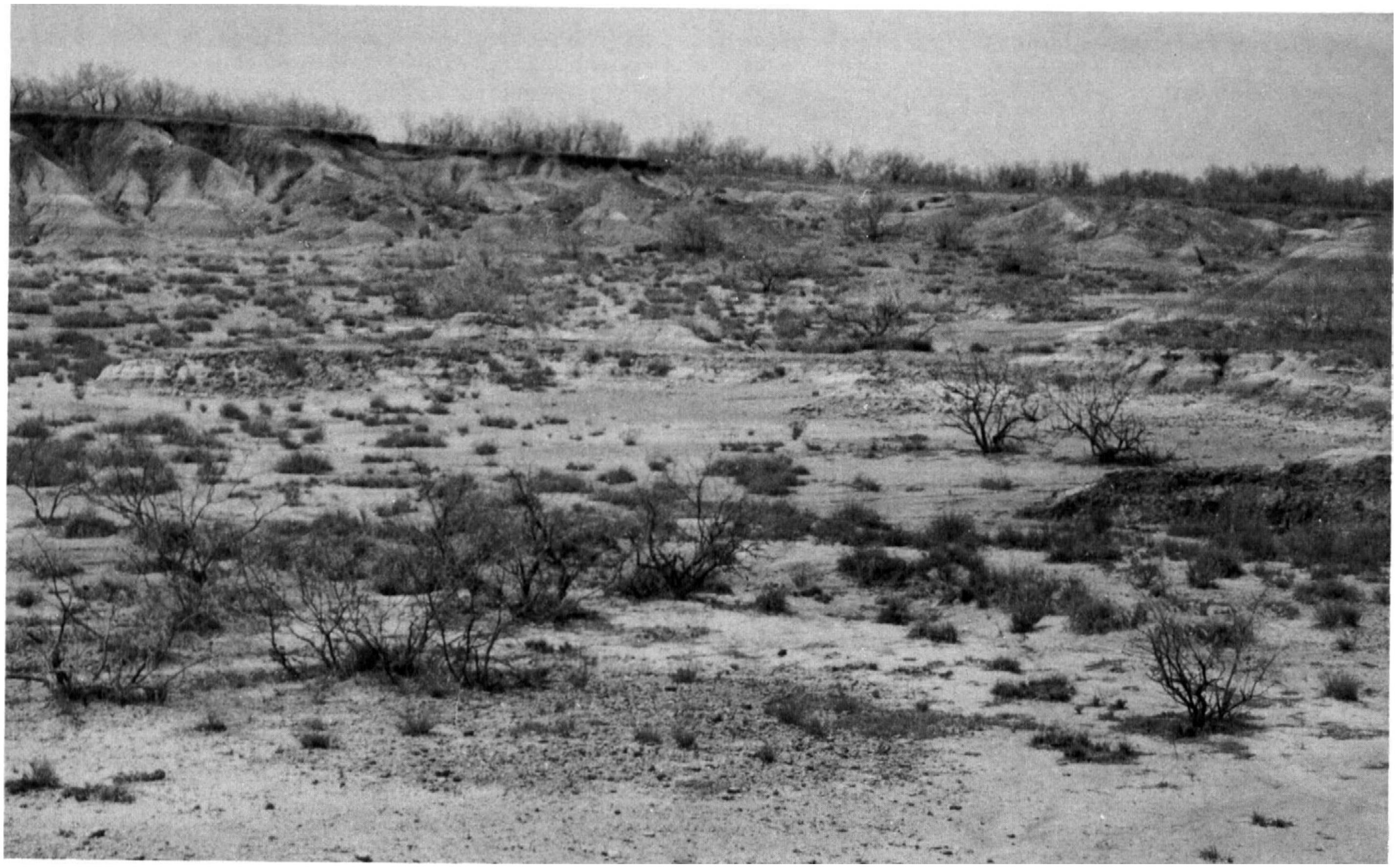


Figure 6.—Eroded Red Clay range site on Badland.

6—Beckman clay. This clayey soil is deep, nearly level, and well drained. It is on flood plains that are subject to occasional flooding. It is slightly affected by saline salts. Slope gradients range from 0 to 1 percent. Areas are irregular in shape and range from 10 to 300 acres.

Typically, the surface layer is reddish brown clay about 6 inches thick. The underlying material to a depth of 60 inches or more is reddish brown clay that has many thin strata of silty clay loam.

Natural fertility and organic matter content are medium. Permeability is very slow, and surface runoff is slow. The available water capacity is medium. Reaction is moderately alkaline throughout the profile. Root development is restricted below a depth of 20 inches because of the dense clay and excess salt content. The shrink-swell potential is high.

Included with this soil in mapping are a few areas of Mangum and Treadway soils. These included soils make up about 10 percent of this map unit, but individual areas are generally less than 5 acres.

Most areas of this Beckman soil are used for native grass, and it has medium potential for this use. Potential is low for cultivated crops. Salt content is high enough to significantly reduce crop yields. Potential is low for tame pasture and hay. This soil is suited to bermudagrass or tall wheatgrass. Overgrazing and grazing when the soil is too wet causes surface compaction and poor tilth and reduces water infiltration. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during prolonged wet or dry periods keep the grass cover and soil in good condition. The proportions of desirable range plants and plant vigor can be maintained or improved with a timely weed and brush control program.

This soil has low potential for trees for windbreaks and post lots. Windbreaks are not recommended on this soil because growth is limited by droughty soil conditions, excess salt content, and the high content of clay in the soil.

The potential is medium for openland wildlife habitat and low for rangeland wildlife habitat.

The potential is low for building sites and sanitary facilities and for recreational development. Shrinking and swelling, flooding, very slow permeability, and the clayey texture are limitations that are difficult to overcome.

This soil is in capability subclass IVs; Alkali Bottomland range site.

7—Carey loam, 1 to 3 percent slopes. This very gently sloping loamy soil is deep and well drained. It is on convex uplands. Areas are irregular in shape and range from 5 to 250 acres.

Typically, the surface layer is loam about 15 inches thick. It is brown in the upper part and dark brown in the lower part. The subsoil extends to a depth of 45 inches. It is reddish brown clay loam to a depth of about 34 inches and yellowish red loam with a few fragments of sandstone to a depth of about 45 inches. The underlying material is red, weakly consolidated, calcareous sandstone.

Natural fertility and organic matter content are high. Permeability is moderate, and surface runoff from cultivated areas is medium. The available water capacity is high. Reaction is neutral or mildly alkaline in the surface layer and neutral to moderately alkaline in the subsoil. The subsoil is usually calcareous in the lower part. The surface layer is friable and easily tilled throughout a fairly wide range in moisture content. The soil surface has a tendency to crust or puddle after hard rains. The root zone is deep, and root development is unrestricted to a depth of 40 inches or more. The shrink-swell potential is low.

Included with this soil in mapping are small areas of St. Paul soils that are in slight depressional areas and Woodward soils that are on small knobs. The included soils make up about 10 percent of this map unit.

Most areas of this Carey soil are cultivated. It has high potential for cultivated crops, and medium potential for hay and tame pasture. This soil is suited to cotton, wheat, grain sorghum, and grasses and legumes for hay and pasture (fig. 7). If the soil is used for cultivated crops, the hazard of erosion is moderate. Minimum tillage, terracing and contour farming, grassed waterways, and winter cover crops reduce erosion. Returning crop residue to the soil or regularly adding other organic material (fig. 8) improves fertility and organic matter content, reduces crusting, and increases water infiltration.

Figure 7.—Wheat on Carey loam, 1 to 3 percent slopes.

Figure 8.—Returning crop residue by stubble mulch tillage on Carey loam, 1 to 3 percent slopes.

This soil has medium potential for native grass; however, only a few areas are used for this purpose. Under good management, this soil will produce high yields of native grass. Overgrazing causes surface compaction, excessive runoff, and poor tilth. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during prolonged wet and dry periods help keep the grass and soil in good condition.

This soil has medium potential for trees in windbreaks and post lots. The potential is high for openland wildlife habitat and medium for rangeland wildlife habitat.

This soil has high potential for building sites. Low strength is a limitation for dwellings, but this limitation can be easily overcome by good design and careful installation procedures. Low strength is also a limitation for local roads and streets, but this can be overcome by strengthening or replacing the base material. This soil has high potential for sanitary facilities. Excessive seepage is a limitation for sewage lagoons, but this can be overcome by proper design or by special treatment to seal the bottom of the lagoon.

The potential is high for most recreational uses. Onsite investigation is necessary to evaluate and plan the development of specific sites.

This soil is in capability subclass IIe; Loamy Prairie range site.

8—Clairemont silt loam, occasionally flooded. This nearly level loamy soil is on flood plains that are subject to occasional flooding. It is deep and well drained. Slope gradients range from 0 to 1 percent. The largest areas are along Sandstone Creek and Elk Creek. Areas are irregular in shape and range from 5 to 250 acres.

Typically, the surface layer is reddish brown, calcareous silt loam about 11 inches thick. The underlying material, to a depth of 26 inches, is reddish brown, calcareous silt loam. Below that to a depth of 60 inches or more it is silt loam that has a few thin strata of very fine sandy loam and sandy loam.

Natural fertility is medium to high, and organic matter content is medium. Permeability is moderate, and surface runoff from cultivated areas is slow. Available water capacity is high. Reaction is mildly alkaline or moderately alkaline throughout, and the soil is calcareous. The surface layer is friable and easily tilled throughout a fairly wide range in moisture content. The soil surface has a tendency to crust or puddle after hard rains. The root zone is deep, and root development is generally unrestricted. The shrink-swell potential is low.

Included with this soil in mapping are small areas of Yahola soils that are along or near the natural stream levees. These included soils make up about 5 percent of this map unit.

Most areas of this Clairemont soil are cultivated. It has high potential for cultivated crops. It is suited to small grain, grain sorghum, and cotton. Minimum tillage, winter cover crops, and returning crop residue to the soil improve fertility, reduce crusting, and increase water infiltration.

This soil has high potential for hay and tame pasture. It is suited to bermudagrass, lovegrass, alfalfa, and other adapted grasses and legumes.

Potential is high for rangeland, although very little of this soil is used for this purpose. Under good management, this soil will produce high yields of native grass. Overgrazing or grazing when the soil is wet causes surface compaction and poor tilth and reduces water infiltration. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during wet periods keep the grass and soil in good condition.

This soil has high potential for trees in windbreaks and post lots. Occasional flooding is the only limitation to establishing trees. The high available water capacity promotes good growth of windbreak and post lot plantings.

Potential is high for openland wildlife habitat and medium for rangeland wildlife habitat.

This soil has low potential for building sites and sanitary facilities. Flooding is the main limitation. The potential is medium for most recreational development. Flooding is the main limitation for camp areas and playgrounds. Onsite investigation is necessary to evaluate and plan the development of specific sites.

This soil is in capability subclass IIw; Loamy Bottomland range site.

9—Clairemont silt loam, frequently flooded. This nearly level loamy soil is deep and well drained. It is on flood plains of small drainageways. The soil is subject to frequent flooding. The flood plain areas are mostly less than 500 feet wide but range up to 800 feet wide. Slope gradients range from 0 to 1 percent. Areas are irregular in shape and range from 3 to 50 acres.

Typically, the surface layer is reddish brown, calcareous silt loam about 12 inches thick. The underlying material, to a depth of about 24 inches, is reddish brown, calcareous silt loam. Below that to a depth of 60 inches or more it is reddish brown, calcareous silty clay loam that has weak to prominent bedding planes.

Natural fertility is high, and organic matter content is medium. Permeability is moderate, and surface runoff is slow. The available water capacity is high. Reaction is mildly alkaline or moderately alkaline throughout, and the soil is calcareous. The surface layer is friable and easily tilled throughout a wide range in moisture content. It has a tendency to crust and puddle after hard rains. The root zone is deep, and root development is generally unrestricted. The shrink-swell potential is low.

Included with this soil in mapping are small areas of Yahola soils along natural levees. Also included are a few small areas of a soil that is similar to the Clairemont soil except that the surface layer is dark reddish brown. The included soils make up about 15 percent of this map unit.

This Clairemont soil has low potential for cultivated crops. Frequent flooding is the main hazard. However, if protected from flooding, the soil has high potential for cultivated crops.

Most areas of this soil are in tame pasture and are used for grazing. The potential is high for hay and tame pasture. The soil is suited to bermudagrass, lovegrass, alfalfa, and other adapted grasses and legumes.

The potential is high for rangeland. Under good management, this soil produces high yields of native grass. Overgrazing or grazing when the soil is wet causes surface compaction and poor tilth and reduces water infiltration. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during wet periods help to keep the grass and soil in good condition.

This soil has high potential for trees in windbreaks and post lots. Frequent flooding is the main limitation to establishing trees. The high available water capacity promotes good growth of windbreak plantings.

The potential is low for openland wildlife habitat and medium for rangeland wildlife habitat.

This soil has low potential for building sites and sanitary facilities. The major limitation is the hazard of frequent flooding. The potential is low for recreational development. Frequent flooding is a major limitation for camp areas and playgrounds. Onsite investigation is necessary to evaluate and plan the development of specific sites.

This soil is in capability subclass Vw; Loamy Bottomland range site.

10—Clark-Owens complex, 5 to 12 percent slopes. This complex consists of the deep, well drained loamy Clark soils and the shallow, well drained loamy Owens soils on uplands. These sloping to strongly sloping soils are mainly on high ridges that are occasionally dissected by steep drains. The Clark soils are on side slopes and foot slopes. The Owens soils are on ridgetops and upper side slopes. Areas of these soils are so intermingled that they could not be shown separately at the scale selected for mapping. Areas are irregular in shape and range from 5 to 150 acres.

Clark soils make up about 45 percent of each mapped area. Typically, the surface layer is dark brown, calcareous loam about 11 inches thick. The next layer, which extends to a depth of 20 inches, is pale brown, calcareous clay loam. The underlying material is very pale brown, calcareous clay loam that has many soft bodies and concretions of calcium carbonate to a depth of 30 inches. Below that to a depth of 60 inches it is pale brown, calcareous clay loam.

The Clark soil is high in natural fertility and organic matter content. Permeability is moderate, and available water capacity is high. Runoff is rapid. The soil is mildly alkaline or moderately alkaline and calcareous throughout. The root zone is deep and easily penetrated by plant roots. The shrink-swell potential is moderate.

Owens soils make up about 40 percent of each mapped area. Typically, the surface layer is brown, calcareous clay loam about 3 inches thick. The subsoil extends to a depth of 11 inches. It is pale brown calcareous clay. The underlying material is very pale brown, calcareous shaly clay.

The Owens soil is medium in natural fertility and low in organic matter content. Permeability is very slow, and available water capacity is low. Runoff is rapid. Reaction is moderately alkaline throughout. This soil is calcareous throughout. The root zone is shallow, and root development is restricted below a depth of about 11 inches by compact shaly clay. The shrink-swell potential is high.

Included in mapping are some small areas of Rock outcrop that are mostly on ridgetops and upper side slopes. Also included are some small isolated areas of Dill, Quinlan, and St. Paul soils that are in less sloping areas. Included soils make up about 15 percent of this map unit, but individual areas are generally less than 5 acres.

Most of the acreage of these Clark and Owens soils is in rangeland and is used for grazing. Potential is low for native grass, but these soils are best suited to this use. With good management, and if in excellent condition, the Clark soils will produce moderate amounts of native grass, and the Owens soils will produce small amounts of native grass. These soils have low potential for tame pasture. Using these soils for rangeland or tame pasture is effective in controlling erosion. Overgrazing will cause surface compaction, excessive runoff, and poor tilth. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during long dry periods help keep the pasture and soil in good condition.

These soils have low potential for cultivated crops. Steepness of slope and the severe hazard of erosion are the main limitations.

The Clark soils have medium potential for trees in windbreaks and post lots. Steepness of slope and lack of summer rainfall are the main limitations. The Owens soils have low potential for windbreaks, and windbreaks are not generally planted on these shallow soils.

These soils have medium potential for openland wildlife habitat and low potential for rangeland wildlife habitat.

The potential is low for building sites and sanitary facilities. Shrinking and swelling, slope, and low strength are the main limitations. If urban development is planned for this complex, the deeper, less clayey Clark soils should be selected.

These soils have medium potential for most recreational uses. Slope and clayey texture are the main limitations. Onsite investigation is essential to evaluate and plan the development of specific sites.

This complex is in capability subclass VIe; Clark part in Loamy Prairie range site and Owens part in Red Clay Prairie range site.

11—Cordell silty clay loam, 1 to 5 percent slopes. This very gently sloping to gently sloping, loamy soil is on convex ridgetops and in small flat areas in the uplands. It is shallow and somewhat excessively drained. Areas are irregular in shape and range from 5 to 200 acres.

Typically, the surface layer is reddish brown, calcareous silty clay loam about 10 inches thick. The subsoil extends to a depth of about 18 inches. To a depth of about 15 inches, it is reddish brown, calcareous silty clay loam that has fragments of siltstone. Below that, it is reddish brown, calcareous, very shaly silty clay loam. Hard red siltstone is at a depth of 18 inches.

Natural fertility is medium, and organic matter content is low to medium. Permeability is moderately slow, and surface runoff is medium to rapid. Available water capacity is low. This soil is mildly alkaline or moderately alkaline and is calcareous throughout. The surface layer is friable, but where the soil is cultivated, siltstone fragments are mixed in the surface layer. The root zone is shallow, and root development is restricted below a depth of about 18 inches by hard, compact siltstone. The shrink-swell potential is low.

Included with this soil in mapping are small areas of Obaro soils on foot slopes or near the base of escarpments. The included soils make up about 10 percent of this map unit, but individual areas generally are less than 5 acres.

Most areas of this Cordell soil are cultivated. The main crop is wheat, but some cotton and grain sorghum are grown. The potential is medium for wheat, but it is low for summer crops. Very low to low available water capacity and shallowness to bedrock are the main limitations. If this soil is used for clean-tilled crops, the hazard of water erosion is severe.

This soil has low potential for hay and tame pasture. It has low potential for rangeland. Under good management, it will produce small amounts of native grass. The use of the soil for rangeland and tame pasture or hay is effective in controlling erosion. Proper stocking, rotation grazing, and timely deferment of grazing help keep the grass and soil in good condition.

The potential is low for trees in windbreaks and post lots. Shallowness to bedrock and low available water capacity are the main limitations. The potential is low for openland wildlife habitat and rangeland wildlife habitat.

This soil has low potential for building sites and sanitary facilities and medium potential for recreational development. Shallowness to bedrock is a limitation that is difficult to overcome. Onsite investigation is necessary to evaluate and plan the development of specific sites.

This soil is in capability subclass IVe; Red Shale range site.

12—Cordell-Rock outcrop complex, 2 to 15 percent slopes. This complex consists of shallow, somewhat excessively drained, loamy Cordell soils and areas of Rock outcrop on uplands. The Cordell soil is very gently sloping to moderately steep. Rock outcrop consists of hard interbedded siltstone, sandstone, and shale bedrock that is at the surface along drainageways and escarpments. Areas of the Cordell soil and Rock outcrop are so intermingled that it was not practical to separate them in mapping. Areas range from 10 to 1,500 acres.

The Cordell soils make up about 58 percent of each mapped area. Typically, the surface layer is reddish brown, calcareous silt loam about 8 inches thick. The subsoil extends to a depth of about 18 inches. To a depth of about 16 inches, it is reddish brown, calcareous silt loam that contains fragments of siltstone. Below that, it is reddish brown, very shaly silt loam. Red, calcareous, hard siltstone is at a depth of 18 inches.

The Cordell soil is medium in natural fertility and low to medium in organic matter content. Permeability is moderately slow, and surface runoff is medium to rapid. Available water capacity is very low to low. The soil is mildly alkaline or moderately alkaline and calcareous throughout. The root zone is shallow, and root development is restricted below a depth of about 18 inches by hard, compact siltstone. The shrink-swell potential is low.

Rock outcrop makes up about 26 percent of each mapped area. It consists of exposures of bare, hard, red siltstone, sandstone, and shale bedrock. Rock outcrop supports very few plants, and it has very rapid surface runoff.

Included in mapping are small areas of Obaro soils which are on foot slopes and at the base of narrow escarpments. The included soils make up about 16 percent of this map unit, but individual areas are generally less than 5 acres.

Most areas of this complex are used as rangeland (fig. 9). The Cordell soils have low potential for native grass, but are best suited to this use. With good management, this soil will produce a small amount of native grass.

The potential is very low for cultivated crops and hay or tame pasture. Shallowness to bedrock, slope, and Rock outcrop are limitations that are difficult to overcome for these uses.

The potential is low for trees in windbreaks and post lots. Shallowness to bedrock and low available water capacity are the main limitations. The potential is low for openland wildlife habitat and rangeland wildlife habitat.

Potential is low for building sites and sanitary facilities. Slope, Rock outcrop, and shallow depth to bedrock are the main limitations. These limitations are difficult to overcome. The potential is medium for most recreational uses. Slope, moderately slow permeability, and depth to bedrock are the main limitations. Onsite investigation is necessary to evaluate and plan the development of specific sites.

This complex is in capability subclass VIe; Cordell part in Red Shale range site and Rock outcrop part not assigned to a range site.

13—Cornick-Vinson-Rock outcrop complex, 1 to 5 percent slopes. This complex consists of very gently sloping to gently sloping, well drained, loamy Cornick and Vinson soils and Rock outcrop of soft gypsum bedrock on uplands. The very shallow Cornick soils are on convex ridgetops and side slopes. The moderately deep Vinson soils are on convex side slopes and foot slopes. The Rock outcrop is scattered throughout the map unit. Areas of these soils and Rock outcrop are so intermingled that they could not be shown separately at the scale selected for mapping. The Cornick and Vinson soils formed in materials weathered from massive beds of gypsum. Areas are irregular in shape and range from 10 to 2,000 acres.

Cornick soils make up about 40 percent of each mapped area. Typically, the surface layer is dark brown silt loam about 6 inches thick. The underlying material is pinkish white weathered gypsum to a depth of about 10 inches. Hard, white gypsum is at a depth of 10 inches.

The Cornick soil is high in natural fertility and organic matter content. Permeability is moderate, and surface runoff is medium. Available water capacity is very low. The soil is moderately alkaline and calcareous throughout. The root zone is very shallow, and root development is restricted below a depth of about 10 inches by hard gypsum. The shrink-swell potential is low.

The Vinson soils make up about 22 percent of each mapped area. Typically, the surface layer is reddish brown silt loam about 13 inches thick. The subsoil is reddish brown silt loam to a depth of 26 inches. White gypsite is at a depth of 26 inches.

The Vinson soil is high in natural fertility and organic matter content. Available water capacity is medium. Permeability is moderate, and surface runoff is medium. Reaction is mildly alkaline or moderately alkaline in the surface layer and moderately alkaline in the subsoil. The soil is calcareous throughout. The root zone is moderately deep, and root development is restricted below a depth of about 26 inches by gypsum bedrock.

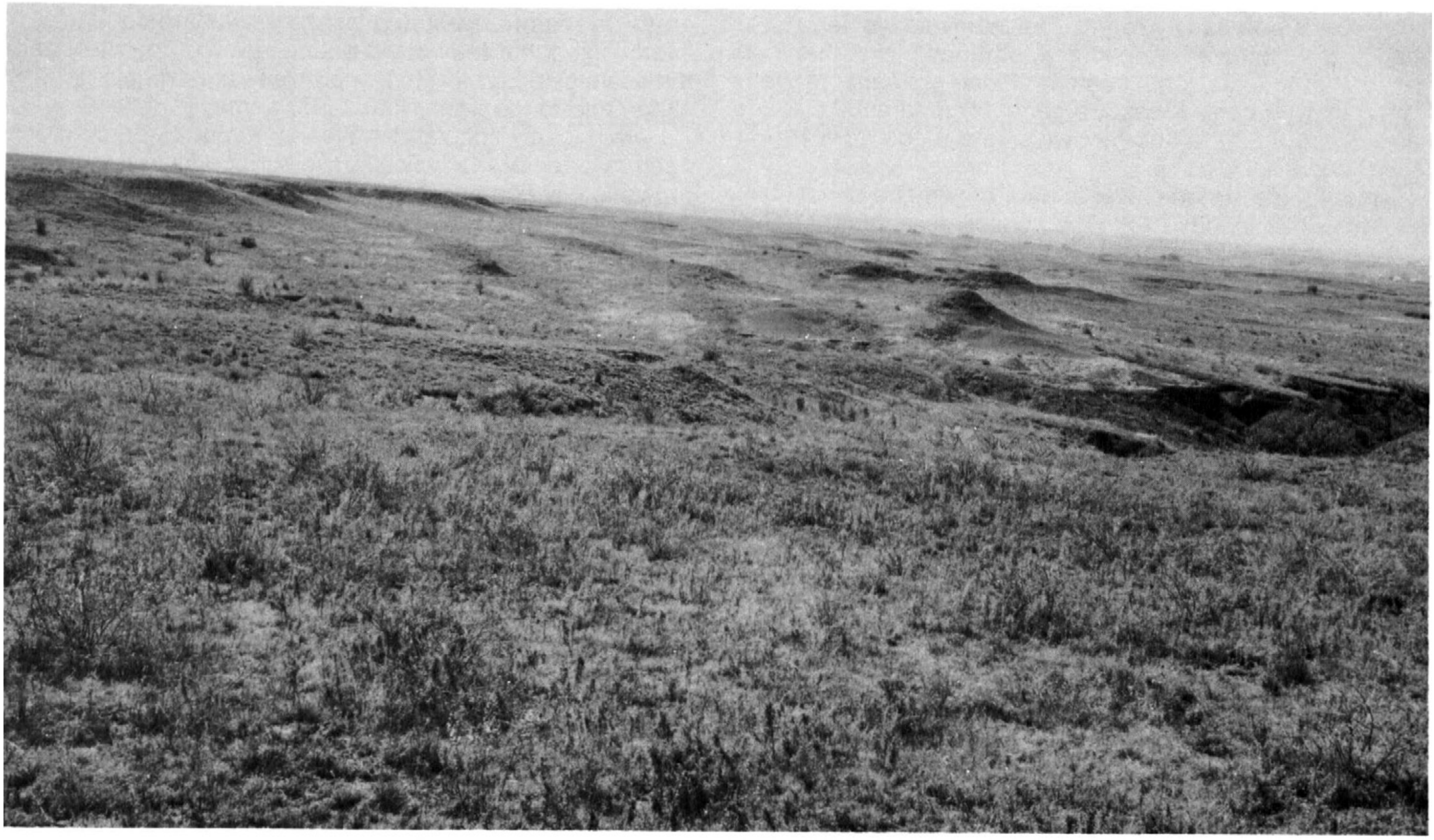


Figure 9.—Red Shale range site in an area of Cordell-Rock outcrop complex, 2 to 15 percent slopes.

The shrink-swell potential is low in the surface layer and moderate in the subsoil.

The Rock outcrop makes up about 15 percent of each mapped area and consists of bare gypsum bedrock. The areas of Rock outcrop cover 1/5 acre to 5 acres and are almost bare of vegetation. Surface runoff is very rapid.

Included in mapping are a few small areas of Vernon soils which are on side slopes and Talpa soils which are mostly on convex side slopes. Also included are a few small areas of Aspermont soils. The included soils make up about 23 percent of this map unit, but individual areas generally are less than 5 acres.

Most areas of this complex are in rangeland and are used for grazing. Potential is low for native grass, but these soils are best suited to this use. Depth to bedrock and very low to medium available water capacity are the main limiting factors. Overgrazing or grazing during prolonged dry periods is detrimental to grass stands and causes excessive runoff and poor tilth. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during dry periods help keep the grass and soil in good condition. Under good management, the Vinson soils will produce moderate amounts of native grass, and the Cornick soils will produce small amounts of native grass.

The potential is very low for cultivated crops, tame pasture, and hay. Depth to bedrock, Rock outcrop, and very low to medium available water capacity are the main limiting factors that are difficult to overcome.

The potential is low for trees in windbreaks and post lots. Depth to bedrock and very low to medium available water capacity are the main limiting factors. The soils in this complex have medium potential for openland wildlife habitat and low potential for rangeland wildlife habitat.

The potential is medium for building sites. These soils have low potential for sanitary facilities. Depth to rock and Rock outcrop are the main limitations. The potential is low for most recreational uses. The shallowness to bedrock of the Cornick soils and Rock outcrop are the main limitations. Where possible, the moderately deep Vinson soils should be selected. Onsite investigation is essential to evaluate and plan the development of specific sites.

This complex is in capability subclass VIIs. Cornick part is in Gyp range site, and Vinson part is in Loamy Prairie range site. Rock outcrop part not assigned to a range site.

14—Cyril fine sandy loam. This loamy soil is deep, nearly level, and well drained. It is on flood plains that are subject to occasional flooding. Slope gradients range from 0 to 1 percent. Areas are generally long and narrow, about 200 to 400 feet wide, and range from 10 to 200 acres.

Typically, the surface layer is dark brown fine sandy loam about 25 inches thick. The subsoil, to a depth of about 40 inches, is reddish brown fine sandy loam. The underlying material to a depth of 60 inches is an old buried soil that is dark reddish brown fine sandy loam.

Natural fertility and organic matter content are high. Permeability is moderate, and surface runoff is slow. Available water capacity is medium. Reaction is mildly alkaline or moderately alkaline in the surface layer and moderately alkaline below. The surface layer is friable and easily tilled throughout a wide range in moisture content. Root development is unrestricted to a depth of 60 inches or more. The shrink-swell potential is low.

Included with this soil in mapping are some small areas of Yahola soils. The included soils make up about 10 percent of this map unit, but individual areas are generally less than 5 acres.

This Cyril soil is cultivated in most areas. It has high potential for cultivated crops and is suited to wheat, cotton, and grain sorghum. Where this soil is used for cultivated crops, there is a moderate hazard of soil blowing. Minimum tillage, cover crops, and residue management help to prevent damage from soil blowing, maintain organic matter content, improve fertility, and increase the water infiltration rate.

This soil has high potential for tame pasture and hay. It is well suited to bermudagrass, lovegrass, alfalfa, and other adapted grasses and legumes for hay and tame pasture. Potential is high for rangeland, but very little acreage is used for this purpose. Under good management, the soil will produce large amounts of native grass. Proper stocking, rotation grazing, and restricted use during prolonged wet or dry periods help keep the grass cover and soil in good condition.

This soil has high potential for trees in windbreaks. There are few limitations for trees. The potential is high for openland wildlife habitat and rangeland wildlife habitat.

Potential is low for building sites and sanitary facilities. Flooding is the main limitation.

This soil has medium potential for most recreational development. Flooding is the main limitation for camp areas and playgrounds. Onsite investigation is essential to evaluate and plan the development of specific sites.

This soil is in capability subclass IIw; Loamy Bottomland range site.

15—Delwin-Nobscot complex, 0 to 3 percent slopes. This complex consists of deep, well drained sandy soils on uplands. The Delwin soils are nearly level to very gently sloping and are in concave areas, and the Nobscot soils are very gently sloping and are in convex areas. Areas of Delwin and Nobscot soils are so intermingled that they could not be shown separately at the scale selected for mapping. Areas are irregular in shape and range from 10 to 1,500 acres.

Delwin loamy fine sand makes up about 45 percent of each mapped area. Typically, the surface layer is grayish brown loamy fine sand about 5 inches thick. The subsurface layer is light brown fine sand to a depth of 17 inches. The subsoil extends to a depth of 70 inches. It is yellowish red sandy clay loam to a depth of 33 inches, reddish yellow fine sandy loam to a depth of 48 inches, and yellowish red fine sandy loam with thin bands or lamellae of reddish brown sandy clay loam to a depth of 70 inches.

The Delwin soil is low in natural fertility and organic matter content. Permeability is moderate, and available water capacity is medium. Surface runoff is very slow. Reaction is neutral or slightly acid in the surface layer and slightly acid to mildly alkaline in the subsoil. The root zone is deep and easily penetrated by plant roots. The shrink-swell potential is low.

Nobscot fine sand makes up about 37 percent of each mapped area. Typically, the surface layer is brown fine sand about 7 inches thick. The subsurface layer is light brown fine sand to a depth of about 24 inches. The subsoil extends to a depth of 64 inches. It is yellowish red fine sandy loam to a depth of about 37 inches and has thin bands or lamellae of sandy loam. It is reddish yellow loamy fine sand to a depth of 64 inches and has thin bands of fine sandy loam.

The Nobscot soil is low in natural fertility and organic matter content. Permeability is moderately rapid, and available water capacity is low. Surface runoff is very slow. The root zone is deep and easily penetrated by plant roots. Reaction ranges from medium acid to neutral in the surface and subsurface layers and from strongly acid to neutral in the subsoil. The shrink-swell potential is low.

Included in mapping are small areas of soils that are similar to the Delwin soils, but which are underlain by old buried soils. These soils are in depressional areas and in areas where the sandy mantle is thin. Also included are some small areas of soils on small convex dunes that are sandy throughout. These included soils make up about 18 percent of this map unit, but individual areas are generally less than 5 acres.

Most areas of this complex are used as rangeland. Potential is high for rangeland. Under good management, the soils will produce large amounts of native grass. Since a large part of the area has been invaded with shinnery oak, a bush control program is needed to suppress the oak growth and allow the native grasses to reestablish.

The potential is medium for cultivated crops such as wheat, cotton, and grain sorghum. The potential is limited because of the high susceptibility to soil blowing. The hazard of wind erosion is severe where cultivated crops are grown, and very intensive conservation measures are required to prevent damage from soil blowing. Minimum tillage, cover crops, returning crop residue to the soil, and applying adequate fertilizer promote and help to establish crop growth and maintain cover. Maintaining a good cover and returning crop residue to the soil reduce soil erosion, increase fertility and water infiltration, and improve soil tilth.

The potential is medium for tame pasture and hay. These soils are suited to bermudagrass, lovegrass, alfalfa, and other adapted grasses and legumes for hay and pasture. Overgrazing when the soils are dry causes reduction in surface cover, increases soil blowing, causes poor tilth, and reduces water infiltration. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during prolonged dry periods keep the grass cover and soil in good condition.

The potential is medium for trees in windbreaks and post lots. The medium to low available water capacity is the main limitation.

These soils have medium potential for openland wildlife habitat and high potential for rangeland wildlife habitat.

The potential is high for building sites and medium for sanitary facilities. Excessive seepage is a limitation for sanitary facilities. Permeability of the lower layers is a limitation for sewage lagoons, but this can be overcome by special treatment to seal the bottom of the lagoon.

Potential is medium for most recreational uses. The sandy surface texture is the main limitation. Onsite investigation is essential to evaluate and plan the development of specific sites.

This complex is in capability subclass IIIe; Deep Sand Savannah range site.

16—Devol loamy fine sand, 0 to 3 percent slopes. This nearly level to very gently sloping, sandy soil is on convex ridgetops and broad side slopes of uplands. It is deep and well drained. Areas are irregular in shape and range from 10 to 1,500 acres.

Typically, the surface layer is brown loamy fine sand about 18 inches thick. The subsoil extends to a depth of about 42 inches. It is reddish brown fine sandy loam to a depth of about 36 inches, and yellowish red loamy fine sand to a depth of 42 inches. The underlying material is yellowish red loamy fine sand to a depth of 60 inches or more.

Natural fertility is medium, and organic matter content is low. Permeability is moderately rapid, and runoff is very slow. Available water capacity is medium. Reaction ranges from slightly acid to mildly alkaline in the surface layer and from neutral to moderately alkaline in the subsoil. The surface layer is friable and easily tilled throughout a wide range in moisture content. Root development is unrestricted throughout the soil. The shrink-swell potential is low.

Included with this soil in mapping are a few areas of Grandfield soils. Also included are a few areas of soils that are similar to the Devol soil but are underlain by a mottled buried soil. The included soils make up about 30 percent of the map unit.

Most areas of this Devol soil are cultivated. It has medium potential for most cultivated crops and is suited to wheat, cotton, and grain sorghum. A small acreage is used for peanuts and mung beans. Where this soil is used for cultivated crops, the hazard of wind erosion is severe, and very intensive conservation treatment is required to prevent damage from soil blowing. Minimum tillage, residue management, and winter cover crops reduce wind erosion. This soil is generally too sandy for terraces, but the use of crop residues can slow runoff and soil blowing.

Potential is medium for tame pasture and hay. This soil is suited to alfalfa, bermudagrass, lovegrass, and other adapted grasses and legumes for hay and pasture. The use of this soil for pasture or hay is also effective in controlling erosion. The potential is medium for rangeland. Under good management, this soil will produce a moderate amount of native grass. Overgrazing during dry periods causes the stand to die out and increases the hazard of soil blowing. Proper stocking, rotation grazing, and timely deferment of grazing help keep the grass in a good vigorous growing condition.

This soil has medium potential for trees in field and farmstead windbreaks. The medium available water capacity is the main limitation. Potential is medium for openland wildlife habitat and rangeland wildlife habitat.

Potential is high for building sites. Low strength is a limitation for local roads and streets, but this can be easily overcome by strengthening or replacing the bâse material. This soil has medium potential for sanitary facilities. Excessive seepage is the main limitation.

This soil has medium potential for most recreational uses. The sandy surface layer is a limitation for most uses, but this can be overcome by maintaining a good grass cover. Onsite investigation is essential when planning the development of specific sites.

This soil is in capability subclass IIIe; Deep Sand range site.

17—Devol loamy fine sand, 3 to 8 percent slopes. This gently sloping to sloping sandy soil occupies convex ridgetops and side slopes of hummocky areas on uplands. It is deep and well drained. Areas are irregular in shape and range from 10 to 250 acres.

Typically, the surface layer is brown loamy fine sand about 20 inches thick. The subsoil extends to a depth of about 40 inches. It is reddish brown fine sandy loam to a depth of about 34 inches and is yellowish red loamy fine sand to a depth of about 40 inches. The underlying material is reddish yellow loamy fine sand to a depth of 60 inches or more.

This soil is medium in natural fertility, and organic matter content is low. Reaction is neutral or mildly alkaline in the surface layer and neutral to moderately alkaline in the subsoil. Permeability is moderately rapid, and available water capacity is medium. Surface runoff is slow. The surface layer is friable and can be worked throughout a wide range in moisture content. The root zone is deep and is easily penetrated by plant roots. The shrink-swell potential is low.

Included with this soil in mapping are small areas of Grandfield soils and soils that are similar to the Devol soil but are mottled in the subsoil below a depth of 35 inches. Also included are a few small areas of a soil that is similar to the Devol soil except the surface layer is darker and has more organic matter than is typical for the Devol soil. The included soils make up about 35 percent of this map unit.

Most areas of this Devol soil are cultivated and have medium potential for cultivated crops. This soil is suited to wheat, cotton, and grain sorghum. Where this soil is used for cultivated crops, the hazard of erosion is severe, and very intensive conservation measures are required to prevent damage from wind and water erosion. Minimum tillage, residue management, and winter cover crops reduce erosion. This soil is too sandy for terraces and waterways. Leaving crop residue on the soil surface will reduce runoff and soil blowing.

The potential is medium for tame pasture and hay. This soil is suited to alfalfa, bermudagrass, lovegrass, and other adapted grasses and legumes for hay and pasture. This soil has medium potential for rangeland. Under good management, it will produce a moderate amount of native grass. The use of this soil for range, pasture, or hay is also effective in controlling erosion. Overgrazing during dry periods causes the stand to die out and increases the hazard of soil blowing. Proper stocking, rotation grazing, and timely deferment of grazing help keep the grass in good condition.

This soil has medium potential for trees in field and farmstead windbreaks. The medium available water capacity is the main limitation.

The potential is medium for openland wildlife habitat and rangeland wildlife habitat.

The potential is high for building sites. Low strength is a limitation for local roads and streets, but this can be overcome by strengthening or replacing the base material. This soil has medium potential for sanitary facilities. Excessive seepage is the main limitation for sewage lagoons and sanitary landfills.

This soil has medium potential for most recreational development. Slope and the sandy surface layer are the main limitation. Onsite investigation is essential to evaluate and plan development of specific sites.

This soil is in capability subclass IVe; Deep Sand range site.

18—Devol-Grandfield complex, 3 to 12 percent slopes. This complex consists of deep, well drained, loamy soils on uplands. The Devol soils are sloping to strongly sloping and are on side slopes, and the Grandfield soils are gently sloping to sloping and are on ridgetops and upper side slopes. These soils formed in sandy and loamy outwash materials that contain gravel and in many places have pebbles on the surface. Areas of these soils are so intermingled that it was not practical to separate them in mapping. Areas range from 10 to 200 acres.

Devol soils make up about 55 percent of each mapped area. Typically, the surface layer is reddish brown fine sandy loam about 12 inches thick. The subsoil, which extends to a depth of about 50 inches, is red fine sandy loam. The underlying material is red fine sandy loam to a depth of 62 inches or more.

The Devol soil is medium in natural fertility, and low in organic matter content. Permeability is moderately rapid, and surface runoff is medium. Available water capacity is medium. Reaction is neutral or mildly alkaline in the surface layer and mildly alkaline or moderately alkaline in the subsoil. The root zone is deep and is easily penetrated by plant roots. The shrink-swell potential is low.

Grandfield soils make up about 20 percent of each mapped area. Typically, the surface layer is reddish brown fine sandy loam about 12 inches thick. The subsoil extends to a depth of 60 inches. It is reddish brown fine sandy loam to a depth of about 37 inches, red sandy clay loam to a depth of about 51 inches, and red fine sandy loam to a depth of 60 inches.

The Grandfield soil is medium in natural fertility, and low to medium in organic matter content. Permeability is moderate, and runoff is rapid. The available water capacity is medium. Reaction ranges from slightly acid to mildly alkaline in the surface layer and from neutral to moderately alkaline in the subsoil. The root zone is deep and is easily penetrated by plant roots. The shrink-swell potential is low.

Included with these soils in mapping are small areas of sandy Tivoli soils that are mainly on side slopes. Also included are areas of similar soils that formed in Permian red-bed sediments and are on the side slopes where the red beds outcrop. These included soils make up about 25 percent of this map unit, but individual areas are generally less than 5 acres.

Most areas of these Devol and Grandfield soils are in rangeland and are used for grazing. These soils have medium potential for range, and where good range management is followed, they will produce moderate amounts of native grass. The potential is medium for tame pasture and hay. These soils are suited to lovegrass, bermudagrass, and other adapted grasses and legumes for hay and pasture. Overgrazing during dry periods causes the stand to die out and increases the hazard of erosion. Proper stocking, rotation grazing, and timely deferment of grazing help keep the grass in vigorous growing condition.

These soils have very low potential for cultivated crops. Slope and the hazard of erosion are the main limiting factors. The potential is low for trees in windbreaks. The growth is limited due to steepness of slope and lack of summer rainfall in the area.

These soils have high potential for openland wildlife habitat and medium potential for rangeland wildlife habitat.

The potential is medium for building sites and for sanitary facilities. Slope is the main limiting factor for most uses. Excessive seepage is a limitation for sewage lagoons and trench sanitary landfills.

Potential is medium for most recreational uses. Slope is the main limitation for playgrounds. Onsite investigation is essential to evaluate and plan the development of specific sites.

This complex is in capability subclass VIe; Sandy Prairie range site.

19—Dill-Quinlan complex, 1 to 3 percent slopes. This complex consists of very gently sloping, well drained loamy soils on uplands. The moderately deep Dill soils and the shallow Quinlan soils are in convex areas. Areas of these soils are so intermingled that it was not practical to separate them in mapping. Areas range from 10 to 700 acres.

Dill soils make up about 60 percent of each mapped area. Typically, the surface layer is reddish brown fine sandy loam about 15 inches thick. The subsoil extends to a depth of about 30 inches, and is reddish brown fine sandy loam. The underlying material is weakly cemented, red sandstone.

The Dill soil is medium in natural fertility and low in organic matter content. Reaction is slightly acid to mildly alkaline in the surface layer and subsoil. Permeability is moderately rapid, and available water capacity is low to medium. Surface runoff is medium. The root zone is moderately deep, and root development is restricted below a depth of about 30 inches by weakly cemented sandstone. The shrink-swell potential is low.

Quinlan soils make up about 30 percent of each mapped area. Typically, the surface layer is red fine sandy loam about 6 inches thick. The subsoil, which extends to a depth of 12 inches, is red fine sandy loam. The underlying material is weakly cemented, calcareous, red sandstone.

The Quinlan soil is medium in natural fertility and organic matter content. Permeability is moderately rapid, and available water capacity is very low. Surface runoff is medium. The soil is mildly alkaline or moderately alkaline in the surface layer and subsoil and is generally calcareous throughout. The root zone is shallow, and root development is restricted below a depth of about 12 inches by weakly cemented sandstone. The shrink-swell potential is low.

Included with these soils in mapping are small areas of a soil that is similar to the Dill soils except it has a subsoil of clay loam or sandy clay loam. This included soil makes up about 10 percent of this map unit.

Dill and Quinlan soils have medium potential for cultivated crops. These soils are suited to cotton, wheat, and grain sorghum. Where cultivated crops are grown, the hazard of wind erosion is moderate and careful management is required to prevent damage from soil blowing. The hazard of water erosion is moderate. Minimum tillage, terracing, contour farming, grassed waterways, and winter cover crops reduce runoff and erosion. Returning crop residue to the soil or regularly adding other organic material improves fertility, reduces crusting and blowing, and increases water infiltration.

Potential is medium for tame pasture and hay. Use of these soils for pasture is effective in controlling erosion. Bermudagrass and lovegrass are suited to these soils. Proper stocking, weed control, fertilization, restricted use during dry periods, and deferment of grazing will keep the grass and soil in good condition.

The potential is medium for rangeland. Under good management, Dill soils will produce a large amount of native grass, and Quinlan soils will produce a moderate amount of native grass.

The potential is medium for trees in windbreaks and post lots. The main limitations are depth to bedrock and very low to medium available water capacity of the soils.

The potential is medium for openland wildlife habitat and for rangeland wildlife habitat.

Potential is medium for building sites. Depth to bedrock is the main limitation for building sites and roads. These soils have low potential for sanitary facilities. Depth to bedrock is a severe limitation for septic tank absorption fields. The moderately deep Dill soils are better suited to this use than are the shallow Quinlan soils.

The potential is high for most recreational uses. Onsite investigation is necessary to evaluate and plan the development of specific sites.

This complex is in capability subclass IIIe. Dill part is in Sandy Prairie range site, and Quinlan part is in Shallow Prairie range site.

20—Dill-Quinlan complex, 3 to 5 percent slopes. This complex consists of well drained loamy soils on gently sloping convex uplands. Dill soils are moderately deep, and Quinlan soils are shallow. Areas of these soils are so intermingled that they could not be mapped separately at the scale selected for mapping. Areas are irregular in shape and range from 5 to 200 acres.

Dill soils make up about 60 percent of each mapped area. Typically, the surface layer is reddish brown fine sandy loam about 12 inches thick. The subsoil extends to a depth of about 30 inches and is reddish brown fine sandy loam. The underlying material is weakly cemented, red sandstone.

The Dill soil is medium in natural fertility and organic matter content. This soil is slightly acid to mildly alkaline in the surface layer and subsoil. Permeability is moderately rapid, and available water capacity is low to medium. Surface runoff is medium. The root zone is moderately deep, and root development is restricted below a depth of about 30 inches by weakly cemented sandstone. The shrink-swell potential is low.

Quinlan soils make up about 30 percent of each mapped area. Typically, the surface layer is red fine sandy loam about 6 inches thick. The subsoil, which extends to a depth of 10 inches, is red fine sandy loam. The underlying material is weakly cemented, calcareous, red sandstone.

The Quinlan soil is medium in natural fertility and organic matter content. Permeability is moderately rapid, and available water capacity is very low. Surface runoff is medium. This soil is mildly alkaline or moderately alkaline in the surface layer and subsoil and calcareous throughout. The root zone is shallow, and root development is restricted below a depth of about 10 inches by weakly cemented sandstone. The shrink-swell potential is low.

Included with this complex in mapping are small areas of a soil that is similar to the Dill soil, but it has layers of clay loam or sandy clay loam in the subsoil. This soil is on ridgetops and makes up about 10 percent of this map unit.

Most areas of these Dill and Quinlan soils are cultivated. The potential is medium for cultivated crops. These soils are suited to cotton, wheat, and grain sorghum. The hazard of wind erosion is moderate if cultivated crops are grown and careful management is needed to prevent damage from soil blowing. The hazard of water erosion is moderate. Minimum tillage, contour farming, terracing, and grassed waterways help control erosion in these areas. Use of crop residue and cover crops reduces soil blowing between crop seasons.

Potential is medium for tame pasture and hay. These soils are suited to bermudagrass and lovegrass. The use of these soils for pasture or hay is also effective in controlling erosion. Proper stocking, weed control, fertilization, rotation grazing, and restricted use during dry periods will keep the grass and soil in good condition.

These soils have medium potential as rangeland. Under good management, Dill soils will produce a large amount of native grass, and Quinlan soils will produce a moderate amount of native grass.

The potential is medium for trees in windbreaks and post lots. The main limitations are depth to bedrock and very low to medium available water capacity.

The potential is medium for openland wildlife habitat and for rangeland wildlife habitat.

Potential is medium for building sites. Depth to bedrock is the main limitation for building sites and roads. These soils have low potential for sanitary facilities. Depth to bedrock is a severe limitation for septic tank absorption fields. The moderately deep Dill soils are better suited to this use than are the shallow Quinlan soils.

The potential is high for most recreational uses. Slope is a limiting factor for playgrounds. Onsite investigation is necessary to evaluate and plan the development of specific sites.

This complex is in capability subclass IVe. Dill part is in Sandy Prairie range site, and Quinlan part is in Shallow Prairie range site.

21—Dill-Quinlan complex, 5 to 12 percent slopes. This complex consists of sloping to strongly sloping, well drained loamy soils on uplands. The moderately deep Dill soils and the shallow Quinlan soils are on side slopes adjacent to small drainageways. Areas of these soils occur in such an intermingled pattern that it was not practical to separate them in mapping. Areas range from 5 to 500 acres and are mainly in the northeastern part of the county.

Dill soils make up 45 percent of each mapped area. Typically, the surface layer is reddish brown, friable fine sandy loam about 10 inches thick. The subsoil, which extends to a depth of 26 inches, is reddish brown fine sandy loam. The underlying material is red, weakly cemented sandstone.

The Dill soil is medium in natural fertility and organic matter content. Reaction is slightly acid to mildly alkaline in the surface layer and subsoil. Permeability is moderately rapid, and available water capacity is low to medium. Surface runoff is rapid. The root zone is moderately deep, and root development is restricted below a depth of about 26 inches by weakly cemented sandstone. The shrink-swell potential is low.

Quinlan soils make up 30 percent of each mapped area. Typically, the surface layer is reddish brown, friable fine sandy loam about 4 inches thick. The subsoil, to a depth of 10 inches, is red fine sandy loam. The underlying material is red, weakly consolidated, calcareous sandstone.

The Quinlan soil is medium in natural fertility and organic matter content. Reaction is mildly alkaline or moderately alkaline in the surface layer and subsoil. Permeability is moderately rapid, and available water capacity is very low. Surface runoff is rapid. The root zone is shallow, and root development is restricted below a depth of about 10 inches by weakly cemented sandstone. The shrink-swell potential is low.

Included with this complex in mapping are areas of soils that are similar to the Quinlan soil except they are less than 10 inches deep to bedrock. Also included are areas of soils that are similar to the Dill soil but that have layers of clay loam or sandy clay loam in the subsoil and are mostly on ridgetops. Also included are a few small areas of the Cordell soils. The included soils make up about 25 percent of the map unit, but individual areas are generally less than 5 acres.

These Dill and Quinlan soils are not suited to cultivated crops. They are best suited to grass. Slope, depth to bedrock, and a severe hazard of erosion are the main limitations.

These soils have low potential for tame pasture and hay. They are suited to bermudagrass and lovegrass. The potential is medium for rangeland. Under good management, Dill soils will produce large amounts of native grass, and Quinlan soils will produce moderate amounts of native grass. Using these soils for improved grasses or range is effective in controlling erosion. Proper stocking, weed control, fertilization, rotation grazing, deferred grazing, and restricted use during dry periods will keep the grass and soil in good condition.

These soils have low potential for trees in windbreaks and post lots. Steepness of slope, depth to bedrock, and very low to medium available water capacity make establishment of trees very difficult.

The potential is medium for openland wildlife habitat and for rangeland wildlife habitat.

Potential is medium for building sites. Depth to rock is a limitation for shallow excavations and foundations. Potential is low for most sanitary facilities. Depth to bedrock and moderately rapid permeability are major limitations. The moderately deep Dill soils are better suited to this use than are the shallow Quinlan soils.

These soils have medium potential for most recreational uses. Slope and depth to bedrock are the main limitations. Onsite investigation is necessary to evaluate and plan the development of specific sites.

This complex is in capability subclass VIe. Dill part is in Sandy Prairie range site, and Quinlan part is in Shallow Prairie range site.

22—Gracemont clay loam. This nearly level, somewhat poorly drained loamy soil is on narrow flood plains. Slope gradients range from 0 to 1 percent. This soil floods frequently. The stream channels are choked with sediment or the stream drainage is restricted by some other means that allow the water table to rise to within 40 inches of the surface most of the year. Areas are irregular in shape and range from 5 to 50 acres.

Typically, the surface layer is reddish brown clay loam about 6 inches thick. The underlying material to a depth of 62 inches or more is red and reddish brown fine sandy loam and thin strata of loam.

Included with this soil in mapping are small areas of Clairemont and Yahola soils which make up about 10 percent of the map unit. Individual areas are generally less than 5 acres.

This Gracemont soil is medium in natural fertility and organic matter content. Permeability is moderate to moderately rapid, and surface runoff is slow to very slow. Some areas of the soil pond water on the surface for prolonged periods during wet seasons. Available water capacity is medium. The soil is generally moderately alkaline and calcareous throughout. Root development is somewhat restricted below a depth of about 30 inches by a high water table. The shrink-swell potential is low.

The potential is low for cultivated crops. Flooding and the high water table are the main limitations. If this soil is used for cultivated crops, control of flooding and subsurface drainage are needed to lower the water table and provide good rooting depth for the crop.

This soil has high potential for tame pasture and hay. It is suited to tall wheatgrass, bermudagrass, and other adapted grasses and legumes for hay and pasture. It is also suited to fescue, but some winterkill may occur.

Most of this soil is used for rangeland, hay, or tame pasture. The potential is high for rangeland. Under good management, it will produce large amounts of native grass. This soil is among the highest yielding range grass sites in the county. Overgrazing when the soil is too wet, however, causes surface compaction and poor tilth. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during wet periods help keep the grass and soil in good condition.

This soil has low potential for trees in windbreaks and post lots. It has medium potential for openland wildlife habitat.

Potential is low for building sites and sanitary facilities. The high water table and frequent flooding are the main limitations.

This soil has low potential for most recreational uses. The hazard of flooding and the high water table are the main limitations. Onsite investigation is essential to evaluate and plan the development of specific sites.

This soil is in capability subclass Vw; Subirrigated range site.

23—Gracemont clay loam, saline. This nearly level, deep, somewhat poorly drained loamy soil is on flood plains. It is in concave or slightly depressional areas on flood plains. The water table is within 40 inches of the surface most of the year. This soil is slightly to moderately affected by saline salts. Slope gradients range from 0 to 1 percent. Areas are irregular in shape and range from 5 to 100 acres.

Typically, the surface layer is reddish brown clay loam about 6 inches thick. The underlying material to a depth of 60 inches or more is reddish brown, reddish yellow, and light brown fine sandy loam with thin strata of loam, fine sandy loam, and clay loam.

Natural fertility and organic matter content are medium. Permeability is moderate to moderately rapid, and surface runoff is very slow. Some areas of the soil pond water on the surface for prolonged periods during wet seasons. Available water capacity is medium. The soil is moderately alkaline and calcareous throughout. Root development is somewhat restricted below a depth of 30 inches by the high water table and the salts in the soil. The shrink-swell potential is low.

Included with this soil in mapping are a few small areas of Lincoln and Yahola soils. Also included are small areas of Gracemont soils that are not saline. Included soils make up about 10 percent of the map unit, but individual areas generally are less than 5 acres.

Most areas of this Gracemont soil are used for rangeland, hay, or tame pasture. It has medium potential for tame pasture and hay. It is suited to bermudagrass, tall wheatgrass, and other adapted grasses and legumes that are salt tolerant. Tall fescue is also suited to these low lying areas, but some winterkill may occur. The potential is high for rangeland. Under good management, this soil will produce large amounts of native grass. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during wet periods help keep the grass and soil in good condition.

This soil is unsuited for cultivation. Frequent overflow and flooding are hazards. The high water table and salt content limit growth of most field crops.

The potential is low for trees in windbreaks and post lots. Windbreaks are not generally recommended on this soil. Potential is low for openland wildlife habitat.

Potential is low for building sites and sanitary facilities. The high water table and frequent flooding are the major limitations.

This soil has low potential for most recreational uses. The high water table and frequent flooding are the main limitations. Onsite investigation is essential to evaluate and plan the development of specific sites.

This soil is in capability subclass Vs; Saline Subirrigated range site.

24—Gracemore loam, saline. This nearly level, somewhat poorly drained loamy soil is on flood plains. Most of this soil is along the North Fork of the Red River and is parallel to old abandoned stream channels. This soil is slightly saline and has a water table that fluctuates from near the surface to a depth of 40 inches. The water table is nearest the surface during the winter and spring months. Slope gradients range from 0 to 1 percent. Areas are irregular in shape and range from 5 to 50 acres.

Typically, the surface layer is reddish brown loam about 8 inches thick. The underlying material to a depth of 60 inches or more is light brown loamy fine sand and fine sand that contains thin strata of fine sandy loam.

Natural fertility and organic matter content are low. Permeability is moderately rapid, and surface runoff is very slow. Some areas of the soil pond water on the surface for short periods during wet seasons. Available water capacity is low. The soil is moderately alkaline and calcareous throughout. Root development is restricted by a high water table below a depth of 30 inches. The shrink-swell potential is low.

Included in mapping are a few small areas of Gracemont and Lincoln soils. These included soils make up about 15 percent of the map unit, but individual areas are generally less than 5 acres.

Most areas of this Gracemore soil are used for rangeland, hay, or tame pasture. It has medium potential for tame pasture and hay and is suited to tall wheatgrass and bermudagrass. Tall fescue is also suited to these low-lying areas, but some winterkill may occur. This soil is also suited to other adapted grasses and legumes that are salt tolerant. This soil has high potential for rangeland. Under good management, it will produce large amounts of native grass. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during wet periods help keep the grass and soil in good condition.

This soil is unsuited for cultivation. Frequent overflow and flooding are hazards. A water table less than 40 inches from the soil surface and excess salt content limit the growth of most field crops.

The potential is low for trees in windbreaks and post lots. Potential is low for openland wildlife habitat.

Potential is low for building sites and sanitary facilities. A water table at or near the surface and frequent flooding are the main limitations.

This soil has low potential for most recreational uses. It has medium potential for paths and trails. Frequent flooding is the main limitation. Onsite investigation is essential to evaluate and plan the development of specific sites.

This soil is in capability subclass Vs; Saline Subirrigated range site.

25—Grandfield loamy fine sand, 1 to 3 percent slopes. This very gently sloping sandy soil is deep and well drained. It is on broad ridgetops in the uplands. Areas are irregular in shape and range from 10 to 500 acres.

Typically, the surface layer is brown and dark brown loamy fine sand about 14 inches thick. The subsoil extends to a depth of 56 inches. It is reddish brown sandy clay loam to a depth of about 42 inches and yellowish red fine sandy loam to a depth of about 56 inches. The underlying material to a depth of 65 inches or more is yellowish red fine sandy loam.

Natural fertility is medium, and the organic matter content is low. Permeability is moderate, and surface runoff is slow. The available water capacity is medium. Reaction is slightly acid to mildly alkaline in the surface layer and neutral to moderately alkaline in the subsoil and underlying material. The surface layer is friable and is easily tilled throughout a wide range in moisture content. Root development is unrestricted throughout the soil. The shrink-swell potential is low.

Included with this soil in mapping are small areas of Devol soils on ridges and knobs. The included soils make up about 8 percent of this map unit, but individual areas generally are less than 5 acres.

Most areas of this Grandfield soil are cultivated. It has medium potential for cultivated crops. It is well suited to wheat, cotton, and grain sorghum. Where cultivated crops are grown, the hazard of wind erosion is severe, and very intensive conservation measures are required to prevent damage from soil blowing. Minimum tillage, residue management, cover crops, contour farming, terraces, and grassed waterways help prevent soil loss.

Potential is medium for tame pasture and hay. This soil is suited to alfalfa, bermudagrass, and weeping lovegrass. It has medium potential for rangeland. Under good management, this soil will produce a moderate amount of native grass. The use of the soil for tame pasture, hay, or range is effective in controlling erosion. Overgrazing during dry periods causes the stand to die out. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during dry periods help keep the grass and soil in good condition.

This soil has high potential for trees in windbreaks and post lots. There are no serious limitations for trees on this site.

The potential is medium for openland wildlife habitat and high for rangeland wildlife habitat.

This soil has high potential for building sites and for most sanitary facilities. Low strength is a limitation for local roads and streets, but this can be overcome by strengthening or replacing the base material. Excessive seepage from sewage lagoons is a limitation, but this can be overcome by treatments to seal the bottom of the lagoon.

This soil has medium potential for recreational uses. The sandy surface layer limits potential for recreational uses. This can be partially overcome by maintaining a good grass cover.

This soil is in capability subclass IIIe; Deep Sand range site.

26—Grandfield loamy fine sand, 2 to 5 percent slopes, eroded. This very gently sloping to gently sloping sandy soil is on convex eroded uplands. It is deep and well drained. In many areas, the subsoil is exposed in the plow layer. Small gullies that can be crossed with farm machinery are common. Areas are irregular in shape and range from 10 to 600 acres.

Typically, the surface layer is brown loamy fine sand about 6 inches thick. The subsoil extends to a depth of 58 inches. It is reddish brown sandy clay loam to a depth of about 36 inches and yellowish red fine sandy loam to a depth of about 58 inches. The underlying material to a depth of 65 inches or more is yellowish red fine sandy loam.

Natural fertility is medium, and organic matter content is low. Permeability is moderate, and surface runoff from cultivated areas is high. The available water capacity is medium. Reaction ranges from slightly acid to mildly alkaline in the surface layer and from neutral to moderately alkaline in the subsoil and underlying material. The surface layer is friable and easily tilled throughout a fairly wide range in moisture content. In areas where the plow layer contains subsoil material, the soil has a tendency to crust or puddle after hard rains. These areas generally have poor surface structure. Root development is unrestricted to a depth of more than 60 inches. The shrink-swell potential is low.

Included with this soil in mapping are a few small areas of Nobscot soils which are on ridges or knobs. The included soils make up about 5 percent of the map unit, but individual areas are less than 5 acres.

Most of the acreage of this Grandfield soil has been cultivated in the past. About 50 percent of it has been seeded to grass. The potential is low for cultivated crops. This soil is poorly suited to cotton, wheat, and grain sorghum, but fair yields can be obtained with intensive management. The hazards of wind and water erosion are very severe for cultivated crops. Minimum tillage, cover crops, terracing and contour farming, grassed waterways, and residue management reduce soil loss and help conserve soil moisture.

Potential is medium for tame pasture and hay. This soil is suited to bermudagrass, lovegrass, and other adapted plants for pasture and hay. It has medium potential for rangeland. Under good management, this soil will produce a moderate amount of native grass. The use of this soil for pasture or rangeland is also effective in controlling erosion. Overgrazing, especially during dry periods, will cause the stand of grass to die out. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during dry periods help keep the grass and soil in good condition.

This soil has medium potential for trees in windbreaks and post lots. Slope and erosion are the main limitations.

Potential is medium for openland wildlife habitat and high for rangeland wildlife habitat.

This soil has high potential for building sites and for most sanitary facilities. Low strength is a limitation for local roads and streets, but this can be overcome by strengthening or replacing the base material. Excessive seepage from sewage lagoons is a limitation, but this can be corrected by special treatments to seal the bottom of the lagoon.

The potential is medium for most recreational uses. Slope and the sandy surface texture limit potential for recreational use. These limitations can be partially overcome by maintaining a good grass cover.

This soil is in capability subclass IVe; Deep Sand range site.

27—Grandfield fine sandy loam, 1 to 3 percent slopes. This very gently sloping loamy soil is on broad, rolling uplands and on ridgetops. It is deep and well drained. Areas are irregular in shape and range from 5 to 300 acres.

Typically, the surface layer is brown and dark brown fine sandy loam to a depth of about 10 inches. The subsoil extends to a depth of 65 inches. It is reddish brown fine sandy loam to a depth of about 14 inches, reddish brown sandy clay loam to a depth of about 44 inches, and yellowish red sandy clay loam and fine sandy loam to a depth of 65 inches.

Natural fertility and organic matter content are medium. Permeability is moderate, and surface runoff is medium. Available water capacity is medium. Reaction ranges from slightly acid to mildly alkaline in the surface layer and from neutral to moderately alkaline in the subsoil. The surface layer is friable and easily tilled throughout a wide range in moisture content. Root development is unrestricted throughout the soil. The shrink-swell potential is low.

Included with this soil in mapping are small areas of Devol and Altus soils. These inclusions make up about 10 percent of this map unit, but individual areas are less than 5 acres.

Most areas of this Grandfield soil are cultivated. The potential is medium for cultivated crops. This soil is suited to wheat, grain sorghum, cotton, and alfalfa. In some years, a small acreage of mung beans is sown. The hazard of wind and water erosion is moderate, and cultivated crops require careful management to prevent erosion. Terracing, contour farming, cover crops (fig. 10) and residue management help prevent erosion and conserve moisture. Windbreaks, cover crops, and crop residues left on the soil surface help prevent damage from soil blowing.

Potential is high for tame pasture and hay. This soil is well suited to alfalfa, bermudagrass, and lovegrass. Use of this soil for pasture or rangeland is effective in controlling wind and water erosion.

This soil has high potential for rangeland. Under good management, it will produce a large amount of native grass. Care must be taken, however, to control stocking and time of grazing because the grass stand is easily damaged during years of drought.

Potential is high for trees in windbreaks and post lots. Trees grow well and are long lived because of the deep, permeable subsoil. Roots easily penetrate the subsoil.

This soil has high potential for openland wildlife habitat and rangeland wildlife habitat.

Potential is high for building sites and for most sanitary facilities. Low strength is a limitation for local roads and streets, but this can be corrected by strengthening or replacing the base material. Seepage from sewage lagoons can be overcome by treatments to seal the bottom of the lagoon. This soil is a good source of topsoil.

This soil has medium potential for development of all types of park and playground sites. Onsite investigation is essential to evaluate and plan the development of specific sites.

This soil is in capability subclass IIIe; Sandy Prairie range site.

28—Grandfield fine sandy loam, 3 to 5 percent slopes. This gently sloping loamy soil is on broad, rolling uplands and on ridgetops. It is deep and well drained. Areas are irregular in shape and range from 5 to 75 acres.

Figure 10.—Cover crop of rye sown in cotton on Grandfield fine sandy loam, 1 to 13 percent slopes.

Typically, the surface layer is reddish brown fine sandy loam about 8 inches thick. The subsoil extends to a depth of about 53 inches. It is yellowish red sandy clay loam to about 24 inches and red sandy clay loam and fine sandy loam to about 53 inches. The underlying material to a depth of 65 inches or more is red fine sandy loam.

Natural fertility and organic matter content are medium. Permeability is moderate, and surface runoff is medium. Reaction ranges from slightly acid to mildly alkaline in the surface layer and from neutral to moderately alkaline in the subsoil and underlying material. Natural fertility is medium, and organic matter content is low. The surface layer is friable and easily tilled throughout a fairly wide range in moisture content. Available water capacity is medium. Root development is unrestricted throughout the soil. The shrink-swell potential is low.

Included with this soil in mapping are areas of a soil that is similar to the Grandfield soil but is underlain by Permian red-bed material at a depth of about 40 inches. A few small areas of Altus soils are also included. The included soils make up about 10 percent of the map unit, but individual areas are less than 5 acres.

Most areas of this Grandfield soil are cultivated. It has medium potential for cultivated crops and is suited to wheat, cotton, and grain sorghum. If this soil is used for cultivated crops, there is a severe hazard of wind and water erosion and intensive conservation measures are required to prevent erosion. Minimum tillage, cover crops, residue management, terracing, contour farming, and grassed waterways help prevent excessive soil loss. Residue management helps to maintain good tilth and increases the water infiltration rate. Windbreaks, cover crops, and crop residues left on the surface can reduce soil blowing.

Potential is medium for tame pasture and hay. This soil is suited to bermudagrass and lovegrass. The potential is high for rangeland. Under good management, this soil will produce a large amount of native grass. The use of this soil for rangeland, tame pasture, or hay is effective in controlling erosion. Overgrazing during prolonged dry periods causes the stand to die out and increases the hazard of erosion. Proper stocking, rotation grazing, and timely deferment of grazing help keep the grass and soil in good condition.

This soil has high potential for trees in windbreaks and post lots. The potential is high for openland wildlife habitat and rangeland wildlife habitat.

Potential is high for building sites and for most sanitary facilities. Low strength is a limitation for local roads and streets, but this can be overcome by strengthening or replacing the base material. Seepage is a limitation for sewage lagoons, but this can be corrected by treatments to seal the bottom of the lagoon.

Potential is medium for most recreational uses. Slope is a limiting factor for the development of playgrounds. Onsite investigation is essential to evaluate and plan development of specific sites.

This soil is in capability subclass IIIe; Sandy Prairie range site.

29—Grandfield fine sandy loam, 2 to 5 percent slopes, eroded. This very gently sloping to gently sloping loamy soil is on broad, rolling, eroded uplands. It is deep and well drained. In most cultivated areas, the subsoil is exposed in the plow layer. Gullies that can be crossed with farm machinery are common. Areas are irregular in shape and range from 5 to 125 acres.

Typically, the surface layer is reddish brown fine sandy loam to a depth of about 5 inches. The subsoil extends to a depth of about 58 inches. It is reddish brown fine sandy loam to about 14 inches, red sandy clay loam to about 39 inches, and red fine sandy loam to about 58 inches. The underlying material to a depth of 65 inches or more is red fine sandy loam.

Natural fertility is medium, and organic matter content is low. Permeability is moderate, and surface runoff from cultivated areas is medium. Available water capacity is medium. Reaction ranges from slightly acid to mildly alkaline in the surface layer and from neutral to moderately alkaline in the subsoil and underlying material. The surface layer is friable and easily tilled throughout a fairly wide range in moisture content. Root development is unrestricted throughout the soil. The shrink-swell potential is low.

Included with this soil in mapping are areas of a soil that is similar to the Grandfield soil, but is underlain by Permian red-bed materials at a depth of about 30 inches. Also included are a few small areas of Altus soils. These inclusions make up about 10 percent of this map unit, but individual areas generally are less than 5 acres.

All areas of this Grandfield soil are cultivated or have been previously cultivated. About 40 percent of the old cropland has been reseeded to grass. This soil has low potential for cultivated crops. It is suited to wheat, cotton, and grain sorghum. If this soil is used for cultivated crops, there is a very severe hazard of water erosion. Minimum tillage, cover crops, residue management, terracing, contour farming, and grassed waterways help prevent excessive soil loss. Keeping residue on the soil surface increases water infiltration and helps to prevent damage from wind erosion.

Potential is medium for tame pasture and hay, and the soil is suited to bermudagrass and lovegrass. This soil has medium potential for rangeland. Production of native grass is reduced because of the loss of topsoil by erosion. Under good management, this soil will produce a moderate amount of native grass. The use of this soil for tame pasture, range, or hay is also effective in controlling erosion. Overgrazing during prolonged dry periods causes the grass stand to die out and increases the hazard of erosion. Proper stocking, rotation grazing, and timely deferment of grazing help keep the grass and soil in good condition.

This soil has medium potential for trees in windbreaks and post lots. The potential is medium for openland wildlife habitat and high for rangeland wildlife habitat.

Potential is high for building sites and for most sanitary facilities. Low strength is a limitation for local roads and streets, but this can be corrected by strengthening or replacing the base material. Seepage is a limitation for sewage lagoons, but this can be corrected by treatments to seal the bottom of the lagoon.

This soil has medium potential for most recreational uses. Slope is a limitation in the development of playgrounds. Onsite investigation is essential to evaluate and plan the development of specific sites.

This soil is in capability subclass IVe; Sandy Prairie range site.

30—Hardeman fine sandy loam, 1 to 3 percent slopes. This very gently sloping loamy soil is on convex uplands. It is deep and well drained. Most areas of this soil are parallel to the North Fork of the Red River and some of its tributaries. Areas are irregular in shape and range from 5 to 60 acres.

Typically, the surface layer is reddish brown fine sandy loam about 10 inches thick. The subsoil extends to a depth of 50 inches. It is red, calcareous fine sandy loam. The underlying material to a depth of 60 inches or more is red, calcareous fine sandy loam.

Natural fertility and organic matter content are medium. Permeability is moderately rapid, and runoff is medium. Available water capacity is medium. Reaction is mildly or moderately alkaline throughout. The surface layer is friable and easily tilled throughout a wide range in moisture content. It has a tendency to form a crust after hard rains. Root development is unrestricted throughout the soil. The shrink-swell potential is very low.

Included with this soil in mapping are a few small areas of Tipton soils. The included soils make up about 10 percent of this map unit, but individual areas are generally less than 5 acres.

Most areas of this Hardeman soil are cultivated. It has high potential for cultivated crops and is suited to cotton, wheat, and grain sorghum. If this soil is cultivated, the hazard of wind and water erosion is moderate. Intensive conservation treatment is required to prevent damage from soil blowing. Minimum tillage, winter cover crops, terracing, contour farming, and grassed waterways reduce erosion. Returning crop residue to the soil improves fertility, reduces crusting, and increases water infiltration.

Potential is high for tame pasture and hay. This soil is suited to alfalfa, bermudagrass, lovegrass, and other grasses and legumes for hay and pasture. The potential is medium for rangeland. Under good management, this soil will produce moderate amounts of native grass. The use of this soil for rangeland, tame pasture, or hay is effective in controlling erosion. Overgrazing causes surface compaction, excessive runoff, and poor tilth. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during prolonged dry periods help keep the grass and soil in good condition.

This soil has medium potential for trees in field and farmstead windbreaks or post lots. Lack of adequate rainfall is the main limitation.

This soil has high potential for openland wildlife habitat and rangeland wildlife habitat.

Potential is high for building sites and for most sanitary facilities. Low strength is a limitation for local roads and streets, but this can be overcome by strengthening or replacing the base material. Excessive seepage is a limitation for sewage lagoons and sanitary landfills. Excessive seepage from sewage lagoons can be partially overcome by special treatment to seal the bottom of the lagoon.

This soil has high potential for most recreational uses. Onsite investigation is essential to evaluate and plan the development of specific sites.

This soil is in capability subclass IIIe; Sandy Prairie range site.

31—Hardeman fine sandy loam, 3 to 5 percent slopes. This gently sloping loamy soil is on side slopes in the uplands. It is deep and well drained. Areas of this soil are mainly along the North Fork of the Red River, but small areas are scattered throughout the county. Areas are irregular in shape and range from 10 to 50 acres.

Typically, the surface layer is reddish brown fine sandy loam about 6 inches thick. The subsoil extends to a depth of 32 inches. It is red, calcareous fine sandy loam. The underlying material to a depth of 60 inches or more is reddish yellow fine sandy loam.

Natural fertility and organic matter content are medium. Permeability is moderately rapid, and runoff is medium. Available water capacity is medium. Reaction is mildly alkaline or moderately alkaline throughout. The surface layer is friable and easily tilled throughout a wide range in moisture content. Root development is unrestricted to a depth of 40 inches or more. The shrink-swell potential is very low.

Included with this soil in mapping are a few small areas of Woodward soils. Also included are areas of soils that are similar to the Hardeman soil, except that they have a dark surface layer that is high in organic matter content. Other similar soils have buried soil layers in the lower part of the profile. These inclusions make up about 25 percent of the map unit, but individual areas generally are less than 5 acres.

Most areas of this Hardeman soil are cultivated. It has medium potential for cultivated crops and is suited to cotton, wheat, and grain sorghum. When this soil is used for cultivated crops, there is a moderate hazard of wind and water erosion. Intensive conservation treatment is required to prevent damage from soil blowing. Minimum tillage, winter cover crops, residue management, contour farming, and terracing reduce erosion losses. Leaving crop residue on the surface increases water infiltration and reduces runoff.

Potential is medium for tame pasture and hay. This soil is suited to bermudagrass, lovegrass, and other grasses and legumes for hay and pasture. The potential is medium for rangeland. Under good management, this soil will produce moderate amounts of native grass. The use of this soil for rangeland, tame pasture, or hay is also effective in controlling erosion. Proper stocking, rotation grazing, and restricted use during dry periods help keep the grass and soil in good condition. Utilizing grasses that respond well to fertilization adds flexibility to the grazing system.

This soil has medium potential for trees in windbreaks for fields and farmsteads. The main limitation for trees on this site is a lack of adequate rainfall during part of the year.

This soil has high potential for openland wildlife habitat and rangeland wildlife habitat.

Potential is high for building sites and for most sanitary facilities. Low strength is a limitation for local roads and streets, but this can be corrected by strengthening or replacing the base material. Excessive seepage is a limitation for sewage lagoons, but this can be overcome by special treatment to seal the bottom of the lagoon.

This soil has high potential for most recreational uses. Slope is the main limitation for playgrounds. Onsite investigation is essential to evaluate and plan the development of specific sites.

This soil is in capability subclass IIIe; Sandy Prairie range site.

32—Knoco-Cornick-Rock outcrop complex, 2 to 20 percent slopes. This complex consists of very shallow, well drained to excessively drained, clayey and loamy soils and Rock outcrop on uplands. The landscape consists of rough broken areas that are capped with gypsum and dolomitic limestone and has the appearance of a series of ledges or steps. The Knoco soils are on side slopes between the rock ledges. The Cornick soils are on small ridges and upper side slopes. The Rock outcrop is throughout the map unit at various elevations in flat cap-rock areas. The strongly sloping to moderately steep Knoco soils formed in calcareous shale and clay. The very gently sloping to gently sloping Cornick soils formed in materials weathered from gypsum. Areas of these soils and Rock outcrop are so intermingled that they could not be shown separately at the scale selected for mapping. Slope is dominantly between 2 and 20 percent, but in some areas it ranges up to 40 percent. Areas are irregular in shape and range from 50 to 3,000 acres.

Knoco soils make up about 21 percent of each mapped area. Typically, the surface layer is reddish brown clay about 4 inches thick. The underlying material is weathered, interbedded red and bluish green shale.

The Knoco soil is medium in natural fertility and low in organic matter content. Permeability is very slow, and runoff is rapid. Available water capacity is very low. This soil is moderately alkaline and calcareous throughout. The root zone is very shallow, and most roots are restricted by shale. The shrink-swell potential is high.

Cornick soils make up about 21 percent of each mapped area. Typically, the surface layer is brown loam about 10 inches thick. The underlying material, to a depth of 14 inches, is weathered gypsum with streaks and pockets of light brown silt loam. Below a depth of 14 inches is hard white gypsum.

The Cornick soil is high in natural fertility and organic matter content. Permeability is moderate, and runoff is rapid. Available water capacity is very low. Reaction is moderately alkaline, and the soil is calcareous throughout. The root zone is shallow, and roots are restricted by gypsum. The shrink-swell potential is low.

Rock outcrop makes up about 19 percent of each mapped area. It is exposed bare soft gypsum and hard limestock bedrock. Surface runoff is very rapid.

Included with this complex in mapping are small areas of Vinson soils and a soil that is similar to the Cornick soil but is 10 to 20 inches deep over gypsum. Also included are some small areas of Talpa, Aspermont, and Quanah soils. The included soils make up about 39 percent of the map unit, but individual areas are generally less than 5 acres.

All areas of the soils of this complex are used for rangeland. The potential is low for rangeland because of very low available water capacity, slope, and a restricted root zone caused by shallowness over rock or shale (fig. 11). This map unit is not suited to tame pasture. Among the management concerns are proper stocking, controlled grazing, rotation grazing, and weed and brush control. Under good management, these soils will produce low amounts of native grass.

These soils are not suited to trees in windbreaks and post lots. Very low available water capacity and shallowness to bedrock are the main limitations.

The potential is low for openland wildlife habitat and rangeland wildlife habitat.

Potential is low for building sites and for sanitary facilities. Steepness of slope, very shallow depth to bedrock, and the shrinking and swelling of the Knoco soil are limitations that are difficult to overcome.

Potential is low for most recreational uses. Slope, the very slow permeability of the Knoco soils, and depth to bedrock are severe limiting factors. Onsite investigation is essential to evaluate and plan the development of specific sites.

This complex is in capability subclass VIIs. Knoco part is in Red Clay Prairie range site; Cornick part is in Gyp range site; Rock outcrop is not assigned to a range site.

33—Knoco-Rock outcrop complex, 20 to 40 percent slopes. This complex consists of the steep, very shallow, well drained to excessively drained clayey Knoco soils and Rock outcrop on uplands. The landscape consists of steep escarpments and canyons incised in the smoother uplands. The Knoco soils are on

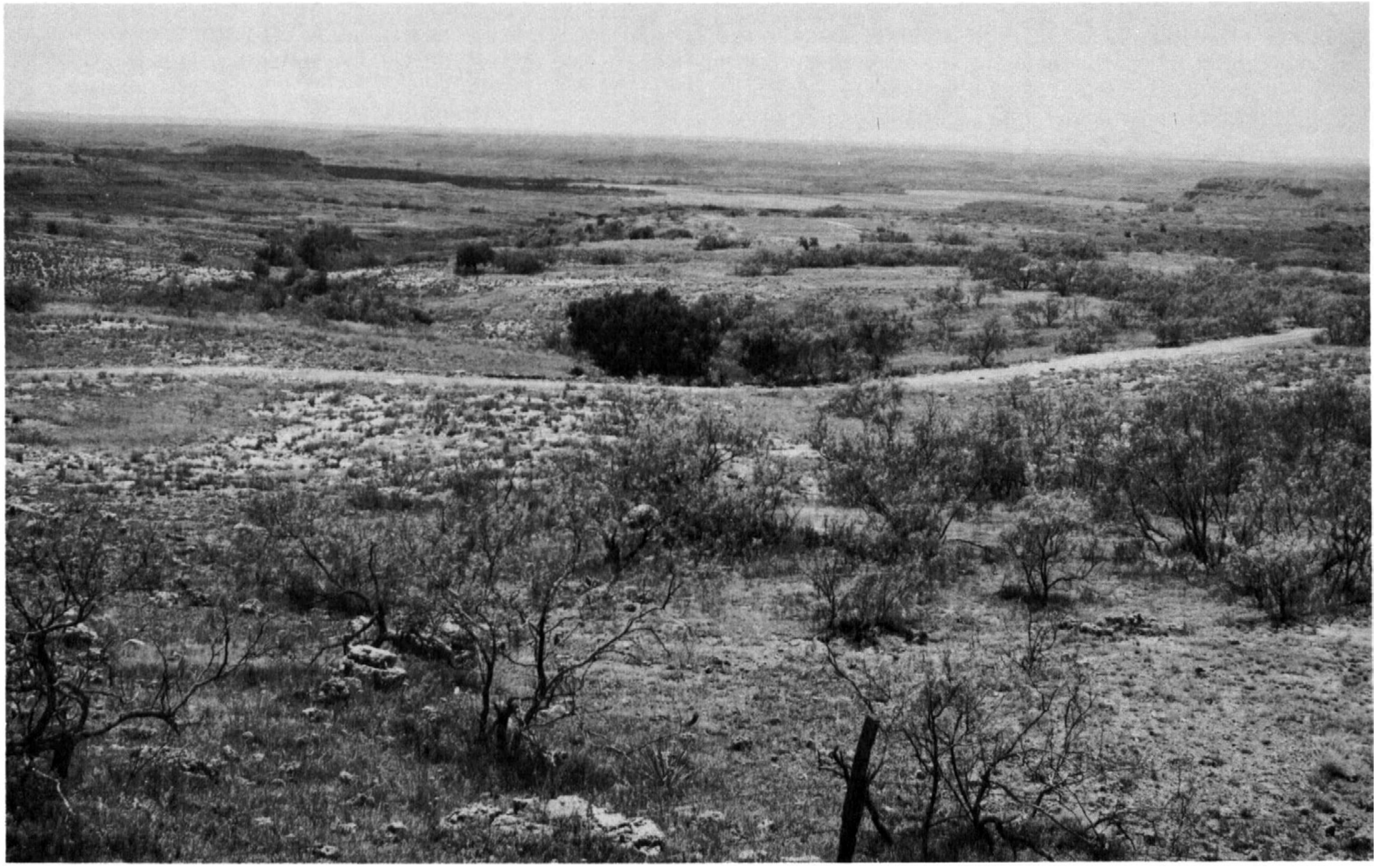


Figure 11.—Gyp range site and Red Clay Prairie range site in an area of Knoco-Cornick-Rock outcrop complex, 2 to 20 percent slopes.

the escarpments and formed in material weathered from shale and clayey shale interbedded with thin layers of gypsum and limestone. Areas of the soils and Rock outcrop are so intermingled that they could not be separated at the scale selected for mapping. Areas range from 70 to 2,000 acres.

Knoco soils make up about 60 percent of each mapped area. Typically, the surface layer is reddish brown clay about 6 inches thick. The underlying material is weakly consolidated red clayey shale.

The Knoco soil is medium in natural fertility and low in organic matter content. Permeability is very slow, and runoff is rapid. The available water capacity is very low. Reaction is moderately alkaline, and the soil is calcareous throughout. The root zone is very shallow, and most roots are restricted by the clayey shale. The shrink-swell potential is high.

Rock outcrop makes up about 20 percent of each mapped area. It consists of exposed areas of bare soft gypsum, shale and clayey shale, and hard limestone bedrock. Surface runoff is very rapid.

Included with this complex in mapping are small areas of Cornick and Talpa soils. The included soils make up about 20 percent of this map unit, but individual areas are generally less than 5 acres.

All areas of this complex are used for range. The potential is low for rangeland, although these soils are best suited to this use. Steep slopes and shallowness to bedrock are the main limiting factors. Overgrazing or grazing during prolonged drought is detrimental to grass stands and causes excessive runoff and poor tilth. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during dry periods keep the grass and soil in good condition. With good management, these soils will produce low amounts of native grass. This complex is not suited to cultivation, tame pasture, or hayland.

The Knoco soils are unsuited to trees in windbreaks. Steep slopes, very shallow depth to bedrock, restricted root zone, and very low available water capacity severely limit establishment and growth.

The potential is low for openland wildlife habitat and rangeland wildlife habitat.

Potential is low for building sites and sanitary facilities. These Knoco soils are unsuited to local roads and streets, septic tank absorption fields, or any type of community development. Low strength, shrinking and swelling, depth to bedrock, steep slopes, and very slow permeability are the main limitations.

Potential is low for most recreational uses. Steep slopes, very slow permeability, and depth to bedrock are the main limitations. Onsite investigation is essential to evaluate and plan the development of specific sites.

This complex is in capability subclass VIIs. Knoco part is in Breaks range site; Rock outcrop is not assigned to a range site.

34—Lincoln loamy fine sand. This deep, nearly level, somewhat excessively drained sandy soil is on flood plains. This soil is subject to frequent flooding. Slope gradients range from 0 to 1 percent. Areas are irregular in shape and range from 10 to 1,500 acres.

Typically, the surface layer is light brown loamy fine sand about 6 inches thick. The underlying material to a depth of 60 inches or more is very pale brown with thin strata of fine sandy loam. Thin bedding planes are evident.

Natural fertility and organic matter content are low. Permeability is rapid, and surface runoff is slow. Available water capacity is low. The surface is very friable, and it is subject to severe blowing when tilled. Reaction is mildly alkaline or moderately alkaline in the surface layer and moderately alkaline in the underlying material. The root zone is deep and easily penetrated by plant roots. The shrink-swell potential is low.

Included with this soil in mapping are a few areas of Tivoli soils and small areas of Gracemore soils that are saline. The Tivoli soils are in the higher areas and the Gracemore soils are in the slightly lower areas. Also included are small areas of Yahola soils. The included soils make up about 20 percent of this map unit, but individual areas generally are less than 5 acres.

Most areas of this Lincoln soil are used for rangeland or bermudagrass pasture. A few areas are used for cultivated crops. This soil has low potential for cultivated crops. Frequent flooding is a major hazard for cultivated crops, and it can cause soil damage and loss of crops. Maintaining fertility and controlling soil blowing are also major management problems. This soil is best suited to grass.

This soil has medium potential for rangeland. Yields are limited because of low available water capacity and the sandy texture of the soil. With good management, this soil will produce a moderate amount of native grass.

Potential is medium for hay and tame pasture. This soil is suited to bermudagrass, lovegrass, fescue, and adapted clovers and other legumes. Overgrazing or grazing when the soil is too dry can reduce the grass stand and lower the vigor of the grass cover. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during extremely wet or dry periods keep the grass and soil in good condition.

This soil has medium potential for trees in windbreaks and post lots. Frequent flooding is the main limitation to establishing trees.

The potential is medium for openland wildlife habitat and rangeland wildlife habitat.

Potential is low for building sites and sanitary facilities. Frequent flooding and seepage are the main limitations and are difficult to overcome.

This soil has low potential for most recreational uses. Frequent flooding and the sandy surface layer are the main limitations. Onsite investigation is essential to evaluate and plan the development of specific sites.

This soil is in capability subclass Vw; Sandy Bottomland range site.

35—Mangum clay. This clayey soil is deep, nearly level, and well drained. It is on flood plains. This soil is subject to rare flooding. Slope gradients range from 0 to 1 percent. Areas are irregular in shape and range from 20 to 250 acres.

Typically, the surface layer is brown clay about 6 inches thick. The subsoil extends to a depth to 25 inches, and it is reddish brown clay. The underlying material to a depth of 60 inches or more is reddish brown clay with a few faint bedding planes.

Natural fertility and organic matter content are medium. Permeability is very slow, and runoff is slow. Available water capacity is high. Reaction is moderately alkaline throughout. The surface layer is very firm and high in clay content. It can be tilled only throughout a very limited range in moisture content. This soil will form a surface crust easily after hard rains. Root development is restricted below a depth of about 20 inches because of the dense clayey lower layers. The shrink-swell potential is high.

Included with this soil in mapping are areas of Treadway soils at slightly higher elevations than the Mangum soils. Also included are small areas of Beckman clay, saline. Included soils make up about 10 percent of this map unit, but individual areas generally are less than 5 acres.

Most areas of this Mangum soil are used for range. About 10 percent of this soil is used for cultivated crops. Potential is low for cultivated crops. It is poorly suited to wheat, grain sorghum, or cotton. Surface crusting, the dense clay texture of the soil, and very slow permeability are the main limiting features. Minimum tillage, winter cover crops, and returning crop residue to the soil improve fertility, reduce crusting, and increase water infiltration.

Potential is medium for tame pasture and hay. This soil is suited to bermudagrass, but without irrigation production is low. Potential is medium for range. With good management this soil will produce large amounts of native grass. Overgrazing or grazing when the soil is too wet or too dry causes surface compaction and poor tilth and reduces water infiltration. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during prolonged wet or dry periods keep the grass and soil in good condition. The proportion of desirable range plants and plant vigor can be maintained or improved with a weed and brush control program.

This soil has low potential for trees in windbreaks. Growth is limited by low summer rainfall and a dense clayey subsoil.

The potential is medium for openland wildlife habitat and low for rangeland wildlife habitat.

This soil has low potential for building sites, sanitary facilities, and recreational development. The major limitations are flooding, shrinking and swelling, and very slow permeability.

This soil is in capability subclass IIIs; Heavy Bottomland range site.

36—Nobscot fine sand, 2 to 5 percent slopes. This very gently sloping to gently sloping sandy soil is on undulating uplands. It is deep and well drained. Areas are irregular in shape and range from 10 to 2,000 acres.

Typically, the surface layer is brown fine sand about 5 inches thick. The subsurface layer is pink fine sand to a depth of about 23 inches. The subsoil extends to a depth of 80 inches. It is red sandy loam with lamellae of reddish brown sandy loam to a depth of about 36 inches, red loamy sand with lamellae of dark red sandy loam to a depth of about 53 inches, and reddish yellow loamy sand and fine sand with lamellae of red sandy loam and loamy fine sand to a depth of about 80 inches.

Natural fertility and organic matter content are low. Permeability is moderately rapid, and runoff is very slow. Available water capacity is low. Reaction ranges from medium acid to neutral in the surface layer and subsurface layer and is mainly strongly acid to slightly acid in the subsoil. The surface layer is loose and easily tilled throughout a wide range in moisture content. The wind erosion hazard is severe where the soil is used for clean-tilled crops. Root development is unrestricted throughout the soil. The shrink-swell potential is low.

Included with this soil in mapping are a few areas of Delwin soils that make up about 10 percent of the map unit. Individual areas are generally less than 5 acres.

About 60 percent of the acreage of this Nobscot soil is in range and about 40 percent is cultivated. It has low potential for cultivated crops. This soil is suited to wheat, cotton, grain sorghum, and rye. There is a severe hazard of wind erosion where this soil is cultivated, and very intensive conservation measures are required to prevent damage from soil blowing. Minimum tillage, winter cover crops, field windbreaks, and keeping crop residue on the surface will reduce excessive soil blowing.

Potential is medium for tame pasture and hay. This soil is suited to bermudagrass, lovegrass, rye, and other adapted grasses and legumes for hay and pasture. Use of this soil for pasture or range is also effective in controlling wind erosion. This soil has high potential for rangeland. The native vegetation is a mixture of tall grasses, mid grasses, and shinnery oak. With good management, this soil will produce large amounts of native grass. Since most areas of this soil have been invaded by shinnery oak, a brush control program is needed to suppress the oak growth and allow the native grasses to reestablish. Overgrazing during dry periods causes the grass stand to die out. Proper stocking, rotation grazing, and restricted use during dry periods help keep the grass and soil in good condition.

This soil has medium potential for trees in field and farmstead windbreaks. Low available water capacity is the main limitation. This soil has medium potential for openland wildlife habitat and high potential for rangeland wildlife habitat. There are many large areas of this soil, and the native vegetation provides food and shelter for a variety of wildlife.

Potential is high for building sites and low for sanitary facilities. Excessive seepage and the sandy texture of the soil are the main limitations for sewage lagoons and sanitary landfills.

The potential is medium for most recreational uses. The sandy surface texture is the main limitation. Slope is also a limitation for playgrounds. Onsite investigation is necessary to evaluate and plan the development of specific sites.

This soil is in capability subclass IVe; Deep Sand Savannah range site.

37—Nobscot fine sand, 5 to 12 percent slopes. This deep, well drained, sloping to strongly sloping sandy soil is on hummocky or hilly uplands. Areas are irregular in shape and range from 5 to 50 acres.

Typically, the surface layer is grayish brown fine sand about 4 inches thick. The subsurface layer is very pale brown fine sand that extends to a depth of about 28 inches. The subsoil extends to a depth of 65 inches. It is reddish yellow fine sandy loam with horizontal bands of sandy loam to a depth of 40 inches and reddish yellow loamy fine sand with lamellae of fine sandy loam to a depth of 65 inches.

Natural fertility and organic matter content are low. Permeability is rapid in the surface and subsurface layers and moderately rapid in the subsoil. Runoff is very slow. Available water capacity is low. The reaction of the surface layer and subsurface layer ranges from neutral to medium acid and the subsoil ranges mainly from slightly acid to strongly acid. The surface layer is very friable and loose when dry. The hazard of wind erosion is severe. Root development is unrestricted throughout the soil. The shrink-swell potential is low.

Included with this soil in mapping are areas of soils that are sandy throughout, and they are on the steepest ridge crests. Also included are a few areas of the Delwin soils that are on ridges. Included soils make up about 15 percent of this map unit, but individual areas are generally less than 5 acres.

Most areas of this Nobscot soil are in range, and the potential is high for use as rangeland. The vegetation is mostly mid and tall grasses and shinnery oak. Overgrazing thins the grass stand and increases the hazard of wind erosion. With good management, this soil will produce large amounts of native grass. Because large areas of this soil have been invaded by shinnery oak, a brush control program is needed to suppress the oak and allow the native grasses to reestablish.

Potential is low for tame pasture and hay. The use of this soil for range, tame pasture, or hay is the most effective method of controlling wind erosion. This soil is suited to bermudagrass and lovegrass. Proper stocking, fertilization, weed control, rotation grazing, and restricted use during dry periods will keep the grass and soil in good condition.

This soil has low potential for cultivated crops, and it is best protected by a permanent grass cover. The severe hazard of erosion, low available water capacity, and slope are the major limitations.

The potential is medium for trees in windbreaks and post lots. Slope, low available water capacity, and the hazard of erosion contribute to the high mortality rate.

This soil has high potential for rangeland wildlife habitat and medium potential for openland wildlife habitat.

Potential is medium for building sites. Slope is a limitation, but this can be overcome if proper design and installation procedures are used. This soil has low potential for sanitary facilities. Seepage is the main limitation.

The potential is low for most recreational uses. Slope and the loose sandy surface layer are the main limitations. Onsite investigation is necessary to evaluate and plan the development of specific sites.

This soil is in capability subclass VIe; Deep Sand Savannah range site.

38—Nobscot and Delwin soils, 2 to 5 percent slopes, gullied. This map unit consists of very gently sloping to gently sloping sandy soils on gullied uplands. These soils are deep and well drained. The Nobscot soils are mainly on ridgetops, and the Delwin soils are on side slopes and the lower slopes. These soils occur between the gullies. They have been cultivated in the past, and very severe water and wind erosion has removed much of the original surface layer and formed many gullies some of which are crossable with farm machinery and some of which are not. The pattern and extent of Nobscot and Delwin soils are not uniform for each mapped area. Some areas consist mostly of Nobscot fine sand, but most areas contain both Nobscot and Delwin soils.

Nobscot soils make up about 50 percent of each mapped area. Typically, the surface layer is light brown fine sand about 6 inches thick. The subsurface layer is pink fine sand to a depth of about 24 inches. The subsoil extends to a depth of 65 inches. It is reddish yellow fine sandy loam with lamellae of yellowish red sandy clay loam to a depth of about 50 inches and reddish yellow loamy fine sand with thin lamellae of yellowish red fine sandy loam to a depth of 65 inches.

The Nobscot soil is low in natural fertility and organic matter content. Permeability is rapid in the surface and subsurface layers and is moderately rapid in the subsoil. Runoff is slow. Available water capacity is low. Reaction ranges from medium acid to neutral in the surface layer and subsurface layer and from strongly acid to slightly acid in the upper part of the subsoil. The lower part of the subsoil is slightly acid to neutral. Root development is unrestricted throughout the soil. The shrink-swell potential is low.

Delwin soils make up about 35 percent of each mapped area. Typically, the surface layer is reddish brown loamy fine sand about 14 inches thick. The subsoil extends to a depth of 65 inches. It is yellowish red sandy clay loam to a depth of about 26 inches, reddish yellow sandy clay loam to a depth of about 36 inches, and reddish yellow fine sandy loam with thin lamellae of yellowish red sandy loam to a depth of 65 inches.

The Delwin soil is low in natural fertility and organic matter content. Permeability is moderate, and runoff is rapid. Available water capacity is medium. Reaction is slightly acid or neutral in the surface layer. The upper part of the subsoil is slightly acid to moderately alkaline, and the lower part is neutral to moderately alkaline. Root development is unrestricted. The shrink-swell potential is low.

Included with these soils in mapping are small areas of Grandfield and Devol soils. The included soils make up about 15 percent of this map unit, but individual areas are generally less than 5 acres.

All areas of these Nobscot and Delwin soils have been cultivated in the past. Most areas are presently seeded to grass and are used for tame pasture or range. In areas where the subsoil is exposed and in areas with sparse vegetation, the surface runoff is rapid. In areas that have a good stand of grass and have been smoothed, the surface runoff is slow.

Potential is low for tame pasture and hay. These soils are suited to bermudagrass, lovegrass, and other adapted grasses and legumes for hay and pasture.

These soils have low potential for rangeland. Severe erosion has removed much of the original surface layer and lowered natural fertility, but with good management these soils will produce a moderate amount of native grass. Use of these soils for pasture or range is also effective in controlling additional erosion. Overgrazing during dry periods causes the grass stand to die out. Proper stocking, rotation grazing, and restricted grazing during dry periods help keep the grass and soil in good condition.

Potential for cultivated crops is low. These soils should have a permanent grass cover. A very severe hazard of erosion and the gullies are the main limitations. An expensive major reclamation of the soils would be required to make them suitable for crops.

Potential is medium for trees in windbreaks and post lots. Low fertility levels and low to medium available water capacity are the major limitations.

These soils have medium potential for openland wildlife habitat and rangeland wildlife habitat.

Potential is high for building sites and low for most sanitary facilities. Seepage is the main limitation for sewage lagoons and sanitary landfills. The potential is high for septic tank absorption fields.

Potential is low for most recreational uses. Slope and the sandy surface texture are the main limitations for playgrounds. Onsite investigation is necessary to evaluate and plan the development of specific sites.

This map unit is in capability subclass VIe; Eroded Sandy Land range site.

39—Obaro silt loam, 1 to 3 percent slopes. This very gently sloping loamy soil is on broad, smooth convex ridgetops and side slopes on uplands. It is well drained and moderately deep. Areas are irregular in shape and range from 20 to 300 acres.

Typically, the surface layer is reddish brown silt loam about 14 inches thick. The subsoil extends to a depth of about 38 inches. It is reddish brown silt loam that has a few concretions of calcium carbonate to a depth of 26 inches. Below that, it is red silt loam that is about 10 percent by volume concretions and soft bodies of calcium carbonate. The underlying material is red, weakly cemented, interbedded siltstone and sandstone.

This soil is medium in natural fertility and organic matter content. Permeability is moderate, and available water capacity is medium. Surface runoff is medium. Reaction is moderately alkaline, and the soil is calcareous throughout. The root zone is moderately deep and is easily penetrated by plant roots. Root development is restricted below a depth of about 38 inches by siltstone and sandstone bedrock.

Included with this soil in mapping are small areas of the Quinlan soils on side slopes. Also included are small areas of Aspermont, Carey, and St. Paul soils that are in nearly level areas or shallow depressions. The included soils make up about 30 percent of this map unit, but individual areas are generally less than 5 acres. The shrink-swell potential is low.

Most areas of this Obaro soil are cultivated. Potential is medium for cultivated crops. This soil is suited to wheat, cotton, and grain sorghum. If this soil is used for cultivated crops, the hazard of erosion is moderate. Minimum tillage, winter cover crops, terracing, contour farming, and grassed waterways reduce runoff and erosion. Returning crop residue to the soil helps to maintain or improve fertility, reduces crusting, and increases water infiltration.

Potential is medium for tame pasture and hay. This soil is suited to bermudagrass, lovegrass, and other adapted grasses and legumes for hay and pasture.

This soil has medium potential as rangeland. With good management, it will produce moderate amounts of native grass. The use of this soil for pasture, range, or hay is also effective in controlling erosion. Overgrazing causes surface compaction, excessive runoff, and poor tilth. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during dry periods help keep the grass and soil in good condition.

The potential is medium for trees in windbreaks and post lots. Medium available water capacity and depth to bedrock are the main limitations.

This soil has medium potential for openland wildlife habitat and rangeland wildlife habitat.

Potential is medium for building sites and low for sanitary facilities. Low strength is a limitation for local roads and streets, but this can be overcome by strengthening or replacing the base material. Depth to bedrock is the main limitation for septic tank absorption fields and sanitary landfills. The limitation of depth to bedrock for septic tank absorption fields can be partially overcome by increasing the size of the filter field.

This soil has medium potential for most recreational uses. Onsite investigation is essential to evaluate and plan the development of specific sites.

This soil is in capability subclass IIIe; Loamy Prairie range site.

40—Obaro-Quinlan complex, 1 to 3 percent slopes. This complex consists of very gently sloping, well drained loamy soils on uplands. Areas of these soils are so intermingled that they could not be shown separately at the scale selected for mapping. The moderately deep Obaro soils and the shallow Quinlan soils are on broad, slightly convex uplands. Areas range from 10 to 300 acres.

Obaro soils make up about 70 percent of each mapped area. Typically, the surface layer is reddish brown silt loam about 13 inches thick. The subsoil extends to a depth of 36 inches. To a depth of 28 inches, it is reddish brown silt loam that has a few concretions of calcium carbonate. Below that, to a depth of about 36 inches, it is red silt loam that is about 10 percent by volume secondary carbonates. The underlying material is red, weakly cemented interbedded sandstone and siltstone.

The Obaro soil is medium in natural fertility and organic matter content. Permeability is moderate, and available water capacity is medium. Surface runoff is medium. Reaction is moderately alkaline, and the soil is calcareous throughout. The root zone is moderately deep and is easily penetrated by plant roots. Root development is restricted below a depth of about 36 inches by siltstone and sandstone bedrock. The shrink-swell potential is low.

Quinlan soils make up about 15 percent of each mapped area. Typically, the surface layer is reddish brown silty clay loam about 6 inches thick. The subsoil extends to a depth of 16 inches, and it is reddish brown silty clay loam. The underlying material is red, weakly cemented sandstone or siltstone.

The Quinlan soil is medium in natural fertility and organic matter content. Permeability is moderate, and available water capacity is low. Surface runoff is medium. Reaction is moderately alkaline, and the soil is calcareous throughout. The root zone is shallow, and the roots are restricted by sandstone or siltstone. The shrink-swell potential is moderate.

Included with this complex in mapping are small areas of Woodward soils on side slopes and lower slopes. Also included are small areas of Carey soils that are in the nearly level or slightly depressional areas. Included soils make up about 15 percent of this map unit, but individual areas are generally less than 5 acres.

Most areas of these Obaro and Quinlan soils are cultivated, and the potential is medium for cultivated crops. These soils are suited to wheat, cotton, and grain sorghum. Minimum tillage, terracing, contour farming, grassed waterways, and winter cover crops reduce runoff and erosion. Returning crop residue to the soil or the regular addition of other organic material improves fertility, reduces crusting and blowing, and increases water infiltration.

Potential is medium for tame pasture and hay. These soils are moderately suited to bermudagrass, lovegrass, and other adapted grasses and legumes.

The potential is medium for trees in windbreaks and post lots. Depth to bedrock and low to medium available water capacity are the main limitations.

These soils have medium potential for openland wildlife habitat and rangeland wildlife habitat.

Potential is medium for building sites and low for sanitary facilities. Depth to bedrock is the main limitation for dwellings and roads. Depth to bedrock is a limiting feature for septic tank absorption fields. The moderately deep Obaro soils are better suited to this use than are the shallow Quinlan soils. The potential is low for sewage lagoons. Depth to bedrock and seepage are the main limitations.

These soils have medium potential for most recreational uses. Slope and depth to bedrock are the main limiting features. Onsite investigation is essential to evaluate and plan the development of specific sites.

This complex is in capability subclass IIIe. Obaro part is in Loamy Prairie range site, and Quinlan part is in Shallow Prairie range site.

41—Obaro-Quinlan complex, 3 to 5 percent slopes. This complex consists of gently sloping, well drained loamy soils on uplands. The moderately deep Obaro soils and the shallow Quinlan soils are on convex side slopes and the lower slopes. Areas of these soils are so intermingled that they could not be shown separately at the scale selected for mapping. Areas range from 10 to 100 acres.

Obaro soils make up about 60 percent of each mapped area. Typically, the surface layer is reddish brown silt loam about 9 inches thick. The subsoil extends to a depth of about 26 inches. It is red silt loam that has a few concretions of calcium carbonate to a depth of 20 inches. Below that it is red silty clay loam with common medium concretions, threads, and films of secondary carbonates. The underlying material is red, weakly cemented, interbedded siltstone and sandstone.

The Obaro soil is medium in natural fertility and organic matter content. Permeability is moderate, and available water capacity is medium. Surface runoff is medium. Reaction is moderately alkaline, and the soil is calcareous throughout. The root zone is moderately deep and is easily penetrated by plant roots. Root development is restricted below a depth of about 26 inches by siltstone and sandstone bedrock. The shrink-swell potential is low.

Quinlan soils make up about 30 percent of each mapped area. Typically, the surface layer is yellowish red silt loam about 5 inches thick. The subsoil, to a depth of 10 inches, is red silty clay loam. The underlying material is weakly cemented siltstone and sandstone.

The Quinlan soil is medium in natural fertility and organic matter content. Permeability is moderate, and available water capacity is low. Reaction is moderately alkaline, and the soil is calcareous throughout. The root zone is shallow, and the roots are restricted by sandstone or siltstone. The shrink-swell potential is low.

Included with this complex in mapping are small areas of Woodward soils. Also included are small areas of Clairemont soils along narrow drainageways. Included soils make up about 10 percent of this map unit, but individual areas generally are less than 5 acres.

These Obaro and Quinlan soils have low potential for cultivated crops. These soils are suited to wheat, cotton, and grain sorghum. Where these soils are used for cultivated crops, there is a severe hazard of erosion. Minimum tillage, terracing, contour farming, grassed waterways, and residue management help control runoff and erosion. Returning crop residue to the soil or regularly adding other organic material improves fertility, reduces crusting and blowing, and increases water infiltration.

Potential is medium for tame pasture and hay. These soils are moderately suited to bermudagrass, lovegrass, and other adapted grasses and legumes for pasture and hay.

These soils have medium potential for rangeland. With good management, these soils will produce a moderate amount of native grass. Use of these soils for pasture or range is also effective in controlling erosion. Proper stocking, timely deferment of grazing, and restricted use during dry periods help keep the grass and soil in good condition.

The potential is low for trees in windbreaks and post lots. The main limitation is depth to bedrock and medium to low available water capacity.

The potential is medium for openland wildlife habitat and rangeland wildlife habitat.

Potential is medium for building sites and low for sanitary facilities. Depth to bedrock is the main limitation for dwellings and roads. Depth to bedrock is a limiting factor for septic tank absorption fields. The moderately deep Obaro soils are better suited to these uses than are the shallow Quinlan soils. The potential is low for sewage lagoons. Depth to bedrock and seepage are the main limitations.

These soils have medium potential for most recreational uses. Slope and depth to bedrock are the main limitations. Onsite investigation is essential to evaluate and plan the development of specific sites.

This complex is in capability subclass IVe. Obaro part is in Loamy Prairie range site, and Quinlan part is in Shallow Prairie range site.

42—Port silty clay loam. This loamy soil is nearly level, well drained, and deep. It is on flood plains and is subject to occasional flooding. Slope gradients range from 0 to 1 percent. Areas are irregular in shape and range from 10 to 200 acres.

Typically, the surface layer is reddish brown silty clay loam about 14 inches thick. The subsoil extends to a depth of 35 inches, and it is reddish brown silty clay loam. The underlying material to a depth of 60 inches or more is red silt loam that has a few thin strata of fine sandy loam.

Permeability is moderate, and runoff is slow. Reaction is neutral or mildly alkaline in the surface layer and mildly alkaline or moderately alkaline in the subsoil. The underlying material is moderately alkaline and calcareous. Available water capacity is high. Natural fertility and organic matter content are high. The surface layer is friable and easily tilled throughout a fairly wide range in moisture content. However, the surface has a tendency to crust or puddle after hard rains. Root development is unrestricted to a depth of 60 inches. The shrink-swell potential is moderate.

Included with this soil in mapping are small areas of Clairemont soils that are near stream channels. Included soils make up about 10 percent of this map unit, but individual areas are generally less than 5 acres.

Most areas of this Port soil are cultivated, and it has high potential for cultivated crops. It is suited to small grain, grain sorghum, and cotton. Minimum tillage, winter cover crops, and returning crop residue to the soil improve fertility, reduce crusting, and increase water infiltration.

This soil has high potential for tame pasture and hay. It is suited to bermudagrass, lovegrass, alfalfa, and other adapted grasses and legumes for hay and pasture.

The potential is high for rangeland, although very little of this soil is used for this purpose. With good management, this soil will produce a large amount of native grass. Overgrazing or grazing when the soil is wet causes surface compaction and poor tilth and reduces water infiltration. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during prolonged wet or dry periods keep the grass and soil in good condition.

This soil has high potential for trees in windbreaks and post lots. It has high potential for openland wildlife habitat and medium potential for rangeland wildlife habitat.

Potential is low for building sites and sanitary facilities. Occasional flooding is the main limitation. Low strength and shrinking and swelling are limitations for local roads and streets. These limitations can be overcome by proper installation procedures and by strengthening or replacing the base material. Sanitary facilities are not suited to this soil because of the hazard of occasional flooding.

This soil has medium potential for most recreational development except camp areas. Occasional flooding is the main limitation. Onsite investigation is essential to evaluate and plan the development of specific sites.

This soil is in capability subclass IIw; Loamy Bottomland range site.

43—Pratt-Tivoli complex, 5 to 12 percent slopes. This complex consists of sloping to strongly sloping sandy soils on uplands. These soils are deep and well drained and excessively drained. Areas of these soils are so intermingled that they could not be shown separately at the scale selected for mapping. These soils are in small areas along the crest of a ridge northeast of Elk City. The Pratt soil is on the ridgetop and upper side slopes, and the Tivoli soil is on the side slopes and foot slopes. The main area of these soils is irregular in shape and covers about 450 acres, but a few smaller areas are about 20 acres.

Pratt soils make up about 60 percent of each mapped area. Typically, the surface layer is brown loamy fine sand about 10 inches thick. The subsoil extends to a depth of 38 inches, and it is reddish yellow loamy fine sand. The underlying material is reddish yellow loamy fine sand to a depth of 60 inches or more.

The Pratt soil is low in natural fertility and organic matter content. Permeability is rapid, and available water capacity is low. Surface runoff is slow. Reaction is medium acid to neutral in the surface layer and slightly acid or neutral below. The hazard of wind erosion is severe. Root development is unrestricted throughout the soil. The shrink-swell potential is low.

Tivoli soils make up about 35 percent of each mapped area. Typically, the surface layer is brown loamy fine sand about 6 inches thick. The underlying material is light brown loamy sand to a depth of 60 inches or more.

The Tivoli soil is low in natural fertility and organic matter content. Permeability is rapid, and available water capacity is low. Surface runoff is slow. Reaction is slightly acid to mildly alkaline in the surface layer and slightly acid to moderately alkaline in the underlying material. The hazard of wind erosion is severe. Root development is unrestricted throughout the soil. The shrink-swell potential is low.

Included with this complex in mapping are a few areas of Clark, Owens, and Devol soils. The included soils make up about 5 percent of this map unit, and individual areas are generally less than 5 acres.

These Pratt and Tivoli soils are mostly used for range. They are not suited to cultivated crops and have low potential for improved grasses and legumes for hay and tame pasture. Severe wind erosion hazard and low available water capacity are the main limitations.

These soils have medium potential for rangeland. With good management, Pratt soils will produce a moderate amount of native grass and Tivoli soils will produce a low amount. Use of these soils for range is effective in controlling wind erosion. Good range management is effective in controlling erosion. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during dry periods will keep the grass and soil in good condition.

These soils have low potential for trees in windbreaks and post lots. Low available water capacity and the severe hazard of wind erosion are the main limitations. Potential is medium for openland wildlife habitat and rangeland wildlife habitat.

Potential is medium for building sites and low for sanitary facilities. Slope, the loose sandy surface, and rapid permeability are the main limitations.

These soils have medium potential for most recreational uses except playgrounds. The sandy surface layer and slope are the main limitations. Onsite investigation is essential to evaluate and plan the development of specific sites.

This complex is in capability subclass VIe. Pratt part is in Deep Sand range site; Tivoli part is in Dune range site.

44—Quanah-Talpa complex, 1 to 5 percent slopes. This complex consists of very gently sloping to gently sloping, well drained loamy soils on uplands. The deep, very gently sloping to gently sloping Quanah soils are on foot slopes and broad convex ridgetops. The very shallow, very gently sloping Talpa soils are on convex ridgetops and side slopes. Areas of these soils are so intermingled that it was not practical to separate them in mapping. The Quanah soils formed in calcareous loamy sediments, and the Talpa soils formed in material weathered from hard limestone. Areas are irregular in shape and range from 5 to 400 acres.

Quanah soils make up about 50 percent of each mapped area. Typically, the surface layer is brown clay loam about 10 inches thick. The subsoil extends to a depth of 24 inches, and it is reddish brown clay loam. The underlying material to a depth of 60 inches or more is yellowish red clay loam.

The Quanah soil is high in natural fertility and organic matter content. Permeability is moderate. The available water capacity is high. Surface runoff is medium. Reaction is mildly alkaline or moderately alkaline in the upper part and moderately alkaline in the lower part. The soil is calcareous throughout. The root zone is deep and easily penetrated by roots. The shrink-swell potential is low.

Talpa soils make up about 20 percent of each mapped area. Typically, the surface layer is brown loam about 8 inches thick. Hard, gray limestone is at a depth of 8 inches.

The Talpa soil is high in natural fertility and organic matter content. Permeability is moderate, and available water capacity is very low. Surface runoff is medium. Reaction is moderately alkaline, and the soil is calcareous throughout. The root zone is very shallow and restricted by the limestone bedrock. The shrink-swell potential is low.

Included with this complex in mapping are areas of Aspermont soils on convex side slopes and Tillman soils in small concave areas of the upland. Also included are small outcrops of limestone and small areas of Cornick soils that are on ridges. Included soils make up about 30 percent of this map unit, but individual areas are generally less than 5 acres.

Most areas of these Quanah and Talpa soils are used for range. These soils have low potential for range, but they are best suited to this use. With good management, the Quanah soils will produce moderate amounts of native grass and the Talpa soils will produce low amounts. The potential for improved pasture is low because of very low available water capacity and the restricted root zone of the Talpa soil. Overgrazing or grazing during prolonged dry periods is detrimental to grass stands, and it causes excessive runoff and poor tilth. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during dry periods help keep the grass and soil in good condition.

These soils have low potential for trees in windbreaks and post lots. Low available water capacity and depth to bedrock in areas of Talpa soils are the main limitations.

The potential is low for openland wildlife habitat and medium for rangeland wildlife habitat.

Potential is medium for building sites and for sanitary facilities. Low strength is a limitation of the Quanah soils for local roads and streets, but this can be corrected by strengthening or replacing the base material. The moderate permeability of the Quanah soils is a limitation for septic tank absorption fields, but this can be easily overcome by increasing the size of the absorption area. The Talpa soils are very shallow to bedrock, and this limitation is very difficult to overcome. The deep Quanah soils are better suited to these uses than are the shallow Talpa soils.

These soils have medium potential for most recreational uses. Slope, texture, and depth to rock are the main limitations. Onsite investigation is essential to evaluate and plan the development of specific sites.

This complex is in capability subclass VIs. Quanah part is in Hardland range site, and Talpa part is in Shallow Prairie range site.

45—Quinlan-Obaro complex, 2 to 5 percent slopes, eroded. This complex consists of very gently sloping to gently sloping, well drained loamy soils on eroded uplands. The shallow Quinlan soils and the moderately deep Obaro soils are on convex side slopes. The surface layer has been thinned by erosion, and the subsoil is exposed in many areas. Small gullies are in many areas. Areas of these soils are so intricately mixed that they could not be shown separately at the scale selected for mapping. Areas are irregular in shape and range from 5 to 75 acres.

Quinlan soils make up about 60 percent of each mapped area. Typically, the surface layer is red silty clay loam about 5 inches thick. The subsoil, to a depth of 12 inches, is red silty clay loam. The underlying material is red siltstone.

The Quinlan soil is medium in natural fertility and low in organic matter content. Permeability is moderate, and available water capacity is low. Runoff is rapid, and the hazard of erosion is very severe. Reaction is mildly alkaline or moderately alkaline, and the soil is calcareous throughout. The root zone is shallow and is restricted by bedrock. The shrink-swell potential is moderate.

Obaro soils make up about 28 percent of each mapped area. Typically, the surface layer is reddish brown silt loam to a depth of about 14 inches. The subsoil, to a depth of 32 inches, is reddish brown silt loam. The underlying material is red, weakly cemented siltstone.

The Obaro soil is medium in natural fertility and low in organic matter content. Permeability is moderate, and runoff is medium. The hazard of erosion is very severe. Available water capacity is medium. Reaction is mildly or moderately alkaline, and typically the soil is calcareous throughout. The root zone is moderately deep, and root development is restricted by siltstone below a depth of about 32 inches. The shrink-swell potential is low.

Included with this complex in mapping are small areas of Woodward and St. Paul soils. Included soils make up about 12 percent of this map unit, but individual areas generally are less than 5 acres.

Most of the acreage of these Quinlan and Obaro soils are cultivated or have been farmed previously. About 25 percent of the area has been reseeded to grass. Potential is low for cultivated crops. These soils are suited to wheat, cotton, and grain sorghum. Where these soils are used for cultivated crops, there is a very severe hazard of erosion. Minimum tillage, terraces, residue management, contour farming, and grassed waterways help control runoff and erosion. Returning crop residue to the soil helps to maintain fertility, reduce crusting and blowing, and improve the water infiltration rate.

Potential is medium for tame pasture and hay. These soils are suited to bermudagrass, lovegrass, and other adapted grasses and legumes for hay and pasture.

These soils have medium potential for rangeland. Under good management, these soils will produce moderate amounts of native grass. Use of these soils for pasture or range is also effective in controlling erosion. Proper stocking, timely deferment of grazing, and restricted use during dry periods keep the grass and soil in good condition.

These soils have low potential for trees in windbreaks and post lots. The main limitation is the depth to bedrock and low to medium available water capacity. The potential is medium for rangeland wildlife habitat and openland wildlife habitat.

Potential is medium for building sites and low for sanitary facilities. Depth to bedrock is the main limitation for dwellings and roads. Depth to bedrock and seepage are limitations for septic tank absorption fields and sewage lagoons. The moderately deep Obaro soils are better suited to this use than are the shallow Quinlan soils.

These soils have medium potential for most recreational uses. Slope and depth to bedrock are the main limitations. Onsite investigation is essential to evaluate and plan the development of specific sites.

This complex is in capability subclass IVe. Quinlan part is in Shallow Prairie range site, and Obaro part is in Loamy Prairie range site.

46—Quinlan-Obaro complex, 5 to 12 percent slopes. This complex consists of sloping to strongly sloping, well drained loamy soils on uplands. The shallow Quinlan soils are on convex side slopes and escarpments along narrow drainageways, and the moderately deep Obaro soils are on ridgetops and foot slopes. Areas of these soils are so intermingled that they could not be shown separately at the scale selected for mapping. Areas range from 10 to 600 acres.

Quinlan soils make up 60 percent of each mapped area. Typically, the surface layer is dark reddish brown silty clay loam about 10 inches thick. The subsoil, to a depth of 18 inches, is reddish brown silty clay loam. The underlying material is compacted silty red beds of stratified sandstone and siltstone.

The Quinlan soil is medium in natural fertility and organic matter content. Permeability is moderate, and the available water capacity is low to very low. Runoff is rapid. Reaction is moderately alkaline, and the soil is calcareous throughout the profile. The root zone is shallow, and root development is restricted below a depth of about 18 inches by siltstone. The shrink-swell potential is moderate.

Obaro soils make up 30 percent of each mapped area. Typically, the surface layer is reddish brown silt loam about 14 inches thick. The subsoil extends to a depth of 36 inches. It is reddish brown silt loam with common calcium carbonate concretions and threads to a depth of about 24 inches, and it is red silt loam that is 5 percent by volume secondary lime in the form of concretions and soft bodies to a depth of about 36 inches. The underlying material is compacted red silty sandstone.

The Obaro soil is medium in natural fertility and organic matter content. Permeability is moderate, and the available water capacity is medium. Runoff is rapid. Reaction is mildly alkaline or moderately alkaline, and the soil is calcareous throughout. The root zone is moderately deep, and root development is restricted below a depth of about 36 inches by sandstone. The shrink-swell potential is low.

Included with this complex in mapping are small areas of Woodward soils. Included soils make up about 10 percent of this map unit.

These Quinlan and Obaro soils are not suited to cultivated crops because of slope and the very severe hazard of erosion. Most areas of these soils are in rangeland, and they have medium potential for this use.

Under good management, these soils will produce a moderate amount of native grass. The potential is low for tame pasture and hay, and these soils are suited to bermudagrass and lovegrass. Use of these soils for pasture or range is effective in controlling erosion. Proper stocking, timely deferment of grazing, rotation grazing, and restricted use during dry periods keep the grass and soil in good condition.

The potential is low for trees in windbreaks and post lots. Depth to bedrock, slope, low to medium available water capacity, and the hazard of erosion are the main limitations that affect survival and growth of the trees.

These soils have medium potential for openland wildlife habitat and low potential for rangeland wildlife habitat.

Potential is medium for building sites and low for sanitary facilities. Slope and depth to bedrock are the main limitations.

Potential is medium for most recreational developments, but it is low for playgrounds. Slope and depth to bedrock are the main limitations. The moderately deep Obaro soils are better suited to these uses than are the shallow Quinlan soils. Onsite investigation is necessary to evaluate and plan the development of specific sites.

This complex is in capability subclass VIe. Quinlan part is in Shallow Prairie range site, and Obaro part is in Loamy Prairie range site.

47—Quinlan-Woodward complex, 2 to 5 percent slopes, eroded. This complex consists of loamy soils on eroded uplands. These soils are very gently sloping to gently sloping and well drained. The Quinlan soils are shallow and the Woodward soils are moderately deep. Areas of these soils are so intermingled that they could not be shown separately at the scale selected for mapping. Rills and small gullies are common, and the subsoil is exposed in more than half of the area. These soils are mainly in the southeastern part of the county. Areas are irregular in shape and range from 10 to 80 acres.

Quinlan soils make up about 55 percent of each mapped area. Typically, the surface layer is yellowish red loam to a depth of about 7 inches. The subsoil, to a depth of 16 inches, is red loam. The underlying material is soft red sandstone.

The Quinlan soil is medium in natural fertility and low in organic matter content. Permeability is moderately rapid, and runoff is medium. Available water capacity is low. Reaction is mostly moderately alkaline. The surface layer is friable and easily tilled throughout a wide range in moisture content. Root development is restricted by sandstone bedrock below a depth of about 16 inches. The shrink-swell potential is low.

Woodward soils make up about 35 percent of each mapped area. Typically, the surface layer is reddish brown loam to a depth of about 10 inches. The subsoil, to a depth of 24 inches, is yellowish red and reddish yellow loam. The underlying material below a depth of 24 inches is soft weathered sandstone.

The Woodward soil is low in natural fertility and organic matter content. Permeability is moderate, and runoff is medium. Available water capacity is medium. Reaction is mildly alkaline or moderately alkaline in all parts of the soil. The surface layer is friable and easily tilled throughout a wide range in moisture content. Root development is restricted below a depth of about 24 inches by sandstone bedrock. The shrink-swell potential is low.

Included with this complex in mapping are small areas of Obaro soils. These soils make up about 10 percent of the map unit, but individual areas are less than 5 acres.

Most areas of these Quinlan and Woodward soils are cultivated. Potential is low for cultivated crops. These soils are suited to wheat, cotton, and grain sorghum. Where cultivated crops are grown, there is a very severe hazard of erosion. Minimum tillage, terraces, contour farming, cover crops, and residue management reduce soil loss. Returning crop residue to the soil also helps to prevent crusting and damage from soil blowing and increases water infiltration.

Potential is medium for tame pasture and hay. These soils are suited to bermudagrass and lovegrass.

These soils have medium potential for rangeland. With good management, Quinlan soils will produce moderate amounts of native grass and Woodward soils will produce large amounts. Using these soils for tame pasture or range is also effective in controlling erosion. Overgrazing or grazing during prolonged dry periods is detrimental to the grass. Proper stocking, timely deferment of grazing, rotation grazing, and restricted use during dry periods help keep the grass and soil in good condition.

The potential is low for trees in windbreaks and post lots. The main limitations are depth to bedrock and medium to low available water capacity.

These soils have medium potential for openland wildlife habitat and rangeland wildlife habitat.

Potential is medium for building sites and low for sanitary facilities. Shallow depth to bedrock is the main limitation for dwellings and roads. Low strength is a limitation for local roads and streets, but this can be overcome by strengthening or replacing base material. Shallow depth to bedrock is a limitation for most sanitary facilities and is difficult to overcome.

Potential is medium for most recreational uses. Slope and depth to bedrock are the main limitations. Onsite investigation is essential to evaluate and plan the development of specific sites.

This complex is in capability subclass IVe. Quinlan part is in Shallow Prairie range site, and Woodward part is in Loamy Prairie range site.

48—Quinlan-Woodward complex, 5 to 12 percent slopes. This complex consists of sloping to strongly sloping, well drained loamy soils on uplands. The shallow

Quinlan soils are on convex side slopes and small escarpments, and the moderately deep Woodward soils are on ridgetops and foot slopes. Areas of these soils are so intermingled that they could not be shown separately at the scale selected for mapping. They are mainly in narrow areas along small drainageways and along the North Fork of the Red River. Areas range from 10 to 300 acres.

Quinlan soils make up about 60 percent of each mapped area. Typically, the surface layer is reddish brown, calcareous loam about 10 inches thick. The underlying material is yellowish red, weakly cemented, calcareous sandstone.

The Quinlan soil is medium in natural fertility and low in organic matter content. Permeability is moderately rapid, and the available water capacity is very low. Surface runoff is rapid. Reaction is mildly alkaline or moderately alkaline, and the soil is calcareous throughout. The root zone is shallow, and root development is restricted below a depth of 10 inches by sandstone bedrock. The shrink-swell potential is low.

Woodward soils make up about 35 percent of each mapped area. Typically, the surface layer is brown loam about 12 inches thick. The subsoil, to a depth of about 30 inches, is reddish brown, calcareous loam. The underlying material is weakly cemented, reddish yellow, calcareous sandstone.

The Woodward soil is medium in natural fertility and organic matter content. Permeability is moderate, and available water capacity is medium. Surface runoff is rapid. Reaction is neutral to moderately alkaline, and the soil is typically calcareous throughout. The root zone is moderately deep, and root development is restricted below a depth of about 30 inches by sandstone bedrock. The shrink-swell potential is low.

Included with this complex in mapping are small areas of Obaro soils. These included soils make up about 5 percent of this map unit, but individual areas are generally less than 5 acres.

These Quinlan and Woodward soils are not suited to cultivated crops because of slope and the severe hazard of erosion. Most of the acreage is in range, and the soils have medium potential for rangeland. With good management, the Quinlan soils will produce moderate amounts of native grass and the Woodward soils will produce large amounts. These soils have low potential for tame pasture and hay, but they are suited to bermudagrass and lovegrass. Overgrazing or grazing during prolonged dry periods is detrimental to the grass stand. Proper stocking, timely deferment of grazing, rotation grazing, and restricted use during dry periods will help keep the grass and soil in good condition.

The potential is low for trees in windbreaks and post lots. Depth to bedrock, slope, low to medium available water capacity, and the hazard of erosion are the main limitations to successful establishment and growth of trees.

These soils have medium potential for openland wildlife habitat and low potential for rangeland wildlife habitat.

Potential is medium for building sites and recreational development. These soils have low potential for sanitary facilities. The moderately deep Woodward soils are better suited to these uses than the shallow Quinlan soils. Slope and depth to bedrock are the main limitations. Onsite investigation is necessary to evaluate and plan the development of specific sites.

This complex is in capability subclass VIe. Quinlan part is in Shallow Prairie range site, and Woodward part is in Loamy Prairie range site.

49—Quinlan and Dill soils, 2 to 12 percent slopes, severely eroded. This map unit consists of shallow and moderately deep, loamy soils on uplands. These soils are very gently sloping to strongly sloping and well drained. The pattern of these soils is variable from one mapped area to the next. Some areas contain only Quinlan soils, and other areas contain both Quinlan and Dill soils. Both soils are on convex, severely eroded uplands. Erosion has removed much of the surface layer, and in many areas sandstone bedrock is exposed at the surface. There are many gullies, some of which are crossable with farm machinery and some of which are not. Areas are irregular in shape and range from 10 to 50 acres.

Quinlan soils make up 75 percent of each mapped area. Typically, the surface layer is reddish brown fine sandy loam about 4 inches thick. The subsoil, to a depth of 10 inches, is reddish brown fine sandy loam. The underlying material is weakly cemented, calcareous sandstone.

The Quinlan soil is medium in natural fertility and low in organic matter content. Permeability is moderately rapid, and available water capacity is very low. Surface runoff is rapid. Reaction is moderately alkaline, and the soil is mostly calcareous throughout. The root zone is shallow, and root development is restricted below a depth of about 10 inches by sandstone bedrock. The shrink-swell potential is low.

Dill soils make up about 20 percent of each mapped area. Typically, the surface layer is reddish brown fine sandy loam about 11 inches thick. The subsoil, to a depth of 30 inches, is reddish brown fine sandy loam. The underlying material is red, weakly cemented sandstone.

The Dill soil is medium in natural fertility and low in organic matter content. Permeability is moderately rapid, and available water capacity is low. Surface runoff is rapid. Reaction is slightly acid to mildly alkaline in the surface layer and subsoil. The root zone is moderately deep, and root development is restricted below a depth of about 30 inches by sandstone bedrock. The shrink-swell potential is low.

Included with these soils in mapping are small areas of Woodward Variant fine sandy loam. These inclusions make up about 5 percent of the map unit, but individual areas are mostly less than 5 acres.

Most areas of Quinlan and Dill soils are abandoned crop fields that have been reseeded to native grasses. Most of the acreage is used for range or tame pasture. These soils have low potential for rangeland. Under good management, Quinlan soils will produce low amounts of native grass and Dill soils will produce moderate amounts of native grass. Potential is low for pasture and hay. These soils are suited to grasses for tame pasture, but low available water capacity and restricted rooting depth are limitations. Overgrazing or grazing during prolonged dry periods is detrimental to grass stands and causes excessive runoff and poor tilth. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during dry periods keep the grass and soil in good condition.

These soils are not suited to cultivated crops. Deep gullies, the very severe hazard of erosion, depth to bedrock, and slope are severe limitations that are difficult to overcome.

The potential is low for trees in windbreaks and post lots. Low available water capacity, the very severe hazard of erosion, and depth to bedrock are the main limitations.

These soils have medium potential for openland wildlife habitat and low potential for rangeland wildlife habitat.

Potential is medium for building sites and low for most sanitary facilities. Slope, gullies, and shallowness to bedrock are the main limitations for building sites. Depth to bedrock and seepage are the main limitations for onsite waste disposal.

The potential is low for most recreational uses. Slope, gullies, and depth to bedrock are limiting factors.

This map unit is in capability subclass VIe; Eroded Prairie range site.

50—Spur loam. This loamy soil is deep, nearly level, and well drained. It is on flood plains and is subject to occasional flooding. Slope gradients range from 0 to 1 percent. Areas are irregular in shape and range from 5 to 150 acres.

Typically, the surface layer is brown and dark brown, calcareous loam about 15 inches thick. The subsoil, to a depth of 30 inches, is dark brown, calcareous loam. The underlying material to a depth of 60 inches or more is reddish brown, calcareous loam.

Natural fertility and organic matter content are high. Permeability is moderate, and surface runoff is slow. Available water capacity is high. The surface layer is friable and easily tilled throughout a fairly wide range in moisture content. However, the surface has a tendency to crust or puddle after hard rains. The root zone is deep, and root development is generally unrestricted. The shrink-swell potential is moderate.

Included with this soil in mapping are small areas of Yahola and Clairemont soils. The included soils make up about 10 percent of this map unit, but individual areas generally are less than 5 acres.

About half of the acreage of this Spur soil is cultivated. The rest is in tame pasture or range. This soil has high potential for cultivated crops. It is suited to small grains, grain sorghum, cotton, and legumes. Minimum tillage, winter cover crops, and returning crop residue to the soil improve fertility, reduce crusting, and increase water infiltration.

This soil has high potential for hay and tame pasture. It is suited to bermudagrass, lovegrass, and other adapted grasses and legumes for hay and pasture.

The potential is high for rangeland. With good management, this soil will produce large amounts of native grass. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth and reduces water infiltration. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during wet periods keep the grass and soil in good condition.

This soil has high potential for trees in windbreaks and post lots. Occasional flooding is the only limitation to establishing trees on this site. The high available water capacity promotes good growth of windbreak plantings.

Potential is high for openland wildlife habitat and rangeland wildlife habitat.

Potential is low for building sites and for sanitary facilities. Flooding is the major limitation.

This soil has low potential for most recreational uses. Occasional flooding is a major limitation for camp areas. Onsite investigation is necessary to evaluate and plan the development of specific sites.

This soil is in capability subclass IIw; Loamy Bottomland range site.

51—Spur clay loam. This loamy soil is deep, nearly level, and well drained. It is on flood plains and is subject to frequent flooding. Slope gradients range from 0 to 1 percent. Areas are irregular in shape and range from 5 to 100 acres.

Typically, the surface layer is dark brown clay loam about 18 inches thick. The subsoil, to a depth of 56 inches, is reddish brown clay loam. The underlying material to a depth of about 65 inches or more is reddish brown clay loam.

Permeability is moderate, and surface runoff is slow. Available water capacity is high. Natural fertility and organic matter content are high. The root zone is deep, and root development is generally unrestricted. The shrink-swell potential is moderate.

Included with this soil in mapping are a few small areas of Yahola soils. The included soil makes up about 5 percent of this map unit, but individual areas generally are less than 5 acres.

This Spur soil has low potential for cultivated crops. Frequent flooding is the major hazard for cultivated crops.

Most areas of this soil are in range. This soil has high potential for rangeland. With good management, it will produce large amounts of native grass. This soil has high potential for hay and tame pasture. It is suited to bermudagrass, lovegrass, and other adapted grasses and legumes for hay and pasture. Overgrazing when the soil is too wet causes surface compaction and poor tilth and reduces water infiltration. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during wet periods keep the grass and soil in good condition.

This soil has high potential for trees in windbreaks and post lots. In some years, frequent flooding may be a limitation for establishing trees on this site.

The potential is medium for rangeland wildlife habitat and low for openland wildlife habitat.

Potential is low for building sites and for most sanitary facilities. Frequent flooding is a limitation that is difficult to overcome.

This soil has low potential for most recreational uses. Frequent flooding is the main limitation. Onsite investigation is necessary to evaluate and plan the development of specific sites.

This soil is in capability subclass Vw; Loamy Bottomland range site.

52—St. Paul silt loam, 0 to 1 percent slopes. This nearly level loamy soil is deep and well drained. It is on broad flats on uplands. Areas are irregular in shape and range from 15 to 250 acres.

Typically, the surface layer is dark grayish brown silt loam to a depth of about 14 inches. The subsoil extends to a depth of 50 inches. It is dark brown silty clay loam to a depth of about 19 inches, reddish brown silty clay loam to a depth of about 42 inches, and yellowish red silty clay loam to a depth of 50 inches. The underlying material is yellowish red silt loam to a depth of 60 inches or more.

Natural fertility and organic matter content are high. Permeability is moderately slow, and surface runoff is slow. Available water capacity is high. Reaction is neutral or mildly alkaline in the surface layer and the upper part of the subsoil and moderately alkaline in the lower part of the subsoil. The surface layer is friable and easily tilled throughout a fairly wide range in moisture content. Root development is unrestricted throughout the soil. The shrink-swell potential is moderate.

Included with this soil in mapping are small areas of Carey soils that are in convex areas. The included soils make up about 5 percent of the map unit, but individual areas generally are less than 5 acres.

Most areas of this St. Paul soil are cultivated. Potential is high for cultivated crops. This soil is suited to wheat, cotton, grain sorghum, and alfalfa. The hazard of erosion is slight. Minimum tillage and residue management will help to maintain fertility, organic matter content, and tilth and will increase water infiltration.

Potential is high for tame pasture and hay. This soil is suited to bermudagrass and weeping lovegrass. Proper grazing management and fertilization will keep the grass and soil in good condition. This soil has high potential for rangeland. With good management, this soil will produce large amounts of native grass. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth and reduces water infiltration. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during wet periods keep the grass and soil in good condition.

This soil has high potential for trees in windbreaks and post lots. The limited rainfall during the summer is the main limiting factor for trees.

This soil has high potential for openland wildlife habitat and medium potential for rangeland wildlife habitat.

Potential is medium for building sites. Low strength and shrinking and swelling are limitations for dwellings that can be overcome by good design and careful installation procedures. Low strength is also a limitation for local roads and streets, but this can be corrected by strengthening or replacing the base material. Potential is medium for most sanitary facilities. Moderately slow permeability is a limitation for septic tank absorption fields, but this can be overcome by increasing the size of the filter field.

This soil has high potential for most recreational uses. Dust blowing is a limitation, but this can be overcome by maintaining a good grass cover. Onsite investigation is essential to evaluate and plan the development of specific sites.

This soil is in capability subclass IIc; Loamy Prairie range site.

53—St. Paul silt loam, 1 to 3 percent slopes. This very gently sloping loamy soil is deep and well drained. It is on broad uplands. Areas are irregular in shape and range from 10 to 300 acres.

Typically, the surface layer is dark grayish brown silt loam about 10 inches thick. The subsoil extends to a depth of 52 inches. It is dark brown silty clay loam to a depth of about 16 inches, and reddish brown silty clay loam to a depth of about 52 inches. The underlying material is yellowish red silt loam to a depth of 65 inches or more.

Natural fertility and organic matter content are high. Permeability is moderately slow, and surface runoff is medium. Available water capacity is high. Reaction is neutral or mildly alkaline in the surface layer and upper part of the subsoil and moderately alkaline in the lower part of the subsoil. The surface layer is friable and can be tilled throughout a fairly wide range in moisture content. Root development is unrestricted throughout the soil. The shrink-swell potential is moderate.

Included with this soil in mapping are convex areas of Woodward and Carey soils. The included soils make up about 10 percent of this map unit, but individual areas are less than 5 acres.

Most areas of this St. Paul soil are cultivated. Potential is high for cultivated crops. This soil is suited to wheat, cotton, grain sorghum, and alfalfa. The hazard of water erosion is moderate. Terracing, contour farming, minimum tillage, and residue management will reduce erosion, help maintain organic matter content and good tilth, and increase the water infiltration rate.

Potential is medium for tame pasture and hay. This soil is suited to bermudagrass and weeping lovegrass. Proper grazing management and fertilization will keep the grass and soil in good condition. This soil has high potential for rangeland. Under good management, it will produce large amounts of native grass. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth and reduces water infiltration. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during wet periods keep the grass and soil in good condition.

This soil has high potential for trees in windbreaks and post lots. The limited rainfall during the summer is the main limiting factor for trees.

This soil has high potential for openland wildlife habitat and medium potential for rangeland wildlife habitat.

Potential is medium for building sites and for sanitary facilities. Low strength and shrinking and swelling are limitations for dwellings that can be easily overcome by good design and careful installation procedures. Low strength is a limitation for local roads and streets, but this can be overcome by strengthening or replacing the base material. There are few limitations for using this soil for sewage lagoons. Moderately slow permeability is a limitation for septic tank absorption fields, but this can be overcome by increasing the size of the filter field.

This soil has high potential for most recreational uses. Dust blowing is a limitation that can be overcome by maintaining a good grass cover. Onsite investigation is essential to evaluate and plan the development of specific sites.

This soil is in capability subclass IIe; Loamy Prairie range site.

54—Tillman clay loam, 1 to 3 percent slopes. This very gently sloping loamy soil is deep, well drained, and slowly permeable. It is on uplands. Slopes are smooth and convex. Areas range from 5 to 120 acres.

Typically, the surface layer is dark brown clay loam about 16 inches thick. The subsoil extends to a depth of 75 inches. It is reddish brown clay to a depth of 55 inches and yellowish red clay to a depth of 75 inches.

This soil is high in natural fertility and organic matter content. Permeability is slow, and available water capacity is high. Surface runoff is medium. Reaction is mildly alkaline or moderately alkaline in the upper part of the soil and moderately alkaline in the lower part of the soil. This soil is calcareous in the lower part. The soil has fair tilth and can be worked throughout a limited range in moisture content. Although the root zone is deep, it is somewhat restricted by very firm clay layers below a depth of 20 inches. The shrink-swell potential is high.

Included with this soil in mapping are small areas of Vernon soils. Included soils make up about 10 percent of this map unit, but individual areas are generally less than 5 acres.

Most areas of this Tillman soil are cultivated, although some areas are used for range. Potential is medium for cultivated crops. This soil is suited to wheat, cotton, and grain sorghum. The hazard of erosion is moderate if cultivated crops are grown. Minimum tillage, winter cover crops, terracing, contour farming, grassed waterways, and residue management help prevent soil loss, improve fertility, reduce surface crusting, and increase water infiltration.

Potential is medium for tame pasture and hay. The soil is suited to bermudagrass and lovegrass.

This soil has medium potential for rangeland. With good management, this soil will produce moderate amounts of native grass. Use of this soil for pasture or range effectively controls erosion. Care must be taken to control stocking rates and time of grazing because grass stands are easily damaged during a drought.

This soil has low potential for trees in windbreaks and post lots. The dense clayey subsoil and lack of summer rainfall are the main limitations to successful establishment of trees.

The potential is high for openland wildlife habitat and medium for rangeland wildlife habitat.

Potential is low for building sites and most sanitary facilities. Low strength and shrinking and swelling are the main limitations for dwellings, but these limitations can be overcome by proper design and installation procedures. Low strength and shrinking and swelling are limitations for local roads and streets, but these limitations can be overcome by strengthening or replacing the base material. The slow permeability is a limitation for septic tank absorption fields, but this can be overcome by increasing the size of the absorption field.

This soil has medium potential for most recreational uses. Slow permeability and the clay loam surface layer are the main limitations. Onsite investigation is necessary to evaluate and plan the development of specific sites.

This soil is in capability subclass IIIe; Hardland range site.

55—Tipton loam, 0 to 1 percent slopes. This nearly level loamy soil is deep and well drained. It is on convex uplands. Areas are irregular in shape and range from 10 to 200 acres.

Typically, the surface layer is brown and dark brown loam to a depth of about 16 inches. The subsoil extends to a depth of 65 inches. It is dark brown clay loam to a depth of about 24 inches, is reddish brown clay loam to a depth of about 50 inches, and dark brown clay loam to a depth of 65 inches.

Permeability is moderate, and surface runoff is slow. Available water capacity is high. Natural fertility and organic matter content are high. Reaction is neutral or mildly alkaline in the surface layer and mildly alkaline or moderately alkaline in the subsoil. The surface layer is friable and easily tilled throughout a fairly wide range in moisture content. It has, however, a tendency to crust or puddle after hard rains. Root development is unrestricted throughout the soil. The shrink-swell potential is low.

Included with this soil in mapping are small concave areas of Abilene soils. The included soil makes up about 5 percent of this map unit, but individual areas are generally less than 5 acres.

Most areas of this Tipton soil are cultivated. Potential is high for cultivated crops. This soil is suited to wheat, grain sorghum, and cotton. The hazard of wind erosion is moderate. Minimum tillage, winter cover crops, and residue management help prevent soil blowing, improve fertility, reduce surface crusting, and increase water infiltration.

Potential is high for tame pasture and hay. This soil is suited to bermudagrass, lovegrass, alfalfa, and other adapted grasses and legumes for hay and pasture.

This soil has high potential for rangeland, although very little is used for this purpose. Under good management, it will produce large amounts of native grass. Use of this soil for tame pasture, range, or hay helps to control wind and water erosion. Overgrazing or grazing when the soil is too wet or too dry may cause surface compaction, which can restrict root development. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during wet or droughty periods help keep the grass and soil in good condition.

This soil has high potential for trees in windbreaks and post lots. It has high potential for openland wildlife habitat and rangeland wildlife habitat.

Potential is high for building sites and for most sanitary facilities. Low strength is a limitation for dwellings but this can be overcome by proper design and installation procedures. Low strength is also a limitation for local roads and streets, but this can be overcome by strengthening or replacing the base material. Seepage is a limitation for sewage lagoons, but this can be overcome by special treatment to seal the bottom of the lagoon.

This soil has high potential for most recreational uses. Onsite investigation is essential for evaluating and planning the development of specific sites.

This soil is in capability class I; Loamy Prairie range site.

56—Tipton loam, 1 to 3 percent slopes. This very gently sloping loamy soil is deep and well drained. It is on convex ridgetops in the uplands. The major acreage is in the southeast part of the county, mostly north of the North Fork of the Red River. Areas are irregular in shape and range from 5 to 200 acres.

Typically, the surface layer is dark reddish gray and reddish brown loam about 14 inches thick. The subsoil extends to a depth of 65 inches. It is reddish brown loam to a depth of about 18 inches, reddish brown clay loam and loam to a depth of about 61 inches, and reddish brown clay loam to a depth of 65 inches.

Natural fertility and the organic matter content are high. Permeability is moderate, and surface runoff is medium. The available water capacity is high. Reaction ranges from neutral to moderately alkaline in the upper part of the profile and is mildly alkaline or moderately alkaline in the lower part. The soil is also calcareous in the lower part. The surface layer is friable and easily tilled throughout a fairly wide range in moisture content. It does have a tendency to crust after hard rains, especially in areas where the plow layer contains subsoil material. The root zone is deep and fairly easily penetrated by plant roots. The shrink-swell potential is low.

Included with this soil in mapping are small areas of Hardeman soil that are on convex knolls. The included soils make up about 10 percent of this map unit, but individual areas are mostly less than 5 acres.

Most areas of this Tipton soil are cultivated. Potential is high for cultivated crops. This soil is suited to wheat, grain sorghum, and cotton. A small acreage of mung beans is sown in some years. The hazard of wind and water erosion is moderate. Minimum tillage, terracing, contour farming, grassed waterways, winter cover crops, and residue management reduce soil loss, improve fertility, reduce surface crusting, and increase water infiltration.

Potential is high for tame pasture and hay. This soil is suited to bermudagrass, lovegrass, alfalfa, and other adapted grasses and legumes for hay and pasture.

This soil has high potential for rangeland, although very little is used for this purpose. With good management, this soil will produce large amounts of native grass. Use of this soil for pasture, range, or hay helps control wind and water erosion. Overgrazing or grazing when the soil is too wet or too dry may cause surface compaction, which can restrict root development. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during wet or droughty periods help keep the grass and soil in good condition.

This soil has high potential for trees in windbreaks and post lots. Slope is the main limitation. This soil has high potential for openland wildlife habitat and for rangeland wildlife habitat.

Potential is high for building sites and for most sanitary facilities. Low strength is a limitation for dwellings but can be overcome by good design and proper installation procedures. Low strength is also a limitation for roads and streets, but this can be overcome by strengthening or replacing the base material. Seepage is a limitation for sewage lagoons, but this can be overcome by special treatment to seal the bottom of the lagoon.

This soil has high potential for most recreational uses. Onsite investigation is essential to evaluate and plan the development of specific sites.

This soil is in capability subclass IIe; Loamy Prairie range site.

57—Tivoli fine sand. This sandy soil is undulating to rolling, deep, excessively drained, and rapidly permeable. It is in hummocky dune areas on flood plains or in higher areas adjacent to the flood plain. Slope gradient is dominantly 5 to 12 percent. Areas are generally long, narrow, sandy dunes and range from 5 to 300 acres.

Typically, the surface layer is brown fine sand about 6 inches thick. The underlying material is very pale brown fine sand to a depth of 60 inches or more.

This soil is low in natural fertility and organic matter content. Permeability is low, and available water capacity is low. Surface runoff is very slow. Reaction is mildly alkaline or moderately alkaline in the upper part of the profile and moderately alkaline in the lower part. The root zone is deep and easily penetrated by plant roots. The shrink-swell potential is low.

Included with this soil in mapping are areas of soils that are similar to the Tivoli soil but that have a buried soil below 40 inches. These soils are in concave areas between dunes. Small areas of Lincoln soils are also included. The included soils make up about 5 percent of the map unit, but individual areas are generally less than 5 acres.

Most areas of this Tivoli soil are in range. Although the soil has low potential for range, it is best suited to this use. Under good management this soil will produce small amounts of native grass. Use of this soil for range is effective in controlling erosion. Very careful management is required to maintain a cover that is adequate to prevent damage from soil blowing. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during dry periods help keep the grass and soil in good condition.

This soil is not suited to cultivation, tame pasture, or hay. The hazard of wind erosion is very severe. In addition, steepness of slope and low available water capacity are limitations for these uses.

This soil is not suited to growing trees in windbreaks and post lots. Slope and low available water capacity are the main limitations. This soil has low potential for openland wildlife habitat and rangeland wildlife habitat.

Potential is medium for building sites and low for most sanitary facilities. Slope is the main limitation for dwellings and roads. Slope and seepage are the main limitations for sanitary facilities.

This soil has low potential for most recreational uses. Slope and the loose sandy surface layer are the main limitations. Onsite investigation is essential to evaluate and plan the development of specific sites.

This soil is in capability subclass VIIe; Dune range site.

58—Treadway clay. This nearly level, deep, well drained clayey soil is on slightly convex alluvial fans and upper parts of flood plains. This soil floods rarely. It formed in clayey material at the base of geologically eroding Permian red beds. Slope gradients range from 0 to 1 percent. Areas are irregular in shape and range from 5 to 300 acres.

Typically, the surface layer is reddish brown clay about 7 inches thick. The underlying material to a depth of 60 inches or more is reddish brown clay that has thin strata of clay loam.

This soil is medium in natural fertility and low in organic matter content. Permeability is very slow, and available water capacity is low. Surface runoff is very rapid. Reaction is moderately alkaline or strongly alkaline, and the soil is typically calcareous throughout. Root development is restricted by the dense clayey substratum and salinity. The shrink-swell potential is high.

Included with this soil in mapping are small areas of Badland on knobs or in convex areas. Also included are a few areas of Beckman and Mangum soils. The included soils make up 20 percent of this map unit, but individual areas generally are less than 5 acres.

Most areas of this Treadway soil are used for native range, but the soil has low potential for range. The vegetation consists of a sparse cover of short grasses, mesquite, and pricklypear. Proper stocking, rotation grazing, timely deferment of grazing, and control of woody plants help keep the grass and soil in good condition. Under good management this soil will produce small amounts of native grass.

This soil is not suited to cultivated crops or grasses and legumes for hay and tame pasture. Dense clayey texture, salinity, and low available water capacity are severe management problems.

This soil is not suited to trees in windbreaks and post lots. Clay texture, salinity, and low available water capacity are the main limitations to the establishment and survival of trees.

The potential is low for openland wildlife habitat and rangeland wildlife habitat.

Potential is low for building sites and sanitary facilities. Shrinking and swelling, low strength, and the hazard of rare flooding are the main limitations. Shrinking and swelling and low strength are also limitations for local roads and streets, but they can be overcome by strengthening or replacing the base material. Very slow permeability is a limitation for septic tank absorption fields, but can be partially overcome by increasing the size of the absorption area. The hazard of flooding is a limitation that is difficult to overcome.

This soil has low potential for most recreational uses. The clay surface texture, very slow permeability, and flood hazard are the main limitations. Onsite investigation is essential to evaluate and plan the development of specific sites.

This soil is in capability subclass VIs; Red Clay Flats range site.

59—Ustorthents, sandy. This map unit consists of areas where the soils and the underlying material have been removed for building roads, dams, foundations, and other structures. These excavated areas have nearly vertical sides and very gently sloping to sloping bottoms. Areas are 5 to 30 feet deep, 300 to 1,500 feet long, and 150 to 1,000 feet wide. The kinds of these areas in the county are borrow pits, gravel pits, and sand pits. The soils in the pit areas are sandy and are variable in content of coarse fragments.

Most areas of these soils are revegetating naturally and support a sparse cover of annual weeds and grasses. Potential for rangeland is low, but most areas are best suited to this use. With good management, low to moderate amounts of native grass can be grown. Good management procedures include seeding of adapted species, deferment of grazing, proper stocking, and rotation grazing.

The potential is low for most urban and recreational uses.

This map unit is not assigned to a capability subclass or range site.

60—Vernon clay, 3 to 10 percent slopes. This gently sloping to strongly sloping clayey soil is moderately deep and well drained. It is on uplands. This soil occupies side slopes and gently sloping foot slopes above flood plains. Areas are irregular in shape and range from about 5 to 100 acres.

Typically, the surface layer is reddish brown clay about 10 inches thick. The subsoil, to a depth of 25 inches, is reddish brown clay. The underlying material is red and gray clayey shale.

Natural fertility is medium, and organic matter content is low. Permeability is very slow, and runoff is rapid. Available water capacity is low. Reaction is mostly moderately alkaline. Root development is restricted below a depth of about 20 inches by very firm clay and shale. The shrink-swell potential is high.

Included with this soil in mapping are a few areas of Treadway soils that are along the small drainageways. Also included are small areas of Aspermont and Knoco soils. Included soils make up about 20 percent of the map unit, but individual areas generally are less than 5 acres.

Most areas of this Vernon soil are in range. Potential is low for rangeland, but the soil is best suited to this use. With good management this soil will produce small amounts of native grass. The use of this soil for range is effective in controlling erosion and maintaining good soil structure. Proper stocking, deferment of grazing, rotation grazing, and restricted use during dry periods help keep the soil and grass in good condition.

This soil has low potential for crops or tame pasture. Slope, low available water capacity, and the severe hazard of erosion are the major limitations.

This soil has low potential for trees in windbreaks. Limiting factors are the high clay content, severe hazard of erosion, and low available water capacity.

Potential is low for building sites and for sanitary facilities. Slope, low strength, and shrinking and swelling are the main limitations for dwellings. Shrinking and swelling and low strength are limitations for local roads and streets, but they can be overcome by strengthening or replacing the base material.

This soil has low potential for most recreational uses. Slope, clayey surface texture, and very slow permeability are the main limitations. Onsite investigation is essential to evaluate and plan the development of specific sites.

This soil is in capability subclass VIe; Red Clay Prairie range site.

61—Woodward loam, 1 to 3 percent slopes. This very gently sloping loamy soil is on broad convex uplands. It is well drained and moderately deep. Areas are irregular in shape and range from 5 to 200 acres.

Typically, the surface layer is yellowish red and reddish brown loam about 14 inches thick. The subsoil is red and light red loam which extends to a depth of about 27 inches. The underlying material is light red, weakly cemented, calcareous sandstone.

Natural fertility and organic matter content are medium. Permeability is moderate, and surface runoff is medium. Available water capacity is medium. Reaction ranges from neutral to moderately alkaline in the surface layer and is mildly alkaline or moderately alkaline in the subsoil. The soil is generally calcareous throughout. The surface layer is friable and easily tilled throughout a wide range in moisture content. It has a tendency to crust or puddle after hard rains. Root development is restricted by soft sandstone below a depth of about 30 inches. The shrink-swell potential is low.

Included with this soil in mapping are small areas of Quinlan soils, which are on small knolls and on rims of convex side slopes. Also included are Carey soils that are on narrow, flat ridgetops and in concave areas. The included soils make up about 10 percent of this map unit, but individual areas are generally less than 5 acres.

Most areas of this Woodward soil are cultivated. Potential is medium for cultivated crops. This soil is suited to wheat, cotton, and grain sorghum. The hazard of erosion is moderate. Minimum tillage, winter cover crops, terraces, contour farming, and grassed waterways help prevent excessive soil loss. Returning crop residue to the soil improves or helps to maintain fertility, reduces crusting, and increases water infiltration.

Potential is medium for tame pasture and hay. This soil is suited to bermudagrass and lovegrass. Potential is high for rangeland. With good management, this soil will produce large amounts of native grass. The use of the soil for tame pasture, range or hay is effective in controlling erosion. Overgrazing will cause surface compaction, excessive runoff, and poor tilth. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during long dry periods help keep the grass and soil in good condition.

The potential is medium for trees in windbreaks and post lots. Medium available water capacity and the moderate depth to bedrock are the main limitations.

The potential of this soil is high for openland wildlife habitat and medium for rangeland wildlife habitat.

Potential is medium for building sites. Low strength is a limitation for dwellings but this can be overcome by good design and proper installation. Low strength is also a limitation for local roads and streets but this can be overcome by strengthening or replacing the base material. This soil has low potential for most sanitary facilities. The moderate depth to bedrock is a limitation for most sanitary facilities. For septic tank absorption fields, this limitation can be partially overcome by increasing the size of the filter field.

The potential of this soil is high for most recreational uses. Onsite investigation is essential for evaluating and planning the development of specific sites.

This soil is in capability subclass IIe; Loamy Prairie range site.

62—Woodward loam, 3 to 5 percent slopes. This gently sloping, loamy soil is on uplands. It is moderately deep and well drained. It mainly occupies the convex side slopes and the side slopes of the drainageways. Areas are irregular in shape and range from 5 to 75 acres.

Typically, the surface layer is reddish brown loam to a depth of about 10 inches. The subsoil, which extends to a depth of 36 inches, is yellowish red loam. The underlying material is red, weakly cemented, calcareous sandstone.

Natural fertility and organic matter content are medium. Permeability is moderate, and surface runoff is medium. Available water capacity is medium. Reaction ranges from neutral to moderately alkaline in the surface layer and is mildly alkaline or moderately alkaline in the subsoil. The surface layer is friable and easily tilled throughout a wide range in moisture content. Root development is restricted by sandstone below a depth of about 36 inches. The shrink-swell potential is low.

Included with this soil in mapping are small areas of Quinlan soils, which are on low knolls and on rims of convex side slopes. Also included are small areas of Carey soils on narrow, flat ridgetops and in concave areas. The included soils make up about 10 percent of this map unit, but individual areas are generally less than 5 acres.

Most areas of this soil are cultivated. Potential is medium for cultivated crops. This soil is suited to wheat, grain sorghum, and cotton. The hazard of erosion is moderate. Terraces, contour farming, residue management, and grassed waterways reduce runoff and help to control erosion.

Potential is medium for tame pasture and hay. This soil is suited to bermudagrass and lovegrass. It has high potential for rangeland. With good management, this soil will produce large amounts of native grass. Use of this soil for range or pasture is also effective in controlling erosion. Overgrazing during periods of drought will kill the grass stand and increase the hazard of erosion. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during dry periods help keep the grass and the soil in good condition.

This soil has medium potential for trees in field and farmstead windbreaks. Medium available water capacity and the moderate depth to bedrock are the main limitations.

The potential is high for openland wildlife habitat and medium for rangeland wildlife habitat.

Potential is medium for building sites and low for sanitary facilities. Low strength is a limitation for local roads and streets, but this can be overcome by strengthening the base material. The moderate depth to bedrock is a limitation for most sanitary facilities. For septic tank absorption fields, this limitation can be partly overcome by increasing the size of the filter field.

This soil has high potential for most recreational uses. Slope is the limiting feature for playgrounds. Onsite investigation is essential for evaluating and planning the development of specific sites.

This soil is in capability subclass IIIe; Loamy Prairie range site.

63—Woodward-Quinlan complex, 1 to 3 percent slopes. This complex consists of very gently sloping, well drained, loamy soils on convex uplands. Areas of the moderately deep Woodward soils and the shallow Quinlan soils are so intermingled that it was not practical to separate them in mapping. These soils are mainly in the southeastern part of the county. Areas range from 5 to 100 acres.

Woodward soils make up about 45 percent of each mapped area. Typically, the surface layer is reddish brown loam about 12 inches thick. The subsoil extends to a depth of 38 inches. It is reddish brown loam to a depth of 34 inches and red loam to a depth of about 38 inches. The underlying material is red, weakly cemented, calcareous sandstone.

The Woodward soil is medium in natural fertility and organic matter content. Permeability is moderate, and available water capacity is medium. Surface runoff is medium. Reaction is neutral to moderately alkaline in the surface layer and mildly alkaline or moderately alkaline in the subsoil. The soil is typically calcareous throughout. Root development is restricted below a depth of about 38 inches by sandstone bedrock. The shrink-swell potential is low.

Quinlan soils make up about 40 percent of each mapped area. Typically, the surface layer is reddish brown loam about 5 inches thick. The subsoil, which extends to a depth of 18 inches, is red loam. The underlying material is red, weakly cemented, calcareous sandstone that has thin layers of soft red siltstone and bluish gray sandstone.

The Quinlan soil is medium in natural fertility and organic matter content. Permeability is moderate, and available water capacity is low. Surface runoff is medium. Reaction is mildly alkaline or moderately alkaline. This soil is generally calcareous throughout. Root development is restricted below a depth of about 18 inches by sandstone bedrock. The shrink-swell potential is low.

Included with this complex in mapping are small areas of Carey soils which make up about 15 percent of each mapped area. Individual areas are generally less than 5 acres.

These Woodward and Quinlan soils are mostly cultivated, or they are used as rangeland. Potential is medium for cultivated crops. These soils are suited to cotton, wheat, and grain sorghum. The shallow to moderate depth to sandstone bedrock and the moderate hazard of erosion are the main limitations. Minimum tillage, terraces, contour farming, grassed waterways, and winter cover crops reduce runoff and erosion. Returning crop residue to the soil or the regular addition of other organic material improves fertility, reduces crusting and soil blowing, and increases water infiltration.

Potential is medium for tame pasture and hay. These soils are suited to bermudagrass and lovegrass. They have medium potential for range. With good management, Woodward soils will produce large amounts of native grass and Quinlan soils will produce moderate amounts of native grass. The use of the soils for tame pasture, range, or hay is effective in controlling erosion. Overgrazing causes surface compaction, excessive runoff, and poor tilth. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during long dry spells help keep the grass and soil in good condition.

These soils have medium potential for trees for windbreaks and post lots. The main limitations are low to medium available water capacity and the shallow to moderate depth to bedrock.

The potential is medium for openland wildlife habitat and for rangeland wildlife habitat.

Potential is medium for building sites, but it is low for most sanitary facilities. The shallow to moderate depth to bedrock and low strength are the main limitations for building sites and roads. The shallow to moderate depth to bedrock is a severe limitation for septic tank absorption fields. The moderately deep Woodward soils are better suited to these uses than are the shallow Quinlan soils.

These soils have high potential for most recreational uses. The shallow to moderate depth to bedrock and slope are the main limitations for playgrounds. Onsite investigation is essential for evaluating and planning the development of specific sites.

This complex is in capability subclass IIIe. Woodward part is in Loamy Prairie range site, and Quinlan part is in Shallow Prairie range site.

64—Woodward-Quinlan complex, 3 to 5 percent slopes. This complex consists of gently sloping, well drained loamy soils on uplands. The moderately deep Woodward soils and the shallow Quinlan soils are mainly in narrow areas, 100 to 500 feet wide, on side slopes and along drainageways. Areas of these soils are so intermingled it was not practical to separate them in mapping. Individual areas are irregular in shape and range from 10 to 200 acres.

Woodward soils make up about 50 percent of each mapped area. Typically, the surface layer is reddish brown loam about 10 inches thick. The subsoil extends to a depth of about 34 inches. It is yellowish red loam to a depth of 24 inches and reddish yellow loam to a depth of about 34 inches. The underlying material is red, weakly cemented, calcareous sandstone.

The Woodward soil is medium in natural fertility and organic matter content. Permeability is moderate, and available water capacity is medium. Surface runoff is medium. Typically, this soil is calcareous throughout but is noncalcareous and moderately alkaline in some places. Root development is restricted below a depth of about 34 inches by sandstone bedrock. The shrink-swell potential is low.

Quinlan soils make up about 45 percent of each mapped area. Typically, the surface layer is yellowish red loam about 10 inches thick. The subsoil, which extends to a depth of 16 inches, is reddish yellow loam. The underlying material, to a depth of about 30 inches, is red, weakly cemented, calcareous sandstone.

The Quinlan soil is medium in natural fertility and organic matter content. Permeability is moderate, and available water capacity is low. Surface runoff is medium. Typically this soil is calcareous throughout, but it is noncalcareous and moderately alkaline in some places. Root development is restricted below a depth of about 16 inches by sandstone bedrock. The shrink-swell potential is low.

Included with these soils in mapping are small areas of Rock outcrop that are mostly sandstone, but a few of the outcrops are gypsum. These inclusions make up about 5 percent of the map unit, but individual areas are generally less than 5 acres.

Most areas of these soils are cultivated or are used as rangeland. Potential is medium for cultivated crops. These soils are suited to cotton, wheat, and grain sorghum. The shallow to moderate depth to bedrock, the hazard of erosion, and slope are the main limitations. Where these soils are used for cultivated crops, the hazard of erosion is moderate. Minimum tillage, contour farming, terraces, and grassed waterways help to control erosion. Returning crop residue to the soil improves soil tilth and fertility, increases water infiltration, and helps to control erosion.

These soils have medium potential for range. With good management, Woodward soils produce large amounts of native grass and Quinlan soils produce moderate amounts of native grass.

Potential is medium for tame pasture and hay. These soils are suited to bermudagrass and lovegrass. Using these soils for range, tame pasture, or hay is also effective in controlling erosion. Overgrazing causes surface compaction, excessive runoff, and poor tilth. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use during long dry spells help keep the grass and soil in good condition.

These soils have medium potential for trees in windbreaks and post lots. The main limitations are low to medium available water capacity and the shallow to moderate depth to bedrock.

The potential is high for openland wildlife habitat and medium for rangeland wildlife habitat.

Potential is medium for building sites and low for sanitary facilities. The shallow to moderate depth to bedrock is a limitation for building sites and roads, and it is a major limitation for septic tank absorption fields and sewage lagoons.

Potential is medium for most recreational uses. Slope and the shallow to moderate depth to bedrock are major limitations for playgrounds. Onsite investigation is essential to evaluate and plan the development of specific sites.

This complex is in capability subclass IVe. Woodward part is in Loamy Prairie range site, and Quinlan part is in Shallow Prairie range site.

65—Woodward Variant fine sandy loam, 1 to 3 percent slopes. This very gently sloping, well drained, loamy soil is on slightly convex uplands. This soil is moderately deep and formed in a thin loamy mantle over sandstone of Permian age. Areas are irregular in shape and range from 10 to 100 acres.

Typically, the surface layer is yellowish red fine sandy loam about 10 inches thick. The subsoil of fine sandy loam extends to a depth of 30 inches. It is reddish yellow to a depth of 17 inches, light red to a depth of about 25 inches, and red to a depth of about 30 inches. The underlying material is red, weakly cemented, calcareous sandstone.

Natural fertility and organic matter content are medium. Permeability is moderately rapid, and surface runoff is medium. Available water capacity is medium. Reaction is mildly alkaline or moderately alkaline in the surface layer and moderately alkaline below. This soil is generally calcareous throughout, but in some places the surface layer is noncalcareous. The surface layer is friable and easily tilled throughout a fairly wide range in moisture content. This soil has a tendency to form a crust after hard rains, especially in areas where the plow layer contains subsoil material. Root development is restricted below a depth of about 30 inches by compact sandstone. The shrink-swell potential is low.

Included with this soil in mapping are a few small areas of Dill and Quinlan soils. These included soils make up about 10 percent of the map unit, but individual areas generally are less than 5 acres.

Most areas of this Woodward Variant soil are cultivated. Potential is medium for cultivated crops. This soil is suited to cotton, wheat, and grain sorghum. This soil erodes easily, and where it is used for cultivated crops, the hazard of wind and water erosion is severe. Minimum tillage, winter cover crops, terraces, contour farming, and grassed waterways help prevent excess surface runoff and erosion and conserve soil moisture.

Potential is medium for tame pasture and hay. This soil is suited to bermudagrass, lovegrass, alfalfa, and other adapted grasses and legumes. It has high potential for range. With good management, this soil will produce moderate amounts of native grass. Use of this soil for range, tame pasture, or hay helps to control wind and water erosion. Overgrazing or grazing during extremely dry periods can restrict root development and cause loss of the grass stand. Proper stocking, rotation grazing, timely deferment of grazing, and restricted use when wet or dry keep the grass and soil in good condition.

This soil has medium potential for trees in windbreaks and post lots. The moderate depth to bedrock and medium available water capacity are the main limitations.

This soil has high potential for openland wildlife habitat and medium potential for rangeland wildlife habitat.

Potential is medium for building sites if proper design procedures are used. This soil has low potential for most sanitary facilities. The moderate depth to bedrock and seepage are major limitations that can be overcome by special design and installation procedures.

This soil has medium potential for most recreational uses. Dust blowing and the moderate depth to bedrock are the major limitations. Onsite investigation is essential to evaluate and plan the development of specific sites.

This soil is in capability subclass IIIe; Sandy Prairie range site.

66—Yahola fine sandy loam. This loamy soil is deep, nearly level, and well drained. It is on flood plains that border the major drainageways. This soil floods occasionally. Slope gradients range from 0 to 1 percent. Areas are mostly long and narrow and range from 10 to 200 acres.

Typically, the surface layer is red, calcareous fine sandy loam about 8 inches thick. The underlying material to a depth of 60 inches or more is red, calcareous fine sandy loam stratified with thin layers of loam and silt loam.

Natural fertility and organic matter content are medium. Permeability is moderately rapid, and surface runoff is slow. Available water capacity is medium. The surface layer is mildly alkaline or moderately alkaline and calcareous. The underlying material is moderately alkaline and calcareous. The surface layer is friable and easily tilled throughout a wide range in moisture content. Root development is unrestricted to a depth of 72 inches or more. The shrink-swell potential is low.

Included with this soil in mapping are a few small areas of Clairemont soils. Inclusions make up about 10 percent of the map unit, but individual areas are generally less than 3 acres.

Most areas of this Yahola soil are cultivated. Potential is high for cultivated crops. This soil is well suited to cotton, grain sorghum, and wheat. If this soil is used for cultivated crops, there is a moderate hazard of soil blowing. Intensive conservation measures are required to prevent damage from wind erosion. Minimum tillage, winter cover crops, and residue management help prevent damage from soil blowing, maintain organic matter content, improve fertility, and increase the water infiltration rate.

Potential is high for tame pasture and hay. This soil is suited to bermudagrass, lovegrass, alfalfa, and other adapted grasses and legumes for hay and pasture. This soil has high potential for rangeland. With good management, this soil will produce large amounts of native grass. Proper stocking, rotation grazing, and restricted use during prolonged wet or dry periods help keep the grass and soil in good condition.

This soil has high potential for trees in windbreaks. There are few limitations for trees on this site. The potential is high for openland wildlife habitat and rangeland wildlife habitat.

Potential is low for building sites and for most sanitary facilities. Flooding and seepage are limitations that are difficult to overcome.

This soil has medium potential for most recreational development. Dust blowing can be overcome by maintaining a good grass cover. Flooding is the main limitation for camp areas. Onsite investigation is essential to evaluate and plan the development of specific sites.

This soil is in capability subclass IIw; Loamy Bottomland range site.

use and management of the soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and windbreaks and environmental planting; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

crops and pasture

Gerald Duke, district conservationist, Soil Conservation Service, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed soil map units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

More than 258,000 acres in the survey area was used for crops and pasture in 1967 (*3*). Of this total, 12,559 acres was used for permanent pasture; 60,712 acres for row crops, mainly cotton; 74,728 acres for close-growing crops, mainly wheat and grain sorghum; and 7,624 acres for rotation hay and pasture. The rest was idle cropland.

More than 290,000 acres in the survey area was used for rangeland, and 3,116 acres was wooded, mainly field windbreaks.

The soils in Beckham County have medium potential for increased production of food. About 34,000 acres that has medium potential for crops is currently used as rangeland, and about 10,500 acres is used as pasture. In addition to the reserve productive capacity represented by this land, food production could also be increased considerably by extending the latest crop production technology to all cropland in the survey area. This soil survey can facilitate the application of such technology.

Acreage in crops and pasture has gradually been decreasing as more and more land is used for urban development. In 1967 there was about 16,000 acres of urban and built-up land in the survey area, and this figure has been growing at the rate of about 200 acres per year. The use of this soil survey to help make land use decisions that will influence the future role of farming in the survey area is discussed in the section "General soil map units."

Soil erosion is the major concern on about 90 percent of the cropland, rangeland, and pasture in Beckham County. If slope is more than 2 percent, erosion is a hazard. Dill, Quinlan, Obaro, Grandfield, and Woodward soils, for example, have slopes of 2 to 5 percent.

Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging on soils that have a clayey subsoil, such as Abilene, Tillman, and Vernon soils, and on soils that have a layer in or below the subsoil that limits the depth of the root zone and the available water capacity. Such layers include bedrock, as in Cordell, Dill, Quinlan, and Woodward soils. Erosion also reduces productivity on soils that tend to be droughty, such as Tillman soils. Second, soil erosion on farmland results in sedimentation of streams. Control of erosion minimizes the pollution of streams by sediment and improves the quality of water for municipal use, for recreation, and for fish and wildlife.

In many sloping fields, tilling or preparing a good seedbed is difficult because the original friable surface soil has been eroded away and the less friable subsoil is exposed. Such spots are common in areas of moderately eroded Grandfield and Obaro soils.

Erosion control practices provide protective surface cover, reduce runoff, and increase infiltration. A cropping system that keeps vegetative cover on the soil for extended periods can hold soil erosion losses to amounts that will not reduce the productive capacity of the soils. On livestock farms, which require pasture and hay, the legume and grass forage crops in the cropping system reduce erosion on sloping land, provide nitrogen, and improve tilth for the following crop.

The very gently sloping to strongly sloping Delwin, Devol, and Nobscot soils are so sandy that terracing is not practical. On these soils, a cropping system that provides substantial vegetative cover is required to control erosion unless minimum tillage is practiced. Minimizing tillage and leaving crop residue on the surface help increase infiltration and reduce the hazards of runoff and erosion. These practices can be adapted to most soils in the survey area, but they are more difficult to use successfully on the eroded soils and on the soils that have a clayey surface layer, such as Abilene and Tillman soils. No-tillage for cotton and wheat is effective in reducing erosion on sloping land and can be adapted to most soils in the survey area. It is more difficult to practice successfully, however, on the soils that have a clayey surface layer. At present, however, it is not economically feasible because of the marginal production on most soils in the county.

Terraces and diversions reduce the length of slope and reduce runoff and erosion. They are not practical on deep, well drained soils that have regular slopes. Tipton, Dill, Quinlan, Woodward, St. Paul, Carey, Hardeman, and some Grandfield soils are suitable for terraces. The other soils are less suitable for terraces and diversions because of irregular slopes, a clayey subsoil which would be exposed in terrace channels, or bedrock at a depth of less than 40 inches.

Contouring and contour stripcropping are widespread erosion control practices in the survey area. They are best adapted to soils that have smooth, uniform slopes, including most areas of the sloping Dill, Quinlan, Carey, Woodward, Obaro, Tipton, and St. Paul soils.

Soil blowing is a hazard on the sandy Delwin, Devol, Dill, Hardeman, Lincoln, Quinlan, Nobscot, and Tivoli soils. Soil blowing can damage these soils in a few hours if winds are strong and the soils are dry and bare of vegetation or surface mulch. Maintaining vegetative cover, surface mulch, or a rough surface through proper tillage minimizes soil blowing on these soils. Windbreaks of adapted trees, such as Austrian pine, red mulberry, or autumn-olive, are effective in reducing soil blowing.

Information for the design of erosion control practices for each kind of soil is available from local offices of the Soil Conservation Service.

Soil drainage is the major management need on about 1 percent of the acreage used for crops and pasture in the survey area. Some soils are so wet that the production of crops common to the area is generally not possible or is greatly reduced in most years. These are the somewhat poorly drained Gracemont and Gracemore soils, which cover about 6,500 acres in the survey area.

The design of both surface and subsurface drainage systems varies with the kind of soil. Subsurface drainage can be used successfully in most of these areas. Drains have to be more closely spaced in slowly permeable soils than in more permeable soils. Finding adequate outlets for subsurface drainage systems is difficult in some areas of Gracemont and Gracemore soils, especially where they occur along the North Fork of the Red River. Information on drainage design for each kind of soil is available from local offices of the Soil Conservation Service.

Soil fertility is naturally low in most soils on uplands in the survey area. All but Delwin, Devol, Grandfield, and Nobscot soils are naturally alkaline. The soils on flood plains, such as Clairemont, Cyril, Gracemont, Gracemore, Beckman, Lincoln, Mangum, Port, Spur, and Yahola soils, are mildly alkaline or moderately alkaline and are naturally higher in plant nutrients than most soils on uplands.

Available phosphorus levels are naturally low in most of these soils. On all soils, additions of fertilizer should be based on the results of soil tests, on the need of the crop, and on the expected level of yields. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer to apply.

Soil tilth is an important factor in the germination of seeds and in the infiltration of water into the soil. Soils with good tilth are granular and porous.

Most of the soils used for crops in the survey area have a surface layer of silt loam or fine sandy loam that is light in color and low to medium in content of organic matter. Generally the structure of such soils is weak, and intense rainfall causes the formation of a crust on the surface. The crust is hard when dry and nearly impervious to water. Once the crust forms, it reduces infiltration and increases runoff. Regular additions of crop residue, manure, and other organic material can help improve soil structure and reduce crust formation.

Fall plowing is generally not a good practice on the light colored soils that have a surface layer of loamy fine sand or fine sandy loam because of soil blowing during winter and spring. Also, about two-thirds of the cropland consists of sloping soils that are subject to damaging erosion if they are plowed in the fall.

Tilth is a concern for the dark colored Abilene, Tillman, and St. Paul soils. If they are wet when plowed, they tend to be very cloddy when dry, and a good seedbed is difficult to prepare. Fall plowing on these soils generally results in better tilth than plowing in the spring.

Field crops suited to the soils and climate of the survey area include many that are not now commonly grown. Cotton and grain sorghum are the row crops. Guar, corn, sunflowers, mung beans, soybeans, peanuts, potatoes, and similar crops can be grown if economic conditions are favorable.

Wheat and oats are the common close-growing crops. Rye, barley, millet, and flax could be grown, and seed could be produced from rye, vetch, fescue, alfalfa, and lovegrass.

Special crops grown commercially in the survey area are vegetables, small fruits, tree fruits, and nursery plants. A small acreage throughout the sandy part of the survey area is used for melons, sweet corn, tomatoes, and small fruits. Apples and peaches are the most important tree fruits grown in the survey area.

Deep soils that have good natural drainage and that warm up early in spring are especially well suited to many vegetables and small fruits. In the survey area these are the Delwin, Devol, Grandfield, and Nobscot soils. Irrigation is essential for good production most years.

Most of the well drained soils in the survey area are suitable for orchards and nursery plants. Soils on flood plains where frost is frequent and air drainage is poor, however, generally are poorly suited to early vegetables, small fruits, and orchards. Pecans are an exception in that they are not generally susceptible to late frosts. Pecan trees have a deep root system and have a high moisture requirement. They grow best on flood plain soils such as Clairemont, Port, Spur, and Yahola soils and uplands soils such as Devol and Grandfield soils.

Latest information and suggestions for growing special crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

Farming and other land uses are competing for large areas of the survey area. About 16,000 acres, or nearly 3 percent of the survey area, was urban or built-up land in 1967. Much of this acreage was well suited to crops. Each year additional land is being developed for urban uses in Elk City, Erick, Sayre, and other cities in the survey area.

In general, the soils in the survey area that are well suited to crops are also well suited to urban development. The data about specific soils in this soil survey can be used in planning future land use patterns. Potential productive capacity in farming should be weighed against soil limitations and potential for nonfarm development.

In some areas, however, are soils well suited to farming but poorly suited to nonfarm development. These areas are identified as map units 1, 2, and 3 on the general soil map at the back of this publication. In these areas the dominant soils are Clairemont, Lincoln, Mangum, Port, and Spur soils, all of which are on flood plains and are subject to overflow, which create serious hazards for nonfarm development.

Some soils are only fairly well suited to farming but are generally well suited to nonfarm development. This area is identified as map unit 8, dominated by Nobscot and Delwin soils. These soils are sandy, droughty, and subject to soil blowing; however, the rolling landscape, good soil drainage, and other soil qualities are favorable for residential and other urban areas.

management of tame pasture

Odos G. Henson, conservation agronomist, Soil Conservation Service, and Gerald O. Duke, district conservationist, Soil Conservation Service, helped prepare this section.

Pasture plants grown in Beckham County and guidelines for managing them are described in this section.

About 2 percent of Beckham County is used for tame pasture. Many idle fields formerly used for crops have been converted or are being converted to tame pasture. Also, small areas of native range that is in poor condition are being converted to tame pasture, especially where sandy soils are being cleared of shinnery oak. Most of the soils in the county are suited to tame pasture.

The principal tame grasses used in this area are improved bermudagrass and lovegrass. Weeping lovegrass is used mostly in the western part of the county. Weeping lovegrass provides good quantity and quality of forage on soils that were previously heavily infested with shinnery oak and sand sagebrush. It is used in conjunction with small-grain winter pasture to provide dry matter for livestock. It also provides excellent forage for livestock in early spring when deferred grazing of the native range grasses is needed. When used as pasture in early spring and summer, lovegrass should be fertilized, and cattle should be rotated from one pasture to the next every 14 to 21 days.

Bermudagrass is used mostly on the east side of the county. For maximum production, bermudagrass should be regularly fertilized in split applications of 75 pounds of actual nitrogen every 21 days if moisture is available. Hairy vetch can be overseeded in bermudagrass to provide a higher quality forage in winter and early in spring. The vetch should be innoculated to help provide some of the nitrogen requirement of the bermudagrass.

Bermudagrass, lovegrass, and native grasses should be fenced and managed in separate pastures. Fencing allows efficient management of the grass for maximum production. Also, maximum utilization of the forage can be obtained without the cattle overgrazing one grass and undergrazing the other species.

Proper grazing and rotation grazing will help lengthen the life of most pasture plants. Deferred grazing is beneficial during periods of low food reserve. This allows plants to regain vigor by maintaining a more adequate root system where food can be stored for the next growing season. Total production of forage will be increased.

Increasing the fertility level of the soil results in more vigorous pasture plants and lengthens the lifespan of the plants. This increases forage production. Plant nutrients can be added by using commercial fertilizers. Legumes such as vetch or alfalfa can be seeded in bermudagrass to furnish nitrogen to the plants. Larger amounts of nitrogen are needed in areas where legumes are not grown with the grass.

The desired kind of pasture plants can only be maintained in the stand if the invasion of undesirable plants is controlled. Brush management is essential. A mowing or spraying program properly used reduces the problem created by weeds and brush.

A good pasture program provides the desired amount of forage during each month of the year. A study of the growth habits of the different plants is necessary to assure adequate forage during each month. The months in which various kinds of forage plants grow are indicated in figure 12. The percentage of growth that can be safely grazed each month without substantially reducing the total yields for each kind of plant is illustrated. For example, 20 percent of the yearly growth of bermudagrass can be grazed during June.

Soils vary in their ability to produce forage for grazing. The Tipton soils produce more forage than Woodward soils, primarily because they furnish more available moisture to the plant. The total yearly production of each

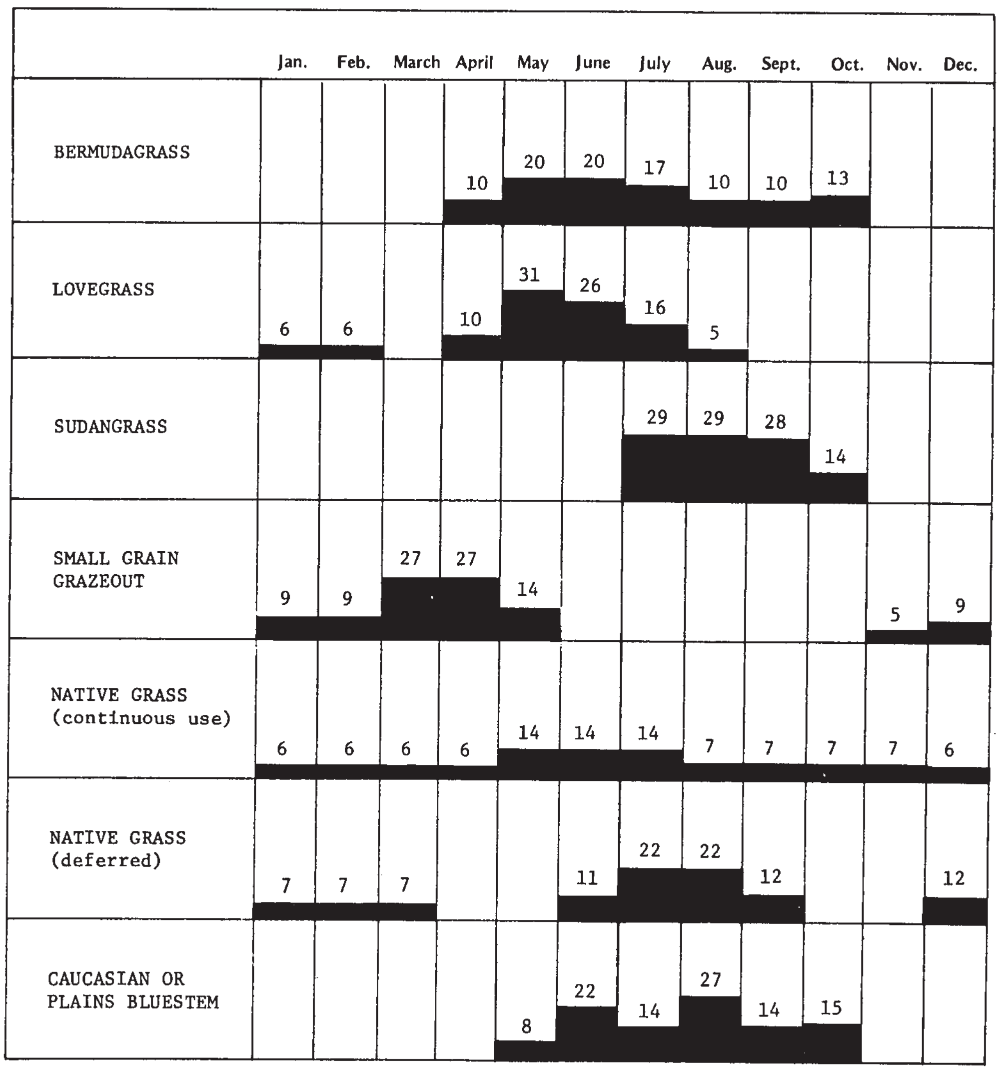


Figure 12.—Forage calendar showing percentage of use of major grasses.

soil for various kinds of pasture plants is given in animal-unit-months (AUM) in table 5. Tipton loam, 1 to 3 percent slopes, in bermudagrass pasture, will furnish grazing for one animal unit 6 months during the year.

In planning a pasture program, one must consider the total yearly production of the pasture plant in AUM (table 5) and the amount of growth of the plant in a certain month. As illustrated in figure 12, bermudagrass furnishes 20 percent of its annual forage during June. Bermudagrass will provide grazing for 1.2 animals (.20 x 6 AUM = 1.2 AUM) on the Tipton soil since its yearly production is 6 AUM as indicated in table 5. A pasture of 50 acres would then furnish grazing for 60 animals (50 acres x 1.2 AUM = 60 AUM) during June. Personnel of the Soil Conservation Service or Cooperative Extension Service can assist in planning a total pasture program.

Periods of low rainfall are common. They may last for a month or more, or rainfall may be below normal for a year or more. Yields in table 5 are an average over a period of several years. To insure continuous, adequate forage during these dry periods, either numbers of livestock must fluctuate or a feed reserve is needed. This reserve can be provided in two ways: by harvesting part of the pasture for hay during periods of above-normal moisture and by withholding areas from grazing until a later period. For example, use of a reserve pasture of bermudagrass grown in May and June can be delayed until a dry period in August and September, which occurs occasionally. However, close grazing during August and September should be avoided, because this is the period when storage roots are developed so that the plants can survive the winter.

yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

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

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

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

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, wildlife habitat, or recreation.

rangeland

Ernest Snook, range conservationist, Soil Conservation Service, helped prepare this section.

About 48 percent of Beckham County is rangeland and about half of the farm income is derived from livestock. Cow-calf operations are dominant in the county, with stocker-feeder operations making up a lesser part of the cattle industry.

The native vegetation in many parts of the county has been greatly depleted by continued excessive grazing. Much of the acreage that was once open grassland is now covered with mesquite or shinnery oak. The amount of forage may be less than two-thirds of that originally produced. Productivity of the range can be increased by using management practices that are effective for specific kinds of soil and range sites.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 6 shows, for each soil, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as or are suited to rangeland are listed. Explanation of the column headings in table 6 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was established during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre of air-dry vegetation.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—is listed by common name. Under *composition*, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only. It does not have a specific meaning that pertains to the present plant community in a given use.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, reduction of undesirable brush, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

windbreaks and environmental plantings

Norman E. Smola, staff forester, Soil Conservation Service, helped prepare this section.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 7 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 7 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

recreation

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 8, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

wildlife habitat

Wildlife is abundant throughout the county. Bobwhite quail, dove, rabbit, and coyote are in all areas of the county. Blue quail occur in the extreme southern part of the county. Deer, red fox, beaver, bobcat, and wild turkey are common along the bottomlands. Deer, wild turkey, bobcats, and badgers are found less frequently on uplands. Landowners in some areas have reintroduced deer, prairie chicken, pheasant, and wild turkey on their lands. Ducks and geese are common to the area during fall and spring.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be established, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, lovegrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, and grama.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are oak, apple, hawthorn, dogwood, and blackberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

Coniferous plants furnish browse, seeds, and cones. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are cedar and juniper.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are bitterbrush and big sagebrush.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, saltgrass, cordgrass, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail, and red fox.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include antelope, deer, sage grouse, meadowlark, and lark bunting.

engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

building site development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

sanitary facilities

Table 11 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to effectively filter the effluent. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

construction materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill, topsoil, and sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and *gravel* are used in great quantities in many kinds of construction. The ratings in table 12 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in table 14.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

water management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 19.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

engineering properties and classifications

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains particles coarser than sand, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 19.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

physical and chemical properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 15, the estimated content of organic matter of the plow layer is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

soil and water features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes are not considered flooding.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered is local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is shown for all soils that are underlain by bedrock at a depth of 5 to 6 feet or less. For many soils, the limited depth to bedrock is a part of the definition of the soil series. The depths shown are based on measurements made in many soil borings and on other observations during the mapping of the soils. The kind of bedrock and its hardness as related to ease of excavation is also shown. Rippable bedrock can be excavated with a single-tooth ripping attachment on a 200-horsepower tractor, but hard bedrock generally requires blasting.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

physical and chemical analyses of selected soils

The results of physical analysis of several typical pedons in the survey area are given in table 17 and the results of chemical analysis in table 18. The data are for soils sampled at carefully selected sites. The pedons are typical of the series and are described in the section "Soil series and morphology." Soil samples were analyzed by the Soil Morphology, Genesis, and Classification Laboratory, Department of Agronomy, Oklahoma State University.

Most determinations, except those for grain-size analysis and bulk density, were made on soil material smaller than 2 millimeters in diameter. Measurements reported as percent or quantity of unit weight were calculated on an oven-dry basis. The methods used in obtaining the data are indicated in the list that follows. The codes in parentheses refer to published methods (*5*).

Sand—(0.05-2.0 mm fraction) weight percentages of materials less than 2 mm (3A1).
Silt—(0.002-0.05 mm fraction) pipette extraction, weight percentages of all materials less than 2 mm (3A1).
Clay—(fraction less than 0.002 mm) pipette extraction, weight percentages of materials less than 2 mm (3A1).
Organic matter—peroxide digestion (6A3).
Extractable bases—ammonium acetate pH 7.0, uncorrected; calcium (6N2), magnesium (602), sodium (6P2), potassium (6Q2).
Cation-exchange capacity—sum of cations (5A3a).
Base saturation—sum of cations, TEA, pH 8.2 (5C3).
Reaction (pH)—1:1 water dilution (8C1a).
Total phosphorus—perchloric acid; colorimetry (6S1a).

engineering test data

Table 19 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are typical of the series and are described in the section "Soil series and morphology." The soil samples were tested by the Oklahoma Department of Transportation, Materials Division.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are: AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); Shrinkage—T 92 (AASHTO), D 427 (ASTM).

classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*6*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 20, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ustoll (*Ust*, meaning dry, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Argiustolls (*Argi*, meaning argillic horizon, plus *ustolls*, the suborder of the Mollisols that have an ustic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Argiustolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, thermic, Typic Argiustolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

soil series and morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (*4*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*6*). Unless otherwise stated, colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Soil maps for detailed planning."

Abilene series

The soils of the Abilene series are deep, well drained, and moderately slowly permeable. These nearly level soils formed in thick deposits of calcareous, clayey sediments on uplands. The soils of the Abilene series are fine, mixed, thermic Pachic Argiustolls. Slope ranges from 0 to 1 percent.

Abilene soils are associated with Altus, Grandfield, St. Paul, and Tipton soils on the landscape. These soils have less than 35 percent clay in the control section. In addition, Grandfield soils do not have a mollic epipedon.

Typical pedon of Abilene clay loam, 0 to 1 percent slopes, about 1,780 feet south and 25 feet west of the northeast corner of sec. 28, T. 8 N., R. 23 W.

Ap—0 to 4 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; hard, friable; many fine roots; mildly alkaline; abrupt smooth boundary.

A1—4 to 11 inches; dark brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate fine and medium blocky structure; hard, firm; few fine roots; mildly alkaline; gradual smooth boundary.

B21t—11 to 19 inches; dark brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate fine and medium blocky structure; extremely hard, very firm; few fine roots; few worm casts; continuous clay films on faces of peds; mildly alkaline; gradual smooth boundary.

B22t—19 to 25 inches; dark brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; strong medium blocky structure; extremely hard, very firm; few fine roots in cracks; continuous clay films on faces of peds; mildly alkaline; gradual smooth boundary.

B23tca—25 to 35 inches; brown (7.5YR 5/2) clay, dark brown (7.5YR 4/2) moist; strong medium blocky structure; extremely hard, very firm; few fine roots in cracks; patchy clay films on faces of peds; common fine concretions and soft bodies of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

B3—35 to 46 inches; brown (7.5YR 5/2) clay, dark brown (7.5YR 4/2) moist; weak medium blocky structure; extremely hard, very firm; few fine concretions and soft bodies of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

C—46 to 60 inches; brown (7.5YR 5/2) clay, dark brown (7.5YR 4/2) moist; few fine grayish brown mottles; massive; extremely hard, very firm; calcareous; moderately alkaline.

The thickness of the solum ranges from 28 to 60 inches.

The A horizon is 8 to 16 inches thick. It has hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 2. It has a clay content of 27 to 35 percent. Reaction ranges from neutral to moderately alkaline. The B21t and B22t horizons have hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 2 or 3. Texture is clay loam or clay. The clay content ranges from 35 to 50 percent. Reaction ranges from neutral to moderately alkaline. The B23tca horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4. Texture is clay or clay loam. This horizon is moderately alkaline and calcareous. The B3 horizon, where there is one, has hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 2 or 3. Texture is clay or clay loam. This horizon is moderately alkaline and calcareous. The C horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 2 to 4. Texture ranges from clay to clay loam, and clay content ranges from 30 to 40 percent. This horizon is moderately alkaline and calcareous.

Altus series

The soils of the Altus series are deep, well drained, and moderately permeable. These very gently sloping soils formed in thick deposits of neutral or mildly alkaline loamy sediments on uplands. The soils of the Altus series are fine-loamy, mixed, thermic Pachic Argiustolls. Slope ranges from 1 to 3 percent.

Altus soils are associated with Abilene, Grandfield, and Tipton soils on the landscape. Abilene soils have more than 35 percent clay in the control section. Grandfield soils do not have a mollic epipedon. Tipton soils are loam or clay loam throughout the argillic horizon.

Typical pedon of Altus fine sandy loam, 1 to 3 percent slopes, in a field about 9 miles south of Sayre, 1,900 feet south and 1,200 feet east of the northwest corner of sec. 22, T. 8 N., R. 23 W.

Ap—0 to 8 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak granular structure; hard, very friable; slightly acid; abrupt smooth boundary.

B1—8 to 17 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak coarse prismatic structure parting to moderate fine granular; hard, very friable; common fine roots; common worm casts; few fine pebbles; neutral; gradual smooth boundary.

B21t—17 to 25 inches; dark grayish brown (10YR 4/2) sandy clay loam, very dark brown (10YR 2/2) moist; weak coarse prismatic structure parting to moderate fine subangular blocky; hard, friable; few fine roots; common worm casts; few fine pebbles; clay films on vertical faces of peds; neutral; gradual smooth boundary.

B22t—25 to 40 inches; brown (7.5YR 4/2) sandy clay loam, dark brown (7.5YR 3/2) moist; moderate coarse prismatic structure; hard, friable; few fine roots; common worm casts; few fine pebbles; clay films on vertical faces of peds; neutral; gradual smooth boundary.

B3—40 to 80 inches; reddish brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; weak coarse prismatic structure; hard, friable; few fine roots; few worm casts; few fine pebbles; patchy clay films on vertical faces of peds; neutral; clear boundary.

The thickness of the solum ranges from 42 to more than 80 inches. The mollic epipedon is 20 to 40 inches thick.

The A horizon is 8 to 20 inches thick. It has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3. Reaction is slightly acid or neutral. The B1 horizon is similar to the A horizon in color. Reaction is neutral or mildly alkaline. Texture is fine sandy loam or sandy clay loam. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3 in the upper part. The lower part has hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 3 or 4. The Bt horizon is sandy clay loam. Reaction is neutral or mildly alkaline in the upper part and neutral to moderately alkaline in the lower part. The B3 horizon has color, texture, and reaction similar to the Bt horizon. The C horizon, where present, generally ranges from yellowish red to reddish brown but is mottled in shades of yellowish red or gray in some places. Texture is sandy clay loam or sandy loam. Reaction ranges from neutral to moderately alkaline. The C horizon is calcareous in some pedons.

Aspermont series

The soils of the Aspermont series are deep, well drained, and moderately permeable. These very gently to gently sloping soils formed in silty colluvial material over silty Permian red beds on uplands. The soils of the Aspermont series are fine-silty, mixed, thermic Typic Ustochrepts. Slope ranges from 2 to 5 percent.

Aspermont soils are associated with Cornick, Knoco, Obaro, Quanah, Talpa, Tillman, Vernon, and Vinson soils on the landscape. Cornick, Knoco, and Talpa soils are less than 20 inches deep. Obaro soils have weakly cemented sandstone within 40 inches of the surface. Quanah soils have a mollic epipedon. Tillman soils have a mollic epipedon and have more than 35 percent clay in the control section. Vernon soils have more than 35 percent clay in the control section and have shale within 40 inches of the surface. Vinson soils have hard gypsum at a depth of 20 to 40 inches.

Typical pedon of Aspermont silt loam, 3 to 5 percent slopes, 2,450 feet east and 50 feet north of the southwest corner of sec. 6, T. 8 N., R. 25 W.

Ap—0 to 7 inches; reddish brown (5YR 4/4) silt loam, dark reddish brown (5YR 3/4) moist; weak fine granular structure; slightly hard, friable; calcareous; moderately alkaline; abrupt smooth boundary.

A1—7 to 14 inches; reddish brown (5YR 4/4) silt loam, dark reddish brown (5YR 3/4) moist; moderate medium granular structure; slightly hard, friable; few fine concretions of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

B21—14 to 22 inches; reddish brown (5YR 4/4) silt loam, dark reddish brown (5YR 3/4) moist; weak fine subangular blocky structure; hard, firm; few fine and medium concretions of calcium carbonate, common threads and films of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B22—22 to 31 inches; yellowish red (5YR 4/6) silt loam, yellowish red (5YR 3/6) moist; weak fine subangular blocky structure; hard, firm; few fine and medium concretions of calcium carbonate, common threads and films of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B23ca—31 to 39 inches; yellowish red (5YR 5/6) silt loam, yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; hard, firm; common medium soft bodies of calcium carbonate, few fine and medium concretions of calcium carbonate, about 10 percent by volume calcium carbonate in the form of soft bodies and concretions; common fine fragments of shale; calcareous; moderately alkaline; clear smooth boundary.

C—39 to 60 inches; yellowish red (5YR 5/6) silty clay loam, yellowish red (5YR 4/6) moist; massive; hard, firm; few thin strata of greenish siltstone and reddish sandstone in the lower part; few medium soft bodies of calcium carbonate; calcareous; moderately alkaline.

The thickness of the solum ranges from 24 to 60 inches. The soil is moderately alkaline and calcareous throughout.

The A horizon has hue of 5YR or 2.5YR, value of 4 or 5, and chroma of 3 or 4. The B2 horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 6. Texture is silt loam or silty clay loam. The B3ca horizon has color and texture similar to the B2 horizon but has an accumulation of calcium carbonate that ranges from a few films to common bodies and concretions. The bodies and concretions of calcium carbonate make up 2 to 15 percent by volume of the horizon. The C horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 6. Texture is silt loam or silty clay loam. Some pedons have weakly cemented sandstone, siltstone, or shale below a depth of 40 inches.

Beckman series

The soils of the Beckman series are deep, well drained, and very slowly permeable. These nearly level soils formed in recent calcareous and saline clayey alluvium on flood plains. These soils crack when dry. The soils of the Beckman series are fine, mixed (calcareous), thermic Vertic Ustifluvents. Slope ranges from 0 to 1 percent.

Beckman soils are commonly adjacent to Mangum, Spur, and Treadway soils on the landscape. Mangum soils are in slightly higher lying areas than the Beckman soils and have a cambic horizon. Spur soils are along the stream channels. They have a mollic epipedon and less than 35 percent clay in the 10- to 40-inch control section. Treadway soils are in similar areas but are generally in the upper part of the flood plain near the uplands, and they are dry for longer periods.

Typical pedon of Beckman clay, 3 miles south and 2 1/4 miles east of Delhi, Oklahoma, 600 feet east and 520 feet north of the southwest corner of sec. 28, T. 8 N., R. 23 W.

A1—0 to 6 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; moderate fine granular structure; extremely hard, very firm; few fine roots; cracks 1/2 to 1 centimeter wide; slightly saline; calcareous; moderately alkaline; clear smooth boundary.

C1—6 to 18 inches; reddish brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; massive; extremely hard, very firm; few fine roots; many thin strata of silty clay loam; few bodies of gypsum and other salts; gypsum crystals make up about 10 percent by volume; cracks 1 centimeter wide extend from top to bottom of this layer; moderately saline; calcareous; moderately alkaline; clear smooth boundary.

C2—18 to 40 inches; reddish brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; massive; extremely hard, very firm; few fine roots in cracks; many thin strata of silty clay loam; few fine fragments of gray shale; few pressure faces; few bodies of gypsum and other salts; gypsum crystals make up approximately 25 percent by volume; cracks 1/2 to 1 centimeter wide extend through this layer; moderately saline; few films, soft bodies, and concretions of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

C3—40 to 60 inches; reddish brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; massive; extremely hard, very firm; many thin strata of silty clay loam and silt loam; few fine fragments of gray shale; few bodies of gypsum and other salts; gypsum crystals make up approximately 5 percent by volume; moderately saline; few films, soft bodies, and concretions of calcium carbonate; calcareous; moderately alkaline.

The A horizon has hue of 5YR, value of 4 or 5, and chroma of 3 or 4. When the soil is moist, value and chroma are less than 3.5. The horizon is less than 10 inches thick. Electrical conductivity of extract ranges from 2 to 4 millimhos per centimeter. The C horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 3 to 6. It has few to many thin strata of silt loam and silty clay loam. The C horizon contains few to common threads, films, and concretions of calcium carbonate. It contains few to many salt crystals and gypsum crystals. Electrical conductivity ranges from 4 to 8 millimhos per centimeter.

Carey series

The soils of the Carey series are deep, well drained, and moderately permeable. These very gently sloping soils formed in weakly consolidated sandstone of the Permian red beds on uplands. The soils of the Carey series are fine-silty, mixed, thermic Typic Argiustolls. Slope ranges from 1 to 3 percent.

Carey soils are associated with the Obaro, St. Paul, Tipton, and Woodward soils on the landscape. Obaro soils have an ochric epipedon and are less than 40 inches deep. St. Paul soils have a mollic epipedon more than 20 inches thick and have secondary carbonates at a depth of 30 to 45 inches. Tipton soils have more than 15 percent fine or coarser sand in the control section. The Woodward soils have less than 18 percent clay in the control section and have an ochric epipedon.

Typical pedon of Carey loam, 1 to 3 percent slopes, in a cultivated field 1,320 feet north and 1,320 feet east of the southwest corner of sec. 24, T. 8 N., R. 21 W.

Ap—0 to 7 inches; brown (7.5YR 5/2) loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; hard, friable; many fine roots; many worm casts; neutral; abrupt smooth boundary.

A1—7 to 15 inches; dark brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; hard, friable; many fine roots; many worm casts; mildly alkaline; gradual smooth boundary.

B2t—15 to 34 inches; reddish brown (5YR 5/4) clay loam, dark reddish brown (5YR 3/4) moist; moderate medium prismatic structure; very hard, friable; many worm casts; clay films on faces of peds; few soft bodies of calcium carbonate in the lower part; calcareous; moderately alkaline; gradual smooth boundary.

B3—34 to 45 inches; yellowish red (5YR 5/6) loam, yellowish red (5YR 4/6) moist; weak coarse prismatic structure; hard, friable; few worm casts; few fragments of sandstone; calcareous; moderately alkaline; clear smooth boundary.

Cr—45 to 60 inches; red (2.5YR 5/6) weakly consolidated fine grained sandstone.

The thickness of the solum ranges from 40 to 70 inches. Reaction is neutral or mildly alkaline in the A horizon and neutral to moderately alkaline in the Bt and C horizons. Depth to secondary carbonates ranges from 11 to 30 inches.

The A horizon is 8 to 18 inches thick. It has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3. The B2t horizon has hue of 5YR or 2.5YR, value of 4 or 5, and chroma of 2 to 6. Texture is loam or clay loam. Clay content ranges from 20 to 32 percent. The B3 horizon is similar to the Bt horizon in color. In addition, it contains a few fragments of sandstone. The Cr horizon is weakly consolidated fine grained sandstone.

Clairemont series

The soils of the Clairemont series are deep, well drained, and moderately permeable. These nearly level soils formed in loamy calcareous alluvium on flood plains. The soils of the Clairemont series are fine-silty, mixed (calcareous), thermic Typic Ustifluvents. Slope is mostly less than one percent.

Clairemont soils are on flood plains associated with Gracemont, Mangum, Port, Spur, and Yahola soils. Gracemont soils have more than 15 percent material coarser than very fine sand and a water table within 40 inches of the surface during some part of the year. Mangum soils have more than 35 percent clay in the control section. Port and Spur soils have a mollic epipedon. Yahola soils have less than 18 percent clay in the control section and more than 15 percent material coarser than very fine sand.

Typical pedon of Clairemont silt loam, occasionally flooded, 650 feet south and 300 feet east of the northwest corner of sec. 20, T. 12 N., R. 22 W.

Ap—0 to 11 inches; reddish brown (2.5YR 5/4) silt loam, reddish brown (2.5YR 4/4) moist; weak platy structure; hard, very friable; many fine roots; few thin strata of very fine sandy loam; calcareous; moderately alkaline; abrupt smooth boundary.

C1—11 to 26 inches; reddish brown (2.5YR 4/4) silt loam, dark reddish brown (2.5YR 3/4) moist; weak fine granular structure; hard, friable; many fine roots; many worm casts; calcareous; moderately alkaline; gradual smooth boundary.

C2—26 to 60 inches; red (2.5YR 4/6) silt loam, dark red (2.5YR 3/6) moist; massive; hard, friable; few worm casts in the upper part; few thin strata of very fine sandy loam and sandy loam; calcareous; moderately alkaline.

These soils are typically calcareous throughout.

The A horizon is 8 to 14 inches thick. The A horizon has hue of 2.5YR to 7.5YR, value of 4 or 5, and chroma of 4 to 6. Texture is silt loam or silty clay loam. This horizon is mildly alkaline or moderately alkaline and calcareous. The C horizon has color, reaction, and texture similar to the A horizon. Bedding planes range from faint to prominent. Some pedons have buried horizons.

Clark series

The soils of the Clark series are deep, well drained, and moderately permeable. These soils formed in a moderately thick, calcareous, loamy deposit of Tertiary age. These soils are on sloping to strongly sloping ridgetops in the northeast part of the county. The soils of the Clark series are fine-loamy, mixed, thermic Typic Calciustolls. Slope ranges from 5 to 12 percent.

Clark soils are associated with Dill, Quinlan, Owens, and Pratt soils on the landscape. Dill and Quinlan soils are in the lower lying areas and formed in sandstone of Permian age. Quinlan soils do not have a mollic epipedon and are less than 20 inches thick. Dill soils do not have a mollic epipedon and have less than 18 percent clay in the control section. The shallow Owens soils are on the higher-lying, convex ridges and are more than 35 percent clay. Pratt soils are deep and sandy and are at higher elevations than the Clark soils.

Typical pedon of Clark loam, in an area of Clark-Owens complex, 5 to 12 percent slopes, in a pasture 3 3/4 miles north and 5 1/4 miles west of Elk City, 2,000 feet east and 1,650 feet south of the northwest corner of sec. 3, T. 11 N., R. 22 W.

A1—0 to 11 inches; dark brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; moderate fine granular structure; hard, friable; many worm casts; calcareous; moderately alkaline; gradual smooth boundary.

AC—11 to 20 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; moderate fine granular structure; very hard, friable; many worm casts; few soft bodies of calcium carbonate; calcareous; moderately alkaline; clear wavy boundary.

Cca—20 to 30 inches; very pale brown (10YR 7/3) clay loam, pale brown (10YR 6/3) moist; weak medium prismatic structure parting to weak medium subangular blocky; hard, friable; many soft bodies of calcium carbonate; calcareous; moderately alkaline; clear wavy boundary.

C2—30 to 60 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; massive; hard, friable; stratified with thin lenses of yellowish brown or strong brown loamy fine sand; calcareous; moderately alkaline.

The thickness of the solum ranges from 10 to 24 inches. The soil is mildly alkaline or moderately alkaline and calcareous throughout. The mollic epipedon is 6 to 14 inches thick.

The A horizon has hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 2 or 3. The AC horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 4. Texture ranges from loam to clay loam. There are few to many soft bodies or concretions of calcium carbonate. The Cca horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 3 or 4. Texture ranges from loam to clay loam. There are few to many soft bodies or concretions of calcium carbonate. The C2 horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 2 to 4. Texture is clay loam or clay. In some pedons, this horizon contains thin strata of loamy fine sand or fine sandy loam. In some pedons, a lithologic discontinuity is below the calcic horizon.

Cordell series

The soils of the Cordell series are shallow, somewhat excessively drained, and moderately slowly permeable. These very gently sloping to moderately steep soils formed in calcareous material weathered from siltstone, shale, and sandstone of the Permian red beds on uplands. The soils of the Cordell series are loamy, mixed, thermic Lithic Ustochrepts. Slope ranges from 1 to 15 percent.

Cordell soils are similar to Quinlan soils and are associated with Dill, Quinlan, Obaro, and Woodward soils on the landscape. Dill, Obaro, and Woodward soils are more than 20 inches deep. Quinlan soils are over weakly cemented sandstone bedrock.

Typical pedon of Cordell silty clay loam, 1 to 5 percent slopes, 2,000 feet north and 200 feet east of the southwest corner of sec. 6, T. 9 N., R. 21 W.

Ap—0 to 6 inches; reddish brown (5YR 5/4) silty clay loam, dark reddish brown (5YR 3/4) moist; weak fine granular structure; hard, friable; calcareous; moderately alkaline; clear smooth boundary.
A1—6 to 10 inches; reddish brown (5YR 4/4) silty clay loam, dark reddish brown (5YR 3/4) moist; moderate fine and medium granular structure; hard, friable; many worm casts; calcareous; moderately alkaline; gradual smooth boundary.
B21—10 to 15 inches; reddish brown (2.5YR 4/4) silty clay loam, dark reddish brown (2.5YR 3/4) moist; moderate fine granular structure; hard, friable; few worm casts; few fragments of siltstone; calcareous; moderately alkaline; clear wavy boundary.
B22—15 to 18 inches; reddish brown (2.5YR 5/4) very shaly silty clay loam, reddish brown (2.5YR 4/4) moist; weak fine granular structure; hard, friable; 55 percent by volume fragments of siltstone less than 1 inch in diameter; calcareous; moderately alkaline; clear wavy boundary.
R—18 inches; red (2.5YR 4/6) hard siltstone, dark red (2.5YR 3/6) moist; breaks readily into fragments 1/3 to 1/2 inch in diameter; calcareous; moderately alkaline.

Thickness of the solum ranges from 10 to 20 inches. The soil is mildly alkaline or moderately alkaline and calcareous throughout.

The A horizon has hue of 2.5YR and 5YR, value or 4 or 5, and chroma of 4 to 6. The B2 horizon has hue of 2.5YR, value of 4 or 5, and chroma of 4 to 6. Texture is silt loam or silty clay loam and averages between 25 and 30 percent clay in the upper part. Texture is very shaly silt loam or very shaly silty clay loam in the lower part. Fragments of siltstone less than 1 inch in diameter make up 50 to 75 percent by volume of the B22 horizon. The R layer is red, hard siltstone interbedded with shale or sandstone.

Cornick series

The soils of the Cornick series are very shallow, well drained, and moderately permeable. These convex, very gently sloping to gently sloping soils formed in material weathered from impure gypsum on uplands. Areas of Cornick soils are commonly interrupted by rock outcrops and entrenched drains. The soils of the Cornick series are loamy, mixed, thermic, shallow Entic Haplustolls. Slope is dominantly 1 to 5 percent.

Cornick soils are associated with Aspermont, Knoco, Quanah, Talpa, and Vinson soils on the landscape. Aspermont soils are generally in higher lying convex areas than the Cornick soils, they have a solum more than 20 inches thick, and they do not have a mollic epipedon. Quanah soils are generally on the higher lying ridgetops and have a solum more than 20 inches thick. Knoco soils have more than 35 percent clay and are over shale or clayey sediment. Talpa soils are underlain by hard limestone. Vinson soils are more than 20 inches thick over gypsum.

Typical pedon of Cornick silt loam, in an area of Cornick-Vinson-Rock outcrop complex, 1 to 5 percent slopes, in a pasture 9 1/2 miles south and 1 mile east of Erick, 2,340 feet south and 180 feet west of the northeast corner of sec. 17, T. 7 N., R. 25 W.

A1—0 to 6 inches; dark brown (7.5YR 4/2) silt loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; hard, friable; few fine roots; calcareous; clear smooth boundary.
C1—6 to 10 inches; pinkish white (5YR 8/2) weathered gypsum with streaks and bodies of pinkish gray (5YR 7/2) moist; massive; hard, friable; calcareous; moderately alkaline; abrupt smooth boundary.
Cr—10 to 15 inches; hard, white gypsum.

Thickness of the solum and depth to gypsum bedrock are 5 to 10 inches.

The A horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 or 3. The C1 horizon is pinkish white or pink weathered gypsum mixed with loamy calcareous material. It is 4 to 8 inches thick. The Cr horizon is hard, white gypsum that can easily be chipped or scratched with a knife or spade.

Cyril series

The soils of the Cyril series are deep, well drained, and moderately permeable. These nearly level soils formed in loamy alluvium on flood plains. The soils of the Cyril series are coarse-loamy, mixed, thermic Cumulic Haplustolls. Slope ranges from 0 to 1 percent.

Cyril soils are on flood plains associated with Yahola soils. Yahola soils do not have a mollic epipedon.

Typical pedon of Cyril fine sandy loam, about 1 mile south and 3/4 mile east of Hext, Oklahoma, 3,100 feet east and 820 feet north of the southwest corner of sec. 21, T. 9 N., R. 24 W.

Ap—0 to 15 inches; dark brown (7.5YR 4/2) fine sandy loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; soft, very friable; mildly alkaline; abrupt smooth boundary.
A1—15 to 25 inches; dark brown (7.5YR 4/2) fine sandy loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; soft, friable; calcareous; moderately alkaline; clear smooth boundary.
B2—25 to 40 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; weak medium granular structure; soft, friable; calcareous; moderately alkaline; clear smooth boundary.
Ab—40 to 60 inches; dark reddish brown (5YR 3/2) fine sandy loam, dark reddish brown (5YR 2/2) moist; weak medium prismatic structure; soft, friable; calcareous; moderately alkaline.

Buried soils commonly occur below depths of 40 inches. The A horizon is 20 to 40 inches thick. It has hue of 7.5YR, value of 3 or 4, and chroma of 2. Reaction is mildly alkaline or moderately alkaline. The Ab horizon has hue of 5YR, value of 3 or 4, and chroma of 2 to 4. The C horizon, where present, has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4. Reaction is moderately alkaline, and the horizon is calcareous. The B2 horizon has hue of 5YR, value of 3 to 5, and chroma of 2 to 4. Reaction is mildly alkaline or moderately alkaline, and the soil is calcareous.

The Cyril soils in this survey area are taxadjuncts to the Cyril series because they have slightly redder colors throughout than is typical for the Cyril series. Use, behavior, and management are similar to those of the Cyril soils.

Delwin series

The soils of the Delwin series are deep, well drained, and moderately permeable. These nearly level to gently sloping soils formed in loamy and sandy eolian deposits of Quaternary age on sandy uplands. The soils of the Delwin series are fine-loamy, mixed, thermic Udic Paleustalfs. Slopes ranges from 0 to 5 percent.

Delwin soils are associated with Devol, Grandfield, and Nobscot soils on the landscape. Devol soils are in lower lying areas and have less than 18 percent clay in the control section. Grandfield soils are in areas where the sandy mantle thins out, and clay content decreases by 20 percent or more within a depth of 60 inches from the surface. Nobscot soils have a sandy A horizon more than 20 inches thick and have less than 18 percent clay in the control section.

Typical pedon of Delwin loamy fine sand in an area of Delwin-Nobscot complex, 0 to 3 percent slopes, in a native pasture about 6 miles south and 2 miles east of Sayre, Oklahoma, 240 feet north and 580 feet east of the southwest corner of sec. T. 9 N., R. 23 W.

A1—0 to 5 inches; grayish brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; single grain; loose; common fine roots; neutral; abrupt smooth boundary.

A2—5 to 17 inches; light brown (7.5YR 6/4) fine sand, brown (7.5YR 5/4) moist; single grain; loose; common fine roots; neutral; clear smooth boundary.

B21t—17 to 33 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; weak coarse prismatic structure; hard, firm; few fine roots; patchy clay films on faces of peds; neutral; clear smooth boundary.

B22t—33 to 48 inches; reddish yellow (5YR 6/6) fine sandy loam, yellowish red (5YR 5/6) moist; weak coarse prismatic structure; hard, friable; few fine roots; sand grains coated and bridged with clay; neutral; gradual smooth boundary.

B23t—48 to 70 inches; yellowish red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak coarse prismatic structure; hard, friable; sand grains coated and bridged with clay; few thin broken horizontal reddish brown (5YR 4/4) sandy clay loam lamellae about 1/4 to 1/2 inch thick and 4 to 10 inches apart; neutral.

The thickness of the solum exceeds 70 inches. Where these soils are cultivated, the A1 and A2 horizons are mixed. In areas where these soils are deeply plowed, the A1 and A2 horizons are mixed with the B horizon. The combined thickness of the A1 and A2 horizons ranges from 10 to 20 inches.

The A1 horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 or 3. Reaction is slightly acid or neutral. In cultivated areas, the Ap horizon is as much as 2 units higher in value and 1 unit higher in chroma. The A2 horizon has hue of 7.5YR, value of 5 or 6, and chroma of 4 to 6. Reaction is slightly acid or neutral. The B21t horizon has hue of 2.5YR to 7.5YR, value of 4 to 6, and chroma of 3 to 8. Texture is sandy clay loam with clay content of 20 to 30 percent. Reaction ranges from slightly acid to mildly alkaline. The B22t horizon has hue of 5YR or 7.5YR, value of 5 or 6, and chroma of 4 to 8. Texture is fine sandy loam or sandy clay loam. Thin lamellae of sandy clay loam may be present in some pedons. Reaction ranges from slightly acid to mildly alkaline. The B23t horizon has hue of 5YR or 7.5YR, value of 5 to 7, and chroma of 6 to 8. Thin lamellae of fine sandy loam or sandy clay loam are present in most pedons. Reaction is neutral or mildly alkaline. Where present, the B3 horizon has color similar to the B23t horizon. Texture is fine sandy loam. Most pedons have lamellae of fine sandy loam or sandy clay loam. Reaction is neutral to moderately alkaline. Some pedons are calcareous in the lower part.

Devol series

The soils of the Devol series are deep, well drained, and moderately rapidly permeable. These nearly level to strongly sloping soils formed in deep sandy eolian deposits or old alluvium that has been reworked by wind. They are on sandy, hummocky uplands. The soils of the Devol series are coarse-loamy, mixed, thermic Udic Haplustalfs. Slope ranges from 0 to 12 percent.

Devol soils are similar to the Grandfield soils and commonly are near Delwin, Grandfield, Hardeman, Nobscot, and Tivoli soils on the landscape. Delwin soils have more than 18 percent clay in the upper 20 inches of the subsoil. Nobscot soils have an A horizon more than 20 inches thick. Tivoli soils are loamy fine sand or coarser in the control section and do not have an argillic horizon. Grandfield soils have more than 18 percent clay in the Bt horizon. Hardeman soils do not have an argillic horizon and are calcareous throughout.

Typical pedon of Devol loamy fine sand, 0 to 3 percent slopes, 7 miles south and 1 mile east of Carter, 330 feet east and 300 feet north of the southwest corner of sec. 34, T. 8 N., R. 22 W.

Ap—0 to 12 inches; brown (7.5YR 5/4) loamy fine sand, dark brown (7.5YR 4/4) moist; single grain; loose, very friable; neutral; abrupt smooth boundary.

A1—12 to 18 inches; brown (7.5YR 5/4) loamy fine sand, dark brown (7.5YR 4/4) moist; weak fine granular structure; slightly hard, very friable; slightly acid; gradual smooth boundary.

B2t—18 to 36 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; moderate medium prismatic structure; hard, friable; thin clay films on faces of peds; neutral; diffuse smooth boundary.

B3—36 to 42 inches; yellowish red (5YR 5/6) loamy fine sand, yellowish red (5YR 4/6) moist; weak coarse prismatic structure; hard, very friable; neutral; gradual smooth boundary.

C—42 to 60 inches; yellowish red (5YR 5/6) loamy fine sand, yellowish red (5YR 4/6) moist; single grain; hard, very friable; neutral.

The solum is 30 to 60 inches thick.

The A horizon is 6 to 20 inches thick. The A horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 2 to 4. Reaction ranges from slightly acid to mildly alkaline. The B2t horizon has hue of 2.5YR to 7.5YR, value of 4 to 6, and chroma of 4 to 6. It is fine sandy loam and is 12 to 18 percent clay. Reaction ranges from neutral to mildly alkaline. The B3 horizon has hue of 2.5YR to 7.5YR, value of 4 to 6, and chroma of 4 to 6. It is loamy fine sand or fine sandy loam. Reaction ranges from neutral to moderately alkaline. The C horizon has the same color range as the B3 horizon. It is loamy sand, loamy fine sand, or fine sandy loam. Reaction is neutral to moderately alkaline.

The Devol soils in Devol-Grandfield complex, 3 to 12 percent slopes, are taxadjuncts to the Devol series because they have more gravel than is typical for the Devol series. Use, behavior, and management are similar to those of the Devol soils.

Dill series

The soils of the Dill series are moderately deep, well drained, and moderately rapidly permeable. These very gently sloping to strongly sloping soils formed in material weathered from noncalcareous sandstone of the Permian red beds on uplands. The soils of the Dill series are coarse-loamy, mixed, thermic Udic Ustochrepts. Slope is dominantly 1 to 5 percent but ranges to 12 percent.

Dill soils are commonly near Clark, Cordell, Grandfield, Owens, Quinlan, Woodward, and Woodward Variant soils on the landscape. Clark soils have more than 18 percent clay in the control section. Cordell soils are less than 20 inches thick over hard siltstone. Grandfield soils have an argillic horizon. Owens soils are less than 20 inches deep and have more than 35 percent clay. Quinlan soils are less than 20 inches deep. Woodward soils are calcareous and have less than 15 percent material coarser than very fine sand. Woodward Variant soils are calcareous throughout.

Typical pedon of Dill fine sandy loam (fig. 13), in an area of Dill-Quinlan complex, 1 to 3 percent slopes, 1,200 feet south and 700 feet west of the northeast corner of sec. 33, T. 11 N., R. 21 W.

Ap—0 to 6 inches; reddish brown (5YR 5/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; very weak fine granular structure; soft, very friable; neutral; abrupt smooth boundary.

A1—6 to 15 inches; reddish brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; weak fine granular structure; slightly hard, very friable; neutral; gradual smooth boundary.

B2—15 to 30 inches; reddish brown (2.5YR 4/4) fine sandy loam, dark reddish brown (2.5YR 3/4) moist; weak medium prismatic structure parting to weak

Figure 13.—Profile of Dill fine sandy loam in an area of Dill-Quinlan complex, 1 to 3 percent slopes.

fine granular; hard, very friable; many worm casts; few fragments of soft sandstone in the lower 4 inches; neutral; abrupt irregular boundary.

Cr—30 to 45 inches; red (2.5YR 4/6) weakly cemented noncalcareous sandstone.

Solum thickness ranges from 20 to 40 inches.

The A horizon is 6 to 16 inches thick. It has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 3 or 4. Reaction is slightly acid to mildly alkaline. The B2 horizon has hue of 10R to 5YR, value of 4 or 5, and chroma of 4 to 6. Texture is fine sandy loam or very fine sandy loam. Reaction is slightly acid to mildly alkaline. The Cr horizon is weakly cemented, noncalcareous sandstone. It is similar in color to the B2 horizon. Reaction is slightly acid to moderately alkaline. Some areas are underlain by bedded siltstone, shale, or sandstone that has seams of calcium carbonate.

Gracemont series

The soils of the Gracemont series are deep, somewhat poorly drained, and moderately permeable to moderately rapidly permeable. These nearly level soils formed in loamy calcareous alluvium on narrow flood plains. The soils of the Gracemont series are coarse-loamy, mixed (calcareous), thermic Aquic Udifluvents. Slope ranges from 0 to 1 percent.

Gracemont soils are similar to Yahola soils and are commonly near Clairemont, Gracemore, Lincoln, and Yahola soils on the landscape. Clairemont soils have more than 18 percent clay in the control section. Gracemore and Lincoln soils have a horizon of fine sand or loamy fine sand below a depth of 10 inches. Yahola and Lincoln soils are dry for longer periods and do not have a water table above a depth of 40 inches.

Typical pedon of Gracemont clay loam, 500 feet east and 160 feet north of the southwest corner of sec. 12, T. 10 N., R. 22 W.

A1—0 to 6 inches; reddish brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) moist; moderate medium granular structure; slightly hard, friable; many fine and medium roots; calcareous; moderately alkaline; abrupt smooth boundary.

C1—6 to 10 inches; red (2.5YR 5/6) fine sandy loam, red (2.5YR 4/6) moist; massive; soft, very friable; many fine and medium roots; few thin bedding planes of reddish brown (5YR 4/4) loam; calcareous; moderately alkaline; abrupt smooth boundary.

C2—10 to 14 inches; red (2.5YR 4/6) fine sandy loam, dark red (2.5YR 3/6) moist; massive; soft, very friable; many fine roots; common dark worm casts; thin strata of dark reddish brown (5YR 3/4) loam in the upper part; calcareous; moderately alkaline; clear smooth boundary.

C3—14 to 62 inches; reddish brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; massive; soft, very friable; common fine roots; calcareous; moderately alkaline.

These soils are typically calcareous and moderately alkaline throughout.

The A horizon ranges from 6 to 14 inches thick. The A horizon has hue of 2.5YR to 10YR, value of 4 or 5, and chroma of 2 to 6. The electrical conductivity of saturation extract ranges from 0 to 8 millimhos per centimeter. The C horizon has hue of 2.5YR to 7.5YR, value of 4 to 6, and chroma of 4 to 8. Texture is fine sandy loam. Thin strata or bedding planes range from few to many, and they have texture ranging from loamy fine sand to clay loam. Some pedons have buried layers which have mottles in shades of red, gray, and brown. The electrical conductivity of saturation extract ranges from 0 to 8 millimhos per centimeter.

Gracemore series

The soils of the Gracemore series are deep, somewhat poorly drained, and moderately rapidly permeable. These nearly level soils formed in calcareous sandy alluvium on flood plains. These soils have a water table within 40 inches of the surface most of the year. The soils of the Gracemore series are sandy, mixed, thermic Aquic Udifluvents. Slope ranges from 0 to 1 percent.

The Gracemore soils are commonly associated with Gracemont, Lincoln, and Yahola soils. Gracemont soils have a fine sandy loam horizon below a depth of 10 inches. Lincoln soils have a water table at a depth of 40 inches or more most of the year. Yahola soils are dry for longer periods than the Gracemore soils and have a water table at a depth of 40 inches or more. Lincoln and Yahola soils are slightly higher on the landscape than Gracemore soils and are better drained.

Typical pedon of Gracemore loam, saline, 2,320 feet north and 1,780 feet west of the southeast corner of sec. 10, T. 9 N., R. 24 W.

A1—0 to 8 inches; reddish brown (5YR 4/4) loam, dark reddish brown (5YR 3/4) moist; moderate medium granular structure; hard, friable; common fine roots; slightly saline; calcareous; moderately alkaline; abrupt smooth boundary.

C1—8 to 22 inches; light brown (7.5YR 6/4) loamy fine sand, brown (7.5YR 5/4) moist; single grain; loose; few fine roots; few thin strata of yellowish red (5YR 4/6) fine sandy loam; bedding planes are evident; moderately saline; calcareous; moderately alkaline; clear smooth boundary.

C2—22 to 60 inches; light brown (7.5YR 6/4) fine sand, brown (7.5YR 5/4) moist; single grain; loose; common fine reddish brown stains; evident thin bedding planes; moderately saline; calcareous; moderately alkaline.

These soils are moderately alkaline and calcareous throughout the control section. They are affected by saline salts which occur as a white crust on the surface and as salt crystals in the solum.

The A horizon has hue of 5YR to 10YR, value of 4 to 6, and chroma of 2 to 4. Electrical conductivity ranges from 2 to 8 millimhos per centimeter. The C horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 3 or 4. Texture is fine sand or loamy fine sand. Bedding planes of finer textured materials range from few to many. Electrical conductivity ranges from 4 to 8 millimhos per centimeter.

Grandfield series

The soils of the Grandfield series are deep, well drained, and moderately permeable. They are on broad, very gently sloping to sloping uplands. These soils formed in eolian deposits or old alluvium that has been reworked by wind. The soils of the Grandfield series are fine-loamy, mixed, thermic Udic Haplustalfs. Slope ranges from 1 to 8 percent.

Grandfield soils are associated with Abilene, Altus, Delwin, Devol, Dill, and Nobscot soils. Abilene soils have a mollic epipedon and have more than 35 percent clay in the control section. Altus soils have a mollic epipedon more than 20 inches thick. Delwin soils do not have a decrease of as much as 20 percent in clay from its maximum within a depth of 60 inches of the soil surface as Grandfield soils. Devol soils have less than 18 percent clay in the control section. Dill soils are less than 40 inches deep to sandstone. Nobscot soils have less clay in the argillic horizon and have an A horizon that is more than 20 inches thick.

Typical pedon of Grandfield loamy fine sand, 1 to 3 percent slopes, in a cultivated field, about 6 miles east and 3 miles north of Sayre, 2,300 feet east and 300 feet north of the southwest corner of sec. 10, T. 10 N., R. 22 W.

Ap—0 to 10 inches; brown (7.5YR 5/4) loamy fine sand, dark brown (7.5YR 4/4) moist; single grain; slightly hard, very friable; many fine roots; few fine pebbles; slightly acid; abrupt smooth boundary.

A1—10 to 14 inches; dark brown (7.5YR 4/4) loamy fine sand, dark brown (7.5YR 3/4) moist; weak fine granular structure; slightly hard, very friable; many fine roots; slightly acid; gradual smooth boundary.

B21t—14 to 30 inches; reddish brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; moderate medium prismatic structure; hard, firm; many fine roots; few fine pebbles; continuous clay films on faces of peds; slightly acid; gradual smooth boundary.

B22t—30 to 42 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; moderate coarse prismatic structure; hard, friable; many fine roots; few fine pebbles; continuous clay films on faces of peds; neutral; gradual smooth boundary.

B3—42 to 56 inches; yellowish red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak coarse prismatic structure; hard, friable; few fine roots; few fine pebbles; patchy clay films on faces of peds; neutral; gradual smooth boundary.

C—56 to 65 inches; yellowish red (5YR 5/8) fine sandy loam, yellowish red (5YR 4/8) moist; massive; slightly hard, very friable; few fine roots; few fine pebbles; neutral.

The thickness of the solum ranges from 50 to 80 inches.

The A horizon ranges from 4 to 16 inches in thickness. The A horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 2 to 4. Reaction is slightly acid to mildly alkaline. Content of gravel ranges from 0 to 5 percent by volume. The B1 horizon, where present, has the same color and reaction range as the A1 horizon. It is fine sandy loam or sandy clay loam. The B2t horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 3 to 6. It is sandy clay loam or fine sandy loam. Clay content ranges from 18 to 32 percent. Reaction is slightly acid to mildly alkaline in the upper part and neutral to moderately alkaline in the lower part. Content of gravel ranges from 0 to 5 percent by volume. The B3 horizon has color and texture similar to the B2t horizon except that it has chroma of 8 in some pedons. Reaction is neutral to moderately alkaline. Content of gravel ranges from 0 to 5 percent by volume. The C horizon, where present, has color and reaction similar to the B3 horizon. Texture ranges from fine sandy loam to loamy sand. Some pedons are calcareous in the C horizon. In a few areas buried horizons occur below a depth of 40 inches.

The Grandfield soils in Devol-Grandfield complex, 3 to 12 percent slopes, are taxadjuncts to the Grandfield series because they have more gravel than is typical for the Grandfield series. Use, behavior, and management are similar to those of the Grandfield soils.

Hardeman series

The soils of the Hardeman series are deep, well drained, and moderately rapidly permeable. These soils formed in calcareous eolian deposits on very gently sloping to gently sloping uplands. The soils of the Hardeman series are coarse-loamy, mixed, thermic Typic Ustochrepts. Slope ranges from 1 to 5 percent.

Hardeman soils are similar to Woodward soils and are commonly near Devol and Woodward soils on the landscape. Devol soils are noncalcareous throughout and have an argillic horizon. Woodward soils have less than 15 percent material coarser than very fine sand in the control section and are underlain by sandstone at a depth of 20 to 40 inches.

Typical pedon of Hardeman fine sandy loam, 3 to 5 percent slopes, 2,000 feet north and 180 feet east of the southwest corner of sec. 12, T. 9 N., R. 21 W.

Ap—0 to 6 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; weak fine granular structure; slightly hard, friable; few fine roots; moderately alkaline; clear smooth boundary.

B21—6 to 20 inches; red (2.5YR 5/6) fine sandy loam, red (2.5YR 4/6) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable; few fine roots; few medium concretions of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B22—20 to 32 inches; red (2.5YR 5/6) fine sandy loam, red (2.5YR 4/6) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable; few medium concretions of calcium carbonate and few films and threads of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

C1ca—32 to 55 inches; reddish yellow (5YR 6/6) fine sandy loam, yellowish red (5YR 5/6) moist; massive; slightly hard, friable; common medium soft bodies of calcium carbonate and few films of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

C2—55 to 60 inches; reddish yellow (5YR 6/6) fine sandy loam, yellowish red (5YR 5/6) moist; massive; slightly hard, very friable; few fine pebbles; few medium fragments of sandstone; calcareous; moderately alkaline.

The thickness of the solum ranges from 30 to 50 inches.

The A horizon is 6 to 18 inches thick. It has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. Reaction is mildly alkaline or moderately alkaline. This horizon is typically noncalcareous, but in some pedons it is calcareous. The B2 horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 6. It is fine sandy loam or sandy loam. This horizon is mildly alkaline or moderately alkaline and is mostly calcareous with few to many threads and soft powdery bodies of calcium carbonate. In a few pedons this horizon is noncalcareous. Where present, the B3 horizon is similar in color and texture to the B2 horizon. The C horizon has hue of 2.5YR to 7.5YR, value of 4 to 6, and chroma of 4 to 6. Reaction is mildly alkaline or moderately alkaline.

Knoco series

The soils of the Knoco series are very shallow, well drained to excessively drained, and very slowly permeable. These strongly sloping to steep soils formed in material weathered from shale and from clayey shale of the Permian red beds on uplands. The soils of the Knoco series are clayey, mixed (calcareous), thermic, shallow Ustic Torriorthents. Slope ranges from 10 to 40 percent.

The Knoco soils are commonly adjacent to Aspermont, Cornick, Vernon, and Vinson soils on the landscape. Aspermont soils have a solum more than 40 inches thick and have less than 35 percent clay in the control section. Cornick and Vinson soils are underlain by gypsum and have a mollic epipedon. Vernon soils have a solum that is 20 to 40 inches thick.

Typical pedon of Knoco clay, in an area of Knoco-Rock outcrop complex, 20 to 40 percent slopes, 880 feet west and 600 feet north of the southeast corner of sec. 17, T. 7 N., R. 26 W.

A1—0 to 6 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; moderate medium granular structure; very hard, firm; few fine roots; about 5 percent by volume fragments of limestone and pebbles of quartz; common fragments of limestone and pebbles of quartz on the surface; calcareous; moderately alkaline; clear smooth boundary.

Cr—6 to 40 inches; red (2.5YR 4/6) clayey shale, dark red (2.5YR 3/6) moist; massive; extremely hard, very firm; few fine roots in cracks; many granules and soft crystals of gypsum in the upper 6 inches; few thin strata of bluish green shale; calcareous; moderately alkaline.

The thickness of the solum and depth to red-bed shale range from 3 to 12 inches. The soil is moderately alkaline and calcareous throughout.

The A1 horizon has hue of 5YR or 2.5YR, value of 4 or 5, and chroma of 4 to 6. Content of coarse fragments on the surface and in the solum ranges from 0 to 15 percent by volume. The Cr horizon is red with gray or bluish green gypsiferous shale or clayey shale. It is weakly consolidated to massive. Gypsum in the form of soft crystals, granules, or thin horizontal strata occur in some pedons.

Lincoln series

The soils of the Lincoln series are deep, somewhat excessively drained, and rapidly permeable. These nearly level soils formed in thick sandy alluvium on flood plains. The soils of the Lincoln series are sandy, mixed, thermic Typic Ustifluvents. Slope ranges from 0 to 1 percent.

Lincoln soils are associated with Gracemont, Gracemore, Spur, Tivoli, and Yahola soils on the landscape. Gracemore soils have a water table at a depth of less than 40 inches. Spur soils have a mollic epipedon and have more than 18 percent clay in the control section. Tivoli soils are on the higher lying convex dunes and do not have strata with textures finer than loamy fine sand in the control section. Yahola and Gracemont soils have textures finer than loamy fine sand in the control section. In addition, Gracemont soils have a water table at a depth of less than 40 inches.

Typical pedon of Lincoln loamy fine sand, in a pasture 5 miles north of Texola, 500 feet east of the north end of bridge over the North Fork of the Red River; 1,750 feet north of the southwest corner of SE1/4 sec. 31, T. 10 N., R. 26 W.

A1—0 to 6 inches; light brown (7.5YR 6/4) loamy fine sand, brown (7.5YR 5/4) moist; weak fine granular structure; loose; very friable; calcareous; moderately alkaline; clear smooth boundary.
C—6 to 60 inches; very pale brown (10YR 7/3) fine sand, brown (10YR 5/3) moist; single grain; loose, very friable; thin strata of fine sandy loam; calcareous; moderately alkaline.

These soils are calcareous throughout. The average texture of the control section is coarser than loamy fine sand.

The A horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 3 or 4. Thickness ranges from 6 to 12 inches. The C horizon has hue of 5YR to 10YR, value of 6 or 7, and chroma of 3 or 4. Thin strata of loamy material occur throughout this horizon.

Mangum series

The soils of the Mangum series are deep, well drained, and very slowly permeable. These nearly level soils formed in clayey alluvium on flood plains in the southern part of the county. The soils of the Mangum series are fine, mixed, thermic Vertic Ustochrepts. Slope ranges from 0 to 1 percent.

Mangum soils commonly are near Beckman, Clairemont, Spur, and Treadway soils on the landscape. Beckman soils do not have a cambic horizon and are saline. Clairemont soils have less than 35 percent clay in the control section. Spur soils have a mollic epipedon and are less than 35 percent clay in the control section. Treadway soils have electrical conductivity greater than 2 millimhos at a depth of less than 40 inches and do not have a cambic horizon.

Typical pedon of Mangum clay, 3 3/4 miles south of the Sayre Airport and 400 feet east of road, SW1/4NE1/4SW1/4 sec. 32, T. 8 N., R. 23 W.

Ap—0 to 6 inches; brown (7.5YR 5/2) clay, dark brown (7.5YR 4/2) moist; moderate fine and medium granular structure; extremely hard, firm; common fine roots; few fine soft white bodies of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.
B21—6 to 18 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; moderate fine and medium angular blocky structure; extremely hard, very firm; common fine roots; few fine threads and coatings of calcium carbonate in cracks; calcareous; moderately alkaline; gradual smooth boundary.
B22—18 to 25 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; moderate fine and medium angular blocky structure; extremely hard, very firm; common white bodies of calcium carbonate and crystals of gypsum; few fine crystals of calcium sulfate; few fine black concretions; calcareous; moderately alkaline; gradual smooth boundary.
C1—25 to 40 inches; reddish brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; massive; extremely hard, very firm; faint bedding planes; few very fine crystals of gypsum; common fine threads of calcium carbonate; few fine fragments of gray shale; calcareous; moderately alkaline; gradual smooth boundary.
C2—40 to 60 inches; reddish brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; massive; extremely hard, very firm; very weak bedding planes with thin lenses of fine sand; few fine crystals of gypsum; common fine threads of calcium carbonate; few fine fragments of gray shale; calcareous; moderately alkaline.

Typically, these soils are moderately alkaline and calcareous throughout.

The A horizon has hue of 7.5YR or 5YR, value of 5, and chroma of 2 to 4. It ranges from 6 to 20 inches in thickness. The B horizon has hue of 5YR or 2.5YR, value of 4 or 5, and chroma of 4 to 6. The C horizon is similar to the B horizon in color, texture, and reaction. Thin bedding planes commonly occur in the C horizon.

Nobscot series

The soils of the Nobscot series are deep, well drained, and moderately rapidly permeable. These nearly level to strongly sloping soils formed in deep sandy deposits on sandy uplands. The soils of the Nobscot series are loamy, mixed, thermic Arenic Paleustalfs. Slope is dominantly 0 to 5 percent but ranges to 12 percent.

Nobscot soils are associated with Delwin, Devol, Grandfield, and Tivoli soils. Delwin soils have more than 18 percent clay in the control section and an A horizon that is less than 20 inches thick. Devol and Grandfield soils have an A horizon less than 20 inches thick. Tivoli soils do not have an argillic horizon.

Typical pedon of Nobscot fine sand, 2 to 5 percent slopes (fig. 14), 6 miles south and 2 miles east of Sayre, 600 feet east and 80 feet north of the southwest corner of sec. 35, T. 9 N., R. 23 W.

A1—0 to 5 inches; brown (7.5YR 5/2) fine sand, dark brown (7.5YR 4/2) moist; weak fine granular structure; soft, very friable; many fine and medium roots; slightly acid; gradual wavy boundary.
A2—5 to 23 inches; pink (7.5YR 7/4) fine sand, light brown (7.5YR 6/4) moist; single grain; loose; many fine and medium roots; slightly acid; clear wavy boundary.
B21t—23 to 36 inches; red (2.5YR 4/6) sandy loam, dark red (2.5YR 3/6) moist; weak coarse prismatic structure; hard, friable; few bands about 1/4 inch thick of dark reddish brown (2.5YR 3/4) sandy loam;

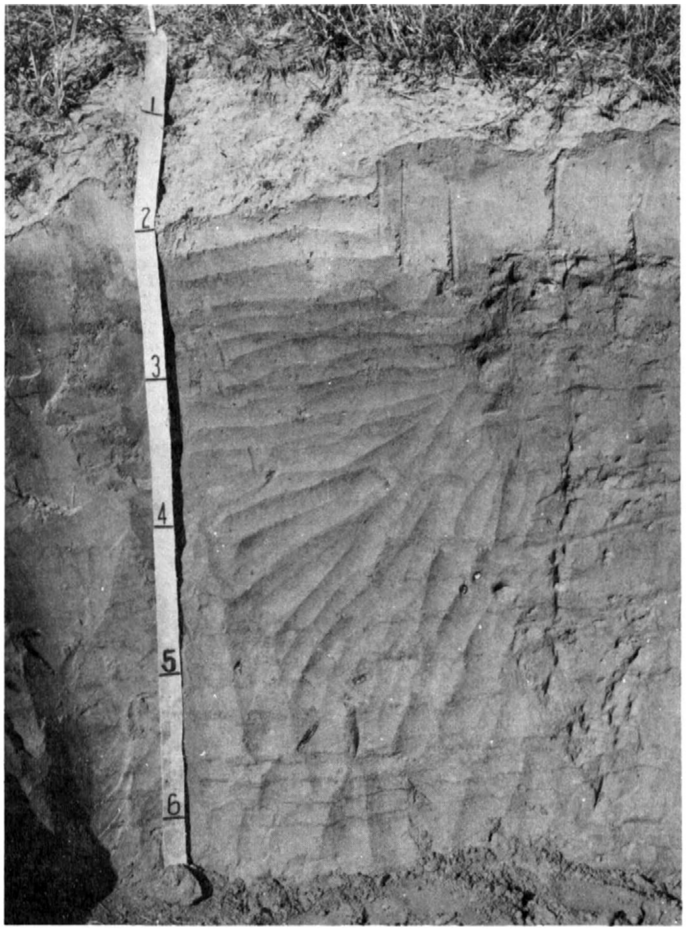


Figure 14.—Profile of Nobscot fine sand, 2 to 5 percent slopes.

sand grains coated and bridged with clay; few very fine pores; few fine root channels filled or partially filled with clean sand grains; few fine and medium roots; slightly acid; gradual smooth boundary.

B22t—36 to 53 inches; red (2.5YR 5/6) loamy sand, red (2.5YR 4/6) moist; weak coarse prismatic structure; hard, very friable; common bands of dark red (2.5YR 3/6) sandy loam about 1/4 inch thick and 4 to 6 inches apart between layers of loamy sand; sand grains coated and bridged with clay; few fine pores; few fine roots; slightly acid; gradual smooth boundary.

B23t—53 to 71 inches; reddish yellow (5YR 6/6) loamy sand, yellowish red (5YR 5/6) moist; weak coarse prismatic structure; hard, very friable; common bands of red (2.5YR 4/6) sandy loam about 1/8 to 1 inch thick and 5 inches apart between layers of loamy sand; sand grains coated and bridged with clay; about 5 percent by volume pockets of clean sand grains; few fine roots; slightly acid; diffuse smooth boundary.

B3—71 to 80 inches; reddish yellow (5YR 6/6) fine sand, yellowish red (5YR 5/6) moist; weak coarse prismatic structure; slightly hard, loose; common bands of red (2.5YR 4/6) loamy fine sand about 1/8 inch thick and 5 inches apart between layers of fine sand; about 5 percent by volume pockets of clean sand grains; slightly acid.

The thickness of the solum is greater than 70 inches.

The thickness of the A horizon is 20 to 40 inches. The A horizon is fine sand. In cultivated areas, the A1 and A2 horizons are mixed. The A horizon has hue of 7.5YR or 10YR, value of 4 to 7, and chroma of 2 to 4. Where cultivated, the Ap horizon is as much as 2 units higher in value and 1 unit higher in chroma. Reaction is neutral to medium acid. Where this soil is deeply plowed, material from the subsoil is mixed into the plow layer. The B2t horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 8. Texture is sandy loam on fine sandy loam in the upper part and loamy fine sand, or loamy sand in the lower part. Reaction ranges from slightly acid to strongly acid. The B2t horizon contains lamellae of sandy clay loam or fine sandy loam that are 1/4 inch to 6 inches thick and from 2 to 6 inches apart. The B3 horizon has hue of 2.5YR or 5YR, value of 5 or 6, and chroma of 6 to 8. It is loamy sand or loamy fine sand and contains lamellae of fine sandy loam that are 4 to 10 inches apart and 1/8 inch to 2 inches thick. Reaction is slightly acid or neutral. The C horizon, where present, is similar to the B3 horizon in texture, color, and reaction.

Obaro series

The soils of the Obaro series are moderately deep, well drained, and moderately permeable. They formed in calcareous, interbedded silty sandstone and siltstone of the Permian red beds. These very gently sloping to strongly sloping soils are on uplands. The soils of the Obaro series are fine-silty, mixed, thermic Typic Ustochrepts. Slope ranges from 1 to 12 percent.

Obaro soils are near Aspermont, Carey, Cordell, Quinlan, St. Paul, and Woodward soils. Aspermont soils do not have weakly cemented sandstone or siltstone above a depth of 40 inches. Carey and St. Paul soils are more than 40 inches deep, have a mollic epipedon, and have an argillic horizon. Cordell soils are less than 20 inches thick over shale or siltstone. Quinlan soils are less than 20 inches thick. Woodward soils have less than 18 percent clay in the control section.

Typical pedon of Obaro silt loam (fig. 15), in an area of Obaro-Quinlan complex, 1 to 3 percent slopes, about 1 mile north and 1/2 mile west of Sayre, 600 feet north and 500 feet east of the southwest corner of sec. 21, T. 10. N., R. 23 W.

Ap—0 to 6 inches; reddish brown (5YR 5/3) silt loam, reddish brown (5YR 4/3) moist; weak granular structure; hard, friable; many worm casts; few fine

Figure 15.—Profile of Obaro silt loam, 1 to 3 percent slopes.

roots; calcareous; moderately alkaline; abrupt smooth boundary.

A1—6 to 13 inches; reddish brown (5YR 5/3) silt loam, reddish brown (5YR 4/3) moist; moderate fine granular structure; hard, friable; many worm casts; many fine roots; few fine concretions and soft bodies of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B2—13 to 28 inches; reddish brown (2.5YR 4/4) silt loam, dark reddish brown (2.5YR 3/4) moist; moderate medium and fine granular structure; hard, friable; many worm casts, which are usually darker in chroma than the mass; many fine roots; few films and threads of calcium carbonate and few fine concretions of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

B3ca—28 to 36 inches; red (2.5YR 4/6) silt loam, dark red (2.5YR 3/6) moist; weak fine granular structure; hard, friable; concretions and soft bodies of calcium carbonate make up about 10 percent by volume; few fragments of sandstone; calcareous; moderately alkaline; abrupt smooth boundary.

Cr—36 to 76 inches; red (2.5YR 4/6) weakly cemented interbedded siltstone and sandstone; firm.

The thickness of the solum ranges from 20 to 40 inches. Typically, this soil is calcareous throughout.

The A horizon has hue of 7.5YR or 5YR, value of 4 or 5, and chroma of 3 or 4. It is dominantly silt loam, but the range includes silty clay loam and loam. Thickness of the A horizon is 6 to 16 inches. Reaction is mildly alkaline or moderately alkaline. The B2 horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 6. It is silt loam or silty clay loam, and averages between 18 to 35 percent clay. Reaction is mildly alkaline or moderately alkaline and the horizon is calcareous. Calcium carbonate ranges from a few films and threads to about 5 percent by volume soft bodies. The B3ca horizon has hue of 2.5YR, value of 4 or 5, and chroma of 4 to 6. Texture is silt loam or silty clay loam. Visible segregated calcium carbonate ranges from a few films and threads to about 14 percent by volume calcium carbonate concretions and soft bodies. The Cr horizon has hue of 2.5YR, value of 4 to 6, and chroma of 4 to 6. It is weakly cemented interbedded siltstone and sandstone. The Cr horizon is calcareous and moderately alkaline.

Owens series

The soils of the Owens series are shallow, well drained, and very slowly permeable. These sloping to strongly sloping soils formed in clay of Pliocene or Pleistocene age on uplands. The soils of the Owens series are clayey, mixed, thermic, shallow Typic Ustochrepts. Slope ranges from 5 to 12 percent.

Owens soils are near Clark, Dill, Pratt, and Quinlan soils. Clark soils have less than 35 percent clay and have a mollic epipedon. Dill soils are more than 20 inches thick, have less than 35 percent clay, and are over soft sandstone. Pratt soils are sandy and occupy higher positions than the Owens soils. Quinlan soils have less than 35 percent clay and formed in residuum weathered from soft sandstone.

Typical pedon of Owens clay loam in an area of Clark-Owens complex, 5 to 12 percent slopes, about 6 miles west and 3 3/4 miles north of Elk City, Oklahoma, 900 feet south and 1,100 feet east of the northwest corner of sec. 3, T. 11 N., R. 22 W.

A1—0 to 3 inches; brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) moist; weak medium granular structure; hard, firm; common fine roots; common flat fragments of hematite 1/4 inch thick and 4 inches in diameter; calcareous; moderately alkaline; abrupt smooth boundary.

B2ca—3 to 11 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; few fine faint yellowish brown mottles; moderate fine subangular blocky structure; extremely hard, extremely firm; few fine roots; few fine concretions of calcium carbonate; ped faces are coated with films of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

Cr—11 to 30 inches; very pale brown (10YR 7/3) clay, pale brown (10YR 6/3) moist; massive; extremely hard, extremely firm; calcareous; moderately alkaline.

The thickness of the solum is 10 to 20 inches. These soils are calcareous throughout and crack when dry.

The A horizon has hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 2 to 4. Fragments of hematite or limonite occur on the surface and in the A horizon. The fragments are 2 to 6 inches in diameter and 1/2 to 1/4 inch thick and make up 0 to 20 percent by volume of the horizon. The B2ca horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4. The C horizon is grayish or brownish, calcareous clay or shaly clay.

Port series

The soils of the Port series are deep, well drained, and moderately permeable. They formed in loamy calcareous alluvium on level and nearly level flood plains. The soils of the Port series are fine-silty, mixed, thermic Cumulic Haplustolls. Slope ranges from 0 to 1 percent.

Port soils are near Clairemont, Spur, and Yahola soils on the landscape. Clairemont soils do not have a mollic epipedon. Spur soils have a mollic epipedon less than 20 inches thick and have more than 15 percent material that is coarser than very fine sand in the control section. Yahola soils do not have a mollic epipedon and have less than 18 percent clay in the control section.

Typical pedon of Port silty clay loam, about 14 miles east of Sayre on Oklahoma Highway 152, 1,840 feet south and 880 feet east of the northwest corner of sec. 1, T. 9 N., R. 21 W.

Ap—0 to 6 inches; reddish brown (5YR 4/3) silty clay loam, dark reddish brown (5YR 3/3) moist; weak medium granular structure; soft, friable; common fine roots; mildly alkaline; abrupt smooth boundary.

A1—6 to 14 inches; reddish brown (5YR 4/3) silty clay loam, dark reddish brown (5YR 3/3) moist; moderate coarse granular structure; slightly hard, friable; few fine roots; mildly alkaline; clear smooth boundary.

B21—14 to 22 inches; reddish brown (5YR 4/3) silty clay loam, dark reddish brown (5YR 3/3) moist; weak fine and medium subangular blocky structure; hard, firm; few fine roots; calcareous; moderately alkaline; gradual smooth boundary

B22—22 to 35 inches; reddish brown (2.5YR 4/4) silty clay loam, dark reddish brown (2.5YR 3/4) moist; weak fine and medium subangular blocky structure; hard, firm; few fine roots; few fine black concretions; few films and threads of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

C—35 to 60 inches; red (2.5YR 5/6) silt loam, red (2.5YR 4/6) moist; massive; hard, friable; few thin strata of fine sandy loam; few medium fragments of sandstone; calcareous; moderately alkaline.

The A horizon has hue of 5YR, value of 3 to 5, and chroma of 2 or 3. Reaction is neutral or mildly alkaline. The B2 horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 3 to 6. Reaction is mildly alkaline or moderately alkaline. The C horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 4 to 6. Reaction is moderately alkaline and the horizon is calcareous. Texture is silty clay loam or silt loam.

Pratt series

The soils of the Pratt series are deep, well drained, and rapidly permeable. These sloping to strongly sloping soils are on ridgetops and upper parts of side slopes on uplands in the northeastern part of the county. These soils formed in sandy deposits that have been reworked by wind. The soils of the Pratt series are sandy, mixed, thermic Psammentic Haplustalfs. Slope ranges from 5 to 12 percent.

Pratt soils are adjacent to Clark, Owens, and Tivoli soils. Clark soils have more than 18 percent clay in the control section and have a mollic epipedon. Owens soils are shallow over clayey shale. These soils are at lower elevations on the landscape than Pratt soils. Tivoli soils do not have an argillic horizon.

Typical pedon of Pratt loamy fine sand, in an area of Pratt-Tivoli complex, 5 to 12 percent slopes, about 3 1/4 miles west and 4 1/2 miles north of Elk City, Oklahoma, about 1,650 feet west and 1,650 feet north of the southeast corner of sec. 1, T. 11 N., R. 22 W.

A1—0 to 10 inches; brown (7.5YR 4/2) loamy fine sand, dark brown (7.5YR 3/2) moist; single grain; loose; slightly acid; clear smooth boundary.

B21t—10 to 28 inches; reddish yellow (7.5YR 6/6) loamy fine sand, strong brown (7.5YR 5/6) moist; weak coarse prismatic structure; very friable; clay bridging between sand grains; slightly acid; clear smooth boundary.

B22t—28 to 38 inches; reddish yellow (7.5YR 6/6) loamy fine sand, strong brown (7.5YR 5/6) moist; weak coarse prismatic structure; very friable; few clay bridges between sand grains; slightly acid; gradual smooth boundary.

C—38 to 60 inches; reddish yellow (7.5YR 6/6) loamy fine sand, strong brown (7.5YR 5/6) moist; single grain; loose; neutral.

The solum ranges from 24 to 50 inches in thickness.

The A horizon has hue of 7.5YR, value of 4 or 5, and chroma of 2 or 3. Reaction is medium acid to neutral. The B2t horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 4 to 6. It is slightly acid or neutral. The C horizon has hue of 7.5YR, value of 6, and chroma of 4 to 6. It is loamy fine sand or loamy sand and is slightly acid or neutral.

Quanah series

The soils of the Quanah series are deep, well drained, and moderately permeable. These very gently sloping to gently sloping soils formed in loamy material of the Permian red beds on uplands. The soils of the Quanah series are fine-silty, mixed, thermic Typic Calciustolls. Slope ranges from 1 to 5 percent.

Quanah soils are near Aspermont, Cornick, Talpa, Tillman, Vernon, and Vinson soils. Aspermont soils do not have a mollic epipedon. Cornick soils are shallow over gypsum. Talpa soils are shallow over limestone. Tillman soils have an argillic horizon with more than 35 percent clay in the control section. Vernon soils do not have a mollic epipedon and have more than 35 percent clay in the control section. Vinson soils are 20 to 40 inches thick over gypsum.

Typical pedon of Quanah clay loam, in an area of Quanah-Talpa complex, 1 to 5 percent slopes, about 4 miles west and 5 miles south of Erick, Oklahoma, 2,000 feet west and 400 feet north of the southeast corner of sec. 28, T. 8 N., R. 26 W.

A1—0 to 10 inches; brown (7.5YR 5/2) clay loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; hard, friable; many worm casts; many fine roots; calcareous; moderately alkaline; gradual smooth boundary.

B2—10 to 24 inches; reddish brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) moist; moderate medium granular structure; hard, friable; many worm casts; common fine roots; few concretions of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

C1ca—24 to 36 inches; yellowish red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; massive; hard, friable; about 15 percent concretions of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

C2—36 to 60 inches; yellowish red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; massive; hard, friable; calcareous; moderately alkaline.

Thickness of the solum to the Cca horizon is 20 to 40 inches. The soil is calcareous throughout.

Thickness of the A horizon is 6 to 12 inches. The A horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 or 3. It is mildly alkaline or moderately alkaline. Where present, the B1 horizon is similar in color to the A horizon and similar in texture to the B2 horizon. The B2 horizon has hue of 5YR, value of 4 or 5, and chroma of 3 or 4. It is clay loam or silty clay loam. Some pedons have a B22ca or B3ca horizon that is 1 to 5 percent calcium carbonate in the form of concretions, films, and soft bodies. Reaction is moderately alkaline. The C1ca horizon has hue of 5YR, value of 5, and chroma of 4 to 6. It is clay loam or silty clay loam. It is 15 to 25 percent calcium carbonate in the form of concretions, films, and soft bodies. Reaction is moderately alkaline. The C2 horizon is similar to the C1ca horizon in color, texture, and reaction. It contains less visible calcium carbonate than the C1ca horizon.

Quinlan series

The soils of the Quinlan series are shallow, well drained, and moderately rapidly permeable or moderately permeable. These very gently sloping to strongly sloping soils formed in residuum weathered from calcareous sandstone, shale, and siltstone of the Permian red beds on sandy uplands. The soils of the Quinlan series are loamy, mixed, thermic, shallow Typic Ustochrepts. Slope ranges from 1 to 12 percent.

Quinlan soils are associated with Clark, Cordell, Dill, Obaro, Owens, Woodward, and Woodward Variant soils. Cordell soils have a lithic contact with the underlying hard siltstone. Dill soils are not calcareous and have a solum more than 20 inches thick. Clark soils have a mollic epipedon and have more than 18 percent clay in the control section. Obaro, Woodward, and Woodward Variant soils lack sandstone within a depth of 20 inches. Owens soils have more than 35 percent clay in the control section.

Typical pedon of Quinlan fine sandy loam (fig. 16), in an area of Dill-Quinlan complex, 1 to 3 percent slopes, 1,200 feet south and 500 feet west of the northeast corner of sec. 33, T. 11 N., R. 21 W.

Ap—0 to 6 inches; red (2.5YR 4/6) fine sandy loam, dark red (2.5YR 3/6) moist; weak fine granular structure; hard, very friable; calcareous; moderately alkaline; abrupt smooth boundary.

B2—6 to 12 inches; red (2.5YR 4/6) fine sandy loam, dark red (2.5YR 3/6) moist; weak fine granular structure; hard, very friable; many worm casts; few fragments of sandstone in the lower few inches; calcareous; moderately alkaline; abrupt irregular boundary.

Cr—12 to 30 inches; red (2.5YR 4/8) weakly cemented sandstone.

The thickness of the solum ranges from 10 to 29 inches. Reaction is mildly alkaline or moderately alkaline throughout. These soils are dominantly calcareous throughout but range to noncalcareous.

The A horizon has hue of 2.5YR to 7.5YR, value of 4 to 6, and chroma of 3 to 6. Texture is mostly fine sandy loam but ranges to very fine sandy loam, loam, silt loam, or silty clay loam. The B2 horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 6. Texture is fine sandy loam, loam, silt loam, or silty clay loam. The Cr horizon has hue of 2.5YR or 10R, value of 4 to 6, and chroma of 4 to 8. It is commonly weakly cemented calcareous sandstone but is calcareous siltstone in some pedons. In some pedons the sandstone is calcareous only in fractures and seams. In some pedons the sandstone contains thin seams of gypsum.

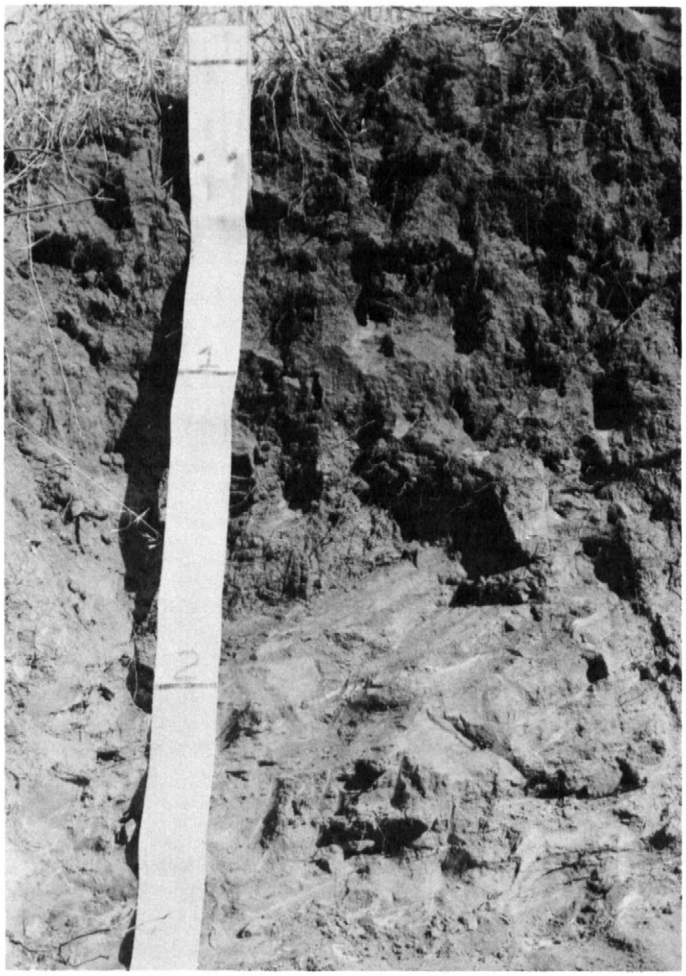


Figure 16.—Profile of Quinlan fine sandy loam from an area of Dill-Quinlan complex, 1 to 3 percent slopes.

Spur series

The soils of the Spur series are deep, well drained, and moderately permeable. These soils formed in calcareous loamy alluvium on nearly level flood plains. The soils of the Spur series are fine-loamy, mixed, thermic Fluventic Haplustolls. Slope ranges from 0 to 1 percent.

Spur soils are near Beckman, Clairemont, Lincoln, Mangum, Port, and Yahola soils. Beckman and Mangum soils do not have a mollic epipedon and have more than 35 percent clay in the control section. Clairemont soils do not have a mollic epipedon. Lincoln soils do not have a mollic epipedon and have textures of loamy fine sand or coarser in the control section. Port soils have a mollic epipedon more than 20 inches thick. Yahola soils have an ochric epipedon and have less than 18 percent clay in the control section.

Typical pedon of Spur loam, about 12 miles south and 4 miles west of Erick, 1,650 feet west and 300 feet north of the southwest corner of sec. 34, T. 7 N., R. 26 W

Ap—0 to 5 inches; brown (7.5YR 5/2) loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; hard, friable; calcareous; moderately alkaline; abrupt smooth boundary.

A1—5 to 15 inches; dark brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; hard, friable; many worm casts; calcareous; moderately alkaline; gradual smooth boundary.

B2—15 to 30 inches; dark brown (7.5YR 4/4) loam, dark brown (7.5YR 3/4) moist; moderate fine granular structure; hard, friable; many worm casts; calcareous; moderately alkaline; gradual smooth boundary.

C—30 to 60 inches; reddish brown (5YR 5/4) loam, reddish brown (5YR 4/4) moist; massive; hard, friable; few thin strata of lighter colored fine sandy loam; calcareous; moderately alkaline.

These deep soils are typically calcareous throughout the pedon. The mollic epipedon is 11 to 20 inches thick.

The A horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 or 3. Texture is loam or clay loam. The B2 horizon has hue of 5YR to 10YR, value of 4 or 5, and chroma of 3 or 4. Texture is loam or clay loam. The C horizon is similar in color and texture to the B horizon. Thin strata are common, and lenses of clay loam, silty clay loam, or fine sandy loam are present in some pedons. Some pedons have dark buried layers between depths of 30 and 50 inches.

St. Paul series

The soils of the St. Paul series are deep, well drained, and moderately slowly permeable. These nearly level to very gently sloping soils formed in loamy materials and in loamy residuum weathered from the underlying soft sandstone on uplands. The soils of the St. Paul series are fine-silty, mixed, thermic Pachic Argiustolls. Slope ranges from 0 to 3 percent.

St. Paul soils are similar to Carey soils and are near Abilene, Carey, Obaro, Tipton, and Woodward soils on the landscape. Abilene soils have more than 35 percent clay in the upper part of the argillic horizon. Carey soils have a mollic epipedon that is less than 20 inches thick. Obaro soils do not have a mollic epipedon and are less than 40 inches deep. Tipton soils have greater than 15 percent fine or coarser sand in the control section. Woodward soils do not have a mollic epipedon, have less than 18 percent clay in the control section, and are less than 40 inches deep.

Typical pedon of St. Paul silt loam, 0 to 1 percent slopes (fig. 17), about 1 mile west and 3 miles north of Retrop, 100 feet north and 100 feet east of the southwest corner of sec. 36, T. 9 N., R. 21 W.

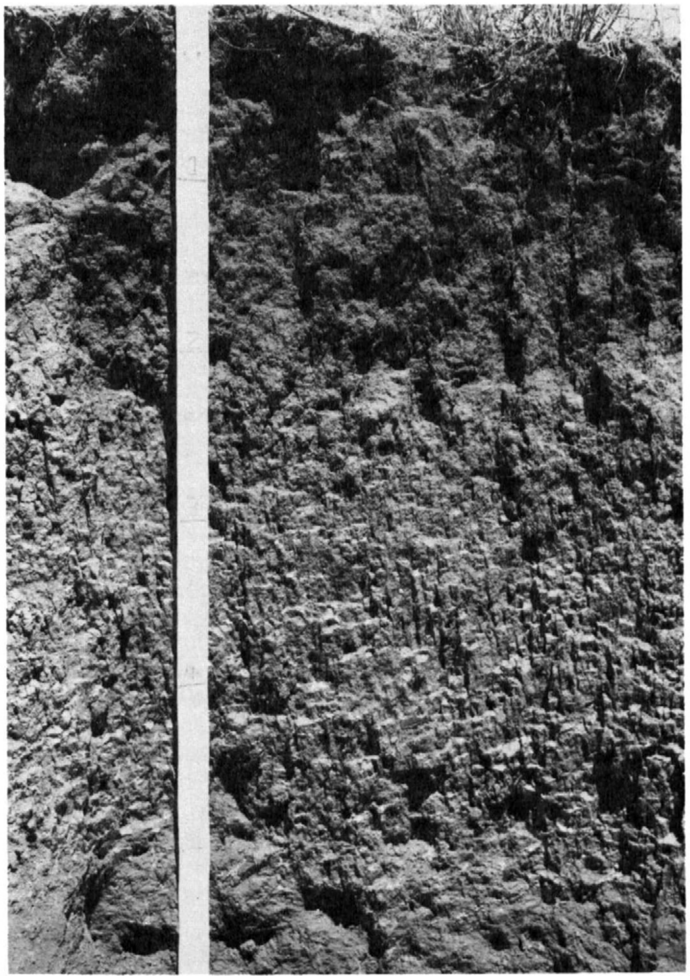


Figure 17.—Profile of St. Paul silt loam, 1 to 3 percent slopes.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; hard, friable; few fine roots; neutral; abrupt smooth boundary.

A1—6 to 14 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate fine and medium granular structure; hard, friable; many worm casts; few fine roots; neutral; gradual smooth boundary.

B1—14 to 19 inches; dark brown (7.5YR 4/2) silty clay loam, dark brown (7.5YR 3/2) moist; moderate fine subangular blocky structure; hard, friable; few worm casts; few fine roots; neutral; gradual smooth boundary.

B21t—19 to 32 inches; reddish brown (5YR 4/3) silty clay loam, dark reddish brown (5YR 3/3) moist; moderate medium subangular blocky structure; hard, friable; continuous clay films on faces of peds; few fine roots; mildly alkaline; gradual smooth boundary.

B22t—32 to 42 inches; reddish brown (5YR 4/4) silty clay loam, dark reddish brown (5YR 3/4) moist; moderate medium subangular blocky structure; hard, friable; continuous clay films on faces of peds; few soft bodies of calcium carbonate in the lower 6 inches; calcareous; moderately alkaline; gradual smooth boundary.

B3—42 to 50 inches; yellowish red (5YR 5/6) silty clay loam, yellowish red (5YR 4/6) moist; weak fine and medium subangular blocky structure; hard, friable; few soft bodies of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

C—50 to 60 inches; yellowish red (5YR 5/8) silt loam, yellowish red (5YR 4/8) moist; massive; hard, friable; few soft bodies of calcium carbonate; calcareous; moderately alkaline.

The solum thickness ranges from 40 to more than 60 inches. Thickness of the mollic epipedon ranges from 20 to 40 inches.

The A horizon has hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 2 or 3. In cultivated areas, some pedons have an Ap horizon with a value of 5. Reaction is neutral or mildly alkaline. The B1 horizon is similar to the A horizon in reaction and color. Texture is silt loam or silty clay loam. The B2t horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4. This horizon is mildly alkaline or moderately alkaline and calcareous in the lower part. The B3 horizon has hue of 2.5YR to 7.5YR, value of 4 or 5, and chroma of 2 to 6. Texture is silt loam or silty clay loam. This horizon is mildly alkaline or moderately alkaline and calcareous. The C horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 8. Texture and reaction are similar to the B3 horizon.

Talpa series

The soils of the Talpa series are shallow and very shallow, well drained, and moderately permeable. These very gently sloping to gently sloping soils formed in residuum weathered from limestone of Permian age on uplands. The soils of the Talpa series are loamy, mixed, thermic Lithic Calciustolls. Slope ranges from 1 to 5 percent.

Talpa soils are associated with Aspermont, Cornick, Quanah, Vernon, and Vinson soils. Aspermont soils do not have a mollic epipedon and have a solum more than 20 inches thick. Cornick soils are shallow over gypsum. Quanah soils have a solum more than 20 inches thick. Vernon soils have a solum more than 20 inches thick and have more than 35 percent clay in the control section. Vinson soils are 20 to 40 inches deep over gypsum.

Typical pedon of Talpa loam, in an area of Quanah-Talpa complex, 1 to 5 percent slopes, about 4 miles west and 5 miles south of Erick, 1,900 feet west and 450 feet north of the southeast corner of sec. 28, T. 8 N., R. 26 W.

A1—0 to 8 inches; brown (7.5YR 5/2) loam, dark brown (7.5YR 3/2) moist; moderate fine and medium granular structure; slightly hard, friable; about 10 percent by volume fragments of limestone; the fragments of limestone have secondary coatings of calcium carbonate; calcareous; moderately alkaline; abrupt smooth boundary.

R—8 to 25 inches; indurated grayish dolomitic limestone that cannot be penetrated with a spade; secondary coatings of calcium carbonate are in the cracks and crevices of the limestone.

The thickness of the solum ranges from 5 to 14 inches. The soil is calcareous throughout. The solum contains 10 to 35 percent fragments of limestone.

The A horizon has hue of 7.5YR, value of 4 or 5, and chroma of 2 or 3. The R layer is hard, grayish dolomitic limestone.

Tillman series

The soils of the Tillman series are deep, well drained, and slowly permeable. These very gently sloping soils formed in old clayey alluvium on convex uplands. The soils of the Tillman series are fine, mixed, thermic Typic Paleustolls. Slope ranges from 1 to 3 percent.

Tillman soils are associated with Aspermont, Quanah, and Vernon soils. Aspermont soils are on adjacent convex side slopes. They do not have a mollic epipedon, and they have less than 35 percent clay in the control section. Quanah soils do not have an argillic horizon and have less than 35 percent clay in the control section. Vernon soils are on the lower lying convex side slopes; they do not have a mollic epipedon and are less than 40 inches deep.

Typical pedon of Tillman clay loam, 1 to 3 percent slopes, 200 feet southeast of Bench Mark No. 41 on Texas-Oklahoma line, in field 200 feet east and 1,600 feet south of the northwest corner of sec. 24, T. 8 N., R. 27 W.

Ap—0 to 10 inches; dark brown (7.5YR 4/2) clay loam; dark brown (7.5YR 3/2) moist; moderate medium granular structure; hard, friable; many fine roots; few fine threads of calcium carbonate; calcareous; moderately alkaline; abrupt smooth boundary.

A1—10 to 16 inches; dark brown (7.5YR 4/2) clay loam; dark brown (7.5YR 3/2) moist; strong medium granular structure; hard, firm; many fine roots; common fine threads of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

B21t—16 to 26 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; moderate fine and medium blocky structure; extremely hard, very firm; continuous clay films on pressure faces; common fine roots; dark organic stains on faces of peds; few fine soft bodies of calcium carbonate and few fine concretions of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B22t—26 to 44 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; moderate medium prismatic structure parting to moderate medium blocky; extremely hard, very firm; nearly continuous clay films; dark organic stains on faces of peds; few fine fragments of gray shale; few slickensides that do not intersect; few fine roots in cracks; common fine concretions of calcium carbonate and a few soft bodies of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B23tca—44 to 55 inches; reddish brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; moderate medium prismatic structure parting to moderate medium blocky; extremely hard, very firm; nearly continuous clay films; few slickensides that do not intersect; few concretions of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

B24tca—55 to 69 inches; yellowish red (5YR 5/6) clay, yellowish red (5YR 4/6) moist; moderate medium prismatic structure parting to moderate medium blocky; extremely hard, very firm; patchy clay films; common crystals of gypsum; few soft bodies of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

B3ca—69 to 75 inches; yellowish red (5YR 5/6) clay, yellowish red (5YR 4/6) moist; weak coarse prismatic structure parting to weak medium blocky; extremely hard, very firm; patchy clay films; about 20 percent fragments of shale; many crystals of gypsum; many films of calcium carbonate and common medium concretions of calcium carbonate; calcareous; moderately alkaline.

The thickness of the solum exceeds 60 inches. Reaction ranges from mildly alkaline or moderately alkaline in the upper part to moderately alkaline in the lower part. The soil is calcareous in the lower part.

The A horizon has hue of 5YR or 7.5YR, value of 3 to 5, and chroma of 2. In cultivated areas, some pedons have an Ap horizon that has chroma of 3. Some pedons have a B1 horizon that is similar in color, texture, and reaction to the A horizon. The B2t horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 3 to 6. Texture is clay loam or clay. The lower part of the B2t horizon in most pedons has an accumulation of calcium carbonate in the form of soft bodies and concretions. The B3ca horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 6. Texture is clay or clay loam. The B3ca horizon has an accumulation of calcium carbonate in the form of soft bodies and concretions.

Tipton series

The soils of the Tipton series are deep, well drained, and moderately permeable. These nearly level to very gently sloping soils formed in loamy calcareous sediment on uplands. The soils of the Tipton series are fine-loamy, mixed, thermic Pachic Argiustolls. Slope ranges from 0 to 3 percent.

Tipton soils are associated with Abilene, Carey, and St. Paul soils. Abilene soils have more than 35 percent clay in the control section. Carey and St. Paul soils have less than 15 percent material coarser than very fine sand in the control section. In addition, Carey soils have a mollic epipedon less than 20 inches thick.

Typical pedon of Tipton loam, 0 to 1 percent slopes, in a field 2 miles south and 1 1/2 miles east of Carter, 2,400 feet west and 1,100 feet south of the northeast corner of sec. 12, T. 8 N., R. 22 W.

Ap—0 to 7 inches; brown (7.5YR 5/2) loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; hard, friable; common worm casts; neutral; abrupt smooth boundary.

A1—7 to 16 inches; dark brown (7.5YR 3/2) loam, very dark brown (7.5YR 2/2) moist; moderate fine granular structure; hard, friable; many fine roots; common worm casts; neutral; gradual smooth boundary.

B21t—16 to 24 inches; dark brown (7.5YR 4/3) clay loam, dark brown (7.5YR 3/3) moist; moderate fine prismatic structure; hard, friable; many fine roots; common worm casts; continuous clay films; neutral; gradual smooth boundary.

B22t—24 to 38 inches; reddish brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) moist; moderate medium prismatic structure; hard, firm; few fine roots; few worm casts; distinct continuous clay films; mildly alkaline; gradual smooth boundary.

B3—38 to 50 inches; reddish brown (5YR 5/4) clay loam, dark reddish brown (5YR 3/4) moist; moderate coarse prismatic structure; hard, friable; few fine roots; few worm casts; patchy clay films; mildly alkaline; clear smooth boundary.

B2tb—50 to 65 inches; dark brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate medium blocky structure; very hard, firm; few roots; distinct continuous clay films; calcareous; moderately alkaline.

The thickness of the solum ranges from 40 to more than 72 inches. The thickness of the mollic epipedon ranges from 20 to 38 inches.

The A horizon has hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 2 or 3. Reaction is neutral or mildly alkaline. Some pedons have a B1 horizon with hue of 5YR or 7.5YR, value of 3 to 5, and chroma of 2 to 4. It is loam or clay loam. Reaction is neutral or mildly alkaline. The B2t horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is loam or clay loam and averages between 22 and 30 percent clay. Reaction is neutral to moderately alkaline and some pedons are calcareous in the lower part. The B3 horizon has hue of 5YR or 7.5YR, value of 5 or 6, and chroma of 2 to 6. Texture ranges from loam to clay loam. Reaction is mildly alkaline to moderately alkaline. Some pedons have a C horizon that is similar in color, texture, and reaction to the B3 horizon. Some pedons have a B2tb horizon that has hue of 7.5YR and 5YR, value of 3 to 5, and chroma of 2 to 4. Texture is loam or clay loam, and reaction is mildly alkaline or moderately alkaline.

The Tipton soils in map unit 56 are taxadjuncts to the Tipton series because they have an A horizon and B1 horizon with hue of 5YR and a slightly thinner mollic epipedon. Behavior, use, and management are similar to those of the Tipton soils.

Tivoli series

The soils of the Tivoli series are deep, excessively drained, and rapidly permeable. These undulating to rolling soils formed in sandy eolian sediment on or adjacent to the flood plain of the North Fork of the Red River. The soils of the Tivoli series are mixed, thermic Typic Ustipsamments. Slope is dominantly 5 to 12 percent but ranges from 3 to 12 percent.

Tivoli soils are associated with Devol, Lincoln, Nobscot, Pratt, and Yahola soils on the landscape. Devol soils occupy the higher lying convex side slopes, are less sandy, and have an argillic horizon. Lincoln soils are on the lower part of the flood plain, contain thin strata finer than loamy fine sand in the control section, and have a water table within 5 to 8 feet of the surface during part of the year. Where Tivoli soils occur near Nobscot soils, Nobscot soils occupy the lower lying convex side slopes. Nobscot soils are less sandy and have an argillic horizon that has lamellae. Pratt soils have an argillic horizon. They are associated with Tivoli soils in ridgetop areas that have a mantle of old Tertiary alluvium. Yahola soils are on the lower part of the flood plain and are fine sandy loam.

Typical pedon of Tivoli fine sand, about 1 mile south and 1/2 mile west of Sayre, 600 feet north and 400 feet west of the southeast corner of sec. 5, T. 9 N., R. 23 W.

A1—0 to 6 inches; brown (10YR 5/3) fine sand, dark brown (10YR 4/3) moist; single grain; loose; moderately alkaline; gradual smooth boundary.

C—6 to 60 inches; very pale brown (10YR 7/3) fine sand, brown (10YR 5/3) moist; single grain; loose; calcareous; moderately alkaline.

Most pedons are calcareous in some part of the control section.

The A horizon has hue of 10YR or 7.5YR, value of 3 to 6, and chroma of 2 to 4. Reaction ranges from slightly acid to moderately alkaline. In some pedons, this horizon is calcareous. The C horizon has hue of 7.5YR or 10YR, value of 6 or 7, and chroma of 3 or 4. Texture ranges from loamy sand to sand. Reaction ranges from slightly acid to moderately alkaline. Buried soils are in some pedons.

The Tivoli soils in map unit 57 are taxadjuncts to the Tivoli series because they are calcareous in the upper part of the C horizon. Behavior, use, and management are similar to those of the Tivoli soils.

Treadway series

The soils of the Treadway series are deep, well drained, and very slowly permeable. These nearly level soils formed in saline, calcareous, clayey local alluvium derived from Permian red beds on alluvial fans and the heads of flood plains. They are at the base of the higher lying clayey soils and below areas of Badland. These soils form wide cracks during the dry season. The soils of the Treadway series are fine, mixed (calcareous), thermic Vertic Torrifluvents. Slope ranges from 0 to 1 percent.

Treadway soils are near Badland and Beckman, Mangum, and Vernon soils on the landscape. Badland is in the higher lying convex areas and consists of raw clay and shale outcrops. Beckman soils occur along drainageways downstream from the Treadway soils. They are moist for longer periods. Mangum soils, which are in the slightly higher lying flat areas, have a cambic horizon, and their electrical conductivity is less than two millimhos per centimeter at a depth of less than 40 inches. Vernon soils, which are on adjacent uplands, are 20 to 40 inches thick over shale.

Typical pedon of Treadway clay, 520 feet east and 320 feet south of the northwest corner of sec. 31, T. 8 N., R. 23 W.

A1—0 to 7 inches; reddish brown (5YR 5/4) clay, dark reddish brown (5YR 3/4) moist; weak firm platy and moderate fine blocky structure; hard, firm; many fine roots; few films of salt; slightly saline; calcareous; moderately alkaline; gradual smooth boundary.

C—7 to 60 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; massive; extremely hard, very firm; many films and bodies of gypsum and other salts; many crystals of gypsum; thin strata of clay loam; few fragments of shale; moderately saline; calcareous; moderately alkaline.

These soils are moderately alkaline or strongly alkaline and calcareous throughout. Buried horizons occur in some pedons below a depth of 30 inches.

The A horizon has hue of 2.5YR to 7.5YR, value of 4 or 5, and chroma of 4. Electrical conductivity ranges from 2 to 8 millimhos per centimeter. The C horizon has hue of 2.5YR and 5YR, value of 4 or 5, and chroma of 4 to 6. Texture is clay, and the clay content ranges from 40 to 60 percent. Bedding planes and thin strata of coarser material are weakly to strongly expressed. Electrical conductivity ranges from 2 to 8 millimhos per centimeter in the upper part and from 4 to 16 millimhos per centimeter in the lower part.

Vernon series

The soils of the Vernon series are moderately deep, well drained, and very slowly permeable. These gently sloping to strongly sloping soils formed in clay and shale of the Permian red beds on uplands. The soils of the Vernon series are fine, mixed, thermic Typic Ustochrepts. Slope ranges from 3 to 10 percent.

Vernon soils are near Aspermont, Knoco, Quanah, Talpa, Tillman, and Treadway soils on the landscape. Aspermont soils have less than 35 percent clay and have a calcic horizon. Knoco soils are less than 12 inches deep over shale. Quanah soils have less than 35 percent clay and have a mollic epipedon. Talpa soils are shallow over hard limestone. Tillman soils have a mollic epipedon, are more than 40 inches deep, and have an argillic horizon. Treadway soils are deep soils on flood plains and are subject to flooding.

Typical pedon of Vernon clay, 3 to 10 percent slopes, 2,640 feet south and 50 feet west of the northeast corner of sec. 36, T. 8 N., R. 23 W.

A1—0 to 10 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; moderate medium subangular blocky structure; very hard, very firm; few fine roots; calcareous; moderately alkaline; clear smooth boundary.

B2—10 to 25 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; moderate coarse blocky structure; very hard, very firm; few fine roots; few fragments of gray shale; calcareous; moderately alkaline; gradual smooth boundary.

Cr—25 to 60 inches; interbedded red and gray clayey shale.

The thickness of the solum ranges from 20 to 40 inches. The soil is moderately alkaline and calcareous throughout.

The A horizon has hue of 5YR, value of 4 or 5, and chroma of 4. The B2 horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 4 to 6. The C horizon is stratified red and gray clayey shale or clay.

Vinson series

The soils of the Vinson series are moderately deep, well drained, and moderately permeable. These very gently sloping to gently sloping loamy soils formed in material weathered from gypsum of Permian age on uplands. The soils of the Vinson series are fine-silty, mixed, thermic Entic Haplustolls. Slope ranges from 1 to 5 percent.

Vinson soils are near Aspermont, Cornick, Knoco, Quanah, and Talpa soils. Aspermont soils do not have a mollic epipedon and are not underlain by gypsum. Cornick soils are less than 20 inches deep over gypsum. Knoco soils have clayey texture and are 3 to 12 inches deep over red-bed shale or clay of the Permian red beds. Quanah soils have a solum more than 40 inches thick. Talpa soils are less than 14 inches deep over limestone.

Typical pedon of Vinson silt loam, in an area of Cornick-Vinson-Rock outcrop complex, 1 to 5 percent slopes, 6 miles south and 4 1/4 miles east of Erick, Oklahoma, 960 feet east and 225 feet south of the northwest corner of sec. 36, T. 8 N., R. 25 W.

A1—0 to 13 inches; reddish brown (5YR 4/3) silt loam, dark reddish brown (5YR 3/3) moist; moderate fine granular structure; slightly hard, friable; many fine roots; many worm casts; common fine films and threads of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

B2—13 to 26 inches; reddish brown (5YR 4/4) silt loam, dark reddish brown (5YR 3/4) moist; weak medium prismatic structure parting to moderate fine and medium subangular blocky; hard, friable; common fine roots; few worm casts; common films and threads of calcium carbonate; few fine concretions of calcium carbonate; calcareous; moderately alkaline; abrupt wavy boundary.

Cr—26 to 30 inches; white gypsite; massive; hard; upper few inches are calcareous and fractures contain coatings of secondary calcium carbonate, lower part noncalcareous.

Depth to gypsum bedrock ranges from 20 to 40 inches. Clay content in the control section ranges from 18 to 30 percent.

The A horizon has hue of 5YR and 7.5YR, value of 3 or 4, and chroma of 2 or 3. Reaction is mildly alkaline or moderately alkaline and the horizon is calcareous. The B2 horizon has hue of 7.5YR and 5YR, value of 4 or 5, and chroma of 3 or 4. Texture is loam, silt loam, clay loam, or silty clay loam. The Cr horizon is white gypsite. Some pedons contain hard alabaster below a depth of 4 feet, but depth to this layer is variable within short distances. Fractures in the upper few inches of the Cr horizon contain coatings of secondary calcium carbonate.

Woodward series

The soils of the Woodward series are moderately deep, well drained, and moderately permeable. These very gently sloping to strongly sloping soils formed in calcareous, very fine grained, soft sandstone on uplands. The soils of the Woodward series are coarse-silty, mixed, thermic Typic Ustochrepts. Slope ranges from 1 to 12 percent.

Woodward soils are similar to Carey, Cordell, Hardeman, Quinlan, and St. Paul soils and are near Dill and Obaro soils on the landscape. Carey and St. Paul soils are deeper to bedrock than the Woodward soils, have more than 18 percent clay in the control section, and have a mollic epipedon. Cordell and Quinlan soils have bedrock within a depth of 20 inches. Dill soils have more than 15 percent material coarser than very fine sand in the control section. Hardeman soils lack sandstone above a depth of 40 inches and have more than 15 percent material coarser than very fine sand in the control section. Obaro soils have more than 18 percent clay in the control section.

Typical pedon of Woodward loam, 1 to 3 percent slopes, 1,400 feet east and 950 feet north of the southwest corner of sec. 11, T. 8 N., R. 21 W.

Ap—0 to 4 inches; yellowish red (5YR 5/6) loam, yellowish red (5YR 4/6) moist; weak fine granular structure; slightly hard, very friable; calcareous; moderately alkaline; abrupt smooth boundary.

A1—4 to 14 inches; reddish brown (5YR 5/4) loam, reddish brown (5YR 4/4) moist; weak fine subangular blocky structure parting to weak fine granular; hard, very friable; few fine roots; calcareous; moderately alkaline; clear smooth boundary.

B2—14 to 22 inches; red (2.5YR 5/6) loam, red (2.5YR 4/6) moist; weak medium subangular blocky structure; hard, friable; few fine roots; calcareous; moderately alkaline; gradual smooth boundary.

B3—22 to 27 inches; light red (2.5YR 6/8) loam, red (2.5YR 5/8) moist; weak medium subangular blocky structure; hard, friable; few pockets and thin strata of soft weathered sandstone; few films of soft powdery lime; calcareous; moderately alkaline; gradual smooth boundary.

Cr—27 to 60 inches; light red (2.5YR 6/8) weakly cemented sandstone; calcareous; moderately alkaline.

The thickness of the solum ranges from 20 to 40 inches. The surface layer is 5 to 14 inches thick. The soil is mostly calcareous throughout.

The A horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 3 to 6. Reaction is neutral to moderately alkaline. The B2 horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 3 to 6. Reaction is mildly alkaline or moderately alkaline. The B3 horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 6 or 8. It usually contains a few fragments of sandstone. Reaction is mildly alkaline or moderately alkaline. Calcium carbonate films and soft bodies range from 0 to 4 percent by volume. The Cr horizon has hue of 2.5YR, value of 5 or 6, and chroma of 6 to 8. It is generally weakly cemented calcareous sandstone but is noncalcareous in some places.

Woodward Variant

The soils of the Woodward Variant are moderately deep, well drained, and moderately rapidly permeable. These very gently sloping soils formed in a calcareous loamy mantle over sandstone of the Permian red beds on smooth convex ridgetops in the uplands. The soils of the Woodward Variant are coarse-loamy, mixed, thermic Typic Ustochrepts. Slope ranges from 1 to 3 percent.

Woodward Variant soils are near Dill and Quinlan soils on the landscape. Dill and Quinlan soils formed in residuum weathered from weakly cemented sandstone. Dill soils are noncalcareous. Quinlan soils have a solum less than 20 inches thick.

Typical pedon of Woodward Variant fine sandy loam, 1 to 3 percent slopes, 250 feet east and 300 feet north of the southwest corner of sec. 16, T. 10 N., R. 21 W.

Ap—0 to 10 inches; yellowish red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak fine and medium granular structure; soft, friable; few fine roots; common fine concretions of calcium carbonate; calcareous; moderately alkaline; abrupt smooth boundary.

B21ca—10 to 17 inches; reddish yellow (5YR 6/6) fine sandy loam, yellowish red (5YR 5/6) moist; moderate medium and coarse prismatic structure; hard, friable; many fine and medium concretions and soft bodies of calcium carbonate comprising approximately 50 percent by volume; calcareous; moderately alkaline; clear smooth boundary.

B22ca—17 to 25 inches; light red (2.5YR 6/8) fine sandy loam, red (2.5YR 5/8) moist; moderate medium prismatic structure parting to weak medium subangular blocky; hard, friable; common fine and medium concretions of calcium carbonate; cracks and root channels coated with films of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

B3ca—25 to 30 inches; red (2.5YR 5/6) fine sandy loam, red (2.5YR 4/6) moist; weak medium prismatic structure parting to weak medium subangular blocky; soft, friable; few soft bodies of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

Cr—30 to 40 inches; red (2.5YR 5/8) weakly cemented calcareous sandstone, red (2.5YR 4/8) moist; moderately alkaline.

The thickness of the solum and depth to sandstone range from 20 to 40 inches. Depth to free carbonates ranges from 0 to 12 inches.

The A horizon has hue of 2.5YR to 7.5YR, value of 4 or 5, and chroma of 3 to 6. This horizon is mildly alkaline or moderately alkaline. In some pedons it is noncalcareous. The B horizon has hue of 2.5YR to 7.5YR, value of 4 to 6, and chroma of 4 to 8. It is calcareous, and has few to many soft bodies of calcium carbonate. The Cr horizon is weakly cemented, calcareous sandstone and is similar to the B horizon in color and reaction.

Woodward Variant soils differ from soils of the Woodward series by having more than 15 percent sand coarser than very fine sand in the control section.

Yahola series

The soils of the Yahola series are deep, well drained, and moderately rapidly permeable. These nearly level soils formed in loamy alluvium on flood plains. The soils of the Yahola series are coarse-loamy, mixed (calcareous), thermic Typic Ustifluvents. Slope ranges from 0 to 1 percent.

Yahola soils are commonly near Clairemont, Cyril, Gracemont, Gracemore, Lincoln, Port, Spur, and Tivoli soils. Clairemont and Port soils have more than 18 percent clay and less than 15 percent sand coarser than very fine sand in the control section. Cyril and Port soils have a mollic epipedon. Gracemont and Gracemore soils have a water table within 40 inches of the surface at some time in most years. Lincoln soils have texture of loamy fine sand or coarser in the control section. Spur soils have a mollic epipedon and have more than 18 percent clay in the control section. Tivoli soils are at a higher elevation than the Yahola soils and are loamy fine sand or coarser throughout.

Typical pedon of Yahola fine sandy loam, 1,900 feet east and 400 feet north of the southwest corner of sec. 21, T. 11 N., R. 23 E.

A1—0 to 8 inches; red (2.5YR 4/6) fine sandy loam, dark red (2.5YR 3/6) moist; weak fine granular structure; slightly hard, very friable; many fine roots; many worm casts; calcareous; moderately alkaline; clear smooth boundary.

C—8 to 60 inches; red (2.5YR 5/6) fine sandy loam, red (2.5YR 4/6) moist; massive; slightly hard, very friable; many thin strata of loam and silt loam; calcareous; moderately alkaline.

Thickness of the A horizon is 5 to 20 inches. The A horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 3 to 6. Most areas are calcareous, but a few pedons may be leached of carbonates in the upper few inches. The C horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 3 to 8. It is dominantly fine sandy loam or loam. Common thin strata have varying texture and color. Loamy fine sand occurs below a depth of 40 inches in some pedons. Buried soils occur below a depth of 30 inches in some pedons.

formation of the soils

Described in this section are the major factors of soil formation and the processes of soil formation as they relate to the soils in Beckham County.

factors of soil formation

Soil is the product of five major factors—parent material, climate, plants and animals (especially plants), relief, and time. If a given factor, vegetation for example, differs from one area to another, the soils that form in the two areas will differ.

parent material

Soils form in unconsolidated material that influences the rate at which the soil forms; the chemical, physical, and mineral composition of the soils; and the color of the soils.

Soils on the uplands of Beckham County formed in material weathered from sandstone, clay, shale, siltstone, gypsum, and limestone. Dill, Quinlan, and Woodward soils are examples of soils that formed in materials weathered from sandstone. Knoco, Tillman, and Vernon soils formed in material weathered from shale. Vinson and Cornick soils formed in material weathered from gypsum, and Talpa soils formed in material weathered from limestone.

Alluvial sediment is extensive along the streams and rivers of the county. The kind of sediment deposited, and the kinds of soil that formed in it, depend largely on the source of the sediment and the velocity of the floodwater. Clairemont and Port soils formed in loamy sediment deposited along streams when these streams overflowed. Beckman and Mangum soils formed in clayey sediment deposited by narrow streams carrying large amounts of clay-sized particles. Lincoln and Yahola soils formed in sandy sediment deposited by fast-moving water near the stream.

climate

Beckham County has a dry subhumid climate. The climate is fairly uniform throughout the county, and differences among soils cannot be attributed to differences in climate. Moisture and warm temperatures have been sufficient to promote the formation of distinct layers in many of the soils. Soil leaching is slow because precipitation is limited.

plant and animal life

Plants, burrowing animals, insects, and soil micro-organisms have a direct influence on the formation of soils. The native grasses and trees in the county have had different effects on the losses and gains of organic matter and plant nutrients and on the soil structure and porosity. St. Paul soils developed under prairie vegetation and have a dark grayish brown surface layer and a moderately high content of organic matter. Nobscot and Delwin soils developed under forest vegetation and have a brown surface layer and a low content of organic matter.

relief

Relief influences the formation of the soils mainly through its effect on water movement, erosion, soil temperature, and the kind of plant cover. In Beckham County, relief is determined largely by the resistance of underlying formations to weathering and geological erosion. About 10 percent of the acreage in Beckham County is nearly level soils on flood plains, and about 90 percent is nearly level to steep soils on uplands.

Carey and Quinlan soils formed in similar sandstone parent material. Their development, however, was controlled to a large extent by relief, and the deep Carey soils are less sloping than the shallow Quinlan soils.

time

As a factor in soil formation, time is difficult to measure strictly in years. The length of time needed for development of genetic horizons depends on the intensity and the interactions of soil-forming factors in promoting the losses, gains, transfers, or transformations of the constituents necessary in forming soil horizons. Soils that have no definite genetic horizons are young, or immature. Mature, or older, soils have approached equilibrium with their environment and tend to have well-defined horizons.

The soils in Beckham County range from young to old. Abilene and St. Paul soils are examples of old soils on uplands. Carey and Tipton soils are younger, but they have well-expressed horizons. Dill and Woodward soils are considered young. They have had sufficient time to develop well-expressed horizons; but, because they are sloping, geological erosion takes away soil material almost as fast as it forms. Lincoln and Yahola soils are young. They formed in recent sediment on flood plains and show little horizon development.

processes of soil formation

Several processes were involved in the formation of the soils of Beckham County. These processes are the accumulation of organic matter, the leaching of calcium carbonates and bases, the reduction and transfer of iron, and the formation and translocation of silicate clay minerals. The results of these processes are not evident to the same degree in all the soils of the county.

Most of the older soils in the county have three major horizons. Some of the properties in which the major horizons differ are color, texture, structure, consistency, reaction, content of organic matter, and thickness. Subdivisions of the major horizons are based on minor differences.

references

(1) American Association of State Highway [and Transportation] Officials. 1970. Standard specifications for highway materials and methods of sampling and testing. Ed. 10. 2 vol., illus.

(2) American Society for Testing and Materials. 1974. Method for classification of soils for engineering purposes. ASTM Stand. D 2487-69. *In* 1974 Annual Book of ASTM Standards, Part 19, 464 pp., illus.

(3) Oklahoma Conservation Needs Committee. 1970. Oklahoma conservation needs inventory. 143 pp.

(4) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus. [Supplement replacing pp. 173-188 issued May 1962]

(5) United States Department of Agriculture. 1967. Soil survey laboratory methods and procedures for collecting soil samples. Soil Surv. Invest. Rep. 1, 50 pp., illus.

(6) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436, 754 pp., illus.

glossary

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	More than 12

Badland. Steep or very steep, commonly nonstony, barren land dissected by many intermittent drainage channels. Badland is most common in semiarid and arid regions where streams are entrenched in soft geologic material. Local relief generally ranges from 25 to 500 feet. Runoff potential is very high, and geologic erosion is active.

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

California bearing ratio (CBR). The load-supporting capacity of a soil as compared to that of a standard crushed limestone, expressed as a ratio. First standardized in California. A soil having a CBR of 16 supports 16 percent of the load that would be supported by standard crushed limestone, per unit area, with the same degree of distortion.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. Mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

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

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

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

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

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

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

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

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

Cemented.—Hard; little affected by moistening.

Contour stripcropping (or contour farming). Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or arresting grazing for a prescribed period.

Depth to rock. Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

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

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

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

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hummocky. Refers to a landscape of hillocks, separated by low sags, having sharply rounded tops and steep sides. Hummocky relief resembles rolling or undulating relief, but the tops of ridges are narrower and the sides are shorter and less even.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics.

The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous areas. Areas that have little or no natural soil and support little or no vegetation.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

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

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

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affects the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, differences in slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

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

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

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Polypedon. A volume of soil having properties within the limits of a soil series, the lowest and most homogeneous category of soil taxonomy. A "soil individual."

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Productivity (soil). The capability of a soil for producing a specified plant or sequence of plants under specific management.

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

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

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

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

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

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

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

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

Soil separates. Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	Less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

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

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

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

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

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

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the low lands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1951-76 at Elk City, Oklahoma]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days*	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	51.0	24.9	37.9	77	0	10	0.56	0.11	0.90	2	1.7
February---	55.2	28.3	41.8	82	7	21	0.95	0.14	1.57	2	2.0
March------	63.5	35.3	49.4	91	13	146	1.49	0.25	2.44	3	0.7
April------	74.5	46.3	60.5	94	24	327	2.22	0.69	3.43	4	0.2
May--------	82.1	55.9	69.0	100	36	589	4.26	1.73	6.30	6	0.0
June-------	90.5	64.7	77.6	104	49	828	3.49	1.33	5.22	5	0.0
July-------	95.6	69.2	82.4	106	56	1,004	2.48	0.43	4.05	4	0.0
August-----	94.5	67.2	80.9	108	53	958	2.26	0.58	3.59	3	0.0
September--	86.5	59.7	73.1	101	40	693	2.69	0.74	4.23	4	0.0
October----	74.8	47.8	61.6	94	28	371	2.16	0.49	3.49	3	0.0
November---	61.3	35.3	48.4	83	13	81	1.20	0.03	2.05	3	0.3
December---	52.1	27.5	39.8	78	6	15	0.76	0.19	1.21	2	1.5
Yearly---	73.5	46.8	60.2	109**	0**	5,043	24.52	17.83	30.95	41	6.4

*A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50° F).

**Extremes.

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1951-76 at Elk City, Oklahoma]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 4	April 16	April 23
2 years in 10 later than--	March 31	April 11	April 18
5 years in 10 later than--	March 22	April 3	April 8
First freezing temperature in fall:			
1 year in 10 earlier than--	October 29	October 22	October 15
2 years in 10 earlier than--	November 4	October 28	October 20
5 years in 10 earlier than--	November 14	November 8	October 30

TABLE 3.--GROWING SEASON

[Recorded in the period 1951-76 at Elk City, Oklahoma]

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	216	196	182
8 years in 10	223	204	190
5 years in 10	237	218	204
2 years in 10	251	232	218
1 year in 10	258	240	225

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
1	Abilene clay loam, 0 to 1 percent slopes	2,977	0.5
2	Altus fine sandy loam, 1 to 3 percent slopes	4,892	0.8
3	Aspermont silt loam, 3 to 5 percent slopes	5,076	0.9
4	Aspermont silt loam, 2 to 5 percent slopes, eroded	3,676	0.6
5	Badland	4,796	0.8
6	Beckman clay	1,688	0.3
7	Carey loam, 1 to 3 percent slopes	11,660	2.0
8	Clairemont silt loam, occasionally flooded	9,005	1.6
9	Clairemont silt loam, frequently flooded	3,299	0.6
10	Clark-Owens complex, 5 to 12 percent slopes	3,613	0.6
11	Cordell silty clay loam, 1 to 5 percent slopes	10,586	1.8
12	Cordell-Rock outcrop complex, 2 to 15 percent slopes	45,230	7.8
13	Cornick-Vinson-Rock outcrop complex, 1 to 5 percent slopes	9,287	1.6
14	Cyril fine sandy loam	821	0.1
15	Delwin-Nobscot complex, 0 to 3 percent slopes	44,902	7.9
16	Devol loamy fine sand, 0 to 3 percent slopes	10,920	1.9
17	Devol loamy fine sand, 3 to 8 percent slopes	8,795	1.5
18	Devol-Grandfield complex, 3 to 12 percent slopes	6,750	1.2
19	Dill-Quinlan complex, 1 to 3 percent slopes	28,257	4.9
20	Dill-Quinlan complex, 3 to 5 percent slopes	17,080	2.9
21	Dill-Quinlan complex, 5 to 12 percent slopes	8,780	1.5
22	Gracemont clay loam	1,635	0.3
23	Gracemont clay loam, saline	4,250	0.7
24	Gracemore loam, saline	619	0.1
25	Grandfield loamy fine sand, 1 to 3 percent slopes	4,580	0.8
26	Grandfield loamy fine sand, 2 to 5 percent slopes, eroded	5,856	1.0
27	Grandfield fine sandy loam, 1 to 3 percent slopes	25,619	4.4
28	Grandfield fine sandy loam, 3 to 5 percent slopes	6,622	1.1
29	Grandfield fine sandy loam, 2 to 5 percent slopes, eroded	2,218	0.4
30	Hardeman fine sandy loam, 1 to 3 percent slopes	3,540	0.6
31	Hardeman fine sandy loam, 3 to 5 percent slopes	2,598	0.4
32	Knoco-Cornick-Rock outcrop complex, 2 to 20 percent slopes	31,552	5.4
33	Knoco-Rock outcrop complex, 20 to 40 percent slopes	10,443	1.8
34	Lincoln loamy fine sand	10,530	1.8
35	Mangum clay	1,510	0.3
36	Nobscot fine sand, 2 to 5 percent slopes	48,397	8.5
37	Nobscot fine sand, 5 to 12 percent slopes	3,724	0.6
38	Nobscot and Delwin soils, 2 to 5 percent slopes, gullied	2,970	0.5
39	Obaro silt loam, 1 to 3 percent slopes	9,464	1.6
40	Obaro-Quinlan complex, 1 to 3 percent slopes	3,974	0.7
41	Obaro-Quinlan complex, 3 to 5 percent slopes	5,420	0.9
42	Port silty clay loam	1,834	0.3
43	Pratt-Tivoli complex, 5 to 12 percent slopes	348	0.1
44	Quanah-Talpa complex, 1 to 5 percent slopes	18,994	3.3
45	Quinlan-Obaro complex, 2 to 5 percent slopes, eroded	2,847	0.5
46	Quinlan-Obaro complex, 5 to 12 percent slopes	8,759	1.5
47	Quinlan-Woodward complex, 2 to 5 percent slopes, eroded	1,294	0.2
48	Quinlan-Woodward complex, 5 to 12 percent slopes	16,403	2.8
49	Quinlan and Dill soils, 2 to 12 percent slopes, severely eroded	8,702	1.5
50	Spur loam	3,536	0.6
51	Spur clay loam	2,541	0.4
52	St. Paul silt loam, 0 to 1 percent slopes	7,112	1.2
53	St. Paul silt loam, 1 to 3 percent slopes	15,389	2.7
54	Tillman clay loam, 1 to 3 percent slopes	5,408	0.9
55	Tipton loam, 0 to 1 percent slopes	1,868	0.3
56	Tipton loam, 1 to 3 percent slopes	3,368	0.6
57	Tivoli fine sand	6,042	1.0
58	Treadway clay	1,865	0.3
59	Ustorthents, sandy	208	*
60	Vernon clay, 3 to 10 percent slopes	3,211	0.6
61	Woodward loam, 1 to 3 percent slopes	9,537	1.6
62	Woodward loam, 3 to 5 percent slopes	3,853	0.7
63	Woodward-Quinlan complex, 1 to 3 percent slopes	2,687	0.5
64	Woodward-Quinlan complex, 3 to 5 percent slopes	10,830	1.9
65	Woodward Variant fine sandy loam, 1 to 3 percent slopes	1,734	0.3
66	Yahola fine sandy loam	8,439	1.5
	Water	6,060	1.0
	Total	580,480	100.0

* Less than 0.1 percent.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Map symbol and soil name	Wheat	Grain sorghum	Cotton lint	Alfalfa hay	Improved bermudagrass	Weeping lovegrass
	Bu	Bu	Lb	Ton	AUM*	AUM*
1------------------------- Abilene	25	35	350	3.0	5.5	5.5
2------------------------- Altus	23	40	350	3.0	6.5	7.0
3------------------------- Aspermont	15	20	150	---	3.5	3.5
4------------------------- Aspermont	10	18	100	---	3.0	3.0
5.** Badland						
6------------------------- Beckman	10	18	100	---	3.0	---
7------------------------- Carey	23	30	275	2.5	5.0	5.0
8------------------------- Clairemont	30	50	450	4.0	7.5	7.5
9------------------------- Clairemont	---	---	---	---	7.0	7.0
10------------------------ Clark-Owens	---	---	---	---	3.0	3.0
11------------------------ Cordell	15	25	150	---	3.0	3.0
12.** Cordell-Rock outcrop						
13.** Cornick-Vinson-Rock outcrop						
14------------------------ Cyril	30	50	450	4.0	7.5	7.5
15------------------------ Delwin-Nobscot	16	28	250	2.5	5.0	5.5
16------------------------ Devol	20	28	250	2.5	5.0	5.5
17------------------------ Devol	15	25	200	2.0	4.5	5.0
18------------------------ Devol-Grandfield	---	---	---	---	4.0	4.5
19------------------------ Dill-Quinlan	18	30	275	---	5.0	5.5
20------------------------ Dill-Quinlan	15	28	225	---	4.5	5.0
21------------------------ Dill-Quinlan	---	---	---	---	3.0	3.5

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Map symbol and soil name	Wheat	Grain sorghum	Cotton lint	Alfalfa hay	Improved bermudagrass	Weeping lovegrass
	Bu	Bu	Lb	Ton	AUM*	AUM*
22------------------------ Gracemont	---	---	---	---	7.5	---
23------------------------ Gracemont	---	---	---	---	6.0	---
24------------------------ Gracemore	---	---	---	---	5.5	---
25------------------------ Grandfield	20	28	250	2.5	5.5	6.0
26------------------------ Grandfield	13	20	150	---	4.0	4.5
27------------------------ Grandfield	20	30	300	2.5	6.0	6.5
28------------------------ Grandfield	17	28	250	1.8	5.5	6.0
29------------------------ Grandfield	13	25	200	---	4.5	5.0
30------------------------ Hardeman	23	30	275	2.0	6.0	6.5
31------------------------ Hardeman	18	28	225	1.8	5.5	6.0
32.** Knoco-Cornick-Rock outcrop						
33.** Knoco-Rock outcrop						
34------------------------ Lincoln	---	---	---	---	5.5	5.5
35------------------------ Mangum	15	20	150	---	4.0	4.0
36------------------------ Nobscot	15	25	200	2.0	4.0	4.5
37------------------------ Nobscot	---	---	---	---	3.5	4.0
38------------------------ Nobscot and Delwin	---	---	---	---	3.0	3.5
39------------------------ Obaro	17	28	200	---	5.0	5.0
40------------------------ Obaro-Quinlan	15	25	200	---	4.5	4.5
41------------------------ Obaro-Quinlan	13	20	150	---	4.0	4.0
42------------------------ Port	30	50	450	4.0	7.5	7.5
43.** Pratt-Tivoli						

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Map symbol and soil name	Wheat	Grain sorghum	Cotton lint	Alfalfa hay	Improved bermudagrass	Weeping lovegrass
	Bu	Bu	Lb	Ton	AUM*	AUM*
44: Quanah-Talpa	---	---	---	---	3.0	3.0
45: Quinlan-Obaro	10	18	100	---	4.0	4.0
46: Quinlan-Obaro	---	---	---	---	3.0	3.0
47: Quinlan-Woodward	10	18	100	---	4.0	4.0
48: Quinlan-Woodward	---	---	---	---	3.0	3.0
49: Quinlan and Dill	---	---	---	---	3.0	3.0
50: Spur	30	50	450	4.0	7.5	7.5
51: Spur	---	---	---	---	7.0	7.0
52: St. Paul	25	35	350	3.0	5.5	5.5
53: St. Paul	23	30	300	2.5	5.0	5.0
54: Tillman	20	28	225	---	4.0	4.0
55: Tipton	30	45	375	3.5	6.5	6.5
56: Tipton	25	40	325	3.0	6.0	6.0
57.** Tivoli						
58.** Treadway						
59.** Ustorthents						
60.** Vernon						
61: Woodward	20	28	275	---	5.0	5.0
62: Woodward	15	25	250	---	4.5	4.5
63: Woodward-Quinlan	18	25	250	---	4.5	4.5
64: Woodward-Quinlan	13	20	200	---	4.0	4.0
65: Woodward Variant	20	30	275	---	5.5	5.5
66: Yahola	25	50	425	3.5	7.5	7.5

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

[Only the soils that support rangeland vegetation suitable for grazing are listed]

Map symbol and soil name	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
1 Abilene	Hardland	Favorable	2,800	Sideoats grama	30
		Normal	1,900	Blue grama	20
		Unfavorable	1,300	Buffalograss	10
				Western wheatgrass	10
				Vine-mesquite	5
				Silver bluestem	5
				Other perennial grasses	15
				Other perennial forbs	5
2 Altus	Sandy Prairie	Favorable	4,300	Little bluestem	25
		Normal	3,100	Sand bluestem	20
		Unfavorable	2,300	Sideoats grama	15
				Blue grama	10
				Indiangrass	5
				Sand lovegrass	5
				Sand sagebrush	5
				Lespedeza	2
				Other perennial grasses	10
				Other perennial forbs	3
3 Aspermont	Hardland	Favorable	2,700	Sideoats grama	30
		Normal	1,900	Blue grama	20
		Unfavorable	1,300	Buffalograss	10
				Western wheatgrass	10
				Sand bluestem	5
				Vine-mesquite	5
				Other perennial grasses	15
				Other perennial forbs	5
4 Aspermont	Hardland	Favorable	2,400	Sideoats grama	30
		Normal	1,600	Blue grama	20
		Unfavorable	1,000	Buffalograss	10
				Western wheatgrass	10
				Sand bluestem	5
				Vine-mesquite	5
				Other perennial grasses	15
				Other perennial forbs	5
5 Badland	Eroded Red Clay	Favorable	600	Sideoats grama	35
		Normal	360	Alkali sacation	15
		Unfavorable	200	Little bluestem	5
				Sand bluestem	5
				Silver bluestem	5
				Tall dropseed	5
				Other perennial grasses	20
				Other perennial forbs	10
6 Beckman	Alkali Bottomland	Favorable	3,000	Alkali sacaton	55
		Normal	2,100	Western wheatgrass	10
		Unfavorable	1,500	Switchgrass	5
				Vine-mesquite	5
				White tridens	5
				Blue grama	5
				Inland saltgrass	5
				Other perennial grasses	5
				Other perennial forbs	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Map symbol and soil name	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
7, Carey	Loamy Prairie	Favorable	4,000	Little bluestem	25
		Normal	2,800	Sand bluestem	20
		Unfavorable	2,000	Switchgrass	10
				Indiangrass	10
				Blue grama	5
				Sideoats grama	5
				Canada wildrye	5
				Tall dropseed	5
				Lespedeza	5
				Dotted gayfeather	5
				Other shrubs	5
8, 9, Clairemont	Loamy Bottomland	Favorable	6,500	Sand bluestem	25
		Normal	4,600	Indiangrass	15
		Unfavorable	3,200	Switchgrass	15
				Little bluestem	10
				Eastern gamagrass	5
				Tall dropseed	5
				Sedge	5
				Eastern cottonwood	5
				Other perennial grasses	10
				Other perennial forbs	5
10:*					
Clark	Loamy Prairie	Favorable	3,800	Little bluestem	20
		Normal	2,600	Sand bluestem	15
		Unfavorable	1,800	Indiangrass	15
				Switchgrass	15
				Sideoats grama	10
				Blue grama	5
				Tall dropseed	5
				Ashy sunflower	5
				Other perennial grasses	10
Owens	Red Clay Prairie	Favorable	2,000	Sideoats grama	30
		Normal	1,300	Little bluestem	25
		Unfavorable	800	Blue grama	10
				Buffalograss	5
				Vine-mesquite	5
				Hairy grama	5
				Silver bluestem	5
				Other perennial grasses	10
				Other perennial forbs	5
11, 12*, Cordell	Red Shale	Favorable	1,400	Little bluestem	25
		Normal	950	Sideoats grama	20
		Unfavorable	700	Blue grama	20
				Buffalograss	10
				Hairy grama	5
				Halfshrub sundrop	3
				Ironplant goldenweed	3
				Fragrant mimosa	3
				Slimflower scurfpea	2
				Purple prairie-clover	2
				Blacksamson	2
				Redroot erogonum	2
				Skunkbush sumac	2
				Trailing krameria	1
13:*					
Cornick	Gyp	Favorable	1,800	Little bluestem	40
		Normal	1,200	Sideoats grama	20
		Unfavorable	1,000	Blue grama	10
				Sand dropseed	5
				Hairy tridens	5
				Buffalograss	3
				Hairy grama	2
				Other perennial forbs	15

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Map symbol and soil name	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
13:*					
Vinson	Loamy Prairie	Favorable	3,800	Little bluestem	25
		Normal	2,500	Sideoats grama	15
		Unfavorable	1,700	Sand bluestem	10
				Indiangrass	10
				Blue grama	5
				Switchgrass	5
				Canada wildrye	5
				Tall dropseed	5
				Lespedeza	5
				Dotted gayfeather	5
				Other perennial grasses	10
Rock outcrop.					
14 Cyril	Loamy Bottomland	Favorable	7,000	Sand bluestem	25
		Normal	4,900	Indiangrass	15
		Unfavorable	3,500	Switchgrass	15
				Little bluestem	10
				Eastern gamagrass	5
				Tall dropseed	5
				Beaked panicum	5
				Compassplant	5
				Heath aster	5
				Sedge	5
				Eastern cottonwood	5
15:*					
Delwin	Deep Sand Savannah	Favorable	3,900	Little bluestem	25
		Normal	2,800	Sand bluestem	20
		Unfavorable	2,000	Shinnery oak	20
				Sideoats grama	5
				Switchgrass	5
				Indiangrass	5
				Purpletop	5
				Arrowfeather threeawn	5
				Scribner panicum	5
				Lespedeza	5
Nobscot	Deep Sand Savannah	Favorable	3,900	Little bluestem	25
		Normal	2,800	Sand bluestem	20
		Unfavorable	2,000	Shinnery oak	20
				Indiangrass	5
				Switchgrass	5
				Purpletop	5
				Arrowfeather threeawn	5
				Scribner panicum	5
				Sideoats grama	5
				Lespedeza	5
16, 17 Devol	Deep Sand	Favorable	3,700	Sand bluestem	25
		Normal	2,600	Little bluestem	15
		Unfavorable	1,900	Indiangrass	10
				Sand lovegrass	10
				Sideoats grama	5
				Sand sagebrush	5
				Skunkbush sumac	5
				Schweinitz flatsedge	3
				Blue grama	2
				Lespedeza	2
				Other perennial grasses	13
				Other perennial forbs	3
				Other shrubs	2

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Map symbol and soil name	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
18:*					
Devol	Sandy Prairie	Favorable	3,500	Little bluestem	25
		Normal	2,500	Sand bluestem	20
		Unfavorable	1,800	Sideoats grama	15
				Blue grama	10
				Indiangrass	5
				Sand lovegrass	5
				Sand sagebrush	5
				Lespedeza	2
				Other perennial grasses	10
				Other perennial forbs	3
Grandfield	Sandy Prairie	Favorable	3,700	Little bluestem	25
		Normal	2,600	Sand bluestem	20
		Unfavorable	1,900	Sideoats grama	15
				Blue grama	10
				Indiangrass	5
				Sand lovegrass	5
				Sand sagebrush	5
				Lespedeza	2
				Other perennial grasses	10
				Other perennial forbs	3
19,* 20,* 21:*					
Dill	Sandy Prairie	Favorable	3,800	Little bluestem	25
		Normal	2,700	Sand bluestem	20
		Unfavorable	2,000	Sideoats grama	15
				Blue grama	10
				Indiangrass	5
				Sand lovegrass	5
				Sand sagebrush	5
				Lespedeza	2
				Other perennial grasses	10
				Other perennial forbs	3
Quinlan	Shallow Prairie	Favorable	2,500	Little bluestem	30
		Normal	1,800	Sand bluestem	15
		Unfavorable	1,300	Indiangrass	10
				Switchgrass	10
				Tall dropseed	10
				Scribner panicum	5
				Sideoats grama	5
				Prairie-clover	5
				Dotted gayfeather	5
				Eastern redcedar	5
22 Gracemont	Subirrigated	Favorable	9,000	Switchgrass	25
		Normal	7,800	Sand bluestem	20
		Unfavorable	7,000	Indiangrass	10
				Eastern gamagrass	10
				Beaked panicum	10
				Canada wildrye	5
				Maximilian sunflower	5
				Eastern cottonwood	5
				Scribner panicum	5
				Purpletop	5
23 Gracemont	Saline Subirrigated	Favorable	7,000	Prairie cordgrass	15
		Normal	5,800	Alkali sacaton	15
		Unfavorable	5,000	Switchgrass	10
				Indiangrass	10
				Inland saltgrass	10
				Sunflower	5
				Tamarisk	5
				Western wheatgrass	5
				Sedge	5
				Other perennial grasses	15
				Other perennial forbs	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Map symbol and soil name	Range site name	Total production		Characteristic vegetation	Compo- sition
		Kind of year	Dry weight		
			Lb/acre		Pct
24----------------- Gracemore	Saline Subirrigated------------	Favorable	7,000	Prairie cordgrass--------------	15
		Normal	5,800	Alkali sacaton-----------------	15
		Unfavorable	5,000	Switchgrass--------------------	10
				Indiangrass--------------------	10
				Inland saltgrass---------------	10
				Sunflower----------------------	5
				Tamarisk-----------------------	5
				Western wheatgrass-------------	5
				Sedge--------------------------	5
				Other perennial grasses--------	15
				Other perennial forbs----------	5
25----------------- Grandfield	Deep Sand----------------------	Favorable	3,700	Sand bluestem------------------	25
		Normal	2,600	Little bluestem----------------	15
		Unfavorable	1,900	Indiangrass--------------------	10
				Sand lovegrass-----------------	10
				Switchgrass--------------------	5
				Sideoats grama-----------------	5
				Sand sagebrush-----------------	5
				Skunkbush sumac----------------	5
				Schweinitz flatsedge-----------	3
				Blue grama---------------------	2
				Lespedeza----------------------	2
				Other perennial grasses--------	8
				Other perennial forbs----------	3
				Other shrubs-------------------	2
26----------------- Grandfield	Deep Sand----------------------	Favorable	3,300	Sand bluestem------------------	25
		Normal	2,250	Little bluestem----------------	15
		Unfavorable	1,700	Indiangrass--------------------	10
				Sand lovegrass-----------------	10
				Switchgrass--------------------	5
				Sideoats grama-----------------	5
				Sand sagebrush-----------------	5
				Skunkbush sumac----------------	5
				Schweinitz flatsedge-----------	3
				Blue grama---------------------	2
				Lespedeza----------------------	2
				Other perennial grasses--------	8
				Other perennial forbs----------	3
				Other shrubs-------------------	2
27, 28------------- Grandfield	Sandy Prairie------------------	Favorable	4,000	Little bluestem----------------	25
		Normal	2,800	Sand bluestem------------------	20
		Unfavorable	2,000	Sideoats grama-----------------	15
				Blue grama---------------------	10
				Indiangrass--------------------	5
				Sand lovegrass-----------------	5
				Sand sagebrush-----------------	5
				Lespedeza----------------------	2
				Other perennial grasses--------	10
				Other perennial forbs----------	3
29----------------- Grandfield	Sandy Prairie------------------	Favorable	3,600	Little bluestem----------------	25
		Normal	2,400	Sand bluestem------------------	20
		Unfavorable	1,600	Sideoats grama-----------------	15
				Blue grama---------------------	10
				Indiangrass--------------------	5
				Sand lovegrass-----------------	5
				Sand sagebrush-----------------	5
				Lespedeza----------------------	2
				Other perennial grasses--------	10
				Other perennial forbs----------	3

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Map symbol and soil name	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
30, 31 Hardeman	Sandy Prairie	Favorable	4,000	Little bluestem	25
		Normal	2,800	Sand bluestem	20
		Unfavorable	2,000	Sideoats grama	15
				Blue grama	10
				Indiangrass	5
				Sand lovegrass	5
				Sand sagebrush	5
				Lespedeza	2
				Other perennial grasses	10
				Other perennial forbs	3
32:*					
Knoco	Red Clay Prairie	Favorable	2,200	Sideoats grama	30
		Normal	1,500	Little bluestem	25
		Unfavorable	1,000	Blue grama	10
				Buffalograss	5
				Vine-mesquite	5
				Hairy grama	5
				Sand bluestem	5
				Other perennial grasses	10
				Other perennial forbs	5
Cornick	Gyp	Favorable	1,800	Little bluestem	40
		Normal	1,200	Sideoats grama	20
		Unfavorable	1,000	Blue grama	10
				Sand dropseed	5
				Hairy tridens	5
				Buffalograss	3
				Hairy grama	2
				Other perennial forbs	15
Rock outcrop.					
33:*					
Knoco	Breaks	Favorable	1,500	Sideoats grama	30
		Normal	1,100	Little bluestem	25
		Unfavorable	800	Blue grama	10
				Buffalograss	5
				Vine-mesquite	5
				Hairy grama	5
				Sand bluestem	5
				Other perennial grasses	10
				Other perennial forbs	5
Rock outcrop.					
34 Lincoln	Sandy Bottomland	Favorable	3,000	Switchgrass	30
		Normal	2,280	Sand bluestem	15
		Unfavorable	1,800	Indiangrass	15
				Little bluestem	5
				Texas bluegrass	5
				Beaked panicum	5
				Purpletop	5
				Maximilian sunflower	5
				Goldenrod	5
				Heath aster	5
				Tamarisk	5
35 Mangum	Heavy Bottomland	Favorable	4,500	Switchgrass	20
		Normal	3,300	Western wheatgrass	10
		Unfavorable	2,500	Alkali sacaton	5
				Vine-mesquite	5
				White tridens	5
				Tall dropseed	5
				Blue grama	5
				Little bluestem	5
				Other perennial grasses	35
				Other perennial forbs	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Map symbol and soil name	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Compo-sition
			Lb/acre		Pct
36, 37----------- Nobscot	Deep Sand Savannah-----------	Favorable	3,900	Little bluestem---------------	25
		Normal	2,800	Sand bluestem-----------------	20
		Unfavorable	2,000	Shinnery oak------------------	20
				Indiangrass-------------------	5
				Switchgrass-------------------	5
				Purpletop---------------------	5
				Arrowfeather threeawn---------	5
				Scribner panicum--------------	5
				Sideoats grama----------------	5
				Lespedeza---------------------	5
38:*					
Nobscot----------	Eroded Sandy Land------------	Favorable	2,800	Little bluestem---------------	25
		Normal	2,100	Sand bluestem-----------------	15
		Unfavorable	1,500	Sideoats grama----------------	10
				Switchgrass-------------------	5
				Lespedeza---------------------	5
				Sand lovegrass----------------	5
				Shinnery oak------------------	5
				Other perennial grasses-------	20
				Other perennial forbs---------	10
Delwin-----------	Eroded Sandy Land------------	Favorable	2,800	Little bluestem---------------	25
		Normal	2,100	Sand bluestem-----------------	15
		Unfavorable	1,500	Sideoats grama----------------	10
				Switchgrass-------------------	5
				Lespedeza---------------------	5
				Sand lovegrass----------------	5
				Shinnery oak------------------	5
				Other perennial grasses-------	20
				Other perennial forbs---------	10
39, 40,* 41:*					
Obaro------------	Loamy Prairie----------------	Favorable	4,000	Little bluestem---------------	25
		Normal	2,800	Sand bluestem-----------------	20
		Unfavorable	2,000	Switchgrass-------------------	10
				Indiangrass-------------------	10
				Blue grama--------------------	5
				Sideoats grama----------------	5
				Canada wildrye----------------	5
				Tall dropseed-----------------	5
				Lespedeza---------------------	5
				Dotted gayfeather-------------	5
				Other shrubs------------------	5
40,* 41:*					
Quinlan----------	Shallow Prairie--------------	Favorable	2,500	Little bluestem---------------	30
		Normal	1,800	Sand bluestem-----------------	15
		Unfavorable	1,300	Indiangrass-------------------	10
				Switchgrass-------------------	10
				Tall dropseed-----------------	10
				Scribner panicum--------------	5
				Sideoats grama----------------	5
				Prairie-clover----------------	5
				Dotted gayfeather-------------	5
				Eastern redcedar--------------	5
42--------------- Port	Loamy Bottomland-------------	Favorable	7,000	Sand bluestem-----------------	25
		Normal	4,900	Indiangrass-------------------	15
		Unfavorable	3,500	Switchgrass-------------------	15
				Little bluestem---------------	10
				Eastern gamagrass-------------	5
				Tall dropseed-----------------	5
				Beaked panicum----------------	5
				Compassplant------------------	5
				Heath aster-------------------	5
				Sedge-------------------------	5
				Eastern cottonwood------------	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Map symbol and soil name	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
43:*					
Pratt	Deep Sand	Favorable	3,700	Sand bluestem	25
		Normal	2,600	Little bluestem	20
		Unfavorable	1,900	Indiangrass	10
				Sand lovegrass	10
				Sideoats grama	5
				Skunkbush sumac	5
				Sagebrush	5
				Schweinitz flatsedge	3
				Lespedeza	2
				Blue grama	2
				Other perennial grasses	8
				Other perennial forbs	3
				Other shrubs	2
Tivoli	Dune	Favorable	2,000	Little bluestem	25
		Normal	1,400	Sand bluestem	20
		Unfavorable	1,000	Big sandreed	10
				Texas bluegrass	10
				Sand lovegrass	5
				Scribner panicum	5
				Sand dropseed	5
				Lespedeza	5
				Sand sagebrush	5
				Other perennial grasses	5
				Other perennial forbs	5
44:*					
Quanah	Hardland	Favorable	2,800	Sideoats grama	30
		Normal	1,900	Blue grama	20
		Unfavorable	1,300	Buffalograss	10
				Western wheatgrass	10
				Vine-mesquite	5
				Sand bluestem	5
				Other perennial grasses	15
				Other perennial forbs	5
Talpa	Shallow Prairie	Favorable	2,000	Sideoats grama	20
		Normal	1,400	Little bluestem	10
		Unfavorable	1,000	Hairy grama	10
				Tridens	10
				Bluegrama	10
				Buffalograss	5
				Threeawns	5
				Prairie-clover	3
				Other perennial grasses	17
				Other perennial forbs	5
				Other trees	5
45:*					
Quinlan	Shallow Prairie	Favorable	2,500	Little bluestem	30
		Normal	1,800	Sand bluestem	15
		Unfavorable	1,300	Indiangrass	10
				Switchgrass	10
				Tall dropseed	10
				Scribner panicum	5
				Sideoats grama	5
				Prairie-clover	5
				Dotted gayfeather	5
				Eastern redcedar	5
Obaro	Loamy Prairie	Favorable	4,000	Little bluestem	25
		Normal	2,800	Sand bluestem	20
		Unfavorable	2,000	Switchgrass	10
				Indiangrass	10
				Blue grama	5
				Sideoats grama	5
				Canada wildrye	5
				Tall dropseed	5
				Lespedeza	5
				Dotted gayfeather	5
				Other shrubs	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Map symbol and soil name	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Compo-sition
			Lb/acre		Pct
46:*					
Quinlan	Shallow Prairie	Favorable	2,500	Little bluestem	30
		Normal	1,800	Sand bluestem	15
		Unfavorable	1,300	Indiangrass	10
				Switchgrass	10
				Tall dropseed	10
				Scribner panicum	5
				Sideoats grama	5
				Prairie-clover	5
				Dotted gayfeather	5
				Eastern redcedar	5
46:*					
Obaro	Loamy Prairie	Favorable	3,800	Little bluestem	25
		Normal	2,600	Sand bluestem	20
		Unfavorable	1,800	Switchgrass	10
				Indiangrass	10
				Blue grama	5
				Sideoats grama	5
				Canada wildrye	5
				Tall dropseed	5
				Lespedeza	5
				Dotted gayfeather	5
				Other shrubs	5
47,* 48:*					
Quinlan	Shallow Prairie	Favorable	2,500	Little bluestem	30
		Normal	1,800	Sand bluestem	15
		Unfavorable	1,300	Indiangrass	10
				Switchgrass	10
				Tall dropseed	10
				Scribner panicum	5
				Sideoats grama	5
				Prairie-clover	5
				Dotted gayfeather	5
				Eastern redcedar	5
Woodward	Loamy Prairie	Favorable	4,000	Little bluestem	25
		Normal	2,800	Sand bluestem	20
		Unfavorable	2,000	Switchgrass	10
				Indiangrass	10
				Sideoats grama	5
				Blue grama	5
				Canada wildrye	5
				Tall dropseed	5
				Lespedeza	5
				Dotted gayfeather	5
				Other shrubs	5
49:*					
Quinlan	Eroded Prairie	Favorable	1,800	Little bluestem	35
		Normal	1,200	Sand bluestem	10
		Unfavorable	800	Tall dropseed	10
				Sideoats grama	10
				Indiangrass	5
				Switchgrass	5
				Prairie-clover	5
				Eastern redcedar	5
				Blue grama	5
				Heath aster	5
				Sunflower	5
Dill	Eroded Prairie	Favorable	2,700	Little bluestem	35
		Normal	1,900	Sand bluestem	15
		Unfavorable	1,400	Sideoats grama	15
				Indiangrass	5
				Sand lovegrass	5
				Blue grama	5
				Sand sagebrush	5
				Switchgrass	5
				Other perennial grasses	5
				Other perennial forbs	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Map symbol and soil name	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
50, 51 Spur	Loamy Bottomland	Favorable	7,000	Sand bluestema	25
		Normal	4,900	Indiangrass	15
		Unfavorable	3,500	Switchgrass	15
				Little bluestem	10
				Eastern gamagrass	5
				Tall dropseed	5
				Beaked panicum	5
				Compass plant	5
				Heath aster	5
				Sedge	5
				Eastern cottonwood	5
52, 53 St. Paul	Loamy Prairie	Favorable	4,000	Little bluestem	25
		Normal	2,800	Sand bluestem	20
		Unfavorable	2,000	Switchgrass	10
				Indiangrass	10
				Sideoats grama	5
				Blue grama	5
				Canada wildrye	5
				Tall dropseed	5
				Lespedeza	5
				Dotted gayfeather	5
				Other shrubs	5
54 Tillman	Hardland	Favorable	2,800	Sideoats grama	30
		Normal	1,900	Blue grama	20
		Unfavorable	1,300	Buffalograss	10
				Western wheatgrass	10
				Vine-mesquite	5
				Sand bluestem	5
				Other perennial grasses	15
				Other perennial forbs	5
55, 56 Tipton	Loamy Prairie	Favorable	4,000	Little bluestem	20
		Normal	2,800	Sand bluestem	15
		Unfavorable	2,000	Indiangrass	15
				Switchgrass	15
				Sideoats grama	10
				Tall dropseed	5
				Blue grama	5
				Ashy sunflower	5
				Other perennial grasses	10
57 Tivoli	Dune	Favorable	2,000	Little bluestem	25
		Normal	1,400	Sand bluestem	20
		Unfavorable	1,000	Big sandreed	10
				Texas bluegrass	10
				Sand lovegrass	5
				Scribner panicum	5
				Sand dropseed	5
				Lespedeza	5
				Shinnery oak	5
				Other perennial grasses	5
				Other perennial forbs	5
58 Treadway	Red Clay Flats	Favorable	1,200	Alkali sacaton	20
		Normal	800	Buffalograss	15
		Unfavorable	600	Vine-mesquite	10
				Western wheatgrass	10
				White tridens	10
				Sideoats grama	5
				Blue grama	5
				Other perennial grasses	17
				Other perennial forbs	5
				Other shrubs	3

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Map symbol and soil name	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
60: Vernon	Red Clay Prairie	Favorable	2,200	Sideoats grama	30
		Normal	1,500	Little bluestem	25
		Unfavorable	1,000	Blue grama	10
				Buffalograss	5
				Vine-mesquite	5
				Hairy grama	5
				Sand bluestem	5
				Other perennial grasses	10
				Other perennial forbs	5
61, 62: Woodward	Loamy Prairie	Favorable	4,000	Little bluestem	25
		Normal	2,800	Sand bluestem	20
		Unfavorable	2,000	Switchgrass	10
				Indiangrass	10
				Sideoats grama	5
				Blue grama	5
				Canada wildrye	5
				Tall dropseed	5
				Lespedeza	5
				Dotted gayfeather	5
				Other shrubs	5
63,* 64:*					
Woodward	Loamy Prairie	Favorable	4,000	Little bluestem	25
		Normal	2,800	Sand bluestem	20
		Unfavorable	2,000	Switchgrass	10
				Indiangrass	10
				Sideoats grama	5
				Blue grama	5
				Canada wildrye	5
				Tall dropseed	5
				Lespedeza	5
				Dotted gayfeather	5
				Other shrubs	5
Quinlan	Shallow Prairie	Favorable	2,500	Little bluestem	30
		Normal	1,800	Sand bluestem	15
		Unfavorable	1,300	Indiangrass	10
				Switchgrass	10
				Tall dropseed	10
				Scribner panicum	5
				Sideoats grama	5
				Prairie-clover	5
				Dotted gayfeather	5
				Eastern redcedar	5
65: Woodward Variant	Sandy Prairie	Favorable	3,800	Little bluestem	25
		Normal	2,700	Sand bluestem	20
		Unfavorable	2,000	Sideoats grama	15
				Blue grama	10
				Indiangrass	5
				Sand lovegrass	5
				Sand sagebrush	5
				Lespedeza	2
				Other perennial grasses	10
				Other perennial forbs	3
66: Yahola	Loamy Bottomland	Favorable	7,000	Sand bluestem	25
		Normal	4,900	Indiangrass	15
		Unfavorable	3,500	Switchgrass	15
				Little bluestem	10
				Eastern gamagrass	5
				Tall dropseed	5
				Beaked panicum	5
				Compassplant	5
				Sedge	5
				Heath aster	5
				Eastern cottonwood	5

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Map symbol and soil name	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
1----------------- Abilene	---	Oneseed juniper, eastern redcedar, osageorange.	Chinese elm, honeylocust.	---	---
2----------------- Altus	---	---	---	Austrian pine, eastern redcedar, red mulberry, ponderosa pine.	Eastern cottonwood, loblolly pine.
3, 4-------------- Aspermont	---	Osageorange, eastern redcedar, oneseed juniper.	Chinese elm, black locust.	---	---
5.* Badland					
6. Beckman					
7----------------- Carey	---	---	Hackberry, Scotch pine, red mulberry, osageorange, eastern redcedar, ponderosa pine, Austrian pine, black locust, honeylocust.	Chinese elm, loblolly pine.	Eastern cottonwood.
8, 9-------------- Clairemont	---	---	---	Osageorange, red mulberry, Chinese elm, Austrian pine, ponderosa pine, eastern redcedar, Scotch pine.	Eastern cottonwood, loblolly pine, green ash, sycamore.
10:*					
Clark------------	---	---	Austrian pine, eastern redcedar, osageorange, ponderosa pine, black locust, Scotch pine.	Chinese elm, honeylocust, loblolly pine, hackberry.	Eastern cottonwood.
Owens.					
11---------------- Cordell	Oneseed juniper---	Eastern redcedar, osageorange, black locust.	---	---	---
12:*					
Cordell----------	Oneseed juniper---	Eastern redcedar, osageorange, black locust.	---	---	---
Rock outcrop.					
13:*					
Cornick----------	---	Oneseed juniper, osageorange, eastern redcedar, black locust.	---	---	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
13:* Vinson	---	Eastern redcedar, osageorange, oneseed juniper.	Black locust, Chinese elm.	---	---
Rock outcrop.					
14 Cyril	---	---	---	Austrian pine, red mulberry, eastern redcedar.	Loblolly pine, eastern cottonwood.
15:* Delwin	---	---	Ponderosa pine, red mulberry, eastern redcedar, Austrian pine.	Loblolly pine	Eastern cottonwood.
Nobscot	---	---	Austrian pine, eastern redcedar, ponderosa pine, red mulberry.	Loblolly pine	Eastern cottonwood.
16, 17 Devol	---	---	Austrian pine, ponderosa pine, red mulberry, eastern redcedar.	Loblolly pine	Eastern cottonwood.
18:* Devol	---	---	Austrian pine, ponderosa pine, red mulberry, eastern redcedar.	Loblolly pine	Eastern cottonwood.
Grandfield	---	---	Austrian pine, eastern redcedar, red mulberry, ponderosa pine.	Loblolly pine	Eastern cottonwood.
19,* 20,* 21:* Dill	---	---	Austrian pine, ponderosa pine, red mulberry, eastern redcedar.	Loblolly pine	Eastern cottonwood.
Quinlan	---	Eastern redcedar oneseed juniper.	Chinese elm, black locust, osageorange.	---	---
22, 23. Gracemont					
24. Gracemore					
25, 26, 27, 28, 29 Grandfield	---	---	---	Austrian pine, eastern redcedar, red mulberry, ponderosa pine.	Eastern cottonwood, loblolly pine.
30, 31 Hardeman	---	---	Austrian pine, eastern redcedar, ponderosa pine, red mulberry.	Loblolly pine	Eastern cottonwood.
32:* Knoco.					
Cornick.					
Rock outcrop.					

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
33:* Knoco.					
Rock outcrop.					
34 Lincoln	American plum	---	Scotch pine, osageorange, autumn-olive, eastern redcedar, red mulberry.	Chinese elm	Eastern cottonwood, sycamore.
35. Mangum					
36, 37 Nobscot	---	---	Austrian pine, eastern redcedar, ponderosa pine, red mulberry.	Loblolly pine	Eastern cottonwood.
38:* Nobscot	---	---	Austrian pine, eastern redcedar, ponderosa pine, red mulberry.	Loblolly pine	Eastern cottonwood.
Delwin	---	---	Ponderosa pine, red mulberry, eastern redcedar, austrian pine.	Loblolly pine	Eastern cottonwood.
39 Obaro	---	---	Austrian pine, ponderosa pine, red mulberry, eastern redcedar.	Loblolly pine	Eastern cottonwood.
40,* 41:* Obaro	---	---	Austrian pine, ponderosa pine, red mulberry, eastern redcedar.	Loblolly pine	Eastern cottonwood.
Quinlan	---	Eastern redcedar, oneseed juniper.	Chinese elm, black locust, osageorange.	---	---
42 Port	---	---	---	Austrian pine, eastern redcedar, red mulberry, ponderosa pine, green ash.	Loblolly pine, eastern cottonwood.
43:* Pratt.					
Tivoli.					
44:* Quanah.					
Talpa.					
45,* 46:* Quinlan	---	Eastern redcedar, oneseed juniper.	Chinese elm, black locust, osageorange.	---	---
Obaro	---	---	Austrian pine, ponderosa pine, red mulberry, eastern redcedar.	Loblolly pine	Eastern cottonwood.
47,* 48:* Quinlan	---	Eastern redcedar, oneseed juniper.	Chinese elm, black locust, osageorange.	---	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
47,* 48:*					
Woodward	---	---	Austrian pine, eastern redcedar, ponderosa pine, red mulberry.	Loblolly pine	Eastern cottonwood.
49:*					
Quinlan.					
Dill.					
50, 51 Spur	---	---	Autumn olive	Osageorange, Austrian pine, eastern redcedar, ponderosa pine, red mulberry, Chinese elm, Scotch pine.	Eastern cottonwood, green ash, loblolly pine, sycamore.
52, 53 St. Paul	---	---	Austrian pine, eastern redcedar, ponderosa pine, red mulberry.	Loblolly pine	Eastern cottonwood.
54 Tillman	---	Eastern redcedar, osageorange, oneseed juniper.	Honeylocust, Chinese elm.	---	---
55, 56 Tipton	---	---	---	Austrian pine, red mulberry, eastern redcedar, ponderosa pine.	Eastern cottonwood, loblolly pine.
57. Tivoli					
58. Treadway					
59.* Ustorthents					
60 Vernon	---	Oneseed juniper, eastern redcedar, osageorange.	Honey locust, Chinese elm.	---	---
61, 62 Woodward	---	---	Austrian pine, eastern redcedar, ponderosa pine, red mulberry.	Loblolly pine	Eastern cottonwood.
63,* 64:*					
Woodward	---	---	Austrian pine, eastern redcedar, ponderosa pine, red mulberry.	Loblolly pine	Eastern cottonwood.
Quinlan	---	Eastern redcedar, oneseed juniper.	Chinese elm, black locust, osageorange.	---	---
65 Woodward Variant	---	---	Austrian pine, eastern redcedar, red mulberry, ponderosa pine.	Loblolly pine	Eastern cottonwood.
66 Yahola	---	---	---	Austrian pine, eastern redcedar, red mulberry, ponderosa pine.	Eastern cottonwood, loblolly pine.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1 Abilene	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Moderate: too clayey, percs slowly.	Moderate: too clayey.	Slight.
2 Altus	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Slight.
3, 4 Aspermont	Slight	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.	Slight.
5.* Badland					
6 Beckman	Severe: floods, percs slowly, too clayey.	Severe: too clayey.	Severe: too clayey, percs slowly.	Severe: too clayey.	Severe: too clayey.
7 Carey	Slight	Slight	Slight	Slight	Slight.
8 Clairemont	Severe: floods.	Slight	Moderate: floods.	Slight	Moderate: floods.
9 Clairemont	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.	Severe: floods.
10:*					
Clark	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Owens	Severe: percs slowly, too clayey, slope.	Severe: too clayey, percs slowly, slope.	Severe: slope, too clayey.	Severe: too clayey.	Severe: thin layer.
11 Cordell	Slight	Slight	Severe: depth to rock.	Slight	Severe: thin layer.
12:*					
Cordell	Moderate: slope.	Moderate: slope.	Severe: slope, depth to rock.	Slight	Severe: thin layer.
Rock outcrop.					
13:*					
Cornick	Severe: depth to rock.	Moderate: dusty.	Severe: depth to rock.	Moderate: dusty.	Severe: thin layer.
Vinson	Moderate: dusty.	Moderate: dusty.	Moderate: slope, depth to rock, dusty.	Moderate: dusty.	Moderate: thin layer.
Rock outcrop.					
14 Cyril	Severe: floods.	Slight	Moderate: floods.	Slight	Moderate: floods.
15:*					
Delwin	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
15:*					
Nobscot	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Slight.
16 Devol	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Slight.
17 Devol	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Slight.
18:*					
Devol	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Slight.
Grandfield	Moderate: dusty.	Moderate: dusty.	Severe: slope.	Moderate: dusty.	Slight.
19,* 20:*					
Dill	Slight	Slight	Moderate: slope, depth to rock, dusty.	Slight	Moderate: thin layer.
Quinlan	Moderate: dusty.	Moderate: dusty.	Severe: depth to rock.	Moderate: dusty.	Severe: thin layer.
21:*					
Dill	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.	Moderate: thin layer.
Quinlan	Moderate: dusty, slope.	Moderate: dusty, slope.	Severe: depth to rock, slope.	Moderate: dusty.	Severe: thin layer.
22 Gracemont	Severe: floods, wetness.	Moderate: floods, wetness.	Severe: floods.	Moderate: wetness, floods.	Severe: floods.
23 Gracemont	Severe: floods, wetness.	Moderate: floods, wetness.	Severe: floods.	Moderate: wetness, floods.	Severe: floods, excess salt.
24 Gracemore	Severe: floods, wetness.	Moderate: floods, wetness.	Severe: floods.	Moderate: wetness, floods.	Severe: floods, excess salt.
25, 26 Grandfield	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Slight.
27, 28, 29 Grandfield	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.	Slight.
30, 31 Hardeman	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.	Slight.
32:*					
Knoco	Severe: slope, too clayey, percs slowly.	Severe: slope, too clayey.	Severe: slope, too clayey, percs slowly.	Moderate: too clayey, slope.	Severe: too clayey, thin layer.
Cornick	Severe: depth to rock.	Moderate: dusty.	Severe: depth to rock.	Moderate: dusty.	Severe: thin layer.
Rock outcrop.					

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
33:*					
Knoco	Severe: slope, percs slowly, too clayey.	Severe: slope, too clayey.	Severe: slope, too clayey, percs slowly.	Severe: slope, too clayey.	Severe: thin layer, too clayey.
Rock outcrop.					
34 Lincoln	Severe: floods.	Moderate: too sandy, floods.	Severe: floods.	Moderate: floods, too sandy.	Severe: floods.
35 Mangum	Severe: floods, percs slowly.	Severe: too clayey.	Severe: too clayey, percs slowly.	Moderate: too clayey.	Severe: too clayey.
36 Nobscot	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Slight.
37 Nobscot	Moderate: too sandy, slope.	Moderate: too sandy, slope.	Severe: slope.	Moderate: too sandy.	Slight.
38:*					
Nobscot	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Slight.
Delwin	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.	Slight.
39 Obaro	Moderate: dusty.	Moderate: dusty.	Moderate: slope, depth to rock, dusty.	Moderate: dusty.	Moderate: thin layer.
40:*					
Obaro	Moderate: dusty.	Moderate: dusty.	Moderate: slope, depth to rock, dusty.	Moderate: dusty.	Moderate: thin layer.
Quinlan	Moderate: dusty.	Moderate: dusty.	Severe: depth to rock.	Moderate: dusty.	Severe: thin layer.
41:*					
Obaro	Moderate: dusty.	Moderate: dusty.	Moderate: slope, depth to rock, dusty.	Moderate: dusty.	Moderate: thin layer.
Quinlan	Moderate: dusty.	Moderate: dusty.	Severe: depth to rock.	Moderate: dusty.	Severe: thin layer.
42 Port	Severe: floods.	Moderate: too clayey.	Moderate: floods, too clayey.	Moderate: too clayey.	Moderate: floods.
43:*					
Pratt	Moderate: too sandy, slope.	Moderate: too sandy, slope.	Severe: slope.	Moderate: too sandy.	Moderate: slope.
Tivoli	Severe: too sandy, slope, dusty.	Severe: too sandy, slope, dusty.	Severe: slope, too sandy. dusty.	Severe: too sandy, dusty.	Severe: droughty.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
44:*					
Quanah	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.	Slight.
Talpa	Moderate: small stones, depth to rock.	Moderate: small stones, too clayey.	Severe: depth to rock.	Moderate: small stones, too clayey.	Severe: thin layer.
45:*					
Quinlan	Moderate: too clayey.	Moderate: too clayey.	Severe: depth to rock.	Moderate: too clayey.	Severe: thin layer.
Obaro	Moderate: dusty.	Moderate: dusty.	Moderate: slope, depth to rock, dusty.	Moderate: dusty.	Moderate: thin layer.
46:*					
Quinlan	Moderate: too clayey, slope.	Moderate: too clayey, slope.	Severe: depth to rock, slope.	Moderate: too clayey.	Severe: thin layer.
Obaro	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.	Moderate: slope, thin layer.
47:*					
Quinlan	Moderate: dusty.	Moderate: dusty.	Severe: depth to rock.	Moderate: dusty.	Severe: thin layer.
Woodward	Moderate: dusty.	Moderate: dusty.	Moderate: slope, depth to rock, dusty.	Moderate: dusty.	Moderate: thin layer.
48:*					
Quinlan	Moderate: dusty, slope.	Moderate: dusty, slope.	Severe: depth to rock, slope.	Moderate: dusty.	Severe: thin layer.
Woodward	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.	Moderate: slope, thin layer.
49:*					
Quinlan	Moderate: dusty, slope.	Moderate: dusty, slope.	Severe: depth to rock, slope.	Moderate: dusty.	Severe: thin layer.
Dill	Moderate: dusty, slope.	Moderate: dusty, slope.	Severe: slope.	Moderate: dusty.	Moderate: thin layer.
50 Spur	Severe: floods.	Slight	Moderate: floods.	Slight	Moderate: floods.
51 Spur	Severe: floods.	Moderate: floods, too clayey.	Severe: floods.	Moderate: floods, too clayey.	Severe: floods.
52 St. Paul	Moderate: dusty, percs slowly.	Moderate: dusty.	Moderate: percs slowly, dusty.	Moderate: dusty.	Slight.
53 St. Paul	Moderate: dusty, percs slowly.	Moderate: dusty.	Moderate: slope, dusty, percs slowly.	Moderate: dusty.	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
54-------------------- Tillman	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Slight.
55-------------------- Tipton	Slight----------	Slight----------	Slight----------	Slight------------	Slight.
56-------------------- Tipton	Slight----------	Slight----------	Moderate: slope.	Slight------------	Slight.
57-------------------- Tivoli	Severe: too sandy, slope.	Severe: too sandy, slope.	Severe: slope, too sandy.	Severe: too sandy.	Severe: droughty.
58-------------------- Treadway	Severe: floods, percs slowly, too clayey.	Severe: too clayey.	Severe: floods, percs slowly, too clayey.	Severe: too clayey.	Severe: too clayey, floods.
59.* Ustorthents					
60-------------------- Vernon	Severe: too clayey.	Severe: too clayey.	Severe: slope, too clayey.	Severe: too clayey.	Severe: too clayey.
61, 62---------------- Woodward	Moderate: dusty.	Moderate: dusty.	Moderate: slope, depth to rock, dusty.	Moderate: dusty.	Moderate: thin layer.
63,* 64:* Woodward-------------	Moderate: dusty.	Moderate: dusty.	Moderate: slope, depth to rock, dusty.	Moderate: dusty.	Moderate: thin layer.
Quinlan--------------	Moderate: dusty.	Moderate: dusty.	Severe: depth to rock.	Moderate: dusty.	Severe: thin layer.
65-------------------- Woodward Variant	Moderate: dusty.	Moderate: dusty.	Moderate: depth to rock, dusty.	Moderate: dusty.	Moderate: thin layer.
66-------------------- Yahola	Severe: floods.	Moderate: dusty.	Moderate: floods, dusty.	Moderate: dusty.	Moderate: floods.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WILDLIFE HABITAT POTENTIALS

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Potential for habitat elements								Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
1------------------- Abilene	Good	Good	Fair	---	Good	Good	Poor	Very poor.	Good	Very poor	Fair.
2------------------- Altus	Good	Good	Good	---	---	Good	Poor	Very poor.	Good	Very poor	Good.
3, 4---------------- Aspermont	Fair	Good	Fair	---	Very poor.	Fair	Very poor.	Very poor.	Fair	Very poor	Fair.
5.* Badland											
6------------------- Beckman	Fair	Fair	Poor	---	---	Fair	Poor	Poor	Fair	Poor	Poor.
7------------------- Carey	Good	Good	Fair	---	Very poor.	Fair	Very poor.	Very poor.	Good	Very poor	Fair.
8------------------- Clairemont	Good	Good	Good	---	Very poor.	Good	Very poor.	Very poor.	Good	Very poor.	Good.
9------------------- Clairemont	Very poor.	Poor	Fair	---	Very poor.	Good	Very poor.	Very poor.	Poor	Very poor.	Fair.
10:* Clark--------------	Fair	Good	Fair	Fair	Fair	Fair	Poor	Very poor.	Fair	Very poor	Poor.
Owens--------------	Poor	Fair	Fair	---	---	Poor	Very poor.	Very poor.	Fair	Very poor	Poor.
11------------------ Cordell	Poor	Poor	Fair	---	---	Very poor.	Very poor.	Very poor.	Poor	Very poor	Poor.
12:* Cordell------------	Poor	Poor	Fair	---	---	Very poor.	Very poor.	Very poor.	Poor	Very poor	Poor.
Rock outcrop.											
13:* Cornick------------	Poor	Poor	Poor	---	---	Very poor.	Very poor.	Very poor.	Poor	Very poor	Very poor.
Vinson-------------	Fair	Good	Good	---	---	Fair	Poor	Very poor.	Good	Very poor	Fair.
Rock outcrop.											
14------------------ Cyril	Good	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Very poor	Good.
15:* Delwin-------------	Fair	Fair	Good	---	---	Good	Very poor.	Very poor.	Fair	Very poor	Good.
Nobscot------------	Fair	Fair	Good	---	---	Good	Poor	Very poor.	Fair	Very poor	Good.
16, 17-------------- Devol	Fair	Fair	Good	---	---	Fair	Poor	Very poor.	Fair	Very poor	Fair.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT POTENTIALS--Continued

Map symbol and soil name	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Wetland wildlife	Rangeland wildlife
18:*											
Devol	Fair	Good	Good	---	---	Fair	Poor	Very poor.	Good	Very poor	Fair.
Grandfield	Good	Good	Good	---	---	Good	Poor	Very poor.	Good	Very poor	Good.
19,* 20:*											
Dill	Fair	Good	Good	---	---	Fair	Poor	Very poor.	Good	Very poor	Fair.
Quinlan	Poor	Poor	Fair	---	---	Poor	Poor	Very poor.	Fair	Very poor	Poor.
21:*											
Dill	Fair	Good	Good	---	---	Fair	Very poor.	Very poor.	Good	Very poor	Fair.
Quinlan	Poor	Poor	Fair	---	---	Poor	Very poor.	Very poor.	Fair	Very poor	Poor.
22 Gracemont	Poor	Fair	Fair	Poor	Fair	Fair	Fair	Poor	Fair	Poor	Fair.
23 Gracemont	Poor	Fair	Very poor	Poor	Poor	Poor	Fair	Poor	Poor	Poor	Poor.
24 Gracemore	Poor	Very poor	Poor	Poor	Poor	Poor	Fair	Poor	Poor	Poor	Poor.
25 Grandfield	Fair	Fair	Good	---	---	Good	Poor	Very poor.	Fair	Very poor	Good.
26 Grandfield	Fair	Fair	Good	---	---	Good	Poor	Very poor.	Fair	Very poor	Good.
27, 28 Grandfield	Good	Good	Good	---	---	Good	Poor	Very poor.	Good	Very poor	Good.
29 Grandfield	Fair	Good	Good	---	---	Good	Poor	Very poor.	Fair	Very poor	Good.
30, 31 Hardeman	Good	Good	Good	---	Very poor.	Good	Very poor.	Very poor.	Good	Very poor	Good.
32:*											
Knoco	Very poor.	Very poor.	Poor	---	---	Very poor.	Very poor.	Very poor.	Very poor	Very poor	Very poor.
Cornick	Poor	Poor	Poor	---	---	Very poor.	Very poor.	Very poor.	Poor	Very poor	Very poor.
Rock outcrop.											
33:*											
Knoco	Very poor.	Very poor.	Poor	---	---	Very poor.	Very poor.	Very poor.	Very poor	Very poor	Very poor.
Rock outcrop.											
34 Lincoln	Poor	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	Very poor.	Fair.
35 Mangum	Fair	Fair	Poor	---	Very poor.	Fair	Poor	Poor	Fair	Poor	Poor.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT POTENTIALS--Continued

Map symbol and soil name	Potential for habitat elements								Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
36, 37------------- Nobscot	Fair	Fair	Good	---	---	Good	Poor	Very poor.	Fair	Very poor	Good.
38:* Nobscot-----------	Fair	Fair	Good	---	---	Good	Poor	Very poor.	Fair	Very poor	Good.
Delwin------------	Poor	Fair	Good	---	Very poor.	Good	Very poor.	Very poor.	Fair	Very poor	Good.
39----------------- Obaro	Fair	Fair	Fair	---	Very poor.	Fair	Very poor.	Very poor.	Fair	Very poor	Fair.
40,* 41:* Obaro-------------	Fair	Fair	Fair	---	Very poor.	Fair	Very poor.	Very poor.	Fair	Very poor	Fair.
Quinlan-----------	Poor	Poor	Fair	---	---	Poor	Poor	Very poor.	Fair	Very poor	Poor.
42----------------- Port	Good	Good	Fair	---	---	Good	Poor	Very poor.	Good	Very poor.	Fair.
43:* Pratt-------------	Fair	Good	Fair	---	---	Fair	Very poor.	Very poor.	Fair	Very poor	Fair.
Tivoli------------	Poor	Poor	Fair	---	---	Poor	Very poor.	Very poor.	Poor	Very poor	Poor.
44:* Quanah------------	Good	Good	Fair	---	---	Fair	Poor	Very poor.	Good	Very poor	Fair.
Talpa-------------	Very poor.	Very poor.	Fair	---	Very poor.	Fair	Very poor.	Very poor.	Poor	Very poor	Fair.
45:* Quinlan-----------	Poor	Poor	Fair	---	---	Poor	Poor	Very poor.	Fair	Very poor	Poor.
Obaro-------------	Fair	Fair	Fair	---	Very poor.	Fair	Very poor.	Very poor.	Fair	Very poor	Fair.
46:* Quinlan-----------	Poor	Poor	Fair	---	---	Poor	Very poor.	Very poor.	Fair	Very poor	Poor.
Obaro-------------	Poor	Fair	Fair	---	Very poor.	Fair	Very poor.	Very poor.	Fair	Very poor	Fair.
47:* Quinlan-----------	Poor	Poor	Fair	---	---	Poor	Poor	Very poor.	Fair	Very poor	Poor.
Woodward----------	Fair	Good	Good	---	---	Fair	Poor	Very poor.	Good	Very poor	Fair.
48:* Quinlan-----------	Poor	Poor	Fair	---	---	Poor	Very poor.	Very poor.	Fair	Very poor	Poor.
Woodward----------	Fair	Good	Good	---	---	Fair	Very poor.	Very poor.	Good	Very poor	Fair.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT POTENTIALS--Continued

Map symbol and soil name	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Wetland wildlife	Rangeland wildlife
49:*											
Quinlan-----------	Poor	Poor	Fair	---	---	Poor	Poor	Very poor.	Fair	Very poor	Poor.
Dill--------------	Fair	Good	Good	---	---	Fair	Very poor.	Very poor.	Good	Very poor	Fair.
50----------------- Spur	Good	Good	Good	---	Very poor.	Good	Very poor.	Very poor.	Good	Very poor	Good.
51----------------- Spur	Very poor.	Poor	Fair	---	Very poor.	Good	Very poor.	Very poor.	Poor	Very poor	Fair.
52, 53------------- St. Paul	Good	Good	Fair	---	---	Fair	Poor	Very poor.	Good	Very poor	Fair.
54----------------- Tillman	Good	Good	Fair	---	Very poor.	Fair	Poor	Very poor.	Good	Very poor	Fair.
55, 56------------- Tipton	Good	Good	Good	---	---	Good	Poor	Very poor.	Good	Very poor	Good.
57----------------- Tivoli	Poor	Poor	Fair	---	---	Poor	Very poor.	Very poor.	Poor	Very poor	Poor.
58----------------- Treadway	Poor	Poor	Poor	---	---	Poor	Poor	Poor	Poor	Very poor	Poor.
59.* Ustorthents											
60----------------- Vernon	Fair	Fair	Poor	---	---	Fair	Poor	Very poor.	Fair	Very poor	Fair.
61, 62------------- Woodward	Fair	Good	Good	---	---	Fair	Poor	Very poor.	Good	Very poor	Fair.
63,* 64:*											
Woodward----------	Fair	Good	Good	---	---	Fair	Poor	Very poor.	Good	Very poor	Fair.
Quinlan-----------	Poor	Poor	Fair	---	---	Poor	Poor	Very poor.	Fair	Very poor	Poor.
65----------------- Woodward Variant	Fair	Good	Good	---	---	Fair	Poor	Very poor.	Good	Very poor	Fair.
66----------------- Yahola	Good	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Very poor	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1----------------- Abilene	Severe: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: low strength.	Slight.
2----------------- Altus	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: low strength.	Slight.
3----------------- Aspermont	Moderate: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: low strength.	Slight.
4----------------- Aspermont	Moderate: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength, slope.	Severe: low strength.	Slight.
5.* Badland						
6----------------- Beckman	Severe: too clayey, floods.	Severe: floods, low strength, shrink-swell.	Severe: floods, low strength, shrink-swell.	Severe: floods, low strength, shrink-swell.	Severe: floods, low strength, shrink-swell.	Severe: too clayey,
7----------------- Carey	Moderate: too clayey.	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Slight.
8----------------- Clairemont	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods.
9----------------- Clairemont	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
10:*						
Clark-------------	Moderate: too clayey, slope.	Moderate: low strength, shrink-swell, slope.	Moderate: low strength, shrink-swell, slope.	Severe: slope.	Severe: low strength.	Moderate: slope.
Owens-------------	Severe: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.	Severe: thin layer.
11----------------- Cordell	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: thin layer.
12:*						
Cordell-----------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: thin layer.
Rock outcrop.						
13:*						
Cornick-----------	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Severe: thin layer.
Vinson------------	Moderate: depth to rock, too clayey.	Moderate: low strength, shrink-swell.	Moderate: depth to rock, low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: shrink-swell, low strength.	Moderate: thin layer.
Rock outcrop.						
14----------------- Cyril	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
15:*						
Delwin	Slight	Slight	Slight	Slight	Moderate: low strength.	Slight.
Nobscot	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Slight.
16 Devol	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: low strength.	Slight.
17 Devol	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: low strength.	Slight.
18:*						
Devol	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: low strength, slope.	Slight.
Grandfield	Slight	Slight	Slight	Moderate: slope.	Moderate: low strength.	Slight.
19:*						
Dill	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Slight	Slight	Moderate: thin layer.
Quinlan	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Severe: thin layer.
20:*						
Dill	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Moderate: slope.	Slight	Moderate: thin layer.
Quinlan	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock, slope.	Moderate: depth to rock.	Severe: thin layer.
21:*						
Dill	Moderate: slope, depth to rock.	Moderate: slope.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: slope.	Moderate: thin layer.
Quinlan	Moderate: slope, depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: depth to rock, slope.	Severe: thin layer.
22 Gracemont	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: floods, wetness.	Severe: floods.
23 Gracemont	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: floods, wetness.	Severe: floods, excess salt.
24 Gracemore	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: floods, excess salt.
25, 26, 27, 28, 29 Grandfield	Slight	Slight	Slight	Slight	Moderate: low strength.	Slight.
30 Hardeman	Slight	Slight	Slight	Slight	Moderate: low strength.	Slight.
31 Hardeman	Slight	Slight	Slight	Moderate: slope.	Moderate: low strength.	Slight.
32:*						
Knoco	Severe: too clayey, slope.	Severe: shrink-swell, low strength, slope.	Severe: shrink-swell, low strength, slope.	Severe: shrink-swell, low strength, slope.	Severe: low strength, slope, shrink-swell.	Severe: thin layer, too clayey.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
32:*						
Cornick	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Severe: thin layer.
Rock outcrop.						
33:*						
Knoco	Severe: too clayey, slope.	Severe: shrink-swell, low strength, slope.	Severe: shrink-swell, low strength, slope.	Severe: shrink-swell, low strength, slope.	Severe: low strength, slope, shrink-swell.	Severe: thin layer, too clayey.
Rock outcrop.						
34 Lincoln	Severe: cutbanks cave, floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
35 Mangum	Severe: too clayey.	Severe: floods, shrink-swell.	Severe: floods, shrink-swell.	Severe: floods, shrink-swell.	Severe: shrink-swell.	Severe: too clayey.
36 Nobscot	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Slight.
37 Nobscot	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Slight.
38:*						
Nobscot	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Slight.
Delwin	Slight	Slight	Slight	Slight	Slight	Slight.
39 Obaro	Moderate: depth to rock.	Moderate: low strength.	Moderate: depth to rock, low strength.	Moderate: low strength.	Moderate: low strength.	Moderate: thin layer.
40:*						
Obaro	Moderate: depth to rock.	Moderate: low strength.	Moderate: depth to rock, low strength.	Moderate: low strength.	Moderate: low strength.	Moderate: thin layer.
Quinlan	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Severe: thin layer.
41:*						
Obaro	Moderate: depth to rock.	Moderate: low strength.	Moderate: depth to rock, low strength.	Moderate: low strength.	Moderate: low strength.	Moderate: thin layer.
Quinlan	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Severe: thin layer.
42 Port	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: low strength, shrink-swell, floods.	Moderate: floods.
43:*						
Pratt	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.
Tivoli	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
44:*						
Quanah	Moderate: too clayey.	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Slight.
Talpa	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: thin layer.
45:*						
Quinlan	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Severe: thin layer.
Obaro	Moderate: depth to rock.	Moderate: low strength.	Moderate: depth to rock, low strength.	Moderate: low strength.	Moderate: low strength.	Moderate: thin layer.
46:*						
Quinlan	Moderate: slope, depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: depth to rock, slope.	Severe: thin layer.
Obaro	Moderate: depth to rock, slope.	Moderate: low strength, slope.	Moderate: depth to rock, slope, low strength.	Severe: slope.	Moderate: low strength, slope.	Moderate: slope, thin layer.
47:*						
Quinlan	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Severe: thin layer.
Woodward	Moderate: depth to rock.	Moderate: low strength.	Moderate: low strength, depth to rock.	Moderate: low strength.	Moderate: low strength.	Moderate: thin layer.
48:*						
Quinlan	Moderate: slope, depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: depth to rock, slope.	Severe: thin layer.
Woodward	Moderate: depth to rock, slope.	Moderate: low strength, slope.	Moderate: depth to rock, slope, low strength.	Severe: slope.	Moderate: low strength, slope.	Moderate: slope, thin layer.
49:*						
Quinlan	Moderate: depth to rock, slope.	Moderate: depth to rock, slope.	Moderate: depth to rock, slope.	Severe: depth to rock, slope.	Moderate: depth to rock, slope.	Severe: thin layer.
Dill	Moderate: depth to rock.	Moderate: slope.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: slope.	Moderate: thin layer.
50 Spur	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods.	Moderate: floods.
51 Spur	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
52, 53 St. Paul	Moderate: too clayey.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Severe: low strength.	Slight.
54 Tillman	Severe: too clayey.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.	Slight.
55, 56 Tipton	Moderate: too clayey.	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Slight.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
57 Tivoli	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Severe: droughty.
58 Treadway	Severe: floods, too clayey.	Severe: floods, shrink-swell, low strength.	Severe: floods, shrink-swell, low strength.	Severe: floods, shrink-swell, low strength.	Severe: floods, shrink-swell, low strength.	Severe: too clayey, floods.
59.* Ustorthents						
60 Vernon	Severe: too clayey.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.	Severe: shrink-swell, low strength, slope.	Severe: low strength, shrink-swell.	Severe: too clayey.
61 Woodward	Moderate: depth to rock.	Moderate: low strength.	Moderate: low strength, depth to rock.	Moderate: low strength.	Moderate: low strength.	Moderate: thin layer.
62 Woodward	Moderate: depth to rock.	Moderate: low strength.	Moderate: low strength, depth to rock.	Moderate: low strength.	Moderate: low strength.	Moderate: thin layer.
63:*						
Woodward	Moderate: depth to rock.	Moderate: low strength.	Moderate: low strength, depth to rock.	Moderate: low strength.	Moderate: low strength.	Moderate: thin layer.
Quinlan	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Severe: thin layer.
64:*						
Woodward	Moderate: depth to rock.	Moderate: low strength.	Moderate: low strength, depth to rock.	Moderate: low strength.	Moderate: low strength.	Moderate: thin layer.
Quinlan	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Severe: thin layer.
65 Woodward Variant	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Slight	Slight	Moderate: thin layer.
66 Yahola	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1------------------ Abilene	Severe: percs slowly.	Slight-----------	Severe: too clayey.	Slight-----------	Poor: too clayey.
2------------------ Altus	Slight-----------	Severe: seepage.	Severe: seepage.	Slight-----------	Good.
3, 4--------------- Aspermont	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: thin layer, area reclaim.
5.* Badland					
6------------------ Beckman	Severe: floods, percs slowly.	Severe: floods.	Severe: floods, too clayey.	Severe: floods.	Poor: too clayey.
7------------------ Carey	Slight-----------	Moderate: slope, seepage.	Slight-----------	Slight-----------	Fair: too clayey.
8, 9--------------- Clairemont	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Good.
10:*					
Clark--------------	Moderate: percs slowly, slope.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: too clayey, slope.
Owens--------------	Severe: percs slowly, depth to rock.	Severe: slope.	Severe: too clayey, depth to rock.	Moderate: slope.	Poor: too clayey, area reclaim, thin layer.
11----------------- Cordell	Severe: percs slowly, depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight-----------	Poor: thin layer, area reclaim.
12:*					
Cordell------------	Severe: percs slowly, depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Moderate: slope.	Poor: thin layer, area reclaim.
Rock outcrop.					
13:*					
Cornick------------	Severe: depth to rock.	Moderate: depth to rock, slope.	Severe: depth to rock.	Slight-----------	Poor: thin layer, area reclaim.
Vinson-------------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight-----------	Poor: thin layer, area reclaim.
Rock outcrop.					
14----------------- Cyril	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Good.
15:*					
Delwin-------------	Slight-----------	Severe: seepage.	Severe: seepage.	Slight-----------	Fair: too sandy.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
15:*					
Nobscot	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: too sandy.
16, 17 Devol	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
18:*					
Devol	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: slope.
Grandfield	Slight	Severe: seepage.	Severe: seepage.	Slight	Good.
19,* 20:*					
Dill	Severe: depth to rock.	Severe: seepage.	Severe: seepage, depth to rock.	Severe: seepage.	Good.
Quinlan	Severe: depth to rock.	Severe: seepage, depth to rock.	Severe: depth to rock.	Slight	Poor: thin layer, area reclaim.
21:*					
Dill	Severe: depth to rock.	Severe: seepage, slope.	Severe: seepage, depth to rock.	Severe: seepage.	Fair: slope.
Quinlan	Severe: depth to rock.	Severe: slope.	Severe: depth to rock.	Moderate: slope.	Poor: thin layer, area reclaim.
22, 23 Gracemont	Severe: wetness, floods.	Severe: wetness, seepage, floods.	Severe: floods, seepage, wetness.	Severe: wetness, floods, seepage.	Poor: wetness.
24 Gracemore	Severe: wetness, floods.	Severe: wetness, seepage, floods.	Severe: floods, seepage, wetness.	Severe: wetness, floods, seepage.	Poor: wetness.
25, 26, 27, 28, 29 Grandfield	Slight	Severe: seepage.	Severe: seepage.	Slight	Good.
30, 31 Hardeman	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
32:*					
Knoco	Severe: depth to rock, percs slowly, slope.	Severe: slope.	Severe: depth to rock.	Severe: slope.	Poor: too clayey, slope.
Cornick	Severe: depth to rock.	Moderate: depth to rock, slope.	Severe: depth to rock.	Slight	Poor: thin layer, area reclaim.
Rock outcrop.					
33:*					
Knoco	Severe: depth to rock, percs slowly, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: too clayey, slope.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
33:*					
Rock outcrop.					
34---Lincoln	Severe: floods.	Severe: seepage, floods.	Severe: floods, seepage, too sandy.	Severe: floods, seepage.	Fair: too sandy.
35---Mangum	Severe: percs slowly.	Severe: floods.	Severe: too clayey.	Moderate: floods.	Poor: too clayey.
36---Nobscot	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: too sandy.
37---Nobscot	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: too sandy.
38:*					
Nobscot	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: too sandy.
Delwin	Slight	Moderate: slope, seepage.	Severe: seepage.	Slight	Fair: too sandy.
39---Obaro	Severe: depth to rock.	Moderate: seepage, slope.	Severe: depth to rock.	Slight	Poor: thin layer, area reclaim.
40,* 41:*					
Obaro	Severe: depth to rock.	Moderate: seepage, slope.	Severe: depth to rock.	Slight	Poor: thin layer, area reclaim.
Quinlan	Severe: depth to rock.	Moderate: seepage, depth to rock, slope.	Severe: depth to rock.	Slight	Poor: thin layer, area reclaim.
42---Port	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Fair: too clayey.
43:*					
Pratt	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: too sandy, slope.
Tivoli	Moderate: slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
44:*					
Quanah	Moderate: percs slowly.	Moderate: slope, seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
Talpa	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Poor: thin layer, area reclaim.
45:*					
Quinlan	Severe: depth to rock.	Moderate: seepage, depth to rock, slope.	Severe: depth to rock.	Slight	Poor: thin layer, area reclaim.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
45:*					
Obaro	Severe: depth to rock.	Moderate: seepage, slope, depth to rock.	Severe: depth to rock.	Slight	Poor: thin layer, area reclaim.
46:*					
Quinlan	Severe: depth to rock.	Severe: slope.	Severe: depth to rock.	Moderate: slope.	Poor: thin layer, area reclaim.
Obaro	Severe: depth to rock.	Severe: slope.	Severe: depth to rock.	Moderate: slope.	Poor: thin layer, area reclaim.
47:*					
Quinlan	Severe: depth to rock.	Moderate: seepage, depth to rock, slope.	Severe: depth to rock.	Slight	Poor: thin layer, area reclaim.
Woodward	Severe: depth to rock.	Moderate: seepage, depth to rock, slope.	Severe: depth to rock.	Slight	Poor: thin layer, area reclaim.
48:*					
Quinlan	Severe: depth to rock.	Severe: slope.	Severe: depth to rock.	Moderate: slope.	Poor: thin layer, area reclaim.
Woodward	Severe: depth to rock.	Severe: slope.	Severe: depth to rock.	Moderate: slope.	Poor: thin layer, area reclaim.
49:*					
Quinlan	Severe: depth to rock.	Severe: slope.	Severe: depth to rock.	Moderate: slope.	Poor: thin layer, area reclaim.
Dill	Severe: depth to rock.	Severe: seepage, slope.	Severe: seepage, depth to rock.	Severe: seepage.	Fair: slope, thin layer.
50 Spur	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Fair: too clayey.
51 Spur	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Fair: too clayey.
52 St. Paul	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey.
53 St. Paul	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
54 Tillman	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey.
55 Tipton	Slight	Moderate: seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
56 Tipton	Slight	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
57 Tivoli	Moderate: slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
58 Treadway	Severe: floods, percs slowly.	Severe: floods.	Severe: floods, too clayey.	Severe: floods.	Poor: too clayey.
59.* Ustorthents					
60 Vernon	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey.
61 Woodward	Severe: depth to rock.	Moderate: seepage, depth to rock, slope.	Severe: depth to rock.	Slight	Poor: thin layer, area reclaim.
62 Woodward	Severe: depth to rock.	Moderate: seepage, depth to rock, slope.	Severe: depth to rock.	Slight	Poor: thin layer, area reclaim.
63,* 64:*					
Woodward	Severe: depth to rock.	Moderate: seepage, depth to rock, slope.	Severe: depth to rock.	Slight	Poor: thin layer, area reclaim.
Quinlan	Severe: depth to rock.	Moderate: seepage, depth to rock, slope.	Severe: depth to rock.	Slight	Poor: thin layer, area reclaim.
65 Woodward Variant	Severe: depth to rock.	Severe: seepage.	Severe: seepage, depth to rock.	Severe: seepage.	Fair: thin layer.
66 Yahola	Severe: floods.	Severe: seepage, floods.	Severe: floods, seepage.	Severe: floods, seepage.	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and "poor." Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
1-------------------- Abilene	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
2-------------------- Altus	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
3, 4----------------- Aspermont	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
5.* Badland				
6-------------------- Beckman	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
7-------------------- Carey	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Fair: thin layer.
8, 9----------------- Clairemont	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
10:*				
Clark----------------	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Owens----------------	Poor: shrink-swell, low strength, thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer.
11------------------- Cordell	Poor: thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, area reclaim, small stones.
12:*				
Cordell--------------	Poor: thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, area reclaim, small stones.
Rock outcrop.				
13:*				
Cornick--------------	Poor: thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer, area reclaim.
Vinson---------------	Poor: low strength, thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: area reclaim, thin layer.
Rock outcrop.				
14------------------- Cyril	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Good.
15:*				
Delwin---------------	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Fair: too sandy.
Nobscot--------------	Good-----------------	Poor: excess fines.	Unsuited: excess fines.	Poor: too sandy.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
16, 17: Devol	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Fair: too sandy, thin layer.
18:*				
Devol	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Fair: slope.
Grandfield	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
19,* 20:*				
Dill	Poor: thin layer.	Poor: excess fines.	Unsuited: excess fines.	Fair: area reclaim.
Quinlan	Poor: thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, area reclaim.
21:*				
Dill	Poor: thin layer.	Poor: excess fines.	Unsuited: excess fines.	Fair: slope, area reclaim.
Quinlan	Poor: thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, area reclaim, slope.
22: Gracemont	Fair: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
23: Gracemont	Fair: wetness, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: excess salt, wetness.
24: Gracemore	Fair: wetness, low strength.	Poor: excess fines.	Unsuited: excess fines.	Poor: wetness, excess salt.
25, 26: Grandfield	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Fair: too sandy.
27, 28, 29: Grandfield	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
30, 31: Hardeman	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
32:*				
Knoco	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey, slope.
Cornick	Poor: thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer, area reclaim.
Rock outcrop.				
33:*				
Knoco	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey, slope.
Rock outcrop.				

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
34: Lincoln	Good	Fair: excess fines.	Unsuited: excess fines.	Fair: too sandy.
35: Mangum	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
36, 37: Nobscot	Good	Poor: excess fines.	Unsuited: excess fines.	Poor: too sandy.
38:*				
Nobscot	Good	Poor: excess fines.	Unsuited: excess fines.	Poor: too sandy.
Delwin	Good	Poor: thin layer.	Unsuited: excess fines.	Poor: too sandy.
39: Obaro	Poor: thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
40,* 41:*				
Obaro	Poor: thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Quinlan	Poor: thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, area reclaim.
42: Port	Fair: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
43:*				
Pratt	Good	Fair: excess fines.	Unsuited: excess fines.	Fair: too sandy, slope.
Tivoli	Good	Fair: excess fines.	Unsuited: excess fines.	Poor: thin layer.
44:*				
Quanah	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey, thin layer.
Talpa	Poor: thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer.
45:*				
Quinlan	Poor: thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, area reclaim.
Obaro	Poor: thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: area reclaim.
46:*				
Quinlan	Poor: thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, area reclaim, slope.
Obaro	Poor: thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: area reclaim, slope.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
47:*				
Quinlan	Poor: thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, area reclaim.
Woodward	Poor: thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: area reclaim.
48:*				
Quinlan	Poor: thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, area reclaim, slope.
Woodward	Poor: thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope, area reclaim.
49:*				
Quinlan	Poor: thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, area reclaim, slope.
Dill	Poor: thin layer, area reclaim.	Poor: excess fines.	Unsuited: excess fines.	Fair: area reclaim, slope.
50 Spur	Fair: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
51 Spur	Fair: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
52, 53 St. Paul	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
54 Tillman	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey, thin layer.
55, 56 Tipton	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
57 Tivoli	Good	Fair: excess fines.	Unsuited: excess fines.	Poor: too sandy.
58 Treadway	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
59.* Ustorthents				
60 Vernon	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
61, 62 Woodward	Poor: thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: area reclaim.
63,* 64:*				
Woodward	Poor: thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: area reclaim.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
63,* 64:*				
Quinlan	Poor: thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer, area reclaim.
65 Woodward Variant	Poor: thin layer, area reclaim.	Poor: excess fines.	Unsuited: excess fines.	Fair: area reclaim.
66 Yahola	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
1 Abilene	Slight	Moderate: hard to pack.	Severe: no water.	Not needed	Favorable	Favorable.
2 Altus	Severe: seepage.	Moderate: seepage.	Severe: no water.	Not needed	Soil blowing	Favorable.
3, 4 Aspermont	Moderate: seepage.	Moderate: thin layer.	Severe: no water.	Not needed	Erodes easily	Erodes easily.
5.* Badland						
6 Beckman	Slight	Moderate: hard to pack.	Severe: no water.	Not needed	Not needed	Percs slowly, erodes easily.
7 Carey	Moderate: seepage.	Moderate: thin layer.	Severe: no water.	Not needed	Favorable	Favorable.
8, 9 Clairemont	Moderate: seepage.	Slight	Severe: no water.	Not needed	Not needed	Favorable.
10:* Clark	Moderate: seepage.	Slight	Severe: no water.	Not needed	Favorable	Slope.
Owens	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Not needed	Percs slowly, depth to rock, erodes easily.	Depth to rock, erodes easily, rooting depth.
11 Cordell	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Not needed	Depth to rock	Rooting depth, depth to rock.
12:* Cordell	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Not needed	Depth to rock, slope.	Rooting depth, depth to rock, slope.
Rock outcrop.						
13:* Cornick	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Not needed	Depth to rock	Droughty, erodes easily, rooting depth.
Vinson	Moderate: depth to rock, seepage.	Moderate: thin layer, piping.	Severe: no water.	Not needed	Favorable	Rooting depth, depth to rock.
Rock outcrop.						
14 Cyril	Moderate: seepage.	Moderate: seepage.	Severe: no water.	Not needed	Not needed	Favorable.
15:* Delwin	Severe: seepage.	Moderate: seepage.	Severe: no water.	Not needed	Too sandy, soil blowing.	Favorable.
Nobscot	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Not needed	Too sandy, soil blowing.	Droughty.
16, 17 Devol	Severe: seepage.	Severe: piping.	Severe: no water.	Not needed	Soil blowing, too sandy.	Favorable.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
18:*						
Devol	Severe: seepage.	Severe: piping.	Severe: no water.	Not needed	Soil blowing	Slope.
Grandfield	Severe: seepage.	Moderate: seepage.	Severe: no water.	Not needed	Soil blowing	Favorable.
19,* 20:*						
Dill	Severe: seepage.	Moderate: seepage.	Severe: no water.	Not needed	Soil blowing, depth to rock.	Depth to rock.
Quinlan	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Not needed	Depth to rock	Depth to rock, rooting depth.
21:*						
Dill	Severe: seepage.	Moderate: seepage.	Severe: no water.	Not needed	Soil blowing, depth to rock.	Depth to rock, slope.
Quinlan	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Not needed	Depth to rock	Depth to rock, slope, rooting depth.
22 Gracemont	Severe: seepage.	Moderate: wetness, seepage.	Slight	Floods	Not needed	Wetness.
23 Gracemont	Severe: seepage.	Severe: excess salt.	Severe: salty water.	Floods, excess salt.	Not needed	Excess salt, wetness.
24 Gracemore	Severe: seepage.	Severe: excess salt.	Severe: salty water.	Floods, excess salt.	Not needed	Excess salt, wetness.
25, 26 Grandfield	Severe: seepage.	Moderate: seepage.	Severe: no water.	Not needed	Soil blowing, too sandy.	Favorable.
27, 28, 29 Grandfield	Severe: seepage.	Moderate: seepage.	Severe: no water.	Not needed	Soil blowing	Favorable.
30, 31 Hardeman	Severe: seepage.	Moderate: seepage.	Severe: no water.	Not needed	Soil blowing	Favorable.
32:*						
Knoco	Severe: depth to bedrock.	Severe: thin layer.	Severe: no water.	Not needed	Slope, depth to rock, percs slowly.	Slope, droughty, rooting depth.
Cornick	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Not needed	Depth to rock	Droughty, erodes easily, rooting depth.
Rock outcrop.						
33*:						
Knoco	Severe: depth to bedrock.	Severe: thin layer.	Severe: no water.	Not needed	Slope, depth to rock, percs slowly.	Slope, droughty, rooting depth.
Rock outcrop.						
34 Lincoln	Severe: seepage.	Severe: seepage.	Severe: no water.	Not needed	Not needed	Droughty.
35 Mangum	Slight	Slight	Severe: no water.	Floods: percs slowly.	Slow intake	Percs slowly.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
36------------------ Nobscot	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Not needed-----	Too sandy, soil blowing.	Droughty.
37------------------ Nobscot	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Not needed-----	Slope, too sandy, soil blowing.	Droughty, slope.
38:*						
Nobscot------------	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Not needed-----	Slope, too sandy, soil blowing.	Droughty.
Delwin-------------	Severe: seepage.	Moderate: piping.	Severe: no water.	Not needed-----	Too sandy, soil blowing.	Favorable.
39------------------ Obaro	Moderate: depth to rock, seepage.	Moderate: thin layer.	Severe: no water.	Not needed-----	Depth to rock	Erodes easily, depth to rock.
40,* 41:*						
Obaro--------------	Moderate: depth to rock, seepage.	Moderate: thin layer.	Severe: no water.	Not needed-----	Depth to rock	Erodes easily, depth to rock.
Quinlan------------	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Not needed-----	Depth to rock	Depth to rock, rooting depth.
42------------------ Port	Moderate: seepage.	Moderate: piping.	Severe: no water.	Not needed-----	Favorable-------	Favorable.
43:*						
Pratt--------------	Severe: seepage.	Severe: seepage.	Severe: no water.	Not needed-----	Too sandy, soil blowing.	Slope.
Tivoli-------------	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Not needed-----	Too sandy, soil blowing.	Droughty, slope.
44:*						
Quanah-------------	Moderate: seepage.	Slight----------	Severe: no water.	Not needed-----	Favorable-------	Favorable.
Talpa--------------	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Not needed-----	Depth to rock	Rooting depth, erodes easily.
45:*						
Quinlan------------	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Not needed-----	Depth to rock	Depth to rock, rooting depth.
Obaro--------------	Moderate: depth to rock, seepage.	Moderate: thin layer.	Severe: no water.	Not needed-----	Depth to rock	Erodes easily, depth to rock.
46:*						
Quinlan------------	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Not needed-----	Depth to rock	Depth to rock, slope, rooting depth.
Obaro--------------	Moderate: depth to rock, seepage.	Moderate: thin layer.	Severe: no water.	Not needed-----	Depth to rock	Erodes easily, slope, depth to rock.
47:*						
Quinlan------------	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Not needed-----	Depth to rock	Depth to rock, rooting depth.
Woodward-----------	Moderate: depth to rock, seepage.	Moderate: thin layer.	Severe: no water.	Not needed-----	Favorable-------	Favorable.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
48:*						
Quinlan	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Not needed	Depth to rock, slope.	Depth to rock, slope, rooting depth.
Woodward	Moderate: depth to rock, seepage.	Moderate: thin layer.	Severe: no water.	Not needed	Favorable	Slope.
49:*						
Quinlan	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Not needed	Depth to rock	Slope, depth to rock, rooting depth.
Dill	Severe: seepage.	Moderate: seepage.	Severe: no water.	Not needed	Soil blowing, depth to rock.	Depth to rock, slope.
50, 51 Spur	Moderate: seepage.	Slight	Severe: no water.	Not needed	Not needed	Favorable.
52, 53 St. Paul	Slight	Slight	Severe: no water.	Not needed	Favorable	Favorable.
54 Tillman	Slight	Moderate: hard to pack.	Severe: no water.	Not needed	Percs slowly	Percs slowly, erodes easily.
55, 56 Tipton	Moderate: seepage.	Slight	Severe: no water.	Not needed	Favorable	Favorable.
57 Tivoli	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Not needed	Too sandy, soil blowing.	Droughty, slope.
58 Treadway	Slight	Moderate: hard to pack, excess salt.	Severe: no water.	Not needed	Not needed	Percs slowly, droughty, excess salt.
59.* Ustorthents						
60 Vernon	Slight	Moderate: hard to pack.	Severe: no water.	Not needed	Percs slowly	Droughty, percs slowly, slope.
61, 62 Woodward	Moderate: depth to rock, seepage.	Moderate: thin layer.	Severe: no water.	Not needed	Favorable	Favorable.
63,* 64:*						
Woodward	Moderate: depth to rock, seepage.	Moderate: thin layer.	Severe: no water.	Not needed	Favorable	Favorable.
Quinlan	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Not needed	Depth to rock	Depth to rock, rooting depth.
65 Woodward Variant	Severe: seepage.	Moderate: seepage.	Severe: no water.	Not needed	Soil blowing, depth to rock.	Depth to rock.
66 Yahola	Severe: seepage.	Moderate: seepage.	Severe: no water.	Not needed	Not needed	Favorable.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Map symbol and soil name	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
1----------------- Abilene	0-11	Clay loam-------	CL	A-4, A-6	0	95-100	95-100	90-100	60-96	25-35	8-16
	11-46	Clay loam, silty clay loam, clay.	CL, CH	A-6, A-7	0	95-100	95-100	90-100	75-95	34-58	22-40
	46-60	Clay loam, clay, silty clay loam.	CL	A-6, A-7	0	90-100	88-100	80-98	60-95	35-50	19-32
2----------------- Altus	0-8	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4	0	100	98-100	94-100	36-60	<26	NP-7
	8-17	Fine sandy loam	SM, ML, SC, CL	A-4	0	100	98-100	94-100	36-60	<30	NP-10
	17-40	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4, A-6	0	100	98-100	90-100	36-65	<37	NP-16
	40-80	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4	0	100	98-100	90-100	36-60	<30	NP-10
3----------------- Aspermont	0-14	Silt loam-------	CL	A-7-6, A-6	0	100	95-100	85-100	65-95	30-42	11-17
	14-39	Silt loam, loam, silty clay loam.	CL	A-4, A-6, A-7	0	100	95-100	85-100	51-95	30-45	12-28
	39-60	Silt loam, loam silty clay loam	CL	A-4, A-6 A-7	0	100	95-100	85-100	51-95	30-45	8-28
4----------------- Aspermont	0-6	Silt loam-------	CL	A-7-6, A-6	0	100	95-100	85-100	65-95	30-42	11-17
	6-27	Silt loam, loam, silty clay loam.	CL	A-4, A-6, A-7	0	100	95-100	85-100	51-95	30-45	12-28
	27-60	Silt loam, loam, silty clay loam	CL	A-4, A-6 A-7	0	100	95-100	85-100	51-95	30-45	8-28
5.* Badland											
6----------------- Beckman	0-6	Clay------------	CH, CL	A-7	0	100	100	96-100	90-95	45-60	19-34
	6-60	Clay------------	CH, CL	A-7	0	95-100	95-100	96-100	90-95	45-60	19-34
7----------------- Carey	0-15	Loam------------	CL, ML, CL-ML	A-4, A-6	0	100	98-100	90-100	51-90	20-32	3-15
	15-34	Silty clay loam, clay loam, loam.	CL, CL-ML	A-4, A-6	0	100	98-100	95-100	60-95	25-40	5-20
	34-45	Silt loam, loam, very fine sandy loam.	CL, ML, CL-ML, SM	A-4, A-6	0	100	90-100	85-100	44-85	20-35	3-12
	45-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---
8, 9-------------- Clairemont	0-60	Silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	98-100	95-100	51-95	25-40	7-20
10:*											
Clark-------------	0-11	Loam------------	CL-ML, CL	A-4, A-6	0	100	95-100	90-100	50-90	20-40	5-20
	11-60	Loam, clay loam	CL	A-6	0	100	95-100	90-100	55-90	25-40	10-25
Owens-------------	0-3	Clay loam-------	CL, CH	A-7-6	0-5	95-100	95-100	85-100	75-95	45-60	22-32
	3-11	Clay, clay loam	CL, CH	A-7-6	0-5	95-100	90-100	85-100	75-95	45-60	22-32
	11-20	Weathered bedrock.	CL, CH	A-7-6	0-5	90-100	85-100	80-100	55-95	40-55	25-35

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
11----------------- Cordell	0-10	Silty clay loam	CL	A-6	0	85-100	85-100	80-100	75-98	33-40	12-19
	10-15	Silty clay loam, silt loam, shaly silty clay loam.	CL, SC, GC	A-4, A-6	0	55-100	55-100	50-100	45-98	20-40	8-20
	15-18	Very shaly silty clay loam, very shaly silt loam.	GC, GP-GC	A-2	0	15-35	15-35	15-35	10-35	20-40	8-20
	18-20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
12:* Cordell-----------	0-8	Silty clay loam	CL	A-6	0	85-100	85-100	80-100	75-98	33-40	12-19
	8-16	Silty clay loam, silt loam, shaly silty clay loam.	CL, SC, GC	A-4, A-6	0	55-100	55-100	50-100	45-98	20-40	8-20
	16-18	Very shaly silty clay loam, very shaly silt loam.	GC, GP-GC	A-2	0	15-35	15-35	15-35	10-35	20-40	8-20
	18-20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
13:* Cornick-----------	0-6	Silt loam-------	CL, ML, CL-ML	A-4, A-6	0	100	100	90-100	70-90	22-37	2-14
	6-10	Weathered bedrock.	---	---	---	---	---	---	---	---	---
	10-15	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Vinson------------	0-13	Silt loam-------	CL, ML	A-4, A-6	0	100	100	96-100	65-97	30-37	8-14
	13-26	Silt loam, loam, clay loam.	CL, ML	A-4, A-6, A-7	0	100	100	96-100	65-98	30-43	8-20
	26-30	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
14----------------- Cyril	0-25	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4	0	100	98-100	94-100	36-60	<26	NP-7
	25-60	Fine sandy loam, loam.	SM, ML, SM-SC, CL-ML	A-4	0	100	98-100	94-100	36-85	<29	NP-7
15:* Delwin------------	0-17	Loamy fine sand	SM, SM-SC, SP-SM	A-2, A-3	0	100	85-100	85-100	9-25	<24	NP-4
	17-70	Sandy clay loam, fine sandy loam.	SC, SM-SC	A-2, A-4, A-6	0	100	90-100	90-100	15-40	20-35	4-15
Nobscot-----------	0-24	Fine sand-------	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-35	---	NP
	24-37	Sandy loam, fine sandy loam.	SM, ML, SM-SC, CL-ML	A-4	0	100	95-100	90-100	36-60	<26	NP-7
	37-64	Fine sand, loamy sand, loamy fine sand.	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-35	---	NP

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
16----------------- Devol	0-18	Loamy fine sand	SM	A-2	0	98-100	98-100	90-100	15-35	---	NP
	18-36	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4, A-2	0	98-100	98-100	94-100	30-60	<26	NP-7
	36-60	Loamy fine sand, fine sand, loamy sand	SM	A-2, A-4	0	98-100	98-100	50-100	15-50	<26	NP-3
17----------------- Devol	0-20	Loamy fine sand	SM	A-2	0	98-100	98-100	90-100	15-35	---	NP
	20-34	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4, A-2	0	98-100	98-100	94-100	30-60	<26	NP-7
	34-60	Loamy fine sand, fine sand, loamy sand.	SM	A-2, A-4	0	98-100	98-100	90-100	15-50	<26	NP-3
18:* Devol-------------	0-12	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4, A-2	0	85-100	85-100	80-100	30-60	<26	NP-7
	12-50	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4, A-2	0	85-100	85-100	80-100	30-60	<26	NP-7
	50-62	Loamy fine sand, loamy sand, fine sand.	SM, SP-SM	A-2, A-4	0	60-100	60-100	50-100	10-50	<26	NP-3
Grandfield--------	0-12	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-2, A-4	0	70-100	70-100	60-100	25-60	<26	NP-7
	12-37	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-2, A-4 A-6	0	85-100	85-100	75-100	30-65	<37	NP-16
	37-51	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-2, A-4 A-6	0	85-100	85-100	75-100	30-65	<37	NP-16
	51-60	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-2, A-4	0	85-100	85-100	75-100	30-60	<30	NP-10
19:* Dill--------------	0-15	Fine sandy loam	SM, ML, CL-ML, SM-SC	A-2, A-4	0	100	100	90-100	20-70	<26	NP-7
	15-30	Fine sandy loam, very fine sandy loam, loam.	SM, ML, CL-ML, SM-SC	A-2, A-4	0	98-100	95-100	90-100	20-70	<26	NP-6
	30-45	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Quinlan-----------	0-12	Fine sandy loam	SM, ML, CL-ML, SM-SC	A-4	0	100	95-100	90-100	36-60	<26	NP-7
	12-30	Weathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
20:*											
Dill	0-12	Fine sandy loam	SM, ML, CL-ML, SM-SC	A-4, A-2	0	100	100	90-100	20-70	<26	NP-7
	12-30	Fine sandy loam, very fine sandy loam, loam.	SM, ML, CL-ML, SM-SC	A-4, A-2	0	98-100	95-100	90-100	20-70	<26	NP-6
	30-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Quinlan	0-10	Fine sandy loam	SM, ML, CL-ML, SM-SC	A-4	0	100	95-100	90-100	36-60	<26	NP-7
	10-30	Weathered bedrock.	---	---	---	---	---	---	---	---	---
21:*											
Dill	0-10	Fine sandy loam	SM, ML, CL-ML, SM-SC	A-4, A-2	0	100	100	90-100	20-70	<26	NP-7
	10-26	Fine sandy loam, very fine sandy loam, loam.	SM, ML, CL-ML, SM-SC	A-4, A-2	0	98-100	95-100	90-100	20-70	<26	NP-6
	26-35	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Quinlan	0-10	Fine sandy loam	SM, ML, CL-ML, SM-SC	A-4	0	100	95-100	90-100	36-60	<26	NP-7
	10-20	Weathered bedrock.	---	---	---	---	---	---	---	---	---
22 Gracemont	0-6	Clay loam	ML, CL, CL-ML	A-4, A-6	0	100	98-100	96-100	65-90	22-40	2-18
	6-14	Fine sandy loam, loam.	ML, CL-ML, SM, SM-SC	A-4	0	100	98-100	94-100	36-90	22-29	2-7
	14-62	Loam, clay loam, fine sandy loam.	ML, CL, SM, SC	A-4, A-6	0	100	98-100	94-100	36-90	22-40	2-18
23 Gracemont	0-6	Clay loam	ML, CL, CL-ML	A-4, A-6	0	100	98-100	96-100	65-90	22-40	2-18
	6-44	Fine sandy loam, loam.	ML, CL-ML, SM, SM-SC	A-4	0	100	98-100	94-100	36-90	22-29	2-7
	44-60	Fine sandy loam, loam, clay loam.	ML, CL, SM, SC	A-4, A-6	0	100	98-100	94-100	36-90	22-40	2-18
24 Gracemore	0-8	Loam	ML, CL, CL-ML	A-4, A-6	0	90-100	85-100	85-100	51-97	22-40	2-18
	8-60	Stratified fine sand to loamy fine sand.	SM, SP-SM	A-2, A-3	0	90-100	85-100	82-100	5-35	---	NP
25 Grandfield	0-14	Loamy fine sand	SM	A-2	0	100	98-100	90-100	15-35	---	NP
	14-30	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4, A-6	0	100	98-100	90-100	36-65	<37	NP-16
	30-56	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4, A-6	0	100	98-100	90-100	36-65	<37	NP-16
	56-65	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4	0	100	98-100	90-100	36-60	<30	NP-10

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
26: Grandfield	0-6	Loamy fine sand	SM	A-2	0	100	98-100	90-100	15-35	---	NP
	6-20	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4, A-6	0	100	98-100	90-100	36-65	<37	NP-16
	20-58	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4, A-6	0	100	98-100	90-100	36-65	<37	NP-16
	58-65	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4	0	100	98-100	90-100	36-60	<30	NP-10
27: Grandfield	0-10	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4	0	100	98-100	94-100	36-60	<26	NP-7
	10-14	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4, A-6	0	100	98-100	90-100	36-65	<37	NP-16
	14-52	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4, A-6	0	100	98-100	90-100	36-65	<37	NP-16
	52-65	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4	0	100	98-100	90-100	36-60	<30	NP-10
28: Grandfield	0-8	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4	0	100	98-100	94-100	36-60	<26	NP-7
	8-24	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4, A-6	0	100	98-100	90-100	36-65	<37	NP-16
	24-53	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4, A-6	0	100	98-100	90-100	36-65	<37	NP-16
	53-65	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4	0	100	98-100	90-100	36-60	<30	NP-10
29: Grandfield	0-5	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4	0	100	98-100	94-100	36-60	<26	NP-7
	5-14	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4, A-6	0	100	98-100	90-100	36-65	<37	NP-16
	14-58	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4, A-6	0	100	98-100	90-100	36-65	<37	NP-16
	58-65	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4	0	100	98-100	90-100	36-60	<30	NP-10
30: Hardeman	0-10	Fine sandy loam	ML, SM, CL-ML, SM-SC	A-4, A-2-4	0	100	98-100	70-95	30-75	18-27	2-9
	10-60	Fine sandy loam, loam.	SM, SM-SC, CL-ML, ML	A-4, A-2-4	0	100	98-100	70-95	30-70	18-25	2-7
31: Hardeman	0-6	Fine sandy loam	ML, SM, CL-ML, SM-SC	A-4, A-2-4	0	100	98-100	70-95	30-75	18-27	2-9
	6-60	Fine sandy loam, loam.	SM, SM-SC, CL-ML, ML	A-4, A-2-4	0	100	98-100	70-95	30-70	18-25	2-7

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
32:*											
Knoco	0-4	Clay	CL, CH	A-7-6, A-6	0-5	90-100	90-100	90-100	80-98	32-60	14-38
	4-40	Weathered bedrock.	CL, CH	A-7-6, A-6	0-5	90-100	85-100	60-100	60-95	30-60	13-38
Cornick	0-10	Silt loam	CL, ML, CL-ML	A-4, A-6	0	100	100	90-100	70-90	22-37	2-14
	10-14	Weathered bedrock.	---	---	---	---	---	---	---	---	---
	14-20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
33:*											
Knoco	0-6	Clay	CL, CH	A-7-6, A-6	0-5	90-100	90-100	90-100	80-98	32-60	14-38
	6-40	Weathered bedrock.	CL, CH	A-7-6, A-6	0-5	90-100	85-100	60-100	60-95	30-60	13-38
Rock outcrop.											
34 Lincoln	0-6	Loamy fine sand	SM	A-2	0	100	98-100	90-100	15-35	---	NP
	6-60	Stratified fine sand to clay loam.	SM, SP-SM	A-2, A-3	0	100	98-100	82-100	5-35	---	NP
35 Mangum	0-6	Clay	CL, CH	A-7-6, A-6	0	100	100	98-100	90-100	40-70	20-45
	6-60	Clay, silty clay	CL, CH	A-7-6, A-6	0	100	100	95-100	80-100	40-70	22-45
36 Nobscot	0-23	Fine sand	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-35	---	NP
	23-36	Sandy loam, fine sandy loam.	SM, ML, SM-SC, CL-ML	A-4	0	100	95-100	90-100	36-60	<26	NP-7
	36-71	Fine sand, loamy sand, loamy fine sand.	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-35	---	NP
	71-80	Fine sand, loamy sand, loamy fine sand.	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-35	---	NP
37 Nobscot	0-28	Fine sand	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-35	---	NP
	28-40	Sandy loam, fine sandy loam.	SM, ML, SM-SC, CL-ML	A-4	0	100	95-100	90-100	36-60	<26	NP-7
	40-63	Fine sand, loamy sand, loamy fine sand.	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-35	---	NP
38:*											
Nobscot	0-24	Fine sand	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-35	---	NP
	24-50	Sandy loam, fine sandy loam.	SM, ML, SM-SC, CL-ML	A-4	0	100	95-100	90-100	36-60	<26	NP-7
	50-65	Fine sand, loamy sand, loamy fine sand.	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-35	---	NP

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
38:* Delwin	0-14	Loamy fine sand	SM, SM-SC, SP-SM	A-2, A-3	0	100	85-100	85-100	9-25	<24	NP-4
	14-65	Sandy clay loam, fine sandy loam.	SC, SM-SC	A-2, A-4 A-6	0	100	90-100	90-100	15-40	20-35	4-15
39 Obaro	0-38	Silt loam	CL, CL-ML, ML	A-4, A-6	0	98-100	95-100	95-98	80-98	25-40	7-20
	38-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---
40:* Obaro	0-36	Silt loam	CL, CL-ML, ML	A-4, A-6	0	98-100	95-100	95-100	80-98	25-40	7-20
	36-76	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Quinlan	0-16	Silty clay loam	CL	A-6, A-7	0	100	95-100	90-100	80-95	33-39	12-17
	16-20	Weathered bedrock.	---	---	---	---	---	---	---	---	---
41:* Obaro	0-26	Silt loam	CL, CL-ML, ML	A-4, A-6	0	98-100	95-100	95-100	80-98	25-40	7-20
	26-50	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Quinlan	0-10	Silt loam	CL, ML, CL-ML	A-4, A-6	0	100	95-100	90-100	51-97	<37	NP-14
	10-20	Weathered bedrock.	---	---	---	---	---	---	---	---	---
42 Port	0-14	Silty clay loam	CL	A-6, A-7	0	100	100	96-100	80-98	33-43	12-20
	14-60	Silty clay loam, clay loam, loam.	CL, ML	A-4, A-6, A-7	0	100	100	96-100	65-98	27-43	8-20
43:* Pratt	0-10	Loamy fine sand	SM	A-2	0	100	95-100	70-100	15-35	---	NP
	10-38	Loamy fine sand, loamy sand, fine sandy loam.	SM, SM-SC	A-2, A-4	0	100	95-100	90-100	15-40	<20	NP-6
	38-60	Loamy fine sand, fine sand.	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-35	---	NP
Tivoli	0-6	Loamy fine sand	SM	A-2	0	100	95-100	90-100	15-35	---	NP
	6-50	Fine sand, sand	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-25	---	NP
44:* Quanah	0-10	Clay loam	CL	A-4, A-6	0	95-100	95-100	90-100	65-95	25-40	8-20
	10-24	Silty clay loam, clay loam, loam.	CL	A-4, A-6	0	95-100	95-100	90-100	55-95	25-40	8-20
	24-60	Silty clay loam, clay loam, loam.	CL	A-4, A-6	0	90-100	85-100	85-98	55-95	25-40	8-20
Talpa	0-8	Loam	CL	A-4, A-6, A-7	0-10	65-90	60-85	55-85	51-80	25-45	8-25
	8-25	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
45:*											
Quinlan	0-12	Silty clay loam	CL	A-6, A-7	0	100	95-100	90-100	80-95	33-43	12-17
	12-30	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Obaro	0-32	Silt loam	CL, CL-ML, ML	A-4, A-6	0	98-100	95-100	95-100	80-98	25-40	7-20
	32-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---
46:*											
Quinlan	0-18	Silty clay loam	CL	A-6, A-7	0	100	95-100	90-100	80-95	33-43	12-17
	18-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Obaro	0-36	Silt loam	CL, CL-ML, ML	A-4, A-6	0	98-100	95-100	95-100	80-98	25-40	7-20
	36-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---
47:*											
Quinlan	0-16	Loam	CL, ML, CL-ML	A-4, A-6	0	100	95-100	90-100	51-97	<37	NP-14
	16-31	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Woodward	0-24	Loam	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	51-95	<31	NP-12
	24-30	Weathered bedrock.	---	---	---	---	---	---	---	---	---
48:*											
Quinlan	0-10	Loam	CL, ML, CL-ML	A-4, A-6	0	100	95-100	90-100	51-97	<37	NP-14
	10-30	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Woodward	0-30	Loam	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	51-95	<31	NP-12
	30-45	Weathered bedrock.	---	---	---	---	---	---	---	---	---
49:*											
Quinlan	0-10	Fine sandy loam	SM, ML, CL-ML, SM-SC	A-4	0	100	95-100	90-100	36-60	<26	NP-7
	10-20	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Dill	0-11	Fine sandy loam	SM, ML, CL-ML, SM-SC	A-4, A-2	0	100	100	90-100	20-70	<26	NP-7
	11-30	Fine sandy loam, very fine sandy loam, loam.	SM, ML, CL-ML, SM-SC	A-4, A-2	0	98-100	95-100	90-100	20-70	<26	NP-6
	30-50	Weathered bedrock.	---	---	---	---	---	---	---	---	---
50 Spur	0-15	Loam	CL, CL-ML	A-4, A-6, A-7-6	0	100	95-100	90-100	51-95	25-45	7-25
	15-60	Loam, clay loam, sandy clay loam.	CL, SC, SM-SC, CL-ML	A-4, A-6, A-7-6	0	100	95-100	90-100	45-95	22-45	7-25

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
51 Spur	0-18	Clay loam	CL, CL-ML	A-4, A-6, A-7-6	0	100	95-100	90-100	51-95	25-45	7-25
	18-65	Loam, clay loam, sandy clay loam.	CL, SC, SM-SC, CL-ML	A-4, A-6, A-7-6	0	100	95-100	90-100	45-95	22-45	7-25
52 St. Paul	0-14	Silt loam	CL, ML, CL-ML	A-4, A-6	0	100	100	95-100	65-98	21-35	2-13
	14-19	Silt loam, loam, silty clay loam.	CL	A-4, A-6	0	100	100	95-100	75-98	27-40	8-18
	19-32	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	95-100	80-98	33-43	12-20
	32-42	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	95-100	80-98	33-50	12-26
	42-50	Silt loam, loam, silty clay loam.	CL	A-4, A-6, A-7	0	100	100	95-100	75-98	27-50	8-26
	50-60	Silt loam, loam, silty clay loam.	CL	A-4, A-6	0	100	100	95-100	75-98	27-40	8-18
53 St. Paul	0-10	Silt loam	CL, ML, CL-ML	A-4, A-6	0	100	100	95-100	65-98	21-35	2-13
	10-16	Silt loam, loam, silty clay loam.	CL	A-4, A-6	0	100	100	95-100	75-98	27-40	8-18
	16-32	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	95-100	80-98	33-43	12-20
	32-42	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	95-100	80-98	33-50	12-26
	42-52	Silt loam, loam, silty clay loam.	CL	A-4, A-6, A-7	0	100	100	95-100	75-98	27-50	8-26
	52-65	Silt loam, loam, silty clay loam.	CL	A-4, A-6	0	100	100	95-100	75-98	27-40	8-18
54 Tillman	0-16	Clay loam	CL	A-6, A-7-6	0	100	95-100	90-100	70-95	35-50	17-30
	16-55	Clay, clay loam	CL, CH	A-6, A-7-6	0	95-100	90-100	90-98	70-98	38-60	20-38
	55-75	Clay, clay loam	CL, CH	A-6, A-7-6	0-5	90-100	85-100	65-95	60-95	30-60	15-38
55 Tipton	0-16	Loam	ML, CL-ML	A-4	0	100	100	95-100	65-85	22-29	2-7
	16-65	Clay loam, loam	CL	A-4, A-6	0	100	100	95-100	65-90	30-40	9-18
56 Tipton	0-14	Loam	ML, CL-ML	A-4	0	100	100	95-100	65-85	22-29	2-7
	14-65	Clay loam, loam	CL	A-4, A-6	0	100	100	95-100	65-90	30-40	9-18
57 Tivoli	0-6	Fine sand	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-25	---	NP
	6-60	Fine sand, sand	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-25	---	NP
58 Treadway	0-7	Clay	CH, CL	A-7	0	100	100	96-100	90-95	45-60	19-34
	7-60	Clay	CH, CL	A-7	0	100	100	96-100	90-95	45-60	19-34
59.* Ustorthents											
60 Vernon	0-10	Clay	CL, CH	A-6, A-7-6	0	95-100	90-100	90-100	80-98	38-60	20-38
	10-25	Clay, silty clay	CL, CH	A-6, A-7-6	0	95-100	90-100	90-100	80-98	38-60	20-38
	25-60	Shaly clay, clay	CL, CH	A-6, A-7-6	0-5	90-100	85-100	65-100	65-95	30-60	15-38

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
61------------------ Woodward	0-27	Loam------------	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	51-95	<31	NP-12
	27-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---
62------------------ Woodward	0-36	Loam------------	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	51-95	<31	NP-12
	36-50	Weathered bedrock.	---	---	---	---	---	---	---	---	---
63*:											
Woodward----------	0-38	Loam------------	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	51-95	<31	NP-12
	38-50	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Quinlan-----------	0-18	Loam------------	CL, ML, CL-ML	A-4, A-6	0	100	95-100	90-100	51-97	<37	NP-14
	18-43	Weathered bedrock.	---	---	---	---	---	---	---	---	---
64:*											
Woodward----------	0-34	Loam------------	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	51-95	<31	NP-12
	34-45	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Quinlan-----------	0-16	Loam------------	CL, ML, CL-ML	A-4, A-6	0	100	95-100	90-100	51-97	<37	NP-14
	16-30	Weathered bedrock.	---	---	---	---	---	---	---	---	---
65------------------ Woodward Variant	0-30	Fine sandy loam	SM, ML, SM-SC, CL-ML	A-4	0	100	98-100	94-100	36-60	<26	NP-7
	30-40	Weathered bedrock.	---	---	---	---	---	---	---	---	---
66------------------ Yahola	0-8	Fine sandy loam	SM, ML, CL-ML, SM-SC	A-4	0	100	95-100	90-100	36-60	<26	NP-7
	8-60	Stratified fine sandy loam to clay loam.	SM, ML, CL-ML, SM-SC	A-2, A-4	0	100	95-100	90-100	15-85	<26	NP-7

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Map symbol and soil name	Depth	Clay <2mm	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH	mmhos/cm					Pct
1	0-11	27-35	---	0.6-2.0	0.17-0.20	6.6-8.4	<2	Moderate	0.32	5	6	1-2.5
Abilene	11-46	35-50	---	0.2-0.6	0.14-0.18	6.6-8.4	<2	Moderate	0.32			
	46-60	35-50	---	0.2-0.6	0.12-0.15	7.9-8.4	<2	Moderate	0.32			
2	0-8	10-18	---	2.0-6.0	0.11-0.15	6.1-7.3	<2	Low	0.24	5	3	1-2
Altus	8-17	12-19	---	2.0-6.0	0.11-0.15	6.1-7.8	<2	Low	0.24			
	17-40	18-28	---	0.6-2.0	0.11-0.17	6.6-8.4	<2	Low	0.32			
	40-80	15-20	---	2.0-6.0	0.11-0.15	6.6-8.4	<2	Low	0.32			
3	0-14	18-27	---	0.6-2.0	0.16-0.22	7.9-8.4	<2	Moderate	0.37	4	4L	<1
Aspermont	14-39	20-35	---	0.6-2.0	0.10-0.18	7.9-8.4	<2	Moderate	0.32			
	39-60	20-35	---	0.6-2.0	0.10-0.18	7.9-8.4	<2	Moderate	0.32			
4	0-6	18-27	---	0.6-2.0	0.16-0.22	7.9-8.4	<2	Moderate	0.37	4	4L	<1
Aspermont	6-27	20-35	---	0.6-2.0	0.12-0.18	7.9-8.4	<2	Moderate	0.32			
	27-60	20-37	---	0.6-2.0	0.10-0.18	7.9-8.4	<2	Moderate	0.32			
5.* Badland												
6	0-6	40-60	---	<0.06	0.12-0.18	7.9-8.4	0-4	High	0.37	1	4	<1
Beckman	6-60	40-60	---	<0.06	0.08-0.12	7.9-8.4	4-8	High	0.37			
7	0-15	10-18	---	0.6-2.0	0.15-0.20	6.6-7.8	<2	Low	0.37	5	6	1-2
Carey	15-34	18-35	---	0.6-2.0	0.15-0.20	6.6-8.4	<2	Low	0.37			
	34-45	15-27	---	0.6-2.0	0.10-0.18	7.9-8.4	<2	Low	0.37			
	45-60	---	---	---	---	---	---	---	----			
8, 9 Clairemont	0-60	18-30	---	0.6-2.0	0.16-0.22	7.4-8.4	<2	Low	0.37	5	6	<1
10:*												
Clark	0-11	15-25	---	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	0.32	5	4L	1-2
	11-60	18-30	---	0.6-2.0	0.15-0.19	7.4-8.4	<2	Moderate	0.32			
Owens	0-3	27-35	---	<0.06	0.13-0.17	7.9-8.4	<2	High	0.43	1	6	0.5-1
	3-11	35-60	---	<0.06	0.13-0.17	7.9-8.4	<2	High	0.37			
	11-30	40-60	---	<0.06	0.03-0.08	7.9-8.4	<2	High	0.32			
11	0-10	27-30	---	0.2-0.6	0.18-0.22	7.4-8.4	<2	Low	0.32	1	4L	0.5-1
Cordell	10-15	15-30	---	0.2-0.6	0.15-0.22	7.4-8.4	<2	Low	0.37			
	15-18	15-30	---	0.2-0.6	0.08-0.12	7.4-8.4	<2	Low	0.28			
	18-20	---	---	---	---	---	---	---	----			
12:*												
Cordell	0-8	15-27	---	0.6-2.0	0.16-0.24	7.4-8.4	<2	Low	0.37	1	4L	0.5-1
	8-16	15-30	---	0.2-0.6	0.15-0.22	7.4-8.4	<2	Low	0.37			
	16-18	15-30	---	0.2-0.6	0.08-0.12	7.4-8.4	<2	Low	0.28			
	18-20	---	---	---	---	---	---	---	----			
Rock outcrop.												
13:*												
Cornick	0-6	15-27	---	0.6-2.0	0.18-0.22	7.9-8.4	<2	Low	0.37	1	4L	1-2
	6-10	---	---	---	---	---	---	---	----			
	10-15	---	---	---	---	---	---	---	----			
Vinson	0-13	15-27	---	0.6-2.0	0.15-0.22	7.4-8.4	<2	Low	0.37	2	4L	1-2
	13-26	18-30	---	0.6-2.0	0.15-0.22	7.9-8.4	<2	Moderate	0.37			
	26-30	---	---	---	---	---	---	---	----			
Rock outcrop.												
14	0-25	10-18	---	0.6-2.0	0.11-0.15	7.4-8.4	<2	Low	0.24	5	3	1-2.5
Cyril	25-60	10-18	---	0.6-2.0	0.11-0.20	7.9-8.4	<2	Low	0.37			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Map symbol and soil name	Depth	Clay <2mm	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH	mmhos/cm					Pct
15:*												
Delwin	0-17	5-10	---	6.0-20	0.04-0.10	6.1-7.3	<2	Low	0.17	5	1	<1
	17-70	18-25	---	0.6-2.0	0.12-0.16	6.6-8.4	<2	Low	0.24			
Nobscot	0-24	2-10	---	6.0-20.0	0.07-0.11	5.6-7.3	<2	Low	0.17	5	2	<1
	24-37	8-15	---	2.0-6.0	0.11-0.15	5.1-6.5	<2	Low	0.20			
	37-64	2-10	---	2.0-6.0	0.05-0.11	6.1-7.3	<2	Low	0.17			
16 Devol	0-18	2-10	---	2.0-6.0	0.07-0.11	6.1-7.8	<2	Low	0.17	5	2	<1
	18-36	10-18	---	2.0-6.0	0.11-0.15	6.6-7.8	<2	Low	0.20			
	36-60	2-10	---	2.0-6.0	0.08-0.12	6.6-8.4	<2	Low	0.17			
17 Devol	0-20	2-10	---	2.0-6.0	0.07-0.11	6.1-7.8	<2	Low	0.17	5	2	<1
	20-34	10-18	---	2.0-6.0	0.11-0.15	6.6-7.8	<2	Low	0.20			
	34-60	2-10	---	2.0-6.0	0.08-0.12	6.6-8.4	<2	Low	0.17			
18:*												
Devol	0-12	10-18	---	2.0-6.0	0.11-0.15	6.1-7.8	<2	Low	0.20	5	3	<1
	12-50	10-18	---	2.0-6.0	0.11-0.15	6.6-7.8	<2	Low	0.20			
	50-62	2-10	---	2.0-6.0	0.08-0.12	6.6-8.4	<2	Low	0.17			
Grandfield	0-12	10-18	---	2.0-6.0	0.11-0.15	6.1-7.8	<2	Low	0.24	5	3	0.5-1
	12-37	18-30	---	0.6-2.0	0.11-0.17	6.1-7.8	<2	Low	0.32			
	37-51	18-30	---	0.6-2.0	0.11-0.17	6.6-8.4	<2	Low	0.32			
	51-60	18-30	---	2.0-6.0	0.11-0.15	6.6-8.4	<2	Low	0.28			
19:*												
Dill	0-15	10-18	---	2.0-6.0	0.11-0.15	6.1-7.8	<2	Low	0.20	3	3	0.5-1
	15-30	10-18	---	2.0-6.0	0.11-0.15	6.1-7.8	<2	Low	0.20			
	30-45	---	---	---	---	---	---	---	----			
Quinlan	0-12	10-18	---	2.0-6.0	0.07-0.15	7.4-8.4	<2	Low	0.20	2	3	<1
	12-30	---	---	---	---	---	---	---	----			
20:*												
Dill	0-12	10-18	---	2.0-6.0	0.11-0.15	6.1-7.8	<2	Low	0.20	3	3	0.5-1
	12-30	10-18	---	2.0-6.0	0.11-0.15	6.1-7.8	<2	Low	0.20			
	30-60	---	---	---	---	---	---	---	----			
Quinlan	0-10	10-18	---	2.0-6.0	0.07-0.15	7.4-8.4	<2	Low	0.20	2	3	<1
	10-30	---	---	---	---	---	---	---	----			
21:*												
Dill	0-10	10-18	---	2.0-6.0	0.11-0.15	6.1-7.8	<2	Low	0.20	3	3	0.5-1
	10-26	10-18	---	2.0-6.0	0.11-0.15	6.1-7.8	<2	Low	0.20			
	26-35	---	---	---	---	---	---	---	----			
Quinlan	0-10	10-18	---	2.0-6.0	0.07-0.15	7.4-8.4	<2	Low	0.20	2	3	<1
	10-20	---	---	---	---	---	---	---	----			
22 Gracemont	0-6	15-28	---	0.6-2.0	0.15-0.20	6.6-8.4	0-4	Low	0.32	5	5	0.5-1
	6-14	10-18	---	0.6-6.0	0.11-0.20	7.9-8.4	0-4	Low	0.32			
	14-62	10-28	---	0.6-6.0	0.11-0.20	7.9-8.4	0-4	Low	0.32			
23 Gracemont	0-6	15-28	---	0.6-2.0	0.08-0.11	6.6-8.4	4->16	Low	0.32	1	5	0.5-1
	6-44	10-18	---	0.6-6.0	0.05-0.11	7.9-8.4	4->16	Low	0.32			
	44-60	10-28	---	0.6-6.0	0.05-0.11	7.9-8.4	4->16	Low	0.32			
24 Gracemore	0-8	15-28	---	2.0-6.0	0.13-0.20	7.4-8.4	4->16	Low	0.32	5	4L	0.5-1
	8-60	2-10	---	2.0-6.0	0.05-0.11	7.9-8.4	4->16	Low	0.17			
25 Grandfield	0-14	5-10	---	2.0-6.0	0.07-0.11	6.1-7.8	<2	Low	0.20	5	2	0.5-1
	14-30	18-30	---	0.6-2.0	0.11-0.17	6.1-7.8	<2	Low	0.32			
	30-56	18-30	---	0.6-2.0	0.11-0.17	6.6-8.4	<2	Low	0.32			
	56-65	18-30	---	2.0-6.0	0.11-0.15	6.6-8.4	<2	Low	0.28			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Map symbol and soil name	Depth	Clay <2mm	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH	mmhos/cm					Pct
26--------------- Grandfield	0-6	5-10	---	2.0-6.0	0.07-0.11	6.1-7.8	<2	Low--------	0.20	5	2	0.5-1
	6-20	18-30	---	0.6-2.0	0.11-0.17	6.1-7.8	<2	Low--------	0.32			
	20-58	18-30	---	0.6-2.0	0.11-0.17	6.6-8.4	<2	Low--------	0.32			
	58-65	18-30	---	2.0-6.0	0.11-0.15	6.6-8.4	<2	Low--------	0.28			
27--------------- Grandfield	0-10	10-18	---	2.0-6.0	0.11-0.15	6.1-7.8	<2	Low--------	0.24	5	3	0.5-1
	10-14	18-30	---	0.6-2.0	0.11-0.17	6.1-7.8	<2	Low--------	0.32			
	14-52	18-30	---	0.6-2.0	0.11-0.17	6.6-8.4	<2	Low--------	0.32			
	52-65	18-30	---	2.0-6.0	0.11-0.15	6.6-8.4	<2	Low--------	0.28			
28--------------- Grandfield	0-8	10-18	---	2.0-6.0	0.11-0.15	6.1-7.8	<2	Low--------	0.24	5	3	0.5-1
	8-24	18-30	---	0.6-2.0	0.11-0.17	6.1-7.8	<2	Low--------	0.32			
	24-53	18-30	---	0.6-2.0	0.11-0.17	6.6-8.4	<2	Low--------	0.32			
	53-65	18-30	---	2.0-6.0	0.11-0.15	6.6-8.4	<2	Low--------	0.28			
29--------------- Grandfield	0-5	10-18	---	2.0-6.0	0.11-0.15	6.1-7.8	<2	Low--------	0.24	5	3	0.5-1
	5-14	18-30	---	0.6-2.0	0.11-0.17	6.1-7.8	<2	Low--------	0.32			
	14-58	18-30	---	0.6-2.0	0.11-0.17	6.6-8.4	<2	Low--------	0.32			
	58-65	18-30	---	2.0-6.0	0.11-0.15	6.6-8.4	<2	Low--------	0.28			
30--------------- Hardeman	0-10	10-18	---	2.0-6.0	0.10-0.18	7.4-8.4	<2	Very low	0.20	5	3	0.5-1
	10-60	10-18	---	2.0-6.0	0.10-0.15	7.4-8.4	<2	Very low	0.28			
31--------------- Hardeman	0-6	10-18	---	2.0-6.0	0.10-0.18	7.4-8.4	<2	Very low	0.20	5	3	0.5-1
	6-60	10-18	---	2.0-6.0	0.10-0.15	7.4-8.4	<2	Very low	0.28			
32:*												
Knoco-----------	0-4	40-60	---	<0.06	0.10-0.17	7.9-8.4	<2	High-------	0.37	1	4	0.5-1
	4-40	40-60	---	<0.06	0.-0.08	7.9-8.4	<2	High-------	0.37			
Cornick----------	0-10	15-27	---	0.6-2.0	0.18-0.22	7.9-8.4	<2	Low--------	0.37	1	6	1-3
	10-14	---	---	---	---	---	---	-----------	----			
	14-20	---	---	---	---	---	---	-----------	----			
Rock outcrop.												
33:*												
Knoco-----------	0-6	40-60	---	<0.06	0.10-0.17	7.9-8.4	<2	High-------	0.37	1	4	0.5-1
	6-40	40-60	---	<0.06	0.-0.08	7.9-8.4	<2	High-------	0.37			
Rock outcrop.												
34--------------- Lincoln	0-6	5-15	---	6.0-20	0.06-0.11	7.4-8.4	<2	Low--------	0.17	5	2	<0.5
	6-60	5-15	---	6.0-20	0.02-0.08	7.9-8.4	<2	Low--------	0.17			
35--------------- Mangum	0-6	40-60	---	<0.06	0.14-0.18	7.9-8.4	<2	High-------	0.32	5	4	0.5-1
	6-60	40-60	---	<0.06	0.14-0.18	7.9-8.4	<4	High-------	0.32			
36--------------- Nobscot	0-23	2-10	---	6.0-20.0	0.05-0.11	5.6-7.3	<2	Low--------	0.17	5	2	<1
	23-36	8-15	---	2.0-6.0	0.10-0.15	5.1-6.5	<2	Low--------	0.20			
	36-71	2-12	---	2.0-6.0	0.05-0.11	5.1-6.5	<2	Low--------	0.17			
	71-80	2-10	---	2.0-6.0	0.05-0.11	6.1-7.3	<2	Low--------	0.17			
37--------------- Nobscot	0-28	2-10	---	6.0-20.0	0.05-0.11	5.6-7.3	<2	Low--------	0.17	5	2	<1
	28-40	8-15	---	2.0-6.0	0.10-0.15	5.1-6.5	<2	Low--------	0.20			
	40-63	2-12	---	2.0-6.0	0.05-0.11	6.1-7.3	<2	Low--------	0.17			
38:*												
Nobscot----------	0-24	2-10	---	6.0-20.0	0.05-0.11	5.6-7.3	<2	Low--------	0.17	5	2	<1
	24-50	8-15	---	2.0-6.0	0.10-0.15	5.1-6.5	<2	Low--------	0.20			
	50-65	2-12	---	2.0-6.0	0.05-0.11	5.1-6.5	<2	Low--------	0.17			
Delwin-----------	0-14	2-12	---	6.0-20.0	0.04-0.10	6.1-7.3	<2	Low--------	0.17	5	1	<1
	14-65	18-30	---	0.6-2.0	0.12-0.16	6.6-8.4	<2	Low--------	0.24			
39--------------- Obaro	0-38	18-35	---	0.6-2.0	0.14-0.20	7.9-8.4	<2	Low--------	0.37	3	4L	0.5-1
	38-60	---	---	---	---	---	---	-----------	----			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Map symbol and soil name	Depth	Clay <2mm	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH	mmhos/cm					Pct
40:*												
Obaro-----------	0-36	18-35	---	0.6-2.0	0.14-0.20	7.9-8.4	<2	Low-------	0.37	3	4L	0.5-1
	36-76	---	---	---	---	---	---	----------	----			
Quinlan---------	0-16	15-27	---	0.6-2.0	0.15-0.20	7.4-8.4	<2	Moderate	0.32	2	4L	<1
	16-20	---	---	---	---	---	---	----------	----			
41:*												
Obaro-----------	0-26	18-35	---	0.6-2.0	0.14-0.20	7.9-8.4	<2	Low-------	0.37	3	4L	0.5-1
	26-50	---	---	---	---	---	---	----------	----			
Quinlan---------	0-10	15-27	---	0.6-2.0	0.13-0.24	7.4-8.4	<2	Low-------	0.32	2	4L	<1
	10-20	---	---	---	---	---	---	----------	----			
42--------------- Port	0-14	27-35	---	0.6-2.0	0.15-0.24	6.1-7.8	<2	Moderate	0.32	5	---	1-2.5
	14-60	18-35	---	0.6-2.0	0.15-0.24	7.4-8.4	<2	Moderate	0.37			
43:*												
Pratt-----------	0-10	2-10	---	6.0-20	0.10-0.13	5.6-7.3	<2	Low-------	0.17	5	2	<1
	10-38	2-10	---	6.0-20	0.09-0.16	6.1-7.3	<2	Low-------	0.17			
	38-60	2-10	---	6.0-20	0.08-0.12	6.1-7.3	<2	Low-------	0.17			
Tivoli----------	0-6	5-10	---	6.0-20.0	0.07-0.11	6.1-7.8	<2	Low-------	0.17	5	2	<1
	6-50	1-10	---	6.0-20.0	0.02-0.08	6.1-8.4	<2	Low-------	0.17			
44:*												
Quanah----------	0-10	27-35	---	0.6-2.0	0.15-0.20	7.9-8.4	<2	Low-------	0.32	4	4L	1-2
	10-24	18-35	---	0.6-2.0	0.15-0.20	7.9-8.4	<2	Low-------	0.37			
	24-60	18-35	---	0.6-2.0	0.10-0.16	7.9-8.4	<2	Low-------	0.37			
Talpa-----------	0-8	18-27	---	0.6-2.0	0.12-0.18	7.9-8.4	<2	Low-------	0.37	1	4L	1-2
	8-25	---	---	---	---	---	---	----------	----			
45:*												
Quinlan---------	0-12	27-30	---	0.6-2.0	0.15-0.22	7.4-8.4	<2	Moderate	0.32	2	4L	<1
	12-30	---	---	---	---	---	---	----------	----			
Obaro-----------	0-32	18-35	---	0.6-2.0	0.14-0.20	7.9-8.4	<2	Low-------	0.37	3	4L	0.5-1
	32-60	---	---	---	---	---	---	----------	----			
46:*												
Quinlan---------	0-18	27-30	---	0.6-2.0	0.15-0.22	7.4-8.4	<2	Moderate	0.32	2	4L	<1
	18-60	---	---	---	---	---	---	----------	----			
Obaro-----------	0-36	18-35	---	0.6-2.0	0.14-0.20	7.9-8.4	<2	Low-------	0.37	3	4L	0.5-1
	36-60	---	---	---	---	---	---	----------	----			
47:*												
Quinlan---------	0-16	15-27	---	0.6-2.0	0.13-0.24	7.4-8.4	<2	Low-------	0.32	2	4L	<1
	16-31	---	---	---	---	---	---	----------	----			
Woodward--------	0-24	10-18	---	0.6-2.0	0.13-0.20	6.6-8.4	<2	Low-------	0.37	3	4L	0.5-1
	24-30	---	---	---	---	---	---	----------	----			
48:*												
Quinlan---------	0-10	15-27	---	0.6-2.0	0.13-0.24	7.4-8.4	<2	Low-------	0.32	2	4L	<1
	10-30	---	---	---	---	---	---	----------	----			
Woodward--------	0-30	10-18	---	0.6-2.0	0.13-0.20	6.6-8.4	<2	Low-------	0.37	3	4L	0.5-1
	30-45	---	---	---	---	---	---	----------	----			
49:*												
Quinlan---------	0-10	10-18	---	2.0-6.0	0.07-0.15	7.4-8.4	<2	Low-------	0.20	2	3	<1
	10-20	---	---	---	---	---	---	----------	----			
Dill------------	0-11	8-18	---	2.0-6.0	0.11-0.15	6.1-7.8	<2	Low-------	0.20	2	3	0.5-1
	11-30	8-18	---	2.0-6.0	0.11-0.15	6.1-7.8	<2	Low-------	0.20			
	30-50	---	---	---	---	---	---	----------	----			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Map symbol and soil name	Depth	Clay <2mm	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH	mmhos/cm					Pct
50--------------- Spur	0-15	15-27	---	0.6-2.0	0.14-0.20	7.9-8.4	<2	Moderate	0.37	5	4L	1-2
	15-60	28-35	---	0.6-2.0	0.14-0.20	7.9-8.4	<2	Moderate	0.32			
51--------------- Spur	0-18	27-35	---	0.6-2.0	0.14-0.20	7.9-8.4	<2	Moderate	0.32	5	6	1-2
	18-65	18-35	---	0.6-2.0	0.14-0.20	7.9-8.4	<2	Moderate	0.32			
52--------------- St. Paul	0-14	15-27	---	0.6-2.0	0.15-0.24	6.6-7.8	<2	Low--------	0.37	5	6	1-2.5
	14-19	18-35	---	0.6-2.0	0.15-0.22	6.6-7.8	<2	Low--------	0.37			
	19-32	27-35	---	0.2-0.6	0.15-0.22	7.4-8.4	<2	Moderate	0.32			
	32-42	27-40	---	0.2-0.6	0.15-0.22	7.4-8.4	<2	Moderate	0.32			
	42-50	20-40	---	0.2-0.6	0.15-0.22	7.4-8.4	<2	Moderate	0.37			
	50-60	15-35	---	0.2-2.0	0.15-0.22	7.9-8.4	<2	Moderate	0.37			
53--------------- St. Paul	0-10	15-27	---	0.6-2.0	0.15-0.24	6.6-7.8	<2	Low--------	0.37	5	6	1-2.5
	10-16	18-35	---	0.6-2.0	0.15-0.22	6.6-7.8	<2	Low--------	0.37			
	16-32	27-35	---	0.2-0.6	0.15-0.22	7.4-8.4	<2	Moderate	0.32			
	32-42	27-40	---	0.2-0.6	0.15-0.22	7.4-8.4	<2	Moderate	0.32			
	42-52	20-40	---	0.2-0.6	0.15-0.22	7.4-8.4	<2	Moderate	0.37			
	52-65	15-35	---	0.2-2.0	0.15-0.22	7.9-8.4	<2	Moderate	0.37			
54--------------- Tillman	0-16	30-40	---	0.2-0.6	0.15-0.20	6.6-8.4	<2	High-------	0.37	5	4	1-2
	16-55	40-60	---	0.06-0.2	0.12-0.18	7.4-8.4	<2	High-------	0.32			
	55-75	40-60	---	0.06-0.2	0.11-0.17	7.9-8.4	<2	High-------	0.32			
55--------------- Tipton	0-16	15-20	---	0.6-2.0	0.15-0.20	6.6-7.8	<2	Low--------	0.37	5	5	1-2
	16-65	20-32	---	0.6-2.0	0.15-0.20	6.6-8.4	<2	Low--------	0.32			
56--------------- Tipton	0-14	15-20	---	0.6-2.0	0.15-0.20	6.6-7.8	<2	Low--------	0.37	5	5	1-2
	14-65	20-32	---	0.6-2.0	0.15-0.20	6.6-8.4	<2	Low--------	0.32			
57--------------- Tivoli	0-6	1-10	---	6.0-20.0	0.02-0.08	7.4-8.4	<2	Low--------	0.17	5	1	<1
	6-60	1-10	---	6.0-20.0	0.02-0.08	7.9-8.4	<2	Low--------	0.17			
58--------------- Treadway	0-7	40-60	---	<0.06	0.08-0.12	7.9-9.0	2-8	High-------	0.37	1	4	<1
	7-60	40-60	---	<0.06	0.08-0.12	7.9-9.0	2-8	High-------	0.37			
59.* Ustorthents												
60--------------- Vernon	0-10	40-60	---	<0.06	0.10-0.17	7.9-8.4	<2	High-------	0.37	2	4	<1
	10-25	40-60	---	<0.06	0.10-0.15	7.9-8.4	<2	High-------	0.37			
	25-60	40-60	---	<0.06	0.-0.10	7.9-8.4	<2	High-------	0.37			
61--------------- Woodward	0-27	10-18	---	0.6-2.0	0.13-0.20	6.6-8.4	<2	Low--------	0.37	3	4L	0.5-1
	27-60	---	---	---	---	---	---	-----------	----			
62--------------- Woodward	0-36	10-18	---	0.6-2.0	0.13-0.20	6.6-8.4	<2	Low--------	0.37	3	4L	0.5-1
	36-50	---	---	---	---	---	---	-----------	----			
63:*												
Woodward---------	0-38	10-18	---	0.6-2.0	0.13-0.20	6.6-8.4	<2	Low--------	0.37	3	4L	0.5-1
	38-50	---	---	---	---	---	---	-----------	----			
Quinlan----------	0-18	15-27	---	0.6-2.0	0.13-0.24	7.4-8.4	<2	Low--------	0.32	2	4L	<1
	18-43	---	---	---	---	---	---	-----------	----			
64:*												
Woodward---------	0-34	10-18	---	0.6-2.0	0.13-0.20	6.6-8.4	<2	Low--------	0.37	3	4L	0.5-1
	34-45	---	---	---	---	---	---	-----------	----			
Quinlan----------	0-16	15-27	---	0.6-2.0	0.13-0.24	7.4-8.4	<2	Low--------	0.32	2	4L	<1
	16-30	---	---	---	---	---	---	-----------	----			
65--------------- Woodward Variant	0-30	10-18	---	2.0-6.0	0.11-0.15	6.6-8.4	<2	Low--------	0.20	3	3	0.5-1
	30-40	---	---	---	---	---	---	-----------	----			
66--------------- Yahola	0-8	10-18	---	2.0-6.0	0.11-0.15	7.4-8.4	<2	Low--------	0.20	5	3	0.5-1
	8-60	2-30	---	2.0-6.0	0.07-0.20	7.9-8.4	<2	Low--------	0.20			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

[The definitions of "flooding" and "water table" in the text explain terms such as "rare," "brief," and "perched." The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern]

Map symbol and soil name	Hydrologic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Uncoated steel	Concrete
					Ft			In			
1------------------ Abilene	C	None---------	---	---	>6.0	---	---	>60	---	High------	Low.
2------------------ Altus	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	Low.
3, 4--------------- Aspermont	B	None---------	---	---	>6.0	---	---	40-60	Rippable	Moderate	Low.
5.* Badland											
6------------------ Beckman	D	Occasional	Very brief	Apr-Oct	>6.0	---	---	>60	---	Very high	Moderate.
7------------------ Carey	B	None---------	---	---	>6.0	---	---	40-70	Rippable	Moderate	Low.
8------------------ Clairemont	B	Occasional	Very brief	Apr-Oct	>6.0	---	---	>60	---	Moderate	Low.
9------------------ Clairemont	B	Frequent----	Very brief	Apr-Oct	>6.0	---	---	>60	---	Moderate	Low.
10:*											
Clark-------------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low.
Owens-------------	D	None---------	---	---	>6.0	---	---	10-20	Rippable	High------	Low.
11----------------- Cordell	D	None---------	---	---	>6.0	---	---	10-20	Hard	Moderate	Low.
12:*											
Cordell-----------	D	None---------	---	---	>6.0	---	---	10-20	Hard	Moderate	Low.
Rock outcrop.											
13:*											
Cornick-----------	D	None---------	---	---	>6.0	---	---	4-10	Rippable	High------	Moderate.
Vinson------------	B	None---------	---	---	>6.0	---	---	20-40	Rippable	Moderate	Low.
Rock outcrop.											
14----------------- Cyril	B	Occasional	Very brief	Apr-Oct	>6.0	---	---	>60	---	Low-------	Low.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Map symbol and soil name	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hard-ness	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In			
15:*											
Delwin-----------	A	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low.
Nobscot----------	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Moderate.
16, 17----------- Devol	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Low.
18:*											
Devol------------	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Low.
Grandfield-------	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Low.
19,* 20,* 21:*											
Dill-------------	B	None--------	---	---	>6.0	---	---	20-40	Rip-pable	Low------	Low.
Quinlan----------	C	None--------	---	---	>6.0	---	---	10-20	Rip-pable	Moderate	Low.
22--------------- Gracemont	B	Frequent----	Very brief to brief.	Apr-Oct	0.5-3.0	Apparent	Nov-May	>60	---	Moderate	Low.
23--------------- Gracemont	B	Frequent----	Very brief to brief.	Apr-Oct	0.5-3.0	Apparent	Nov-May	>60	---	High-----	High.
24--------------- Gracemore	B	Frequent----	Very brief	Apr-Oct	0.5-3.0	Apparent	Nov-May	>60	---	High-----	High.
25, 26, 27, 28, 29--------------- Grandfield	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Low.
30, 31----------- Hardeman	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Low.
32:*											
Knoco------------	D	None--------	---	---	>6.0	---	---	3-12	Rip-pable	High-----	Low.
Cornick----------	D	None--------	---	---	>6.0	---	---	4-10	Rip-pable	High-----	Moderate.
Rock outcrop.											
33:*											
Knoco------------	D	None--------	---	---	>6.0	---	---	3-12	Rip-pable	High-----	Low.
Rock outcrop.											
34--------------- Lincoln	A	Frequent----	Very brief to brief.	Apr-Oct	5.0-8.0	Apparent	Nov-May	>60	---	Low------	Low.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Map symbol and soil name	Hydrologic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Uncoated steel	Concrete
					Ft			In			
35----------------- Mangum	D	Rare---------	Very brief	Apr-Oct	>6.0	---	---	>60	---	High------	Low.
36, 37------------- Nobscot	A	None---------	---	---	>6.0	---	---	>60	---	Low-------	Moderate.
38:*											
Nobscot-----------	A	None---------	---	---	>6.0	---	---	>60	---	Low-------	Moderate.
Delwin------------	A	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low.
39----------------- Obaro	B	None---------	---	---	>6.0	---	---	20-40	Rippable	Low-------	Low.
40,* 41:*											
Obaro-------------	B	None---------	---	---	>6.0	---	---	20-40	Rippable	Low-------	Low.
Quinlan-----------	C	None---------	---	---	>6.0	---	---	10-20	Rippable	Moderate	Low.
42----------------- Port	B	Occasional	Very brief to brief.	Apr-Oct	>6.0	---	---	>60	---	Moderate	Low.
43:*											
Pratt-------------	A	None---------	---	---	>6.0	---	---	>60	---	Low-------	Moderate.
Tivoli------------	A	None---------	---	---	>6.0	---	---	>60	---	Low-------	Low.
44:*											
Quanah------------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low.
Talpa-------------	D	None---------	---	---	>6.0	---	---	5-14	Hard	High------	Low.
45,* 46:*											
Quinlan-----------	C	None---------	---	---	>6.0	---	---	10-20	Rippable	Moderate	Low.
Obaro-------------	B	None---------	---	---	>6.0	---	---	20-40	Rippable	Low-------	Low.
47,* 48:*											
Quinlan-----------	C	None---------	---	---	>6.0	---	---	10-20	Rippable	Moderate	Low.
Woodward----------	B	None---------	---	---	>6.0	---	---	20-40	Rippable	Low-------	Low.
49:*											
Quinlan-----------	C	None---------	---	---	>6.0	---	---	10-20	Rippable	Moderate	Low.
Dill--------------	B	None---------	---	---	>6.0	---	---	20-40	Rippable	Low-------	Low.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Map symbol and soil name	Hydrologic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Uncoated steel	Concrete
					Ft			In			
50----------------- Spur	B	Occasional	Very brief	Apr-Oct	>6.0	---	---	>60	---	Moderate	Low.
51----------------- Spur	B	Frequent----	Very brief	Apr-Oct	>6.0	---	---	>60	---	Moderate	Low.
52, 53------------ St. Paul	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low.
54----------------- Tillman	C	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
55, 56------------ Tipton	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low.
57----------------- Tivoli	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low.
58----------------- Treadway	D	Frequent----	Very brief	Apr-Oct	>6.0	---	---	>60	---	Very high	High.
59.* Ustorthents											
60----------------- Vernon	D	None--------	---	---	>6.0	---	---	20-40	Rippable	High-----	Low.
61, 62------------ Woodward	B	None--------	---	---	>6.0	---	---	20-40	Rippable	Low------	Low.
63,* 64:*											
Woodward---------	B	None--------	---	---	>6.0	---	---	20-40	Rippable	Low------	Low.
Quinlan----------	C	None--------	---	---	>6.0	---	---	10-20	Rippable	Moderate	Low.
65----------------- Woodward Variant	B	None--------	---	---	>6.0	---	---	20-40	Rippable	Low------	Low.
66----------------- Yahola	B	Occasional	Very brief	Apr-Oct	>6.0	---	---	>60	---	Low------	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--PHYSICAL ANALYSES OF SELECTED SOILS

Soil series and sample number	Depth	Horizon	Particle size distribution							
			Very coarse sand (2.0-1.0 mm)	Coarse sand (1.0-0.5 mm)	Medium sand (0.5-0.25 mm)	Fine sand (0.25-0.10 mm)	Very fine sand (0.10-0.05 mm)	Total sand (2.0-0.05 mm)	Silt (0.05-0.002 mm)	Clay (<0.002 mm)
	In		Pct	Pct	Pct	Pct	Pct	Pct	Pct	Pct
Grandfield:										
72-OK-05-02-01----	0-8	Ap	10.0	24.6	24.0	10.6	16.3	85.5	4.2	10.3
72-OK-05-02-02----	8-12	B1	20.3	19.3	28.6	11.1	2.9	82.1	6.2	11.6
72-OK-05-02-03----	12-20	B21t	23.9	9.1	17.9	6.2	4.7	61.8	10.0	28.2
72-OK-05-02-04----	20-31	B22t	3.9	14.1	15.4	11.1	4.3	48.7	36.2	15.1
72-OK-05-02-05----	31-45	B23t	7.5	28.0	13.8	10.2	2.5	62.0	21.9	16.1
72-OK-05-02-06----	45-51	B24t	2.8	21.8	23.6	13.5	3.2	64.8	19.3	15.9
72-OK-05-02-07----	51-64	B31	3.5	22.8	21.5	18.1	4.5	70.4	16.7	12.9
Nobscot:										
72-OK-05-01-01----	0-5	A1	0.1	10.0	24.3	15.3	13.9	63.6	33.0	3.4
72-OK-05-01-02----	5-23	A2	0.3	21.2	26.4	22.3	8.8	79.1	18.8	2.1
72-OK-05-01-03----	23-36	B21t	6.5	8.0	33.0	21.9	6.5	75.8	16.0	8.1
72-OK-05-01-04----	36-53	B22t	15.0	2.8	33.9	19.0	5.6	76.4	18.1	5.4
72-OK-05-01-05----	53-71	B23t	14.8	8.5	34.3	21.6	4.7	83.9	11.6	4.4
72-OK-05-01-06----	71-80	B3	0.1	3.0	35.4	21.7	4.4	64.6	32.2	3.2

TABLE 18.--CHEMICAL ANALYSES OF SELECTED SOILS

Soil series and sample numbers	Depth	Horizon	Extractable bases (Milliequivalents per 100 grams of soil)				Cation exchange capacity	Base saturation	Reaction 1:1 soil:water	Organic matter	Total phosphorus
			Ca	Mg	K	Na					
	In							Pct	pH	Pct	Ppm
Grandfield:											
72-OK-05-02-01----	0-8	Ap	6.55	2.95	0.71	0.08	12.4	92.2	7.3	1.63	16.3
72-OK-05-02-02----	8-12	B1	6.68	3.28	0.42	0.09	12.6	96.9	6.9	1.30	15.9
72-OK-05-02-03----	12-20	B21t	9.89	6.35	0.48	0.09	21.2	82.7	6.4	1.53	18.1
72-OK-05-02-04----	20-31	B22t	7.73	4.45	0.29	0.07	13.7	85.8	6.3	0.62	10.8
72-OK-05-02-05----	31-45	B23t	5.76	4.59	0.19	0.08	11.0	94.0	6.3	0.26	7.9
72-OK-05-02-06----	45-51	B24t	6.68	4.98	0.22	0.09	7.9	94.3	6.2	0.25	7.9
72-OK-05-02-07----	51-64	B31	4.85	4.65	0.13	0.09	7.2	91.8	6.3	0.20	6.0
Nobscot:											
72-OK-05-01-01----	0-5	A1	4.32	0.52	0.07	0.08	3.5	100.0	8.1	1.54	2.8
72-OK-05-01-02----	5-23	A2	1.57	0.52	0.05	0.12	1.3	100.0	7.3	0.47	8.8
72-OK-05-01-03----	23-36	B21t	5.24	2.57	0.21	0.09	7.9	90.3	6.6	0.68	4.1
72-OK-05-01-04----	36-53	B22t	3.01	2.49	0.12	0.09	5.5	82.5	6.3	0.44	5.0
72-OK-05-01-05----	53-71	B23t	2.29	2.03	0.07	0.09	4.0	93.0	6.4	0.43	5.6
72-OK-05-01-06----	71-80	B3	1.31	2.10	0.06	0.09	3.7	100.0	6.5	0.22	4.3

TABLE 19.--ENGINEERING TEST DATA

[Dashes indicate data were not available. NP means nonplastic]

Soil name, report number, horizon, and depth in inches	Classification		Grain size distribution								Liquid limit	Plasticity index	Moisture density		Shrinkage		
			Percentage passing sieve--					Percentage smaller than--									
	AASHTO	Unified	3/8 inch	No. 4	No. 10	No. 40	No. 200	.02 mm	.005 mm	.002 mm			Max. dry density	Optimum moisture	Limit	Linear	Ratio
											Pct		Lb/ft3	Pct	Pct	Pct	Pct
Clairemont silt loam:[1] (S670K-005-008)																	
A1------ 0 to 11	A-6 (10)	CL	100	100	100	100	85	--	29	23	32	13	--	--	0.1	0.0	1.8
C1------11 to 42	A-6 (13)	CL	100	100	100	100	95	--	30	24	34	13	--	--	0.1	0.0	1.7
C2------42 to 60	A-4 (00)	SM	100	100	100	99	48	--	11	9	--	NP	--	--	--	0.0	--
Cordell silt loam:[2] (S670K-005-003)																	
A, B2--- 0 to 10	A-6 (11)	CL	100	100	100	100	91	31	--	21	33	12	--	--	0.1	0.0	1.8
R-------10 to 30	A-4 (04)	CL	100	100	100	74	68	24	--	12	29	8	--	--	0.1	0.0	1.8
Devol loamy fine sand:[3] (S670K-005-009)																	
Ap------ 0 to 14	A-2-4(00)	SM	100	100	100	95	21	--	9	8	--	NP	--	--	--	0.0	--
B2------14 to 24	A-2-4(00)	SM-SC	100	100	100	98	34	--	16	9	22	6	--	--	0.1	0.0	1.8
C-------38 to 70	A-2-4(00)	SM	100	100	100	98	33	--	12	11	--	NP	--	--	--	0.0	--
Dill fine sandy loam:[4] (S670K-005-005)																	
Ap------ 0 to 10	A-2-4(00)	SM	100	100	100	96	27	--	9	8	--	NP	--	--	--	0.0	--
B21-----10 to 26	A-2-4(00)	SM	100	100	100	97	20	--	11	8	--	NP	--	--	--	0.0	--
Cr------36 to 60	A-2-4(00)	SM	100	100	100	99	21	--	7	6	--	NP	--	--	--	0.0	--
Nobscot fine sand:[5] (S670K-005-001)																	
Ap------ 0 to 10	A-3 (01)	SP-SM	100	100	100	93	9	--	3	3	--	NP	--	--	--	0.0	--
B2t-----30 to 70	A-2-4(00)	SM	100	100	100	93	14	--	8	8	--	NP	--	--	--	0.0	--
Obaro silt loam:[6] (S670K-005-002)																	
A1------ 0 to 16	A-6 (14)	CL	100	100	100	99	91	--	34	28	37	15	--	--	0.1	0.0	1.8
B2------16 to 26	A-6 (14)	CL	100	100	100	98	86	--	39	32	38	16	--	--	0.1	0.0	1.8
C-------32 to 48	A-4 (07)	CL	100	95	93	90	80	--	33	24	32	10	--	--	0.1	0.0	1.7
Quanah clay loam:[7] (S670K-005-006)																	
A1------ 0 to 12	A-6 (10)	CL	100	100	100	99	78	--	25	20	33	14	--	--	0.1	0.0	1.7
B2------14 to 26	A-6 (12)	CL	100	100	100	97	82	--	35	29	36	15	--	--	0.1	0.0	1.6
Cca-----28 to 38	A-7-6(19)	CL	100	100	95	91	85	--	44	36	43	22	--	--	0.0	0.0	2.0
Woodward loam:[8] (S670K-005-007)																	
A1------ 0 to 14	A-4 (02)	CL-ML	100	100	100	99	66	--	17	14	26	6	--	--	0.1	0.0	1.7
B2------14 to 36	A-6 (07)	CL	100	100	100	100	71	--	26	21	31	12	--	--	0.1	0.0	1.7
Cr------36 to 60	A-4 (00)	SM	100	100	100	100	46	--	12	11	--	NP	--	--	--	0.0	--

[1]Clairemont silt loam: 50 feet west and 50 feet south of northeast corner sec. 11, T. 9 N., R. 21 W. This pedon is a taxadjunct to the Clairemont series. The percentage passing the 200 sieve, the unified classification, the liquid limit, and the plasticity index of the C2 horizon are outside the range of the series.

[2]Cordell silt loam: 100 feet west and 50 feet north of southeast corner sec. 9, T. 10 N., R. 23 W.

[3]Devol loamy fine sand: 1,000 feet east and 600 feet north of southwest corner sec. 31, T. 8 N., R. 21 W.

[4]Dill fine sandy loam: 1,400 feet south and 600 feet west of northeast corner sec. 33, T. 11 N., R. 21 W.

[5]Nobscot fine sand: 1,600 feet west and 100 feet south of northeast corner sec. 19, T. 9 N., R. 23 W.

[6]Obaro silt loam: 1,900 feet south and 200 feet west of northeast corner sec. 28, T. 10 N., R. 23 W.

[7]Quanah clay loam: 1,200 feet south and 50 feet east of northwest corner sec. 13, T. 8 N., R. 22 W. This pedon is a taxadjunct to the Quanah series. The liquid limit, the plasticity index, and the AASHTO classification of the Cca horizon are outside the range of the series. The sample site occurs in a delineation of map unit 39.

[8]Woodward loam: 800 feet north and 100 feet west of southeast corner sec. 33, T. 9 N., R. 22 W.

TABLE 20.--CLASSIFICATION OF THE SOILS

[An asterisk indicates that some or all of the soils in the series are taxadjuncts to the series. See the series description for characteristics of the soils that are outside the range of the series]

Soil name	Family or higher taxonomic class
Abilene	Fine, mixed, thermic Pachic Argiustolls
Altus	Fine-loamy, mixed, thermic Pachic Argiustolls
Aspermont	Fine-silty, mixed, thermic Typic Ustochrepts
Beckman	Fine, mixed (calcareous), thermic Vertic Ustifluvents
Carey	Fine-silty, mixed, thermic Typic Argiustolls
Clairemont	Fine-silty, mixed (calcareous), thermic Typic Ustifluvents
Clark	Fine-loamy, mixed, thermic Typic Calciustolls
Cordell	Loamy, mixed, thermic Lithic Ustochrepts
Cornick	Loamy, mixed, thermic, shallow Entic Haplustolls
*Cyril	Coarse-loamy, mixed, thermic Cumulic Haplustolls
Delwin	Fine-loamy, mixed, thermic Udic Paleustalfs
*Devol	Coarse-loamy, mixed, thermic Udic Haplustalfs
Dill	Coarse-loamy, mixed, thermic Udic Ustochrepts
Gracemont	Coarse-loamy, mixed (calcareous), thermic Aquic Udifluvents
Gracemore	Sandy, mixed, thermic Aquic Udifluvents
*Grandfield	Fine-loamy, mixed, thermic Udic Haplustalfs
Hardeman	Coarse-loamy, mixed, thermic Typic Ustochrepts
Knoco	Clayey, mixed (calcareous), thermic, shallow Ustic Torriorthents
Lincoln	Sandy, mixed, thermic Typic Ustifluvents
Mangum	Fine, mixed, thermic Vertic Ustochrepts
Nobscot	Loamy, mixed, thermic Arenic Paleustalfs
Obaro	Fine-silty, mixed, thermic Typic Ustochrepts
Owens	Clayey, mixed, thermic, shallow Typic Ustochrepts
Port	Fine-silty, mixed, thermic Cumulic Haplustolls
Pratt	Sandy, mixed, thermic Psammentic Haplustalfs
Quanah	Fine-silty, mixed, thermic Typic Calciustolls
Quinlan	Loamy, mixed, thermic, shallow Typic Ustochrepts
Spur	Fine-loamy, mixed, thermic Fluventic Haplustolls
St. Paul	Fine-silty, mixed, thermic Pachic Argiustolls
Talpa	Loamy, mixed, thermic Lithic Calciustolls
Tillman	Fine, mixed, thermic Typic Paleustolls
*Tipton	Fine-loamy, mixed, thermic Pachic Argiustolls
*Tivoli	Mixed, thermic Typic Ustipsamments
Treadway	Fine, mixed, (calcareous), thermic Vertic Torrifluvents
Vernon	Fine, mixed, thermic Typic Ustochrepts
Vinson	Fine-silty, mixed, thermic Entic Haplustolls
Woodward	Coarse-silty, mixed, thermic Typic Ustochrepts
Woodward Variant	Coarse-loamy, mixed, thermic Typic Ustochrepts
Yahola	Coarse-loamy, mixed (calcareous), thermic Typic Ustifluvents

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