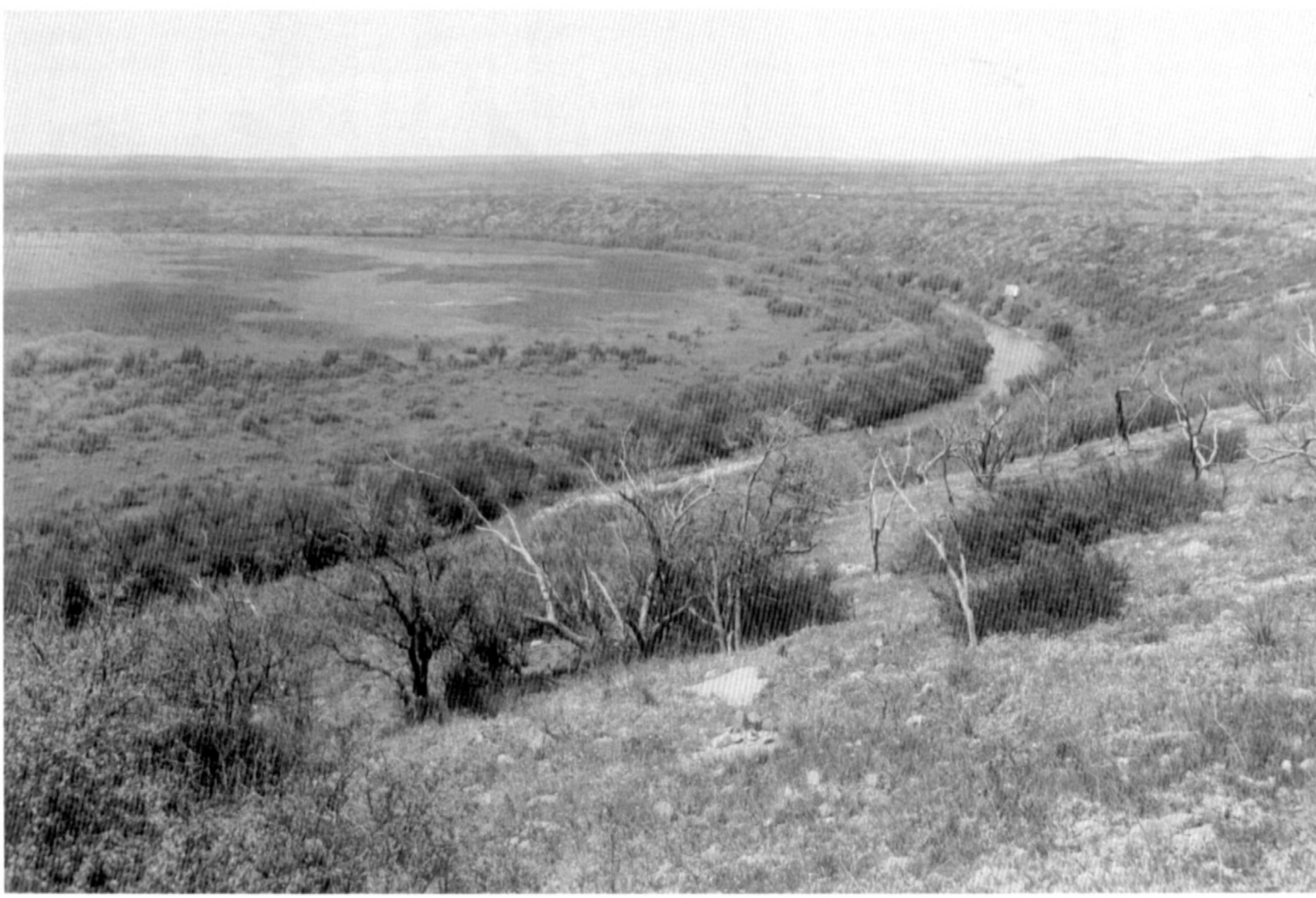
United States
Department of
Agriculture

Soil
Conservation
Service

In cooperation with
Texas Agricultural Experiment
Station and
Texas State Soil and
Water Conservation Board

Soil Survey of Shackelford County, Texas



How To Use This Soil Survey

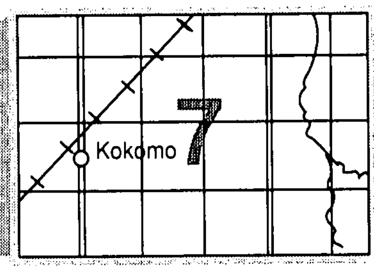
General Soil Map

The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

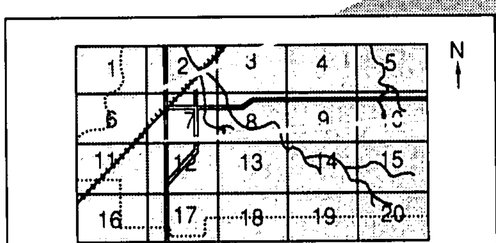
Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.



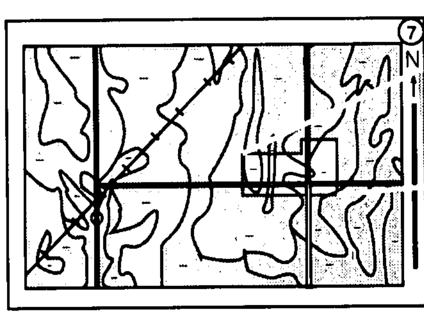
MAP SHEET

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.

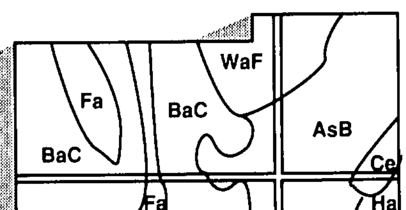


INDEX TO MAP SHEETS

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



MAP SHEET



AREA OF INTEREST

NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

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.

Major fieldwork for this soil survey was completed in 1984. Soil names and descriptions were approved in 1985. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1984. This soil survey was made cooperatively by the Soil Conservation Service, the Texas Agricultural Experiment Station, and the Texas State Soil and Water Conservation Board. It is part of the technical assistance furnished to the Lower Clear Fork of the Brazos Soil and Water 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.

All programs and services of the Soil Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

Cover: View of the Clear Fork of the Brazos River. The soils are Throck-Palopinto association, steep, on the right of the river and Grandfield fine sandy loam, 1 to 5 percent slopes, on the left.

Contents

Soil Series

Issued February 1990

Index to Map Units

Summary of Tables

Foreword

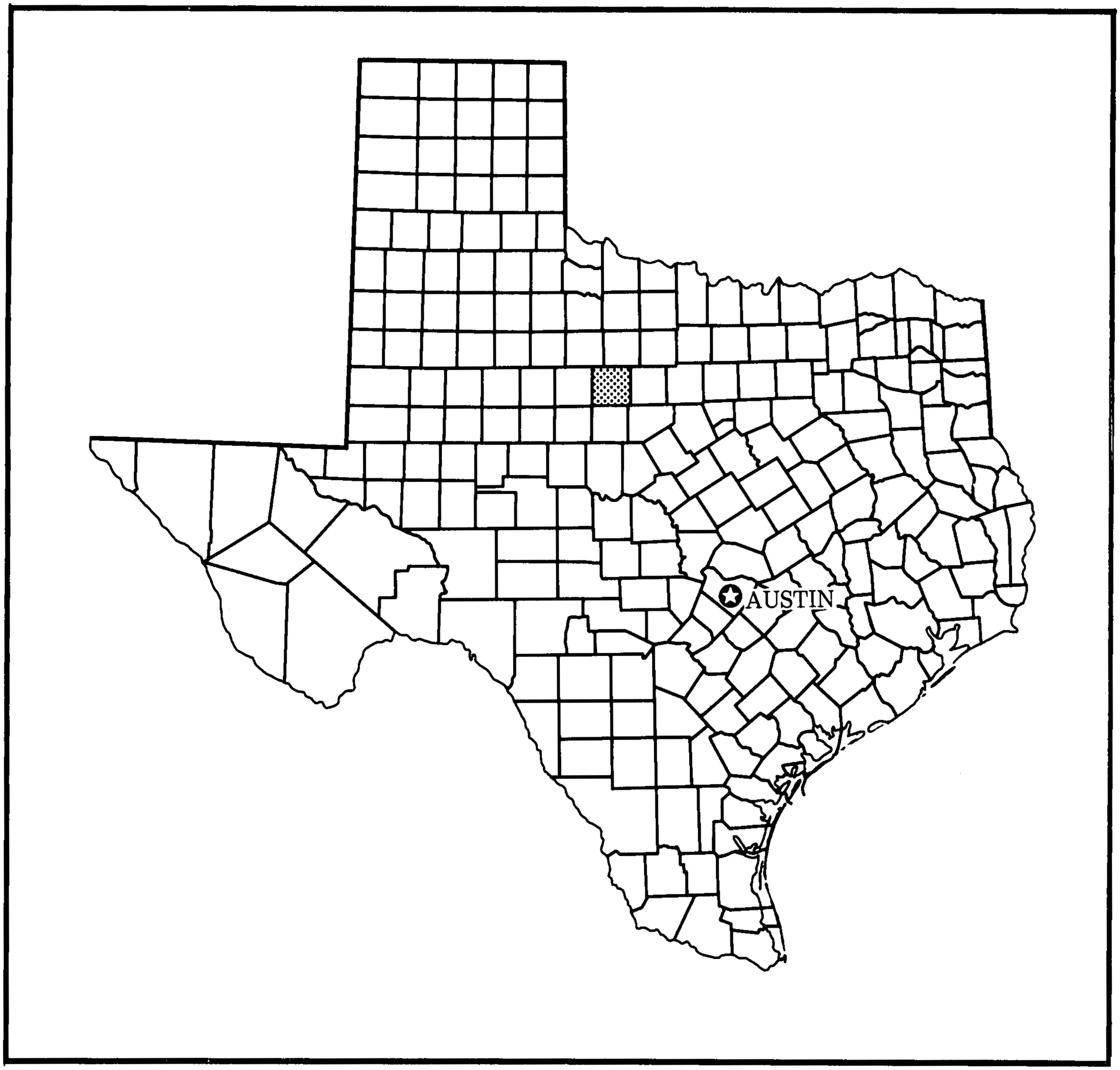
This soil survey contains information that can be used in land-planning programs in Shackelford County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact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

This soil survey is designed for many different users. Farmers, ranchers, foresters, 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.

Billy C. Griffin
State Conservationist
Soil Conservation Service



Location of Shackelford County in Texas.

Soil Survey of Shackelford County, Texas

By A.C. Lowther, Soil Conservation Service

Joe D. Moore and Winfred C. Coburn, Soil Conservation Service, assisted in field mapping

United States Department of Agriculture, Soil Conservation Service
In cooperation with
Texas Agricultural Experiment Station and
Texas State Soil and Water Conservation Board

SHACKELFORD COUNTY is in north-central west Texas. It has an area of 915 square miles, or 585,818 acres. The survey area is bordered on the north by Throckmorton and Haskell Counties, on the west by Jones County, on the east by Stephens County, and on the south by Callahan and Eastland Counties. Altitude ranges from 1,200 feet in the northeastern part of the county to 1,957 feet in the southwest part.

Albany, which is in the central part of the county, is the county seat. The population of Albany is 2,450, and the total population of Shackelford County is 3,915, according to the 1980 census.

Land use in the county has not changed significantly since the early 1940's. The agricultural industry and oil production and related industries provide a well balanced economy.

Approximately 94 percent of the county is in the Rolling Plains Resource Area, and 6 percent is in the North Central Prairie Resource Area.

The Rolling Plains Resource Area consists of gently sloping to undulating plains interrupted intermittently by steep escarpments. The soils have developed in Permian age limestones and shales. This area is mostly used as grazing land. An area of outwash plain occurs in the northwest and southwest part of the county. The soils have developed from calcareous, loamy sediment. Most of this area is used for growing cotton, wheat, and grain sorghum.

The North Central Prairie Resource Area is in the southeast and east-central parts of the county. The soils have developed in Pennsylvanian age sandstones and shales. This area is mostly used for stock farming.

The Clear Fork of the Brazos River flows through the northern part of the county. A narrow band of Recent alluvial and Pleistocene terrace deposits occurs along the drainageways of the river.

General Nature of the County

In this section, environmental and cultural factors that affect the use and management of soils in Shackelford County are described. These factors are history, natural resources, and climate.

History

In about 1787, the Spaniards were the first explorers in the area that is now Shackelford County. As early as 1829, a fairly accurate map was drawn of this region under the direction of Stephen F. Austin.

The first step toward the settlement of north and west Texas was during the period when Texas was a Republic and when the Peters Colony was established. This was later called the Texas Emigration and Land Company, and it opened vast areas of Texas to emigrants from outside Texas. The land was then parceled into 320-acre tracts.

Shackelford County was created in 1858 from Bosque County. It was organized in 1874 and was named for Dr. John (Jack) Shackelford, who personally furnished the clothing and arms for more than 75 Red Rovers who fought for Texas' independence. These men were massacred at Goliad, but the doctor's life was spared by the Mexicans because of his medical skill. He later wrote an excellent account of the battle.

In late 1851, Fort Phantom Hill was established by soldiers at a site on the Clear Fork of the Brazos River west of the Shackelford County line. An Indian agent from Ohio, Jesse Stem, began farming and set up an Indian agency in 1852. Four years later, another pre-Civil War army post, called Camp Cooper, was established about 9 miles northwest of Fort Griffin. Nearby was a Comanche Indian reservation. Although these events did not take place within what is now Shackelford County, they are the first recorded account of the settlement of this area.

Shackelford County was under the legal jurisdiction of Palo Pinto County in 1860. During the Civil War period, families lived in groups along the streams throughout the Clear Fork of the Brazos River and Hubbard Creek areas. Each group had a central fort for protection. Some four or five forts are known to have existed.

Following the war, the U.S. Army established Fort Griffin in Shackelford County about 9 miles below the old Camp Cooper site on the Clear Fork of the Brazos River. People moved near the fort for protection from the Indians. Simultaneously, the land around Fort Griffin was sold, and shortly after, a town emerged at the foot of the hill surrounding the fort. In 1871, General Ranald Mackenzie organized 600 troops at the old Camp Cooper site and started his drive against the Indians, an action that eventually brought peace to the area. The Mackenzie Trail resulted from these military sweeps through northwest Texas and opened the area to civilization.

In May 1874, Shackelford County was under the legal jurisdiction of Jack County. In the fall, a group of 174 pioneers petitioned the Jack County Court to become a separate legal entity. By September, Shackelford County had its own officers. Fort Griffin served as the temporary county seat until the election in November. By a vote of 54 to 39, it was determined that the area in the northeast quarter, section 1 of the Blind Asylum Survey, which was then only a mail station, would be the permanent county seat of Shackelford County. W.R. Cruger named the new location Albany for his hometown of Albany, Georgia. A picket courthouse was built the following year. Henry Carter Jacobs, the county's first sheriff, donated to Shackelford County the land for the courthouse and the land for many of the business and residential lots.

Until 1878, the people of this county were engaged primarily in cattle raising. Thousands of cattle grazed the prairie without restriction from fences. Cattle was marked by the brands of the owners. The first flock of sheep was driven into the county in 1878, and sheep raising became popular.

Cattle drives were numerous up the Western Cattle Trail for 15 years, and herds of longhorns passed Fort Griffin bound for Kansas and Nebraska. For a brief time, buffalo hunting also boosted the economy of this area. Traders, skinners, and hunters used Fort Griffin as a supply point and marketing place. The entire area's population used the flat around the town of Fort Griffin as a watering spot, recreation area, or trading center.

In 1881, after 50,000 dollars had been raised as an incentive, the Texas Central Railroad Company built a railroad into Albany that bypassed Fort Griffin. The fort closed that year, and soon the area was no longer the most important business center west of Fort Worth. Its decline was rapid, but Albany continued to grow.

Many small farmers moved into the county about the turn of the century and attempted to make a living for their families on small tracts. Harsh lessons of the land, droughts, and insects made living difficult if not impossible. Many were forced to sell or move on.

Texas Company Cottle Well No. 1 was brought in near Moran in 1910. The leasing of land for drilling purposes continued slowly until 1921 when Ed A. Landreth discovered the Caddo lime. Ibex was established, and the world's largest gasoline absorption plant of that time was built. Shackelford County became oil territory; and even more so, after Roeser and Pendleton began exploring this area in 1926 and brought in the 1,000 barrel discovery producer on the Cook Ranch northwest of Albany. Later, the discovery of the Ivy Field in the northwest corner of the county opened that area for exploration.

In the middle 1940's, the Sanders Field, producing from the Ellenburger lime, initiated the leasing of most county land to major oil companies. New deep exploration brought several drilling companies to Albany. Both shallow and deep drilling continued through the 1950's. In the 1960's, the Mississippian reefs were discovered in the northeast part of Shackelford County and brought another wave of activity. The demand for energy in the 1970's has brought continued interest in drilling. Shackelford County has led in discoveries in the west-central Texas area for the past several years.

Oil production and discovery, cattle raising, and farming continue to be the major industries in Shackelford County.

Natural Resources

The soil is the most important natural resource in Shackelford County. Most of the people in Shackelford County earn their living by producing cattle and horses, forage for livestock, or food and fiber for market or home.

Oil and gas are produced from numerous wells in the county. They provide a major source of income for some landowners and provide a solid tax base from which public services can be funded.

Water is another resource. McCarty Lake furnishes water for the city of Albany. Numerous ponds and lakes throughout the county provide water for livestock and recreation. The Clear Fork of the Brazos River flows through the northern part of the county providing water for livestock, wildlife, and recreation. A rural water system furnishes water for many areas of the county.

Wildlife produced on the farms and ranches provide recreation and a source of income for many residents. Deer, turkey, and quail are plentiful throughout most of the county.

Other natural resources are gravel and limestone. They are mainly used for the construction of roads.

Climate

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

Table 1 gives data on temperature and precipitation for the survey area as recorded at Albany in the period 1951 to 1981. 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 45 degrees F, and the average daily minimum temperature is 31 degrees. The lowest temperature on record, which occurred at Albany on January 12, 1973, is -5 degrees. In summer the average temperature is 82 degrees, and the average daily maximum temperature is 96 degrees. The highest recorded temperature, which occurred at Albany on June 27, 1972, is 115 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.

The total annual precipitation is 27.18 inches. Of this, 18 inches, or 65 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 12 inches. The heaviest 1-day rainfall during the period of record was 29.05 inches at Albany on August 4, 1978. Thunderstorms occur on about 41 days each year, and most occur in summer.

The average seasonal snowfall is 1 inch. The greatest snow depth at any one time during the period of record was 3 inches. On an average of 1 day, 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 50 percent. Humidity is higher at night, and the average at dawn is about 75 percent. The sun shines 75 percent of the time possible in summer and 65 percent in winter. The prevailing wind is from the south-southeast. Average windspeed is highest, 14 miles per hour, in spring.

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.

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.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material from which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, acidity, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area are generally collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. In the detailed soil map units, these latter soils are called inclusions or included soils. In the general soil map units, they are called soils of minor extent.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed, and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soils on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

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 a 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.

Nine general soil map units are in Shackelford County.

Soils Mainly Underlain by Limestone and Shale

The two general soil map units in this group make up about 50 percent of the county. The major soils are in the Lueders, Nukrum, Palopinto, and Throck series. These soils have developed over interbedded Permian limestone and shale. The landscape is undulating to hilly with some steep scarps and ledges. The surface has a subdued benched appearance because of the alternating beds of hard limestone outcropping in the soft shale. In most areas, these soils are used as rangeland and as habitat for wildlife.

1. Palopinto-Throck

Very shallow, shallow, and deep, gently undulating to steep, loamy and clayey soils, some are very flaggy and stony; on uplands

Palopinto soils are very shallow and shallow and are underlain by hard limestone. These soils are on ridgetops and on benches on the side slopes. Throck soils are deep and are underlain by shale. These soils are on gently undulating foot slopes to steep hillsides (fig. 1). The drainage pattern of the soils in this map unit is well defined with streams flowing eastward. The rock strata tilt gently downward to the west, and east-facing escarpments are a prominent feature of the landscape. As the escarpments recede, limestone boulders break away and creep downslope into the steep areas of Throck soils. The lentils and thinner bedded units of limestone weather to flagstones on the Palopinto soils.

This map unit makes up about 27 percent of Shackelford County. It is about 32 percent Palopinto soils; 31 percent Throck soils; and 37 percent other soils, rock outcrop, and Oil-waste land.

Typically, the surface layer of Palopinto soils is moderately alkaline, calcareous, dark brown very flaggy silty clay loam about 10 inches thick. It contains about 45 percent, by volume, limestone flagstones. Below the surface layer is hard, coarsely fractured, limestone bedrock. About 20 percent of the surface is covered with limestone flagstones and cobbles. A few stones and boulders are on the surface.

Typically, the surface layer of Throck soils is dark grayish brown clay about 4 inches thick. The upper part of the subsoil, to a depth of 11 inches, is brown clay. The middle part, to a depth of 34 inches, is brown silty clay. The lower part, to a depth of 40 inches, is pale brown silty clay. The substratum to a depth of 98 inches is grayish brown, light brownish gray, and gray stratified shale and siltstone. The soils are moderately alkaline and calcareous throughout. A few stones and boulders are on the surface.

Soils of minor extent in this map unit are Cho, Frio, Hensley, Lueders, Nukrum, Nuvalde, and Purves soils, and Oil-waste land and rock outcrop. Cho, Hensley, and Lueders soils are shallow and loamy, and Purves soils are shallow and clayey. These soils are on broad, upland hilltops and ridges. Nukrum soils are deep and clayey, and Nuvalde soils are loamy. These soils are on upland plains and in valleys. Frio soils are deep and loamy and are on flood plains of the larger streams. Oil-waste land is areas where oil and accompanying saltwater brine have been deposited on the surface from overflows and spills from oil exploration and production activity. The rock outcrop areas are exposures of limestone bedrock, 10 to 20 feet wide, that follow the slope contour. In hilly and steep areas, the rock outcrops are ledges, cliffs, or bluffs.

The soils in this map unit are mainly used as rangeland and as habitat for wildlife. The rough terrain is more easily accessible to livestock than to vehicles. These soils are not suited to cropland or pastureland because of slope, surface stones, and depth to bedrock.

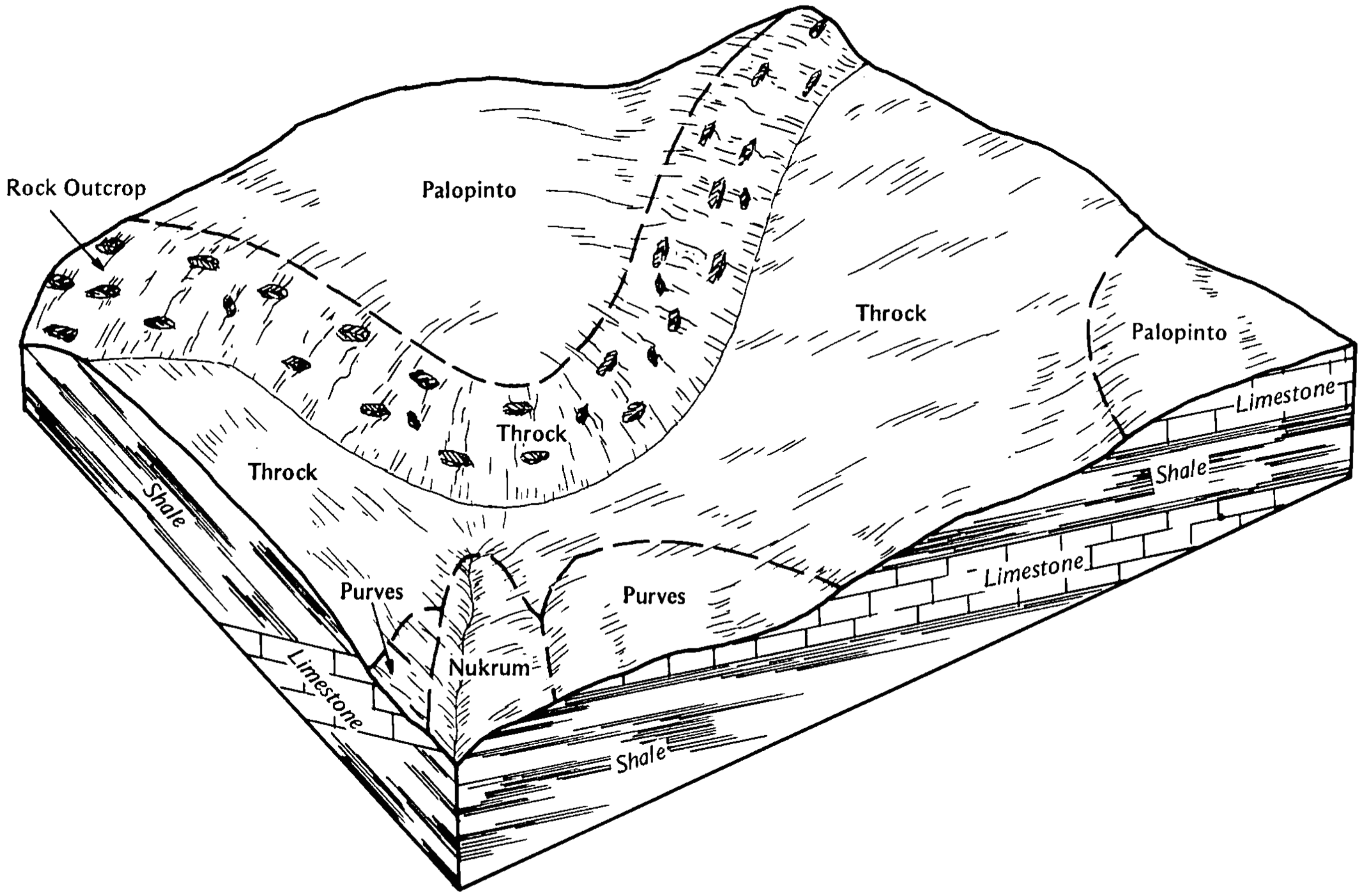


Figure 1.—Typical pattern of soils and parent material in the Palopinto-Throck map unit.

Deer, turkey, quail, and furbearing animals are the main kinds of wildlife. Deer and turkey are plentiful, and most areas are managed by ranchers for hunting. Antelope has been reintroduced into some areas. Nesting areas are plentiful for songbirds.

The main limitations for dwellings, yards, and roads are depth to bedrock, clayey texture, slope, large stones, high content of lime in the soils, and corrosivity to uncoated steel. However, the outstanding views from the hills and valleys make the areas of this map unit desirable for homesites. Special design and proper installation are needed in the construction of buildings and roads. Limestone that is quarried in Shackelford County can be used for roadbuilding material. Excavations are difficult in the hard bedrock. Allowances should be made for the rapid runoff of surface water and for water that seeps from the limestone following rains. Special design is needed for septic tank absorption field systems, and they must be constructed in raised beds or in large fields. Even so, the effluent may seep to the surface downslope or through the bedrock and contaminate the ground water. Corrosion of underground steel utility lines is rapid unless they are protected. The high content of lime in the soils causes iron chlorosis of many plants. Yards are difficult to maintain; therefore, the rustic, natural landscape is generally best and should be included in the landscaping plans.

2. Lueders-Throck-Nukrum

Very shallow, shallow, and deep, gently sloping to undulating, loamy and clayey soils, some are very gravelly; on uplands

Lueders soils are very shallow and shallow and are underlain by hard limestone. These soils are on low irregular ridges. Throck soils are deep and are underlain by shale on hillsides. Nukrum soils are deep. They are on gently sloping valley floors (fig. 2). This is a broad plateau disected by shallow valleys. Streams flow generally westward, which is contrary to most of the county.

This map unit makes up about 23 percent of Shackelford County. It is about 41 percent Lueders soils, 18 percent Throck soils, 17 percent Nukrum soils, and 24 percent other soils.

Typically, the surface layer and subsoil of Lueders soils are moderately alkaline, calcareous, dark brown very gravelly clay loam about 9 inches thick. Below that layer is hard, coarsely fractured, limestone bedrock that is about 6 inches to several feet thick and is underlain by alternating beds of shale and calcareous marl.

Typically, the surface layer of Throck soils is dark grayish brown clay about 4 inches thick. The upper part of the subsoil, to a depth of 11 inches, is brown clay. The middle part, to a depth of 34 inches, is brown silty clay. The lower part, to a depth of 40 inches, is pale brown silty clay. The substratum to a depth of 98 inches is grayish brown, light brownish gray, and gray stratified shale and siltstone. The soils are moderately alkaline and calcareous throughout.

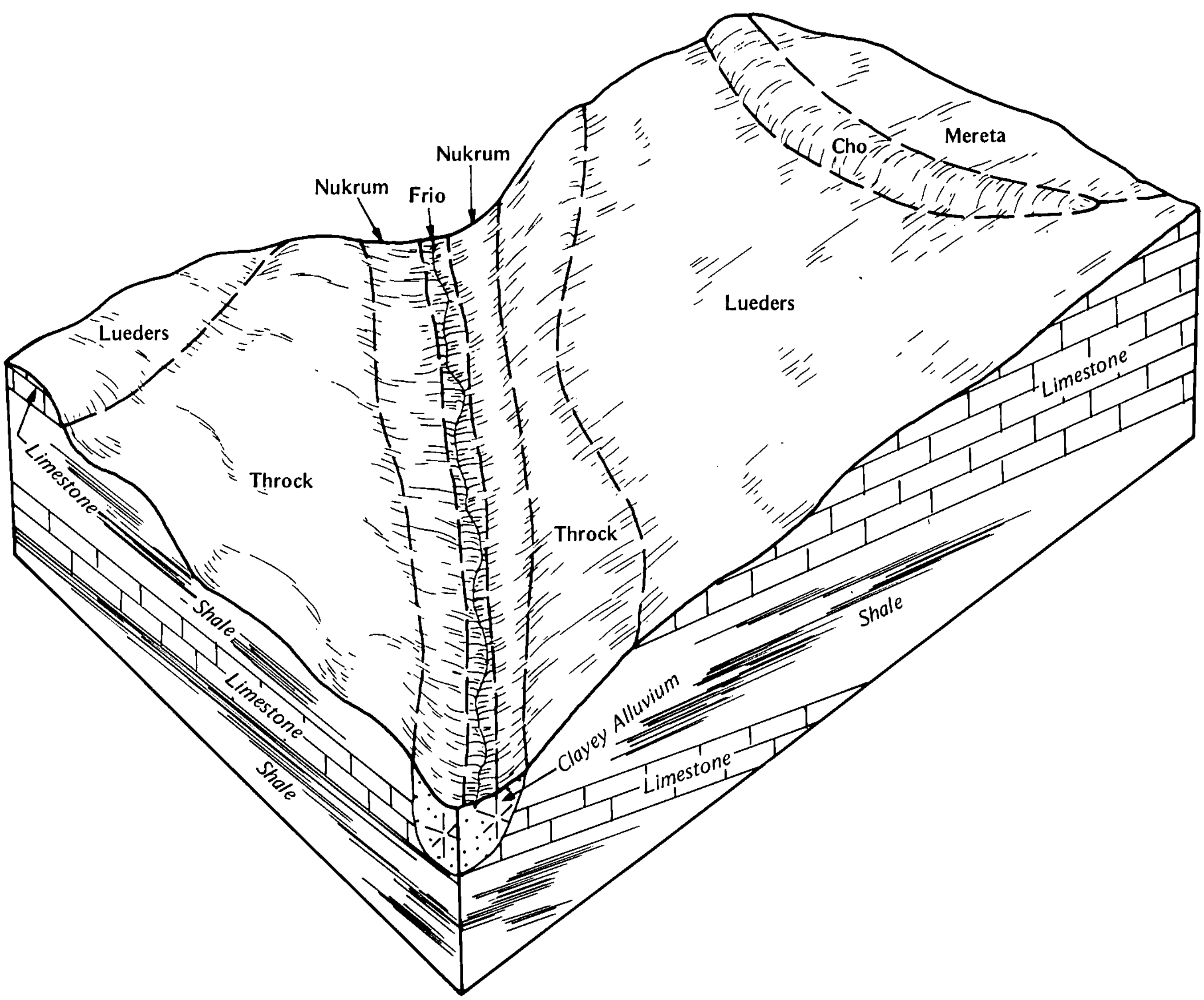


Figure 2.—Typical pattern of soils and parent material in the Lueders-Throck-Nukrum map unit.

Typically, the surface layer of Nukrum soils is dark grayish brown clay about 24 inches thick. The subsoil to a depth of 60 inches is grayish brown clay that has accumulated calcium carbonates below 48 inches. The subsoil also has pressure faces on peds. The soils are calcareous and moderately alkaline throughout.

Soils of minor extent in this map unit are Cho, Frio, Harpersville, Leeray, Mereta, Nuvalde, Owens, and Palopinto soils and rock outcrop. Cho soils are shallow and very shallow and loamy, and Mereta soils are clayey. These soils are on low summits of hills. Frio soils are deep and clayey. They are on flood plains. Harpersville and Owens soils are deep, but thinly developed. These soils are clayey and are on some of the more sloping hillsides. Leeray soils are deep and clayey, and Nuvalde soils are loamy. These soils are in broad valleys and on upland plains. Palopinto soils are very shallow, loamy, and very flaggy. They are on narrow ridges. Rock outcrop mainly occurs along shoulders of slopes.

The soils in this map unit are mainly used as rangeland and as habitat for wildlife. Lueders and Throck soils are not suited to pastureland and cropland because of the surface stones, very shallow depth to bedrock, clayey texture, and slope. Only Nukrum soils are suited to cropland, and a few small fields of this soil are in crops. These crops are used mainly for supplemental grazing and for grain for livestock. Small grains and sorghums are the main crops. The high content of lime in these soils causes phosphorus deficiencies in some cattle.

Deer, turkey, dove, quail, and furbearing animals are the main kinds of wildlife. Deer and turkey are plentiful, and most areas are managed by ranchers for hunting. Antelope has been reintroduced into these areas on a few large ranches. Nesting areas are plentiful for dove and songbirds.

The main limitations for dwellings, yards, and roads are depth to bedrock, large stones, slope, shrink-swell potential, and corrosivity to uncoated steel. Foundations for buildings, roads, and other structures need to be designed to withstand the shrinking and swelling of the soils or need to be placed on solid bedrock; however, excavating the bedrock is difficult. These soils are sticky and slippery when wet making foot and vehicle traffic difficult. Corrosion of underground steel utility lines is rapid unless they are protected. Special design and proper installation are needed if septic tank absorption field systems are to function properly. Pollutants should be prevented from passing through the bedrock and contaminating the ground water. Landscaping of these soils and gardening are difficult because of depth to bedrock or droughtiness. Maintaining a grass cover is also difficult.

Soils Mainly of Ancient Outwash Sediments

The three general soil map units in this group make up about 37 percent of the county. The major soils are in the Leeray, Nukrum, Nuvalde, Pitzer, Rowena, Throck, and Wichita series. These soils have developed mainly in calcareous, alluvial sediments of the Pleistocene period. In most areas, these soils are used as cropland or rangeland.

3. Leeray-Throck-Nukrum

Deep, nearly level to sloping, clayey soils; on uplands

Leeray soils are in broad valleys and on the upland plains, and Nukrum soils are on valley floors (fig. 3). Leeray and Nukrum soils formed in a thin mantle of ancient outwash and valley fill. Throck soils are on hillsides. They formed in shale where geologic erosion has removed the outwash mantle and exposed the underlying shale. The drainage pattern of the soils in this map unit is well defined with streams flowing northeastward.

This map unit makes up about 26 percent of Shackelford County. It is about 26 percent Leeray soils, 18 percent Throck soils, 9 percent Nukrum soils, and 47 percent other soils and Oil-waste land.

Typically, the upper part of the surface layer of Leeray soils is dark grayish brown clay 7 inches thick. The next layer, to a depth of 28 inches, is very dark grayish brown clay. The next layer, to a depth of 33 inches, is dark grayish brown clay. The lower part, to a depth of 48 inches, is dark brown clay. The subsoil to a depth of 60 inches is yellowish brown silty clay that contains soft masses and concretions of calcium carbonate. The soils are calcareous and moderately alkaline throughout.

Typically, the surface layer of Throck soils is dark grayish brown clay about 4 inches thick. The upper part of the subsoil, to a depth of 11 inches, is brown clay. The middle part, to a depth of 34 inches, is brown silty clay. The lower part, to a depth of 40 inches, is pale brown silty clay. The substratum to a depth of 98 inches is grayish brown, light brownish gray, and gray stratified shale and siltstone. The soils are moderately alkaline and calcareous throughout.

Typically, the surface layer of Nukrum soils is dark grayish brown clay about 24 inches thick. The subsoil to a depth of 60 inches is grayish brown clay that has accumulated calcium carbonates below 48 inches. The soils are calcareous and moderately alkaline throughout.

Soils of minor extent in this map unit are Cho, Frio, Harpersville, Hensley, Mereta, Nuvalde, Owens, Palopinto, Pitzer, Purves, and Rowden soils and Oil-waste land. Cho and Pitzer soils are shallow and very shallow and loamy, and Mereta soils are clayey. These soils are on ridge summits. Frio soils are deep and clayey. They are on the flood plains of major streams.

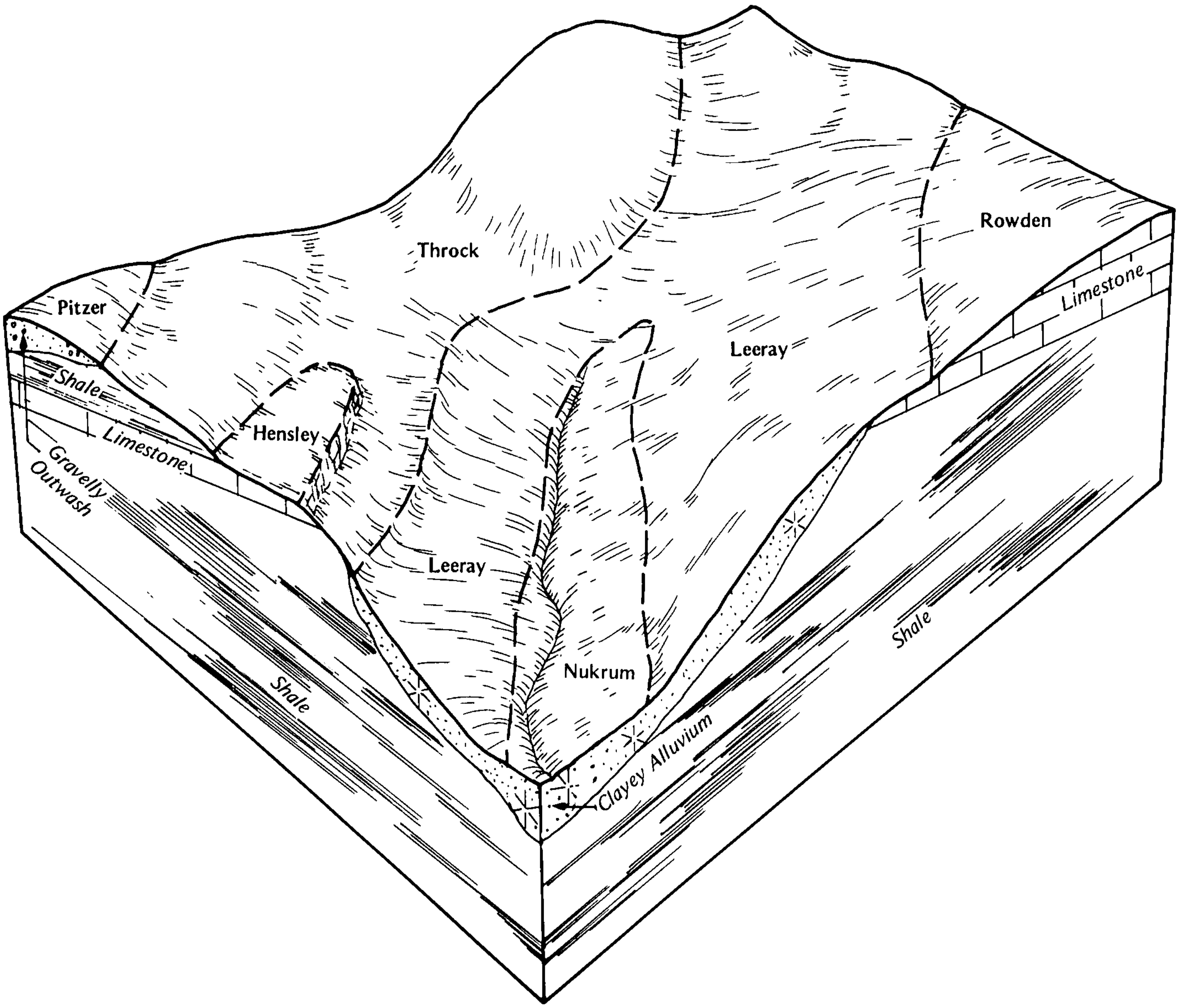


Figure 3.—Typical pattern of soils and parent material in the Leeray-Throck-Nukrum map unit.

Harpersville and Owens soils are deep, but thinly developed. These soils are clayey and are on hillsides below escarpments. Hensley, Palopinto, and Purves soils are shallow. These soils are on uplands. Nuvalde soils are deep and loamy. They are on uplands and in the valley fill material. Rowden soils are moderately deep and loamy. They are on ridge summits. Oil-waste land is areas where oil and accompanying saltwater brine have been deposited on the surface from overflows and spills from oil exploration and production activity. Cho, Mereta, Nuvalde, and Pitzer soils formed in outwash sediments. Harpersville, Hensley, Owens, Palopinto, Purves, and Rowden soils formed in Permian shale or limestone.

The soils in this map unit are mainly used as cropland, rangeland, and pastureland and for recreation and urban land uses. The main crops are oats and wheat. Some forage sorghum and grain sorghum also are grown. Improved pasture grasses mainly are bermudagrass and kleingrass.

Deer, turkey, quail, dove, and squirrel are the main kinds of wildlife. Many areas do not have adequate cover for deer, but the deer graze the oats and wheat at night. These soils furnish nesting areas for dove and grassland birds.

Buildings and roads can be built on these soils, but they should be designed and constructed to withstand the high shrink-swell potential of the soils. Unprotected areas are muddy following rains, which make foot and vehicle traffic difficult. Corrosion of underground steel utility lines is rapid unless they are protected. Special design and proper installation are needed if septic tank absorption field systems are to function properly in these clayey soils.

4. Rowena-Leeray-Nuvalde

Deep, nearly level to gently sloping, loamy and clayey soils; on uplands

Rowena and Nuvalde soils are loamy, and Leeray soils are clayey. These soils are on ancient alluvial plains (fig. 4). They formed in a mantle of ancient outwash. The drainage pattern of the soils in this map unit is poorly defined.

This map unit makes up about 6 percent of Shackelford County. It is about 23 percent Rowena soils, 18 percent Leeray soils, 16 percent Nuvalde soils, and 43 percent other soils.

Typically, the surface layer of Rowena soils is dark grayish brown clay loam about 6 inches thick. The upper part of the subsoil, to a depth of 11 inches, is dark grayish brown silty clay. The middle part, to a depth of 34 inches, is dark brown clay. The lower part, to a depth of 48 inches, is light brown clay loam that contains films, threads, soft masses, and concretions of calcium carbonate. The substratum to a depth of 60 inches is reddish yellow clay loam that is about 50 percent calcium carbonate. The soils are moderately alkaline and calcareous throughout.

Typically, the upper part of the surface layer of Leeray soils is dark grayish brown clay about 7 inches thick. The next layer, to a depth of 28 inches, is very dark grayish brown clay. The next layer, to a depth of 33 inches, is dark grayish brown clay. The lower part, to a depth of 48 inches, is dark brown clay. The subsoil to a depth of 60 inches is yellowish brown silty clay that contains soft masses and concretions of calcium carbonate. The soils are calcareous and moderately alkaline throughout.

Typically, the surface layer of Nuvalde soils is dark brown silty clay loam about 10 inches thick. The upper part of the subsoil, to a depth of 21 inches, is dark brown silty clay. The next layer, to a depth of 34 inches, is light brown silty clay loam. The next layer, to a depth of 44 inches, is pink silty clay loam that contains about 50 percent calcium carbonate. The next layer, to a depth of 60 inches, is light brown silt loam that contains about 50 percent calcium carbonate. The lower part, to a depth of 78 inches, is reddish yellow loam that contains about 30 percent calcium carbonate. The substratum to a depth of 84 inches is reddish yellow loam that contains about 20 percent calcium carbonate. The soils are calcareous and moderately alkaline throughout.

Soils of minor extent in this map unit are Abilene, Cho, Frio, Harpersville, Mereta, Nukrum, Owens, Pitzer, Veal, and Wichita soils. Abilene, Veal, and Wichita soils are deep and loamy. These soils are on upland plains and terraces near major streams. Cho and Pitzer soils are shallow and loamy, and Mereta soils are clayey. These soils are on knolls and ridgetops. Frio soils are deep and clayey. They are on flood plains of major streams. Harpersville and Owens soils are deep but thinly developed. These soils are clayey, and they formed in shale on side slopes where streams have cut through the outwash mantle and exposed the underlying Permian shales. Nukrum soils are deep and clayey. They are on uplands and in the valley fill material.

The soils in this map unit are mainly used as cropland and rangeland. A few areas are used as pastureland and for recreation and urban land uses. The main crops are wheat and cotton. Some oats, forage sorghum, and grain sorghum also are grown. Improved pasture grasses mainly are bermudagrass and kleingrass.

Dove and quail are the main kinds of wildlife. Deer from adjoining areas graze the oats and wheat at night. These soils furnish nesting areas for dove and grassland birds.

Buildings and roads can be built on these soils, but they should be designed and constructed to withstand the high shrink-swell potential. Unprotected areas are muddy following rains, which make foot and vehicle traffic difficult. Corrosion of underground steel utility lines is rapid unless they are protected. Special design and proper installation of septic tank absorption field systems are needed if they are to function properly in these soils that have a clayey subsoil.

5. Leeray-Pitzer-Wichita

Deep and very shallow, nearly level to undulating, clayey and loamy soils, some are gravelly; on uplands and terraces

Leeray soils are deep and clayey, and Wichita soils are deep and loamy. These soils are on plains and high terraces. Pitzer soils are very shallow and loamy and gravelly. These soils are on terrace ridges (fig. 5).

This map unit makes up about 5 percent of Shackelford County. It is about 26 percent Leeray soils, 25 percent Pitzer soils, 17 percent Wichita soils, and 32 percent other soils.

Typically, the surface layer of Leeray soils is dark grayish brown clay 7 inches thick. The next layer, to a depth of 28 inches, is very dark grayish brown clay. The next layer, to a depth of 33 inches, is dark grayish brown clay. The lower part, to a depth of 48 inches, is dark brown clay. The subsoil to a depth of 60 inches is

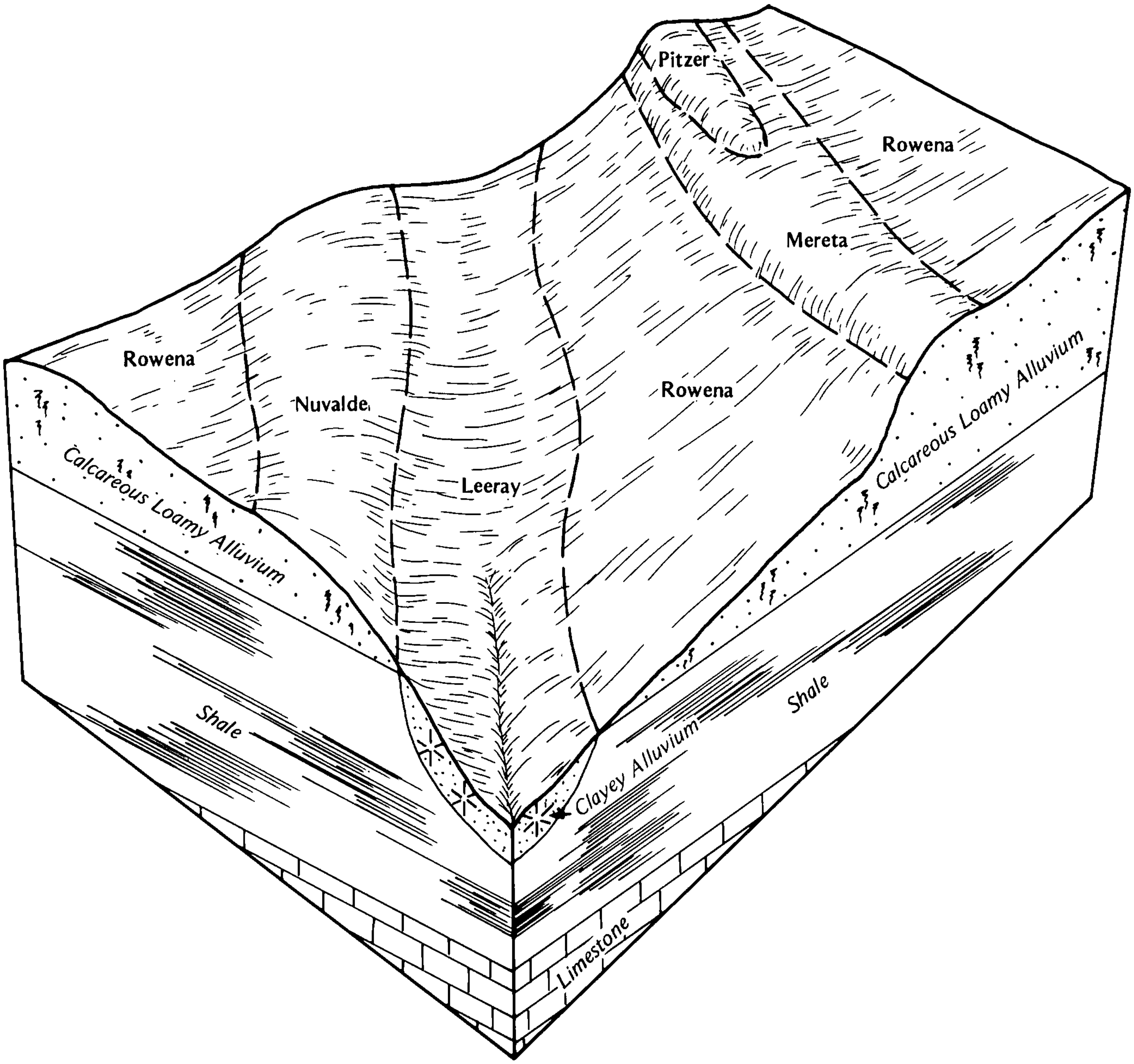


Figure 4.—Typical pattern of soils and parent material in the Rowena-Leeray-Nuvalde map unit.

yellowish brown silty clay that contains soft masses and concretions of calcium carbonate. The soils are calcareous and moderately alkaline throughout.

Typically, the surface layer of Pitzer soils is dark grayish brown gravelly clay loam about 5 inches thick. The subsoil, to a depth of 11 inches, is white, indurated, platy caliche. The upper part of the substratum, to a depth of 54 inches, is yellow very gravelly sandy clay loam that contains pebbles coated with calcium carbonate. The lower part to a depth of 60 inches is light

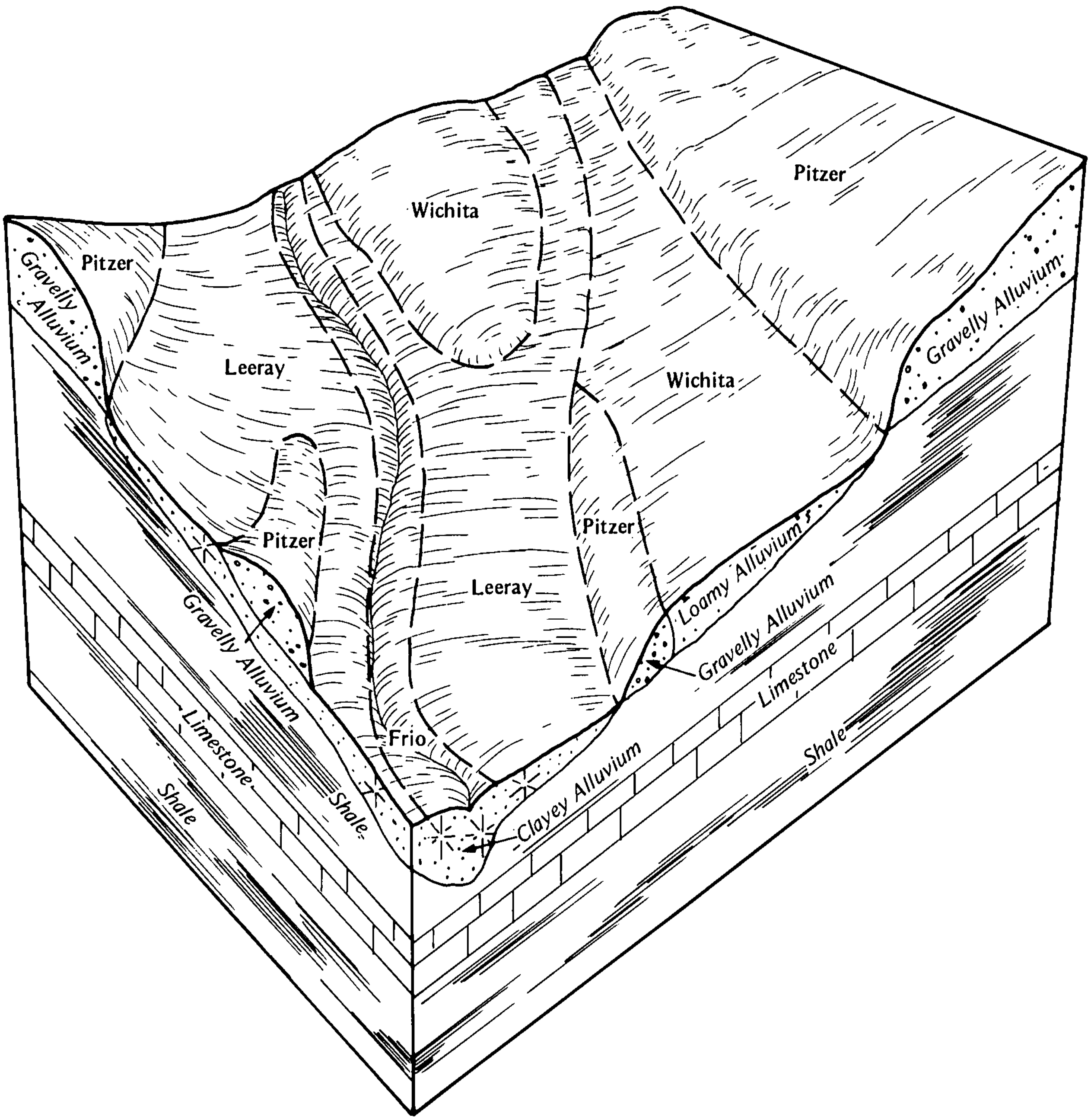


Figure 5.—Typical pattern of soils and parent material in the Leeray-Pitzer-Wichita map unit.

brownish gray shaly clay. The soils are calcareous and moderately alkaline throughout.

Typically, the surface layer of Wichita soils is mildly alkaline, dark brown clay loam about 8 inches thick. The upper part of the subsoil, to a depth of 40 inches, is reddish brown clay. Reaction is mildly alkaline to a depth of 22 inches and moderately alkaline below. The middle part, to a depth of 48 inches, is calcareous, yellowish red clay loam. The lower part to a depth of 60 inches is reddish yellow clay loam that contains about 15 percent calcium carbonate.

Soils of minor extent in this map unit are Frio, Gageby, Lusk, Minwells, Nukrum, Rowden, and Thurber soils. Frio soils are deep and clayey, and Gageby soils are loamy. These soils are on the flood plains of major streams. Lusk soils are moderately deep and gravelly and loamy, and Minwells soils are deep and loamy. They are on stream terraces. Nukrum soils are deep and clayey. They are on upland plains and in the valley fill material. Rowden soils are moderately deep and loamy. They are on upland plains underlain by limestone. Thurber soils are deep and loamy. They are on uplands of ancient outwash.

The soils in this map unit are mainly used as cropland, rangeland, and pastureland and as habitat for wildlife. The main crops are oats and wheat. Some forage sorghum and grain sorghum also are grown. Improved pasture grasses mainly are bermudagrass and kleingrass.

Deer, turkey, quail, dove, and squirrel are the main kinds of wildlife. Many areas do not have adequate cover for deer, but the deer graze the oats and wheat at night. These soils furnish nesting areas for dove and songbirds.

The main limitations of the soils in this map unit for dwellings, roads, and other structures are the shrink-swell potential of Leeray and Wichita soils, the small stones in Pitzer soils, and corrosivity to uncoated steel. Foundations for buildings and roads can be designed and constructed to withstand the high shrink-swell potential of the soils. Corrosion of underground steel utility lines is rapid unless they are protected. Special design and proper installation are needed if septic tank absorption field systems are to function properly. Pollutants should be prevented from passing through the Pitzer soils and contaminating the ground water. Landscaping and gardening are difficult because of small stones or the clay texture of the soils.

Soils Mainly of Recent Flood Plain Sediments

The two general soil map units in this group make up about 7 percent of the county. The major soils are in the Clairemont, Clearfork, Frio, Gageby, and Grandfield series. These soils have developed mainly in recent alluvial sediments on the flood plains of the Clear Fork of the Brazos River and on the flood plains of Deep Creek and Hubbard Creek and their associated terraces. The areas of these soils that are most frequently flooded are in rangeland, and those that are not flooded or only occasionally flooded are in cropland.

6. Clairemont-Grandfield-Clearfork

Deep, nearly level to gently sloping, loamy, clayey, and sandy soils; on bottom land and terraces

Clairemont soils are loamy, and Clearfork soils are clayey. These soils are on the flood plain of the Clear Fork of the Brazos River. Grandfield soils are loamy and sandy. They are on terraces alongside the flood plain (fig. 6).

This map unit makes up about 4 percent of Shackelford County. It is about 30 percent Clairemont soils, 30 percent Grandfield soils, 13 percent Clearfork soils, and 27 percent other soils.

Typically, the surface layer of Clairemont soils is reddish brown silty clay loam about 7 inches thick. The underlying material to a depth of 60 inches is massive, alternating strata of reddish brown and reddish yellow silty clay loam, silt loam, or very fine sandy loam. The soils are moderately alkaline and calcareous throughout.

Typically, the surface layer of Grandfield soils is mildly alkaline, reddish brown fine sandy loam about 5 inches thick. The upper part of the subsoil, to a depth of 15 inches, is neutral, reddish brown sandy clay loam. The next layer, to a depth of 38 inches, is neutral, red sandy clay loam. The next layer, to a depth of 49 inches, is mildly alkaline, light red fine sandy loam. The lower part to a depth of 60 inches is moderately alkaline, light red fine sandy loam that contains a few films and threads of calcium carbonate. Grandfield soils include a few hundred acres that have a loamy fine sand surface layer.

Typically, the upper part of the surface layer of Clearfork soils is dark reddish gray silty clay about 10 inches thick. The lower part, to a depth of 26 inches, is reddish brown silty clay. The subsoil, to a depth of 36 inches, is reddish brown silty clay loam. The substratum to a depth of 60 inches is reddish brown silty clay loam. The soils are moderately alkaline and calcareous throughout.

Soils of minor extent in this map unit are Lueders, Minwells, Palopinto, and Patilo soils. Lueders soils are very shallow and very gravelly and loamy, and Palopinto soils are very flaggy and loamy. They are on limestone ledges and bluffs along the river. Minwells soils are deep and loamy, and Patilo soils are sandy. These soils are on terraces alongside the flood plains.

The soils in this map unit are mainly used as cropland, rangeland, and pastureland, for recreation use, and as habitat for wildlife. Clairemont and Clearfork soils are flooded every 3 to 20 years, and some Clairemont soils are flooded once or twice every 1 to 3 years, and they remain under water from 2 to 48 hours. The current is swift during periods of flooding. The main crops are oats and wheat. Some alfalfa, cotton, forage sorghum, and grain sorghum also are grown. Improved pasture grasses mainly are bermudagrass and kleingrass. A few fields are irrigated.

Deer, turkey, quail, dove, and squirrel are the main kinds of wildlife. Some areas are managed by ranchers for hunting. These soils furnish nesting areas for dove and songbirds.

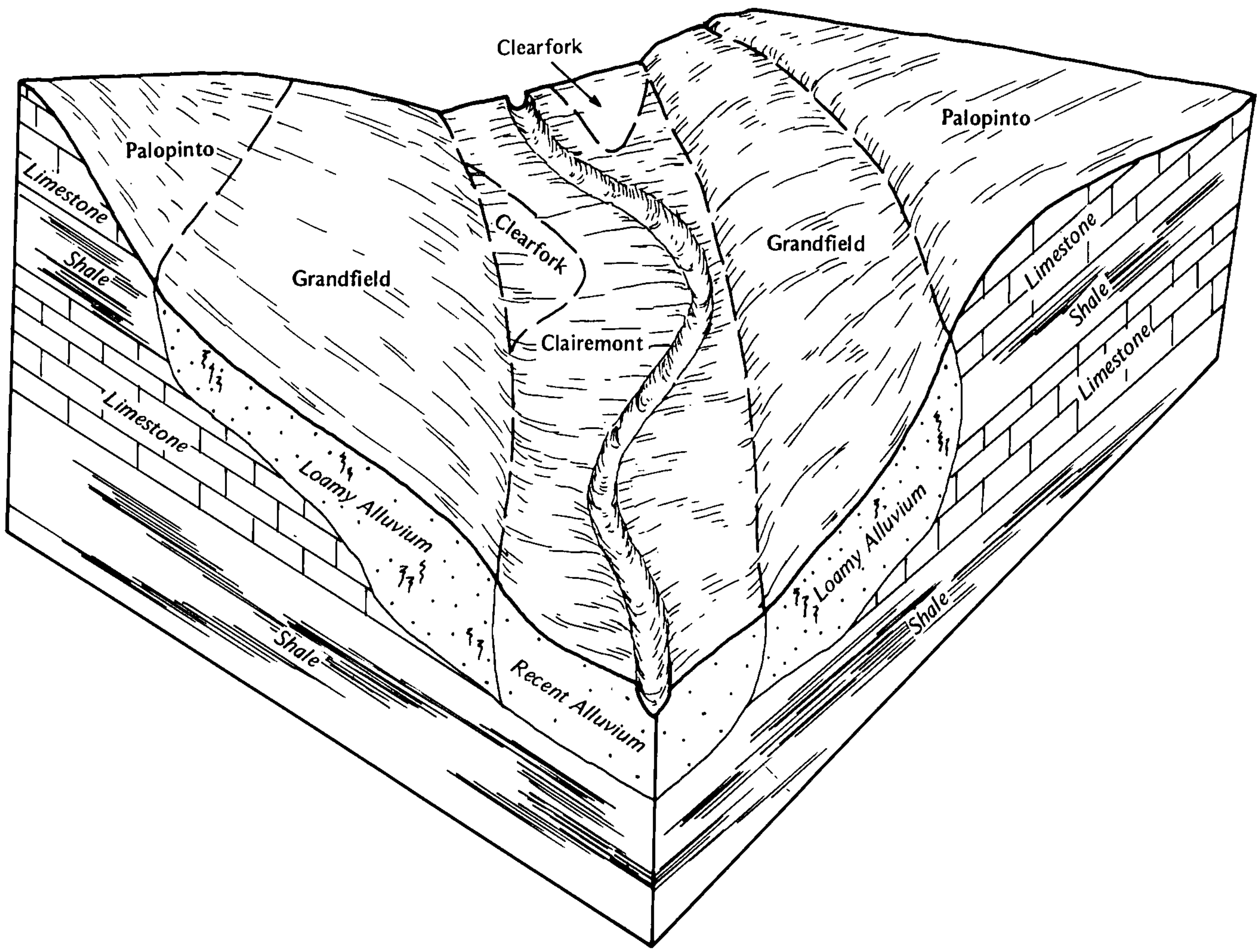


Figure 6.—Typical pattern of soils and parent material in the Clairemont-Grandfield-Clearfork map unit.

The Clear Fork of the Brazos River and areas alongside it are scenic and provide recreational areas for fishing, swimming, boating, hiking, and other related sports. Flooding is a hazard on these soils and must be considered when planning, designing, and building playgrounds, camp areas, houses, and roads. The main limitations for dwellings, roads, and other structures are low strength and corrosivity to uncoated steel. Foundations for buildings and roads can easily be designed and constructed to compensate for low strength. Corrosion of underground steel utility lines is rapid unless they are protected. Special design and proper installation are needed if septic tank absorption field systems are to function properly. Pollutants should be prevented from passing through the substratum and contaminating the ground water.

7. Frio-Gageby

Deep, nearly level, clayey and loamy soils; on bottom lands

Frio soils are clayey, and Gageby soils are loamy. These soils are on the flood plains of Deep Creek and Hubbard Creek.

This map unit makes up about 3 percent of Shackelford County. It is about 71 percent Frio soils, 15 percent Gageby soils, and 14 percent other soils.

Typically, the upper part of the surface layer of Frio soils is dark grayish brown silty clay 24 inches thick. The lower part, to a depth of 44 inches, is dark brown silty clay that contains films and threads of calcium carbonate. The subsoil to a depth of 60 inches is brown silty clay that contains films and threads of calcium carbonate. Strata of silty clay loam occur at varying intervals. The soils are moderately alkaline and calcareous throughout.

Typically, the upper part of the surface layer of Gageby soils is dark grayish brown sandy clay loam about 6 inches thick. The middle part, to a depth of 24 inches, is very dark grayish brown loam. The lower part, to a depth of 31 inches, is dark grayish brown loam that contains films and threads of calcium carbonate. The upper part of the subsoil, to a depth of 48 inches, is brown silt loam. The lower part to a depth of 60 inches is dark brown clay loam. The soils are moderately alkaline throughout and are calcareous below a depth of 24 inches.

Soils of minor extent in this map unit are Clearfork, Minwells, Nukrum, Nuvalde, and Wichita soils. Clearfork soils are deep and clayey. They are on the flood plains. Minwells and Wichita soils are deep and loamy. These soils are on stream terraces. Nukrum soils are deep and clayey, and Nuvalde soils are loamy. These soils are on ancient outwash uplands and in the valley fill material.

The soils in this map unit are mainly used as cropland, rangeland, and pastureland, for recreation use, and as habitat for wildlife. However, Frio and Gageby soils are flooded once or twice every 3 to 12 years, and they remain under water from 2 to 48 hours. The current is swift during periods of flooding. The main crops are oats and wheat. Some forage sorghum and grain sorghum also are grown. Improved pasture grasses mainly are bermudagrass and kleingrass. A few areas are irrigated.

Deer, turkey, quail, dove, and squirrel are the main kinds of wildlife. Many areas do not have adequate cover for deer, but the deer graze the oats and wheat at night. These soils furnish nesting areas for turkey, dove, and songbirds.

Flooding is a hazard on these soils and must be considered when planning, designing, and constructing playgrounds, camp areas, houses, and roads. The main limitations for dwellings, roads, and other structures are low strength, shrink-swell potential, and corrosivity to uncoated steel. Foundations for buildings and roads can be designed and constructed to withstand the high shrink-swell potential and low strength of these soils. Unprotected areas are muddy following rains, making foot and vehicle traffic difficult. Corrosion of underground steel utility lines is rapid unless they are protected. Special design and proper installation are needed if septic tank absorption field systems are to function properly. Pollutants should be prevented from passing through the substratum and contaminating the ground water.

Soils Mainly Underlain by Sandstone and Shale

The two general soil map units in this group make up about 6 percent of the county. The major soils are in the Bluegrove, Bonti, Chaney, Thurber, and Truce series. These soils have developed over sandstone and shale of Permian and Pennsylvanian age. The landscape is generally undulating. Stones and flags of sandstone are on some soils. In most areas, these soils are used as rangeland; and in a few areas, they are used as pastureland or cropland.

8. Bluegrove-Thurber

Moderately deep and deep, nearly level to undulating, loamy soils, some are flaggy; on uplands

Bluegrove soils are moderately deep and gently sloping to undulating. These soils are on ridges. Thurber soils are deep and nearly level to gently sloping. These soils are on ancient outwash plains and on filled valley floors (fig. 7).

This map unit makes up about 5 percent of Shackelford County. It is about 40 percent Bluegrove soils, 39 percent Thurber soils, and 21 percent other soils.

Typically, the surface layer of Bluegrove soils is reddish brown loam about 4 inches thick. The upper part of the subsoil, to a depth of 10 inches, is reddish brown sandy clay loam. The middle part, to a depth of 19 inches, is yellowish red clay. The lower part, to a depth of 24 inches, is reddish yellow clay that contains 30 percent sandstone fragments. Below the subsoil to a depth of 30 inches is yellowish brown sandstone. The soils are neutral throughout.

Typically, the surface layer of Thurber soils is mildly alkaline, dark brown clay loam about 5 inches thick. The upper part of the subsoil, to a depth of 16 inches, is moderately alkaline, noncalcareous, dark grayish brown clay. The next layer, to a depth of 36 inches, is moderately alkaline, calcareous, dark grayish brown clay. The next layer, to a depth of 51 inches, is moderately alkaline, calcareous, dark grayish brown clay that has concretions of calcium carbonate. The lower part to a depth of 60 inches is moderately alkaline, calcareous, grayish brown clay that has concretions of calcium carbonate.

Soils of minor extent in this map unit are Bonti, Gageby, Hensley, Leeray, Harpersville, Owens, and Truce soils. Bonti soils are moderately deep and sandy, and Hensley soils are shallow and loamy. These soils are on upland ridges. Bonti soils are underlain by sandstone, and Hensley soils are underlain by limestone. Gageby soils are deep and loamy. They are on the flood plains. Leeray soils are deep and clayey. They are on the upland plains. Harpersville and Owens soils are deep but thinly developed. These soils are clayey. They

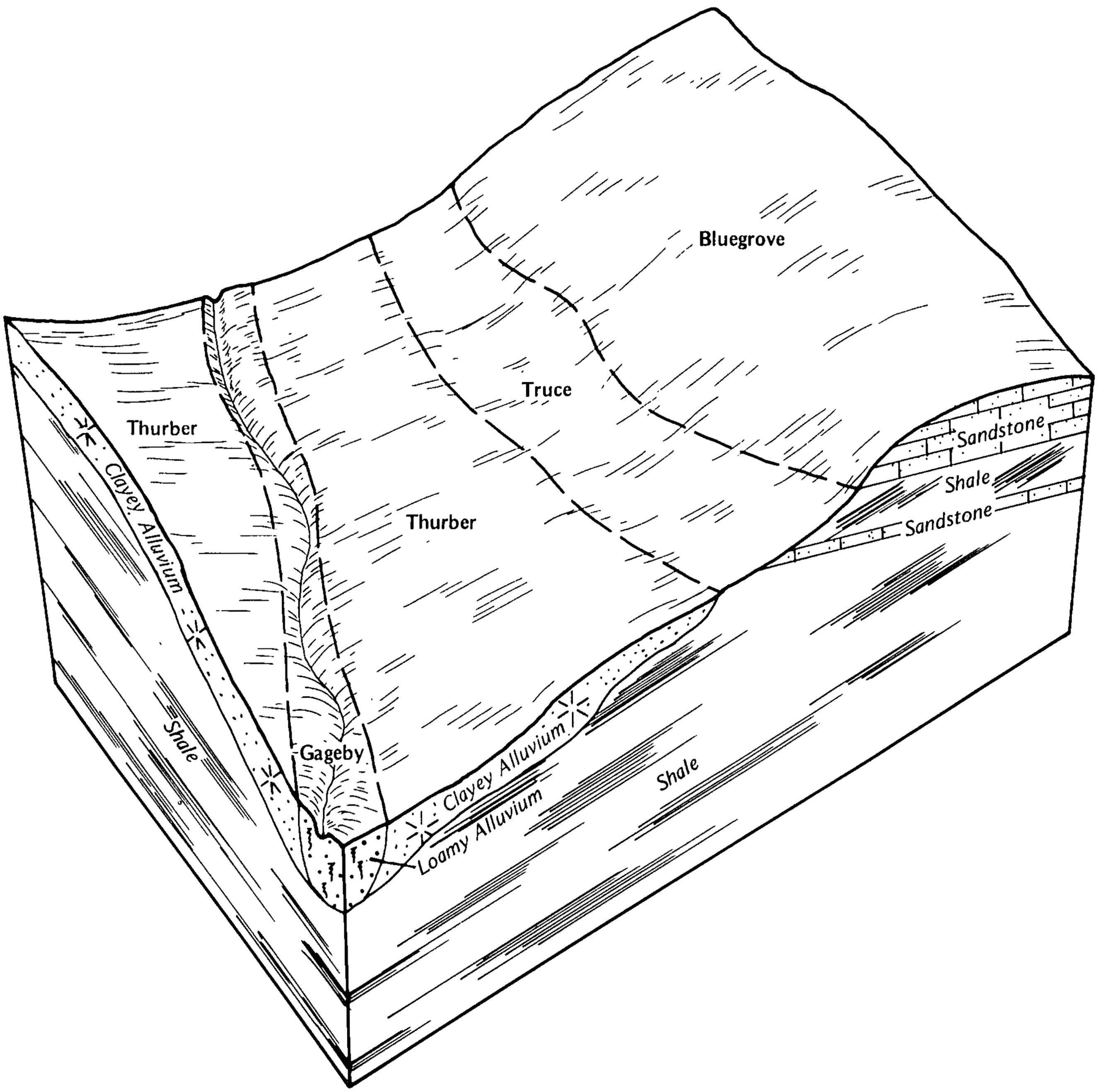


Figure 7.—Typical pattern of soils and parent material in the Bluegrove-Thurber map unit.

formed in shale on ridges and hillsides. Truce soils are deep and loamy. They are on upland plains and are underlain by shale.

The soils in this map unit are mainly used as rangeland, cropland, and pastureland and as habitat for wildlife. A few areas of Thurber soils are used as cropland. The main crops are oats, wheat, forage sorghum, and grain sorghum. Improved pasture grasses mainly are bermudagrass and kleingrass.

Deer, turkey, quail, dove, and squirrel are the main kinds of wildlife. Some areas are managed by ranchers for hunting. Nesting areas for dove, turkey, and songbirds are plentiful.

The main limitations for dwellings, roads, and other structures are depth to bedrock, large stones, and corrosivity to uncoated steel. Thurber soils are subject to shrinking and swelling. Foundations for buildings and roads can be designed and constructed to withstand the shrink-swell potential of these soils. Foundations can be placed on solid bedrock on Bluegrove soils; however, excavating the bedrock is difficult. Corrosion of underground steel utility lines is rapid unless they are protected. Special design and proper installation of septic tank absorption field systems are needed if they are to function properly. Pollutants should be prevented from passing through the bedrock and contaminating the ground water. Landscaping of these soils and gardening are difficult because of stones and depth to bedrock.

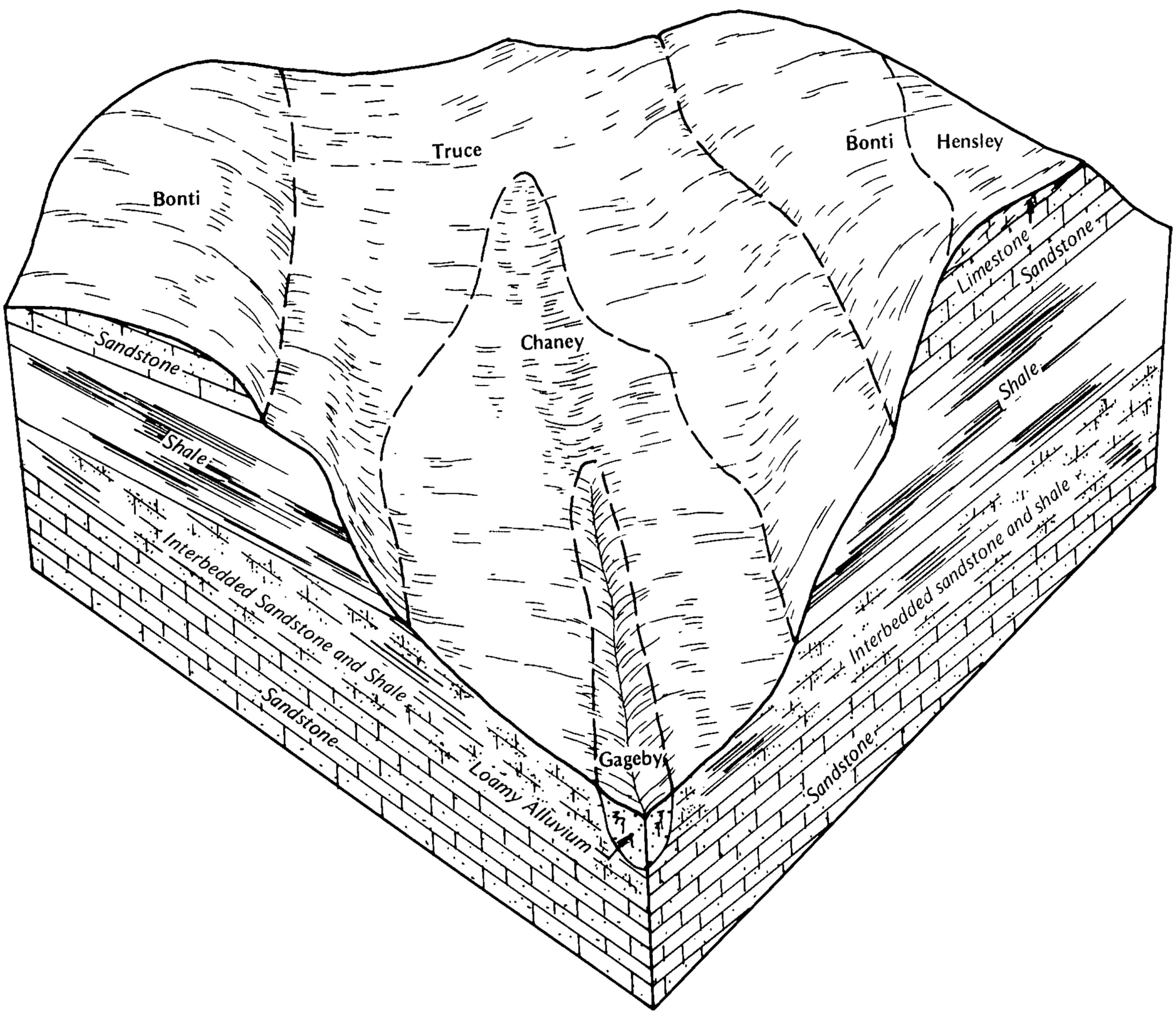


Figure 8.—Typical pattern of soils and parent material in the Truce-Chaney-Bonti map unit.

9. Truce-Chaney-Bonti

Deep and moderately deep, nearly level to gently sloping, loamy and sandy soils; on uplands

Truce soils are deep and gently sloping. These soils are on broad upland plains. Chaney soils are deep and nearly level and gently sloping. Chaney soils are in slightly lower areas than Truce soils and are on broad upland plains. Bonti soils are moderately deep and gently sloping. They are on upland hilltops (fig. 8).

This map unit makes up about 1 percent of Shackelford County. It is about 40 percent Truce soils, 29 percent Chaney soils, 12 percent Bonti soils, and 19 percent other soils.

Typically, the surface layer of Truce soils is neutral, brown fine sandy loam about 5 inches thick. The upper part of the subsoil, to a depth of 15 inches, is neutral, reddish brown clay. The middle part, to a depth of 52 inches, is strong brown clay that is neutral to a depth of 34 inches and moderately alkaline below. The lower part, to a depth of 56 inches, is moderately alkaline, calcareous, yellowish brown clay. The substratum to a depth of 60 inches is calcareous, moderately alkaline, pale brown shaly clay.

Typically, the surface layer of Chaney soils is neutral, brown loamy fine sand about 8 inches thick. The subsurface layer, to a depth of 19 inches, is slightly acid, light brown loamy fine sand. The upper part of the subsoil, to a depth of 24 inches, is slightly acid, yellowish red clay. The next layer, to a depth of 32 inches, is mildly alkaline, yellowish brown clay. The next layer, to a depth of 44 inches, is moderately alkaline, mottled brownish yellow, white, and pale brown clay. The lower part, to a depth of 52 inches, is moderately alkaline, calcareous, mottled very pale brown and yellow sandy clay. The substratum to a depth of 60 inches is calcareous, moderately alkaline, very pale brown sandy clay loam. About 19 percent of the Chaney soils have a stony surface.

Typically, the surface layer of Bonti soils is brown loamy fine sand about 6 inches thick. The upper part of the subsoil, to a depth of 20 inches, is red clay. The lower part, to a depth of 22 inches, is yellowish red clay. Below the subsoil is yellowish brown sandstone and conglomerate. The soils are slightly acid throughout.

Soils of minor extent in this map unit are Gageby, Hensley, Palopinto, Throck, and Thurber soils. Gageby soils are deep and loamy. They are on the flood plains. Hensley and Palopinto soils are shallow and very shallow. These soils are on ridges underlain by limestone. Thurber soils are deep and loamy. They are on upland plains of ancient outwash. Throck soils are deep and clayey. They are on uplands underlain by shale.

The soils in this map unit are mainly used as rangeland, cropland, and pastureland and as habitat for wildlife. These soils were all in oak timber prior to the settlement of the county. The cleared areas have been cropped at some time. Some areas of these soils are eroded, and many areas have been retired to grass. The main crops now are peanuts, cotton, wheat, and forage sorghum. Improved pasture grasses are bermudagrass or tall, native grasses.

Deer, turkey, quail, dove, and squirrel are the main kinds of wildlife. A few areas are managed by landowners for hunting. Nesting areas are plentiful for dove and songbirds.

The main limitations for dwellings, roads, and other structures are depth to bedrock, low strength, and corrosivity to uncoated steel. Foundations for buildings and roads can be placed on solid bedrock, although excavating the bedrock is difficult. Foundations can be designed and constructed to compensate for low soil strength. Corrosion of underground steel utility lines is rapid unless they are protected. Special design and proper installation are needed if septic tank absorption field systems are to function properly. Pollutants should be prevented from passing through the bedrock and contaminating the ground water. Landscaping of these soils and gardening are difficult because of the clayey texture of the subsoil and depth to bedrock.

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 fine sandy loam is one of two phases in the Grandfield series.

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

A *soil association* is made up of two or more geographically associated soils that are shown as one unit on the maps. Because of present or anticipated soil uses in the survey area, it was not considered practical or necessary to map the soils separately. The pattern and relative proportion of the soils are somewhat similar. Throck-Palopinto association, steep, is an example.

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. Pits 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.

AbA—Abilene clay loam, 0 to 2 percent slopes. This soil is deep, nearly level to gently sloping, and well drained. It is on outwash plains and ancient stream terraces on the uplands. The surface is smooth and plane. The slopes average about 1 percent. The mapped areas are irregular in shape and range from 15 to 150 acres.

Typically, this soil has a surface layer of dark grayish brown clay loam about 6 inches thick. The upper part of the subsoil, to a depth of 16 inches, is very dark grayish brown clay. The next part, to a depth of 22 inches, is dark brown clay. The next part, to a depth of 36 inches, is brown clay that has about 10 percent visible soft masses of calcium carbonate. The lower part to a depth of 60 inches is pink clay loam that contains about 60 percent calcium carbonate. Reaction is moderately alkaline throughout. This soil is calcareous below 16 inches of the surface.

This soil is moderately slowly permeable. Surface runoff is slow. The available water capacity is high. The root zone is deep. The hazard of water erosion is moderate, and the hazard of soil blowing is slight. During periods of heavy rains a perched water table is at a depth of more than 40 inches in some areas near saline seeps.

Included with this soil in mapping are small areas of Leeray and Rowena soils. Also included are small areas of soils that are similar to Abilene soil but have a fine sandy loam surface layer. In addition are some areas of soils that have limestone bedrock at a depth of 5 or 6 feet. These included soils make up less than 20 percent of the map unit.

This Abilene soil is mainly used as cropland. A few areas are in improved pasture. Cotton and grain sorghum are the main crops.

This soil is well suited to crops, such as cotton and grain sorghum. Crop residue left on or near the surface helps to control water erosion and soil blowing and conserves moisture. Contour farming, terraces, and grassed waterways control water erosion. Underground drainage systems will lower the water table and reduce the salinity of seepy areas.

The suitability of this soil for native range plants is good. Low rainfall is the most limiting factor, but adequate yields of short- and mid-grasses can be expected in most years.

This soil is well suited to use as habitat for wildlife, especially for doves and quail.

Permeability, shrink-swell potential, low strength, and corrosivity to uncoated steel are the most restrictive features for urban use, but these can be overcome by special design and proper installation of buildings, streets, and utilities. This soil has only slight restrictions for recreational uses.

This Abilene soil is in capability subclass IIe and is in the Clay Loam range site.

BeB—Bluegrove loam, 1 to 3 percent slopes. This soil is moderately deep, gently sloping, and well drained. It is on the uplands. The surface is plane to convex. The slopes average 1.5 percent. The mapped areas are irregular in shape and range from 25 acres to several hundred acres.

Typically, this soil has a surface layer of reddish brown loam about 4 inches thick. The upper part of the subsoil, to a depth of 10 inches, is reddish brown sandy clay loam that contains a few medium sandstone fragments. The middle part, to a depth of 19 inches, is yellowish red clay. The lower part, to a depth of 24 inches, is reddish yellow clay that contains about 30 percent sandstone fragments. Yellowish brown sandstone is below the subsoil to a depth of 30 inches. Reaction is neutral throughout.

This soil is moderately slowly permeable. Runoff is medium. The available water capacity is low. The root zone is moderately deep. The hazard of water erosion is moderate, and the hazard of soil blowing is slight.

Included with this soil in mapping are small areas of Bonti and Truce soils. Also included are some small areas of Bluegrove flaggy fine sandy loam soils, some areas of soils that are similar to Bluegrove soil and have sandstone at a depth of less than 20 inches, and also some soils that are similar but are more clayey in the upper part of the subsoil. These included soils make up less than 25 percent of the map unit.

This Bluegrove soil is used as cropland or rangeland. Small grains and forage sorghum are the main crops.

This soil is poorly suited to cultivated crops. Depth to sandstone and low available water capacity are the most limiting factors. Crop residue left on the surface helps to control water erosion and soil blowing and conserves moisture. Contour farming and terraces help conserve moisture and reduce erosion.

This soil is well suited to native range plants. The climax plant community is a mixture of mid- and short-grasses and scattered live oak and post oak. In most rangeland areas are Texas wintergrass, vine-mesquite, tall dropseed, threeawns, mesquite, pricklypear, and some annual plants. Effective management practices are proper stocking, controlled grazing, and brush management.

This soil is fairly suited to use as habitat for wildlife, especially for doves and quail.

This soil is poorly suited to most urban uses. Depth to bedrock is the most limiting factor. This soil is well suited to recreational uses.

This Bluegrove soil is in capability subclass IIIe and is in the Tight Sandy Loam range site.

BgC—Bluegrove flaggy fine sandy loam, undulating. This soil is moderately deep and well drained. It is on the uplands. The surface is convex. The slopes are complex and range from 1 to 8 percent. The slopes average about 3 percent. The mapped areas are irregular in shape and range from 50 acres to several hundred acres.

Typically, the upper part of the surface layer of this soil is neutral, brown flaggy fine sandy loam about 4 inches thick. It contains about 30 percent flattened sandstone fragments. The lower part, to a depth of 9 inches, is slightly acid, reddish brown fine sandy loam. The subsoil, to a depth of 21 inches, is slightly acid, reddish brown clay. Very pale brown, weakly cemented sandstone is below the subsoil to a depth of 48 inches.

This soil is moderately slowly permeable. Runoff is medium. The available water capacity is low. The root zone is moderately deep. Water erosion and soil blowing are generally not a problem on this soil.

Included with this soil in mapping are some areas of Bonti and Truce soils. Also included are small areas of Bluegrove soils that are not flaggy and some areas of a soil that is similar to Bluegrove soil but has more than 35 percent sandstone fragments in the surface layer. These included soils make up less than 25 percent of the map unit.

This Bluegrove soil is used as rangeland. This soil is not suitable for use as cropland because of stoniness.

This soil is well suited to use as rangeland. Low rainfall is the most limiting factor. Native range plants are mostly mid- and short-grasses and scattered live oak and post oak. In most rangeland areas are Texas wintergrass, sand dropseed, Texas grama, curlymesquite, catclaw acacia, and some annual plants and post oak and mesquite trees.

This soil is fairly suited to use as habitat for wildlife, especially for doves, quail, and small animals.

This soil is poorly suited to most urban uses. Depth to bedrock is the most limiting factor. This soil is only moderately suited to recreational uses because of sandstone flags on the surface.

This Bluegrove soil is in capability subclass VIs and in the Sandstone Hill range site.

BoB—Bonti loamy fine sand, 1 to 3 percent slopes. This soil is moderately deep, gently sloping, and well drained. It is on the upland ridges. The surface is convex. The slopes average about 2 percent. The mapped areas are irregular in shape and range from 15 to more than 100 acres.

Typically, this soil has a surface layer of brown loamy fine sand about 6 inches thick. The upper part of the subsoil, to a depth of 20 inches, is red clay. The lower part, to a depth of 22 inches, is yellowish red clay. Yellowish brown sandstone and conglomerate are below the subsoil. Reaction is slightly acid throughout.

This soil is moderately slowly permeable. Runoff is medium. The available water capacity is low. The root zone is moderately deep, and the penetration of the clayey subsoil by plant roots is difficult. The hazard of water erosion is moderate, and the hazard of soil blowing is severe.

Included with this soil in mapping are some areas of Truce, Bluegrove, and Chaney soils. Also included are small areas of soils that are similar to Bonti soil and are less than 20 inches deep or have more than 15 percent sandstone fragments in the surface layer. These included soils make up less than 25 percent of the map unit.

This Bonti soil is mainly used as rangeland, but some areas are used as cropland. The main crops are small grains and forage sorghum. Most former cropland areas are now in rangeland or improved pasture.

This soil is poorly suited to cultivated crops. Low rainfall and low available water capacity are the most limiting factors. Crop residue left on the surface conserves moisture and helps to control soil blowing. Contour farming, terraces, and grassed waterways also control water erosion and soil blowing.

This soil is moderately suited to native range plants. Low rainfall is the most limiting factor. Native range plants are mostly mid- and short-grasses. In most rangeland areas are little bluestem, sideoats grama, sand lovegrass, purpletop, and greenbrier and post oak and mesquite trees.

This soil is well suited to use as habitat for wildlife, especially for doves and quail.

This soil is poorly suited to most urban uses. Depth to bedrock, low strength, and shrink-swell potential are the most limiting features. This soil is well suited to recreational uses. Slow permeability, depth to bedrock, and the sandy surface layer can limit the use of this soil for recreational use in some places.

This Bonti soil is in capability subclass IVe and is in the Loamy Sand range site.

CaB—Chaney loamy fine sand, 0 to 3 percent slopes. This soil is deep, nearly level to gently undulating, and moderately well drained. It is on the uplands. The surface is concave. The slopes average about 1 percent. The mapped areas are irregular in shape and range from 15 to 150 acres.

Typically, this soil has a surface layer of neutral, brown loamy fine sand about 8 inches thick. The subsurface layer, to a depth of 19 inches, is slightly acid, loamy fine sand. The upper part of the subsoil, to a depth of 24 inches, is slightly acid, yellowish red clay. The next layer, to a depth of 32 inches, is mildly alkaline, yellowish brown clay. The next layer, to a depth of 44 inches, is moderately alkaline, mottled brownish yellow, white, and pale brown clay. The lower part, to a depth of 52 inches, is moderately alkaline, calcareous, mottled very pale brown and yellow sandy clay. The substratum to a depth of 60 inches is calcareous, very pale brown sandy clay loam.

This soil is slowly permeable. Runoff is medium or slow. The available water capacity is medium. The root zone is deep. The hazard of water erosion is moderate, and the hazard of soil blowing is severe. A perched water table is above the subsoil for short periods following heavy rains.

Included with this soil in mapping are some areas of Chaney soils that have a surface layer of fine sand and loamy sand. Also included are soils that are similar to Chaney soil but have an unmottled subsoil, soils that have a sandy surface layer more than 20 inches thick, and soils that are more than 60 inches deep. These included soils make up less than 20 percent of the map unit.

This Chaney soil is used mostly as improved pasture or rangeland. Most areas of this soil were used as cropland at one time. Forage sorghum is the main crop in the few areas that are still used as cropland.

This soil is moderately suited to cultivated crops. Low rainfall and the soil blowing hazard are the most limiting factors. Crop residue left on the surface conserves moisture and helps to control soil blowing.

This soil is moderately suited to native range plants. Native range plants are mostly mid- and tall-grasses. In most rangeland areas are sand bluestem, sideoats grama, hooded windmillgrass, and threeawns. Woody vegetation includes post oak, greenbrier, tasajillo, and catclaw.

This soil is well suited to use as habitat for wildlife, especially for doves and quail.

This soil is moderately suited to most urban uses. The shrink-swell potential and clayey texture of the subsoil are the most limiting factors. This soil is well suited to most recreational uses. The sandy surface layer and slow permeability can limit use of this soil in some places.

This Chaney soil is in capability subclass IIIe and is in the Loamy Sand range site.

CeC—Chaney stony sandy loam, undulating. This soil is deep and moderately well drained. It is on ridges on the uplands. The surface is convex. The slopes range from 1 to 8 percent. The mapped areas are long and narrow and range from 30 to 100 acres. This soil is on the highest elevation in the county, ranging from 2,000 to 2,027 feet. Boulders, stones, and cobble-size quartz conglomerates cover from 5 to 20 percent of the surface. These floating fragments are on the surface and in the surface layer.

This map unit is made up of about 90 percent Chaney stony sandy loam and soils that are very similar. About 10 percent of the map unit is contrasting shallow soils and rock outcrop. The use and management of these soils are the same.

Typically, this soil has a surface layer of neutral, brown stony sandy loam about 13 inches thick. It contains about 30 percent fine quartz gravel in the upper 8 inches and about 65 percent in the lower 5 inches. A discontinuous layer of conglomerate about 4 inches thick is in the lower part of the surface layer. The subsoil extends to a depth of about 65 inches. The upper part, to a depth of 23 inches, is slightly acid, yellowish red clay that contains about 32 percent fine quartz gravel and grayish brown mottles. The middle part, to a depth of 45 inches, is slightly acid, yellowish red clay that contains about 10 percent fine quartz gravel and a few grayish brown mottles. The lower part is slightly acid, strongly brown clay that is coarsely mottled with grayish brown. Gray shaly clay is below the subsoil to a depth of 80 inches.

This soil is slowly permeable. Runoff is medium. The available water capacity is medium. The root zone is deep. Water erosion and soil blowing are generally not problems on this soil.

Included with this soil in mapping are soils that are similar to Chaney soil and are gravelly throughout. Also included are some small areas of soils that do not have stones on the surface. These included soils make up about 25 percent of the map unit.

This Chaney soil is used as rangeland and as habitat for wildlife. It is moderately suited to native range plants. Low rainfall is the most limiting factor in the amount of forage produced. Native range plants are mostly mid- and short-grasses. In most rangeland areas are Texas wintergrass, threeawns, tall dropseed, catclaw, tasajillo, mesquite, and hackberry.

This soil is fairly suited to use as habitat for wildlife, especially for quail, doves, and small animals.

This soil is poorly suited to most urban uses. Permeability and stones are the most limiting factors. One area has been mined for roadbed gravel. This soil is suited to most recreational uses. Slope and stones in and on the surface can restrict the use of the soil for playgrounds.

This Chaney soil is in capability subclass VIs and is in the Loamy Sand range site.

ChC—Cho gravelly loam, undulating. This soil is very shallow or shallow and is well drained. It is on the uplands. The surface is convex. The slopes range from 1 to 8 percent. They average about 3.5 percent. The mapped areas are irregular in shape and range from 100 acres to several hundred acres.

Typically, this soil has a surface layer of dark brown gravelly loam about 7 inches thick. The subsoil, to a depth of 12 inches, is indurated platy caliche. The substratum to a depth of 54 inches is white, yellow, and yellowish brown weakly cemented caliche of clay loam texture.

This soil is moderately permeable. Runoff is medium. The available water capacity is very low. The root zone is shallow or very shallow. Water erosion and soil blowing are not problems on this soil.

Included with this soil in mapping are some areas of Mereta, Purves, Throck, and Lueders soils. Also included are some small areas of rock outcrop, a few areas of soils that have a loamy or gravelly clay loam texture, and a soil that is similar to Cho soil and has a light brownish gray surface layer. These included soils make up less than 25 percent of the map unit.

This Cho soil is used as rangeland and as habitat for wildlife (fig. 9). This soil is not suitable for use as cropland because of shallow depth.

This soil is suited to native range plants. Low rainfall, shallow rooting depth, very low available water capacity, and runoff limits the amount of forage produced. Native range plants are mostly mid- and short-grasses. In most rangeland areas are Texas wintergrass, sand dropseed, Texas grama, curlymesquite, catclaw, and some annual plants and mesquite trees.

The suitability of this soil as habitat for wildlife is fair, especially for quail and doves. Nesting places for quail and doves are plentiful. Antelope has been reintroduced in some areas.

This soil is poorly suited to most urban uses. Slope, depth to a cemented pan, and small stones are the most limiting factors. Some areas are mined for roadbed material. This soil is only moderately suited to recreational uses because of slopes and small stones on the surface.

This Cho soil is in capability subclass VIs and is in the Very Shallow range site.

Cm—Clairemont silty clay loam, occasionally flooded. This soil is deep, nearly level, and well drained. It is on the flood plains of the Clear Fork of the Brazos River. The slopes are less than 1 percent. The mapped

Figure 9.—Cho gravelly loam, undulating, is a soil that is mainly used as rangeland and as habitat for wildlife.

areas are long and narrow and range from 80 acres to several hundred acres.

Typically, this soil has a surface layer of reddish brown silty clay loam about 7 inches thick. The underlying material to a depth of 60 inches is massive, alternating strata of reddish brown and reddish yellow silty clay loam, silt loam, or very fine sandy loam. This soil is moderately alkaline and calcareous throughout.

This soil is moderately permeable. Surface runoff is slow. The available water capacity is high. The root zone is deep and is easily penetrated by plant roots. Water erosion and soil blowing are slight hazards. Flooding occurs once every 3 to 7 years.

Included with this soil in mapping are some small areas of Clearfork soils. Also included are small areas of soils that are adjacent to sloughs and have slopes that exceed 1 percent, some areas of soils that are undulating, and some soils that have a surface texture of silt loam. These included soils make up less than 10 percent of the map unit.

This Clairemont soil is mainly used as cropland. Small grains, cotton, and grain sorghum are the main crops.

The soil is well suited to cultivated crops. Crop residue left on or near the surface increases water infiltration, conserves moisture, and controls soil blowing.

Native range plants grow well on this soil. Low rainfall is the most limiting factor, but yields of short- and mid-grasses are good during favorable years. A concern in management is the loss of livestock during periods of severe flooding.

This soil is well suited to use as habitat for wildlife, especially for deer and turkey.

This soil is poorly suited to most urban uses. Flooding is the most restrictive feature. Flooding also restricts the use of this soil for recreational uses.

This Clairemont soil is in capability subclass IIw and is in the Loamy Bottomland range site.

Cn—Clairemont silty clay loam, channeled. This soil is deep, nearly level to gently sloping, and well drained. It is on the flood plains, which are mostly along and in the channel of the Clear Fork of the Brazos River. The overall slope averages about 1.5 percent but ranges from 0 to 2 percent. Secondary channels that are 1 to 5 feet deep and at intervals of 30 feet parallel to streamflow have developed from frequent flooding. The mapped areas are oblong to elongated and range from 10 to about 200 acres.

Typically, this soil has a surface layer of reddish brown silty clay loam about 18 inches thick. The upper part of the underlying material, to a depth of 35 inches, is brown silt loam and has thin strata of variable textures. The lower part to a depth of 60 inches is brown silt loam that has prominent bedding planes. This soil is moderately alkaline and calcareous throughout.

This soil is moderately permeable. Surface runoff is slow. The available water capacity is high. The root zone is deep and is easily penetrated by plant roots. The hazard of water erosion is moderate. Flooding occurs about once a year to once every 3 years. Soil blowing is not a problem on this soil.

Included with this soil in mapping is a soil that contains more than 35 percent clay and a soil that has less than 18 percent clay in the 10- to 40-inch control section. These included soils make up about 30 percent of the map unit.

This Clairemont soil is mainly used as rangeland and pastureland. A few areas are used to grow native pecan trees.

This soil is not suitable for cultivated crops because of the flood hazard. It is subject to scouring and deposition.

This soil is well suited to native range plants. Loss of livestock during periods of flooding is a concern in management. The climax plant community is a mixture of tall- and mid-grasses. In most rangeland areas are Texas wintergrass, silver bluestem, Canada wildrye, bermudagrass, and western ragweed and mesquite, hackberry, and elm trees. Effective management practices include proper stocking, controlled grazing, and brush management.

This soil is well suited to use as habitat for wildlife, especially for deer and turkey.

This soil is poorly suited to most urban uses. Flooding is a severe hazard that is difficult to overcome. This soil is poorly suited to most recreational uses. Flooding restricts the use of this soil for playgrounds and camp areas.

This Clairemont soil is in capability subclass Vw and is in the Loamy Bottomland range site.

Co—Clearfork silty clay, occasionally flooded. This soil is deep, nearly level, and well drained. It is on the flood plains of the Clear Fork of the Brazos River. The slopes range from 0 to 1 percent. The mapped areas are long and narrow and range from 10 to 200 acres.

Typically, the upper part of the surface layer of this soil is dark reddish gray silty clay about 10 inches thick. The lower part, to a depth of 26 inches, is reddish brown silty clay. The subsoil, to a depth of 36 inches, is reddish brown silty clay loam. The substratum to a depth of 60 inches is reddish brown silty clay loam. This soil is moderately alkaline and calcareous throughout.

This soil is slowly permeable. Runoff is slow. The available water capacity is high. The root zone is deep. Water erosion and soil blowing are slight hazards. This soil is flooded about once in 3 to 20 years.

Included with this soil in mapping are small areas of Clairemont soils. Also included are some small areas of soils that are similar to Clearfork soil but have a light reddish brown surface layer, some areas of soils that have less than 35 percent clay in the 10- to 40-inch control section, and some areas of soils that have a surface texture of clay, silty clay loam, or silt loam. These included soils make up less than 15 percent of the map unit.

This Clearfork soil is mainly used as improved pasture and rangeland.

This soil is not suitable for cultivated crops. Loss of livestock and equipment during periods of flooding are concerns in management. This soil produces high yields of mid- and tall-grasses during most years.

This soil is well suited to use as habitat for wildlife, especially for deer and turkey.

The soil in this map unit is poorly suited to urban use because of flooding. Flooding and the high content of clay are limiting features for recreational uses.

This Clearfork soil is in capability subclass IIw and is in the Loamy Bottomland range site.

Fr—Frio silty clay, occasionally flooded. This soil is deep, nearly level, and well drained. It is on the flood plains of local streams (fig. 10). The slopes average about 0.5 percent but range from 0 to 1 percent. Delineations are long, narrow, and parallel to stream channels. The mapped areas range from 10 to about 200 acres.

Typically, the upper part of the surface layer of this soil is dark grayish brown silty clay about 24 inches thick. The lower part, to a depth of 44 inches, is dark brown silty clay with films and threads of calcium carbonate. The subsoil to a depth of 60 inches is brown silty clay with films and threads of calcium carbonate. Strata of silty clay loam are at varying intervals. This soil is moderately alkaline and calcareous throughout.

This soil is moderately slowly permeable. Surface runoff is slow. The available water capacity is high. The root zone is deep and is easily penetrated by plant roots. Water erosion and soil blowing are slight hazards. Flooding occurs about once every 3 to 10 years.

Included with this soil in mapping are small areas of Nukrum and Gageby soils. Also included are some areas of Frio soils that are frequently flooded. These included soils make up about 20 percent of the map unit.

This Frio soil is used as cropland or rangeland. A few areas are used to grow native pecan trees. The main crops are small grains, grain sorghum, and forage sorghum.

Figure 10.—Frio silty clay, occasionally flooded, is used as rangeland.

This soil is well suited to nonirrigated and irrigated crops, such as small grains, grain sorghum, and forage sorghum. Low rainfall limits nonirrigated crop yields. Crop residue left on the surface helps to conserve moisture. A sprinkler system or surface irrigation system if specially designed and properly installed can be used on this soil.

This soil is well suited to native range plants. Flooding is a severe hazard. The loss of livestock and equipment when flooding occurs is a concern in management. The climax plant community is a mixture of tall- and mid-grasses. In most rangeland areas are Texas wintergrass, silver bluestem, Canada wildrye, bermudagrass, and western ragweed and mesquite, hackberry, pecan, and elm trees. Effective management practices include proper stocking, controlled grazing, and brush management.

This soil is well suited to use as habitat for wildlife, especially for turkey and deer.

This soil is poorly suited to most urban uses. Flooding is a severe hazard that is difficult to overcome. This soil is moderately suited to most recreational uses. Flooding and the clayey surface texture restrict the use of this soil for playgrounds and camp areas.

This Frio soil is in capability subclass IIw and is in the Loamy Bottomland range site.

Ga—Gageby sandy clay loam, occasionally flooded. This soil is deep, nearly level, and well drained. It is on the flood plains of local streams. The overall slope averages about 0.5 percent but ranges from 0 to 2 percent. The mapped areas are long, narrow, and parallel to stream channels. They range from 10 to about 200 acres.

Typically, the upper part of the surface layer of this soil is dark grayish brown sandy clay loam about 6 inches thick. The middle part, to a depth of 24 inches, is very dark grayish brown loam. The lower part, to a depth of 31 inches, is dark grayish brown loam. The upper part of the subsoil, to a depth of 48 inches, is brown silt loam with films and threads of calcium carbonate. The lower part to a depth of 60 inches is dark brown clay loam. Reaction is moderately alkaline throughout. This soil is calcareous below a depth of 24 inches.

This soil is moderately permeable. Surface runoff is slow. The available water capacity is high. The root zone is deep and is easily penetrated by plant roots. Water erosion and soil blowing are slight hazards. Flooding occurs about once every 5 to 12 years.

Included with this soil in mapping are Nukrum and Frio soils. Also included are some areas of soils that have a surface texture of loam or clay loam and some areas of soils that are similar to Gageby soil but are noncalcareous to a depth of 40 inches. These included soils make up about 20 percent of the map unit.

This Gageby soil is used for cropland or rangeland. A few areas are used to grow native pecan trees. The main crops are small grains, grain sorghum, and forage sorghum.

This soil is well suited to nonirrigated and irrigated crops, such as small grains, grain sorghum, and forage sorghum. Low rainfall is the most limiting factor for nonirrigated crops. Crop residue left on the surface helps to conserve moisture. A sprinkler or surface irrigation system can be used.

This soil is well suited to native range plants. Flooding is a severe hazard. Loss of livestock and equipment during periods of flooding are concerns in management. The climax plant community is a mixture of tall- and mid-grasses. In most rangeland areas are Texas wintergrass, silver bluestem, Canada wildrye, bermudagrass and mesquite, post oak, hackberry, pecan, and elm trees. Effective management practices include proper stocking, controlled grazing, and brush management.

This soil is well suited to use as habitat for wildlife, especially for turkey and deer.

This soil is poorly suited to most urban uses. Flooding is a severe hazard and is very difficult to overcome. This soil is moderately suited to most recreational uses. Flooding and the clayey texture restrict the use of this soil for playgrounds and camp areas.

This Gageby soil is in capability subclass IIw and is in the Loamy Bottomland range site.

GdB—Grandfield loamy fine sand, 0 to 5 percent slopes. This soil is deep, nearly level to gently sloping, and well drained. It is on high terraces along the Clear Fork of the Brazos River. The slopes average about 2 percent. The mapped areas are irregular in shape and range from 15 acres to several hundred acres.

Typically, this soil has a surface layer of reddish brown loamy fine sand about 15 inches thick. It is mildly alkaline in the upper part of the surface layer and neutral in the lower part. The upper part of the subsoil, to a depth of 36 inches, is neutral, reddish brown sandy clay loam. The middle part, to a depth of 42 inches, is mildly alkaline, reddish yellow fine sandy loam. The lower part to a depth of 60 inches is moderately alkaline, red sandy clay loam that has a few carbonates.

This soil is moderately permeable. Surface runoff is medium. The available water capacity is medium. The root zone is deep and is easily penetrated by plant roots. The hazard of water erosion is moderate, and the hazard of soil blowing is severe.

Included with this soil in mapping are some small areas of Bonti soils. Also included are some small areas of Grandfield fine sandy loam soils and some areas of soils that have slopes of more than 5 percent. These included soils make up less than 20 percent of the map unit.

This Grandfield soil is mainly used as rangeland. A few areas are in cultivated crops, and a few areas are in Coastal bermudagrass pastures. In areas that are cultivated, small grains and forage sorghum are the main crops.

This soil is moderately suited to cultivated crops, such as small grains and forage sorghum. Crop residue left on or near the surface helps to control water erosion and soil blowing and also conserves moisture. In dry years, emergency tillage is needed to help control soil blowing if crop residue does not adequately protect the surface.

This soil is moderately suited to native range plants. Low rainfall is the most limiting factor. Native range plants are mostly mid- and short-grasses and scattered live oak and post oak. In most rangeland areas are silver bluestem, hooded windmillgrass, sideoats grama, purpletop, Texas grama, threeawn, greenbrier, and some annual plants and mesquite trees.

This soil is fairly suited to use as habitat for wildlife, especially for deer, turkey, quail, squirrel, and furbearing animals. Nesting places for quail and songbirds are plentiful.

This soil is well suited to most urban uses. Slope and seepage are the most restrictive features, but these limitations can be easily overcome by special design and proper installation of buildings, streets, and utilities. This soil has only slight limitations for most recreational uses. The use of the soil for playgrounds is restricted because of slope.

This Grandfield soil is in capability subclass IVe and is in the Loamy Sand range site.

GfC—Grandfield fine sandy loam, 1 to 5 percent slopes. This soil is deep, gently sloping, and well drained. It is on high terraces along the Clear Fork of the Brazos River. The slopes average about 2 percent. The mapped areas are irregular in shape and range from 15 acres to several hundred acres.

Typically, this soil has a surface layer of mildly alkaline, reddish brown fine sandy loam about 5 inches thick. The upper part of the subsoil, to a depth of 15 inches, is neutral, reddish brown sandy clay loam. The next layer, to a depth of 38 inches, is neutral, red sandy clay loam. The next layer, to a depth of 49 inches, is mildly alkaline, light red fine sandy loam. The lower part to a depth of 60 inches is moderately alkaline, light red fine sandy loam with a few films and threads of calcium carbonate.

This soil is moderately permeable. Runoff is medium. The available water capacity is medium. The root zone is deep. Water erosion and soil blowing are moderate hazards.

Included with this soil in mapping are some areas of Wichita soils. Also included are Grandfield soils that have slopes of less than 1 percent or more than 5 percent, some areas of soils that are similar to Grandfield soil but have dark brown layers, and some areas of soils that have a subsoil of fine sandy loam. These included soils make up less than 15 percent of the map unit.

This Grandfield soil is mainly used as rangeland, but some areas are used as cropland. The main crops are small grains and grain sorghum.

This soil is well suited to nonirrigated and irrigated crops, such as small grains and grain sorghum. Low rainfall is the most limiting factor for nonirrigated crops. Crop residue left on the surface conserves moisture and helps to control water erosion and soil blowing. If an irrigation system is to be used, it must be specially designed and properly installed. Proper application of water and fertilizer is needed for cultivated crops. A sprinkler system is best suited to this soil.

This soil is moderately suited to native range plants. Low rainfall is the most limiting factor. Native range plants are mostly mid- and short-grasses and scattered live oak and post oak. In most rangeland areas are silver bluestem, sideoats grama, purpletop, Texas grama, threeawn, and some annual plants and mesquite trees.

This soil is fairly suited to use as habitat for wildlife, especially for deer, turkey, quail, squirrel, and furbearing animals. Nesting places for quail and songbirds are plentiful.

This soil is moderately suited to most urban uses. Slope and seepage are the most limiting factors. This soil is well suited to most recreational uses.

This Grandfield soil is in capability subclass IIIe and is in the Sandy Loam range site.

HeB—Hensley clay loam, 1 to 3 percent slopes. This soil is shallow, gently sloping, and well drained. It is on the uplands. The slopes average about 1.5 percent. The mapped areas are irregular in shape and range from 10 to 50 acres.

Typically, this soil has a surface layer of reddish brown clay loam about 4 inches thick. The subsoil, to a depth of 16 inches, is reddish brown clay. Coarsely fractured limestone is below the subsoil. Reaction is mildly alkaline throughout.

This soil is slowly permeable. Runoff is medium. The available water capacity is very low. The root zone is shallow. The hazard of water erosion is moderate.

Included with this soil in mapping are some areas of Rowden and Palopinto soils. Also included are some small, nearly level areas and some stony areas of Hensley soils and a few areas of a soil that is similar to Hensley soil but has a subsoil that is more yellow. These included soils make up less than 15 percent of the map unit.

This Hensley soil is mainly used as rangeland. A few small areas are used for small grains and forage sorghums.

This soil is poorly suited to most cropland uses because of its shallow depth to bedrock and very low available water capacity.

This soil is suited to native range plants. The very low available water capacity is the most limiting factor. Native range plants are mostly mid- and short-grasses. In most rangeland areas are Texas wintergrass, sideoats grama, and curlymesquite and live oak, post oak, and mesquite trees.

This soil is fairly suited to use as habitat for wildlife, especially for quail, turkey, and deer.

This soil is poorly suited to most urban and recreational uses. Depth to limestone bedrock is the most limiting factor.

This Hensley soil is in capability subclass IVe and is in the Redland range site.

HsB—Hensley stony clay loam, gently undulating. This soil is shallow and well drained. It is on the uplands. The slopes average about 2 percent but range from 1 to 5 percent. The surface is plane to slightly convex. The mapped areas are irregular in shape and range from 10 to more than 1,000 acres. Limestone gravel, cobbles, and stones are on the surface.

Typically, this soil has a surface layer of reddish brown stony clay loam about 4 inches thick. The subsoil, to a depth of 11 inches, is reddish brown clay. Coarsely fractured, hard limestone is below the subsoil. Reaction is mildly alkaline throughout.

This soil is slowly permeable. Runoff is moderate. The available water capacity is very low. The root zone is shallow.

Included with this soil in mapping are some areas of Rowden and Palopinto soils. Also included are soils that are similar to Hensley soil but have a subsoil that is more yellow. These included soils make up less than 15 percent of the map unit.

This Hensley soil is mainly used as rangeland. This soil is not suitable for use as cropland because of stoniness.

This soil is suited to native range plants. The very low available water capacity is the most limiting factor. Native range plants are mostly mid- and short-grasses. In most rangeland areas are Texas wintergrass, sideoats grama, and curlymesquite and live oak, post oak, and mesquite trees.

This soil is fairly suited to use as habitat for wildlife, especially for quail, turkey, and deer.

This soil is poorly suited to most urban uses and to recreational uses. Depth to limestone bedrock is the most limiting factor for urban uses. Surface stoniness and depth to bedrock are limitations to use of this soil for recreational uses.

This Hensley soil is in capability subclass VIs and is in the Redland range site.

LeA—Leeray clay, 0 to 1 percent slopes. This soil is deep, nearly level, and well drained. It is on the uplands. The slopes average about 0.5 percent. The mapped areas are irregular in shape and range from 15 acres to several hundred acres. Undisturbed areas have gilgai microrelief with microknolls that are 4 to 12 inches higher than the microdepressions. Cycles of knolls and depressions are repeated every 7 to 23 feet.

Typically, this soil has a surface layer that extends to a depth of about 48 inches. The upper part, to a depth of 7 inches, is dark grayish brown clay. The next layer, to a depth of 28 inches, is very dark grayish brown clay. The next layer, to a depth of 33 inches, is dark grayish brown clay. The lower part is dark brown clay. The subsoil to a depth of 60 inches is yellowish brown silty clay that contains about 10 percent calcium carbonate. This soil is moderately alkaline and calcareous throughout.

This soil is very slowly permeable. Surface runoff is slow. Water infiltrates rapidly when the soil is dry and cracked and very slowly when it is moist. The available water capacity is medium. The root zone is deep. The hazard of water erosion is slight, and the hazard of soil blowing is moderate.

Included with this soil in mapping are small areas of Nuvalde and Nukrum soils. Also included are small areas of soils that have slopes of 1 to 3 percent and small areas of soils that are similar to Leeray soil but are underlain by limestone at a depth of 20 to 40 inches. The included soils make up less than 20 percent of the map unit.

This Leeray soil is mainly used as rangeland or cropland. The main crops are cotton, small grains, and grain sorghum.

This soil is suited to cotton, small grains, and grain sorghum. Crop residue left on or in the upper part of the soil surface helps to control water erosion and soil blowing and conserves moisture.

This soil is moderately suited to native range plants. Low rainfall is the most limiting factor, but yields of short- and mid-grasses are high during favorable years.

This soil is fairly suited to use as habitat for wildlife, especially for quail and doves.

This soil is poorly suited to most urban uses. The very high shrink-swell potential, low strength, and corrosivity to uncoated steel are the most restrictive features. These restrictions can be partly overcome by special design and proper installation. Recreational uses are also restricted. The clay texture and very slow permeability of this soil are the main limitations for recreational uses.

This Leeray soil is in capability subclass IIIs and is in the Clayey Upland range site.

LeB—Leeray clay, 1 to 3 percent slopes. This soil is deep, gently sloping, and well drained. It is on the uplands. The surface is slightly concave. The slopes average about 1.5 percent. The mapped areas are irregular in shape and range from 30 to more than 200 acres. Undisturbed areas have gilgai microrelief with microknolls that are 4 to 12 inches higher than the microdepressions. Cycles of knolls and depressions are repeated every 7 to 23 feet.

Typically, the upper part of the surface layer of this soil is dark grayish brown clay about 18 inches thick. The lower part, to a depth of 36 inches, is brown clay that has prominent slickensides. The subsoil to a depth of 60 inches is yellowish brown clay that contains a few concretions of iron-manganese (FeMn) and calcium carbonate.

Water infiltrates this soil rapidly when it is dry and cracked and infiltrates very slowly when it is moist. Runoff is medium. The available water capacity is medium. The root zone is deep. Water erosion and soil blowing are moderate hazards.

Included with this soil in mapping are some areas of Nukrum and Nuvalde soils. Also included are small areas of soils that are nearly level and some areas of soils that are similar to Leeray soil but are underlain by limestone at a depth of 20 to 40 inches. These included soils make up less than 15 percent of the map unit.

This Leeray soil is mainly used as cropland, but some areas are used as rangeland. The main crops are cotton, wheat, and grain sorghum.

This soil is suited to cultivated crops, such as cotton, wheat, and grain sorghum. Low rainfall is the most limiting factor. Crop residue left on or near the surface helps to conserve moisture and to control erosion and soil blowing. Terraces and grassed waterways also help control water erosion.

This soil is suited to native range plants. Low rainfall is the most limiting factor. Native range plants are mostly mid- and short-grasses. In most rangeland areas are Texas wintergrass, sand dropseed, Texas grama, curlymesquite, and some annual plants and mesquite trees.

This soil is fairly suited to use as habitat for wildlife, especially for quail and doves.

This soil is poorly suited to most urban uses. Low strength as it affects streets and roads, shrinking and swelling with changes in moisture, and clayey texture are the most limiting factors. This soil is poorly suited to recreational use because of the clayey surface texture.

This Leeray soil is in capability subclass IIIe and is in the Clayey Upland range site.

LrC—Lueders very gravelly clay loam, undulating. This soil is very shallow and shallow and well drained. It is on the uplands. The slopes average about 5 percent and range from 1 to 8 percent. The mapped areas are irregular in shape and range from 25 acres to several hundred acres.

Typically, the surface layer and subsoil are moderately alkaline, calcareous, dark brown very gravelly clay loam about 9 inches thick. Hard, coarsely fractured limestone bedrock, 6 inches to several feet thick, underlain by alternating beds of shale and calcareous marl is below the subsoil to a depth of 40 inches.

This soil is moderately permeable. Surface runoff is medium to rapid. The available water capacity is very low. The root zone is very shallow or shallow. Water erosion and soil blowing are slight hazards.

Included with this soil in mapping are some small areas of Mereta, Cho, and Palopinto soils. Also included are small areas of rock outcrop. These included soils make up less than 20 percent of the map unit.

This Lueders soil is mainly used as rangeland. A few areas are quarried for limestone.

This soil is fairly suited to native range plants. Low rainfall, shallow rooting depth, and very low available water capacity are the most limiting factors. Livestock may exhibit phosphorus deficiencies over prolonged periods of grazing.

This soil is poorly suited to use as habitat for wildlife. A few areas in the county are being restocked with antelope.

This soil is poorly suited to most urban uses. Slope, seepage, and depth to bedrock are the most restrictive features. It is also poorly suited to recreational uses. Slope, depth to bedrock, and small stones are limitations for recreational uses.

This Lueders soil is in capability subclass VIIs and is in the Very Shallow range site.

LuC—Lusk gravelly fine sandy loam, undulating. This soil is moderately deep and well drained. It is on the uplands. The slopes are complex on broad, weakly convex terraces. The slopes average about 2 percent on ridgetops and 5 percent on side slopes. The slopes range from 1 to 8 percent. The mapped areas are somewhat oval and range from 25 to 150 acres.

Typically, this soil has a surface layer of mildly alkaline, dark brown gravelly fine sandy loam about 5 inches thick. The upper part of the subsoil, to a depth of 10 inches, is neutral, reddish brown gravelly sandy clay. The lower part, to a depth of 22 inches, is neutral, reddish brown very gravelly clay that contains about 50 percent quartz gravel. The substratum to a depth of 60 inches is a massive bed of gravelly coarse sand. The siliceous gravel is mostly less than three-quarters of an inch across and is cemented with calcium carbonate to form a conglomerate. In places, it is not cemented.

This soil is slowly permeable but is rapid in the gravelly substratum. Runoff is medium. The available water capacity is low. The root zone is moderately deep. Water erosion and soil blowing are slight hazards.

Included with this soil in mapping are some areas of Minwells soils. These included soils make up less than 20 percent of the map unit.

This Lusk soil is used almost entirely as rangeland and as habitat for wildlife.

This soil is moderately suited to native range plants. Low rainfall is the most limiting factor. Native range plants are mostly mid- and short-grasses. In most rangeland areas are Texas wintergrass, tall dropseed, and buffalograss and an overstory of mesquite, live oak, hackberry, elm, pricklypear, tasajillo, and bumelia trees.

The soil is fairly suited to use as habitat for wildlife. Scattered shrubs are desirable for deer.

This soil is poorly suited to most urban uses. Slope and depth to bedrock are the most limiting factors. Gravel is mined and used as a source of construction material. This soil is only moderately suited to recreational uses because of small gravel in the surface layer.

This Lusk soil is in capability subclass VIs and is in the Sandy Loam range site.

MeB—Mereta silty clay, 1 to 3 percent slopes. This soil is shallow, gently sloping, and well drained. It is on the uplands. The slopes are dominantly about 1.5 percent. The mapped areas are irregular in shape and range from 25 acres to several hundred acres.

Typically, the upper part of the surface layer of this soil is dark brown silty clay about 5 inches thick. The lower part, to a depth of 14 inches, is reddish brown silty clay. The upper part of the subsoil, to a depth of 16 inches, is reddish brown gravelly silty clay. The lower part, to a depth of 20 inches, is strongly cemented caliche plates. The substratum to a depth of 42 inches is reddish yellow clay loam that contains about 60 percent soft masses and concretions of calcium carbonate. This soil is moderately alkaline and calcareous throughout.

This soil is moderately slowly permeable. Surface runoff is medium. The available water capacity is low. The root zone is shallow. The hazard of water erosion is moderate, and the hazard of soil blowing is slight.

Included with this soil in mapping are some small areas of Cho, Lueders, and Rowena soils. Also included are small areas of soils that are similar to Mereta soil but are underlain by hard limestone. These included soils make up less than 20 percent of the map unit.

This Mereta soil is mainly used as rangeland. Some small areas are used as cropland. Small grains and forage sorghum are the main crops.

This soil is poorly suited to cultivated crops. Crop residue left on or near the soil surface helps control water erosion and soil blowing and conserves soil moisture.

The suitability of this soil for native range plants is fair. Low rainfall is the most limiting factor, but yields of short- and mid-grasses are good during favorable years.

This soil is fairly suited to use as habitat for wildlife, especially for quail and doves.

The suitability of this soil for most urban uses is fair. Depth to bedrock is the most restrictive feature. This soil is also moderately suited to recreational uses.

This Mereta soil is in capability subclass IIIe and is in the Shallow range site.

MnB—Minwells loam, 1 to 3 percent slopes. This soil is deep, gently sloping, and well drained. It is on high river terraces. The slopes are complex and average about 2 percent. The mapped areas are irregular in shape and range from 25 to more than 100 acres.

Typically, this soil has a surface layer of mildly alkaline, brown loam about 6 inches thick. The upper part of the subsoil, to a depth of 15 inches, is neutral, reddish brown clay that contains a few quartz pebbles. The middle part, to a depth of 24 inches, is mildly alkaline, yellowish red clay that contains a few quartz pebbles. The lower part, to a depth of 47 inches, is moderately alkaline, yellowish red gravelly sandy clay loam. The substratum to a depth of 60 inches is a stratified, massive bed of calcareous, loamy material that has a high content of well graded quartz gravel.

This soil is slowly permeable. Runoff is medium. The available water capacity is low. The root zone is moderately deep. The hazard of water erosion is moderate, and the hazard of soil blowing is slight.

Included with this soil in mapping are some areas of Grandfield, Lusk, and Wichita soils. Also included are small areas of soils that are similar to Minwells soil that are less than 20 inches deep or have more than 35 percent gravel in the subsoil, a few areas of soils that are nearly level, and some soils that have a fine sandy loam surface texture. These included soils make up less than 20 percent of the map unit.

This Minwells soil is mainly used as rangeland and as habitat for wildlife.

This soil is moderately suited to native range plants. Low rainfall is the most limiting factor. Native range plants are mostly mid- and short-grasses. In most rangeland areas are Texas wintergrass, sand dropseed, Texas grama, curlymesquite, and some annual plants and mesquite and post oak trees.

This soil is well suited to use as habitat for wildlife, especially for quail, doves, and small animals.

This soil is moderately suited to most urban uses. Permeability and shrink-swell potential are the most limiting factors. Gravel is mined as a source of construction materials in a few areas. This soil is well suited to recreational uses.

This Minwells soil is in capability subclass IIe and is in the Sandy Loam range site.

NcB—Nukrum clay, 1 to 3 percent slopes. This soil is deep, gently sloping, and well drained. It is in narrow valleys surrounded by limestone hills. The slopes average about 1.5 percent. The mapped areas are irregular in shape and range from 15 to 300 acres.

Typically, this soil has a surface layer of dark grayish brown clay about 24 inches thick. The subsoil to a depth of 60 inches is grayish brown clay that has accumulated calcium carbonates below 48 inches of the surface. The subsoil also has pressure faces on peds. This soil is calcareous and moderately alkaline throughout.

This soil is slowly permeable. Surface runoff is slow. The available water capacity is high. The root zone is deep and is easily penetrated by plant roots. Water erosion and soil blowing are moderate hazards. Flooding may occur for short periods every 15 or more years.

Included with this soil in mapping are small areas of Leeray and Purves soils. Also included are small areas of Nukrum soils that have slopes of 0 to 1 percent. The included soils make up less than 20 percent of the map unit.

This Nukrum soil is mainly used as rangeland. A few areas are in cultivated crops. If cultivated, small grains and forage sorghum are the main crops.

This soil is well suited to growing small grains and forage sorghum. Crop residue left on or near the soil surface helps to control water erosion and soil blowing, and it conserves moisture. Contour farming, terraces, and grassed waterways help to conserve moisture and control erosion.

This soil is well suited to native range plants. Low rainfall is the most limiting factor, but yields of short- and mid-grasses are good during favorable years.

This soil is fairly suited to use as habitat for wildlife, especially for quail and doves.

The suitability of this soil for most urban uses is poor. Low strength, shrink-swell potential, permeability, and corrosivity to uncoated steel are the most restrictive features. These limitations can be partly overcome by special design and proper installation. The suitability of this soil for recreational uses is fair, but the clay surface is a restrictive feature for some recreational uses.

This Nukrum soil is in capability subclass IIe and is in the Clayey Upland range site.

NuA—Nuvalde silty clay loam, 0 to 1 percent slopes. This soil is deep, nearly level, and well drained. It is on the uplands. The surface is plane to slightly convex. The slopes average about 0.5 percent. The mapped areas are irregular in shape and range from 10 to more than 100 acres.

Typically, this soil has a surface layer of dark brown silty clay loam about 10 inches thick. The upper part of the subsoil, to a depth of 21 inches, is dark brown silty clay. The next layer, to a depth of 34 inches, is light brown silty clay loam. The next layer, to a depth of 44 inches, is pink silty clay loam that contains about 50 percent calcium carbonate. The next layer, to a depth of 60 inches, is light brown silt loam that contains about 50 percent calcium carbonate. The lower part, to a depth of 78 inches, is reddish yellow loam that contains about 30 percent calcium carbonate. The substratum to a depth of 84 inches is reddish yellow loam that contains about 20 percent calcium carbonate. This soil is calcareous and moderately alkaline throughout.

This soil is moderately permeable. Runoff is slow. The available water capacity is high. The root zone is deep. Water erosion and soil blowing are slight hazards.

Included with this soil in mapping are some areas of Mereta, Rowena, Leeray, Cho, and Purves soils. Also included are small areas of Nuvalde soils that are gently sloping and some small areas of soils that are similar to Nuvalde soil but have limestone at a depth of more than 50 inches. These included soils make up less than 20 percent of the map unit.

This Nuvalde soil is used as cropland or rangeland. The main crops are small grains, forage sorghum, and grain sorghum.

This soil is well suited to nonirrigated and irrigated crops. Low rainfall is the most limiting factor for nonirrigated crops. Crop residue left on the surface helps to conserve moisture.

This soil is well suited to native range plants. Low rainfall is a limiting factor. Native range plants are mostly tall- and mid-grasses. In most rangeland areas are Texas wintergrass, sand dropseed, Texas grama, curlymesquite, and some annual plants and mesquite trees.

This soil is well suited to use as habitat for wildlife, especially for doves and quail.

This soil is moderately suited to most urban uses. Low strength as it affects streets and roads and shrinking and swelling with changes in moisture are the most limiting factors. This soil is only moderately suited to recreational uses because of the surface texture.

This Nuvalde soil is in capability subclass IIc and is in the Clay Loam range site.

NuB—Nuvalde silty clay loam, 1 to 3 percent slopes. This soil is deep, gently sloping, and well drained. It is on the uplands. The surface is plane to slightly convex. The slopes average about 1.5 percent. The mapped areas are irregular in shape and range from 10 to more than 100 acres.

Typically, this soil has a surface layer of dark brown silty clay loam about 11 inches thick. The upper part of the subsoil, to a depth of 24 inches, is brown silty clay. The next layer, to a depth of 44 inches, is pink clay loam that contains many concretions and soft masses of calcium carbonate. The lower part to a depth of 60 inches is pink clay loam that contains a few carbonates.

This soil is moderately permeable. Runoff is medium. The available water capacity is high. The root zone is deep. The hazard of water erosion is moderate, and the hazard of soil blowing is slight.

Included with this soil in mapping are some areas of Mereta, Rowena, Leeray, Cho, and Purves soils. Also included are small areas of Nuvalde soils that are nearly level and some areas of soils that are similar to Nuvalde soil but have limestone at a depth of 40 to 60 inches. These included soils make up about 45 percent of the map unit.

This Nuvalde soil is used as cropland or rangeland. The main crops are small grains, forage sorghum, and grain sorghum.

This soil is well suited to nonirrigated and irrigated crops. Low rainfall is the most limiting factor for nonirrigated crops. Crop residue left on the surface helps to conserve moisture. Terraces help to control water erosion.

This soil is well suited to native range plants. Low rainfall is a limiting factor. Native range plants are mostly tall- and mid-grasses. In most rangeland areas are Texas wintergrass, sand dropseed, Texas grama, curlymesquite, and some annual plants and mesquite trees.

This soil is well suited to use as habitat for wildlife, especially for doves and quail.

This soil is moderately suited to most urban uses. Low strength as it affects streets and roads and shrinking and swelling with changes in moisture are the most limiting factors. This soil is only moderately well suited to recreational uses because of the surface texture.

This Nuvalde soil is in capability subclass IIe and is in the Clay Loam range site.

Ow—Oil-waste land. The soils in this map unit are in areas where oil and accompanying saltwater brine have been deposited on the surface from overflows and spills from oil exploration and production activity. These spills are in areas that range from 0.5 acre to more than 40 acres but average about 3 acres. The spills and overflows occur on any soil on which oil exploration and production have occurred. The surface texture is variable. Most slopes range from 0 to 3 percent, but some slopes are as much as 12 percent. Most areas are eroded and void of vegetation (fig. 11).

These areas are poorly suited to any use. A few of these areas are being reclaimed and sodded to Coastal bermudagrass.

This Oil-waste land is in capability subclass VIIIs but has not been assigned to a range site.

OXC—Owens-Harpersville association, undulating, very stony. The soils in this association are deep and well drained. These soils are on smooth knolls and low hills and ridges that have rounded crests with sloping sides. They are also on foot slopes below escarpments. These soils formed in soft shale interbedded with thin, alternating layers of limestone and sandstone. Flattened

Figure 11.—This Oil-waste land is the result of spills and overflows of oil and saltwater brine from oil exploration and production activity in the area.

stones and a few boulders (fig. 12) cover 2 to 3 percent of the soil surface. The slopes are mainly convex and have gradients of 1 to about 8 percent. Owens soil is on the lower side slopes and foot slopes. Harpersville soil is on the upper side slopes. The mapped areas of this association are generally oval and range from 50 to more than 300 acres. These erodible soils contribute a large amount of sediment to some local streams and lakes.

This association is made up of about 40 percent Owens soil, 35 percent Harpersville soil, and about 25 percent other soils and rock outcrop. The areas of this map unit are large, and the composition is variable from delineation to delineation; however, the detail is adequate for the foreseeable uses of the soils.

Typically, Owens soil has a surface layer that is light yellowish brown clay about 5 inches thick. The subsoil, to a depth of 18 inches, is pale olive clay that contains a few calcium carbonate concretions. The substratum to a depth of 60 inches is light brownish gray shaly clay. This soil is moderately alkaline and calcareous throughout.

Typically, Harpersville soil has a surface layer that is light yellowish brown silty clay about 5 inches thick. The upper part of the underlying material, to a depth of 17 inches, is brownish yellow shaly clay. The middle part, to a depth of 26 inches, is light yellowish brown shaly clay. The lower part to a depth of 60 inches is grayish brown shale. This soil is moderately alkaline and calcareous throughout, but some of the underlying shale is noncalcareous.

Owens and Harpersville soils are very slowly permeable. Surface runoff is rapid. The available water capacity is very low. The hazard of water erosion is severe. The susceptibility to soil blowing is slight. Rapid geological erosion is evident on Harpersville soil.

Included in mapping are small areas of Throck, Palopinto, and Bluegrove soils. Throck soils are in similar positions on the landscape as Owens and Harpersville soils. Palopinto soils are on the summits of limestone hills and ridges. Bluegrove soils are on the summits of sandstone hills and ridges. Also included are some areas of rock outcrop along ledges.

The soils in this association are used as rangeland.

These soils are moderately suited to use as rangeland. They presently support a sparse cover of short- and mid-grasses, mainly sideoats grama, threeawns, and a few scrubby mesquite trees. Proper management is needed to prevent overuse. Effective management practices are proper stocking and controlled grazing.

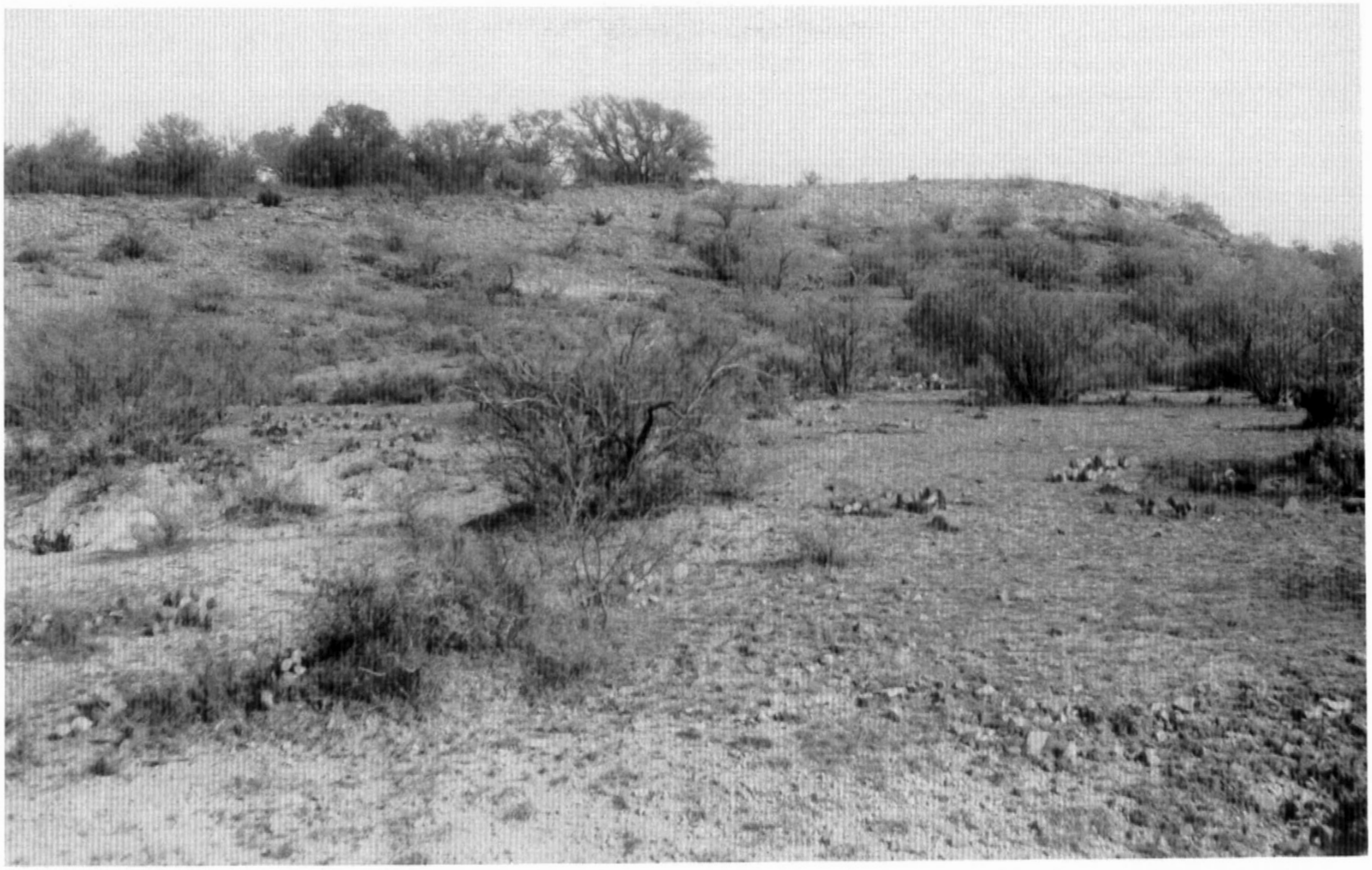


Figure 12.—Soils of the Owens-Harpersville association, undulating, very stony, are used as rangeland; but a well planned program is needed to control grazing.

These soils are not suited to use as cropland. Slope and stoniness are limitations that make the use of these soils as cropland impractical.

These soils are poorly suited to use as habitat for wildlife, especially for deer. They provide food and nesting places for quail, doves, and songbirds. Rock ledges provide cover for furbearing animals.

These soils are poorly suited to urban and recreational uses. Slope, stones, very slow permeability, and high shrink-swell potential are the main limitations. These limitations are difficult to overcome.

Owens soil is in capability subclass VIs and is in the Shallow Clay range site. Harpersville soil is in capability subclass VIIs and is in the Shaly Hill range site.

OXF—Owens-Harpersville association, hilly, extremely stony. The soils in this association are deep, strongly sloping to steep, and well drained. They are on hillsides (fig. 13). Owens soil is on mid- and low-parts of the hillsides. Harpersville soils are on steep hillsides and in areas around branching gullies that are prominent in this map unit. Flattened stones and boulders cover about 12 percent of the soil surface. The underlying material in most areas is thick, alternating layers of shale and thin layers of limestone, but thin sandstone ledges are in a few areas. Flattened rock fragments that range from 3 inches to 6 feet across have broken off the rock ledges and are floating or creeping downslope on the soil surface. Most fragments are lying flat on the surface, but a few are embedded at a low angle. The mapped areas are long and narrow and range from 100 acres to several hundred acres. The slopes are mostly simple. They range from 8 to about 30 percent and include a few escarpments.

This association is made up of about 60 percent Owens soil, ranging from 50 to 80 percent; about 28 percent Harpersville soil, ranging from 10 to 40 percent; and about 12 percent other soils, rock outcrop, and soils in barren, eroding areas that do not support vegetation. The areas of this map unit are large, and the

Figure 13.—Soils of the Owens-Harpersville association, hilly, extremely stony, are moderately suited to use as rangeland if proper stocking rates are maintained and grazing is controlled.

composition is variable from delineation to delineation; however, the detail is adequate for the foreseeable uses of the soils.

Typically, Owens soil has a surface layer that is light yellowish brown clay about 5 inches thick. Scattered fragments of limestone occur on the surface. The subsoil, to a depth of 18 inches, is light yellowish brown clay that contains a few calcium carbonate concretions. The substratum to a depth of 60 inches is light brownish gray shaly clay. This soil is moderately alkaline and calcareous throughout.

Typically, Harpersville soil has a surface layer that is light yellowish brown silty clay about 5 inches thick. The upper part of the underlying material, to a depth of 17 inches, is brownish yellow and yellowish brown shaly clay. The middle part, to a depth of 26 inches, is light yellowish brown shaly clay. The lower part to a depth of 60 inches is grayish brown shale. Reaction is moderately alkaline throughout. This soil is calcareous in the surface layer and upper part of the underlying material, and it is noncalcareous in the lower part of the underlying material.

The soils in this association are very slowly permeable. Surface runoff is rapid. The available water capacity is very low. The root zone is shallow, and penetration by plant roots is difficult. The hazard of water erosion is severe. The susceptibility to soil blowing is slight. Geological erosion is evident on Harpersville soil and on the included soils in the barren, eroding areas.

Included in mapping are small areas of Throck, Palopinto, and Bluegrove soils. Throck soils are associated with Owens soil. Palopinto soils are above the limestone rock ledges on the summits of hills and ridges. Bluegrove soils are on the summits of sandstone hills and ridges. Also included are small areas that have ledges of limestone and sandstone rock outcrop and some barren, eroding areas that do not support vegetation.

The soils in this association are used as rangeland.

These soils are moderately suited to use as rangeland. They presently support a sparse cover of short grasses, mainly hairy grama, sideoats grama, and threeawn. A well planned management program is needed to prevent overuse and to reduce sediment loss. Effective management practices are proper stocking and controlled grazing.

The soils in this association are not suited to use as cropland. Slope and stoniness are limitations that make the use of these soils as cropland impractical.

These soils provide poor habitat for wildlife, especially for deer. They provide adequate food and nesting places for quail, doves, and songbirds. The numerous rock ledges and stones and boulders provide cover for furbearing animals.

These soils are poorly suited to urban and recreational uses. Slope, stoniness, very slow permeability, and shrink-swell potential are the main limitations. These limitations are difficult to overcome.

Owens soil is in capability subclass VIIe and is in the Rocky Hills range site. Harpersville soil is in capability subclass VIIs and is in the Shaly Hill range site.

PaC—Palopinto very flaggy silty clay loam, undulating. This soil is very shallow and shallow and well drained. It is on the uplands. The slope is complex. Most areas of this soil are on narrow, convex ridges. The slopes average about 3 percent, but they range from 1 to about 8 percent. The mapped areas are irregular in shape and range from 50 to more than 500 acres.

Typically, this soil has a surface layer that is moderately alkaline, dark brown very flaggy silty clay loam about 10 inches thick. It contains about 45 percent, by volume, limestone flagstones. Hard, coarsely fractured limestone bedrock is below the surface layer. About 20 percent of the surface is covered with limestone flagstones and cobbles (fig. 14).

This soil is moderately permeable. Runoff is medium or rapid. The available water capacity is very low. The root zone is very shallow. Water erosion and soil blowing are slight hazards.

Included with this soil in mapping are some areas of Cho, Lueders, and Purves soils. Also included are some areas of rock outcrop. These included soils make up less than 25 percent of the map unit.

This Palopinto soil is mainly used as rangeland and as habitat for wildlife. This soil is not suitable for use as cropland because of stoniness and very shallow depths.

This soil is moderately suited to native range plants. Low rainfall and very shallow depth are the most limiting factors. Native range plants are mostly tall- and mid-grasses. In most rangeland areas are Texas wintergrass, sand dropseed, Texas grama, curlymesquite, and some annual plants and mesquite trees.

This soil is fairly suited to use as habitat for wildlife.

This soil is poorly suited to most urban uses. Depth to bedrock and stoniness are the most limiting factors. This soil is poorly suited to recreational uses because of depth to bedrock and large stones.

This Palopinto soil is in capability subclass VIs and is in the Low Stony Hill range site.

PoB—Patilo fine sand, 0 to 5 percent slopes. This soil is deep, gently undulating, and moderately well drained. It is on the uplands. On the surface is a pattern of small basins, knolls, and short ridges. The mapped areas are oblong to irregular in shape and range from 10 acres to several hundred acres. These surfaces are the result of geological wind deposition and shifting. The base slopes average about 1.5 percent.

Typically, this soil has a surface layer of neutral, pale brown fine sand about 6 inches thick. The subsurface layer, to a depth of 54 inches, is slightly acid, light yellowish brown fine sand. The subsoil to a depth of 66 inches is slightly acid, reddish yellow sandy clay loam with common light brown mottles.

This soil is very rapidly permeable in the sandy surface layer and moderately slowly permeable in the subsoil. Runoff is very slow. The available water capacity is low. The root zone is deep. The hazard of water erosion is slight, and the hazard of soil blowing is severe.

Included with this soil in mapping are some areas of Grandfield and Chaney soils. Also included are some areas of soils that are similar to Patilo soil but have a sandy surface layer about 20 to 40 inches thick. They are in depressions. These included soils make up about 30 percent of the map unit.

This Patilo soil is mostly used as rangeland. A few areas are in improved pasture. Coastal bermudagrass and weeping lovegrass are the dominant plants.

This soil is normally poorly suited to nonirrigated cultivated crops because of droughtiness and soil blowing. It is well suited to use for orchard and truck crops. Crop residue left on the surface helps to control soil blowing. Sand accumulates in the fence rows around most fields.

This soil is poorly suited to native range plants. Low rainfall, low available water capacity, and low fertility are the most limiting factors. Native forage plants are mostly mid- and short-grasses. In most rangeland areas are sand lovegrass, little bluestem, purpletop, and some annual plants and shinnery oak and post oak trees.

This soil is fairly suited to use as habitat for wildlife, especially for doves and quail.

This soil is well suited to most urban uses. It is poorly suited to recreational uses because of the sandy surface texture.

This Patilo soil is in capability subclass IVe and is in the Deep Sand range site.

Ps—Pits. Pits are areas where limestone has been quarried for construction material. These areas include the excavation pit and piles of limestone slab waste material. These quarries range from 3 to 25 acres but average about 10 acres. They are near the Lueders community in the Lueders Quarry Bed Limestone Formation (fig. 15). In most areas, a thin mantle of Pleistocene terrace deposits cover the underlying limestone. Most quarries are now inactive.

Most areas are void of vegetation. Reclamation of most of these areas would be difficult and costly.

Pits is in capability subclass VIIIs but has not been assigned to a range site.

PtC—Pitzer gravelly clay loam, undulating. This soil is very shallow and well drained. It is on the uplands. The surface is convex. The slopes average about 3.5 percent. The slopes range from 1 to 8 percent. Limestone gravel is on and in the surface layer. The platy caliche layer is underlain by beds of limestone and quartz gravel. The mapped areas are irregular in shape and range from 30 to more than 300 acres.

Typically, this soil has a surface layer of calcareous, dark grayish brown gravelly clay loam about 5 inches thick. The subsoil, to a depth of 11 inches, is white, indurated, platy caliche. The upper part of the substratum, to a depth of 54 inches, is yellow very gravelly sandy clay loam that contains pebbles coated with calcium carbonate. The lower part to a depth of 60 inches is light brownish gray shaly clay.

This soil is moderately permeable, but it is slowly permeable in the cemented layer. Runoff is medium. The available water capacity is very low. The root zone is very shallow. Water erosion and soil blowing are slight hazards.

Included with this soil in mapping are some areas of Mereta, Cho, and Nuvalde soils. These included soils make up less than 15 percent of the map unit.

Figure 14.—This soil, Palopinto very flaggy silty clay loam, undulating, is used as rangeland and as habitat for wildlife. It is moderately suited to native range plants.

Figure 15.—This limestone was quarried from the Lueders Quarry Bed Limestone Formation.

This Pitzer soil is used as rangeland and as habitat for wildlife. A few areas are being mined for road gravel.

This soil is not suitable for use as cropland because of its very shallow depth.

This soil is moderately suited to native range plants. Shallow rooting depth, very low available water capacity, and low rainfall limit the amount of forage produced. Native range plants are mostly mid- and short-grasses. In most rangeland areas are Texas wintergrass, sand dropseed, Texas grama, curlymesquite, and some annual plants and mesquite trees.

This soil is poorly suited to use as habitat for wildlife.

This soil is poorly suited to most urban uses. Depth to a cemented pan is the most limiting factor. This soil is poorly suited to recreational uses because of the cemented pan and gravelly surface.

This Pitzer soil is in capability subclass VIs and is in the Very Shallow range site.

PuB—Purves clay, 1 to 3 percent slopes. This soil is shallow, gently sloping, and well drained. It is on the uplands. The surface is slightly convex. The slopes are about 1.5 percent. The mapped areas are irregular in shape and range from 10 to more than 100 acres.

Typically, this soil has a surface layer of dark grayish brown clay about 12 inches thick. The subsoil, to a depth of 14 inches, is dark brown very gravelly clay that contains about 50 percent limestone fragments coated with calcium carbonate. Coarsely fractured limestone bedrock is below the subsoil. This soil is moderately alkaline and calcareous throughout.

This soil is moderately permeable. Runoff is medium. The available water capacity is very low. The root zone is shallow. The hazard of water erosion is moderate, and the hazard of soil blowing is slight.

Included with this soil in mapping are some areas of Leeray, Mereta, Cho, and Palopinto soils. Also included are small areas of Purves soils that are nearly level and a soil that is similar to Purves soil, but it has a noncalcareous surface layer. These included soils make up less than 15 percent of the map unit.

This Purves soil is mostly used as rangeland, but some areas are used as cropland. The main crops are cool-season or fast-growing crops, such as oats, wheat, and forage sorghum.

This soil is poorly suited to cropland. Shallow depth to bedrock and very low available water capacity are the most limiting factors. Residue from close-growing, high residue producing crops left on the surface helps to conserve moisture and also effectively controls erosion. This soil is too shallow for constructing terraces and diversions.

This soil is well suited to native range plants. Low rainfall is the most limiting factor. Native range plants are mostly mid- and tall-grasses. In most rangeland areas are Texas wintergrass, sideoats grama, sand dropseed, Texas grama, curlymesquite, greenbrier, and some annual plants and hackberry, bumelia, and mesquite.

This soil is fairly suited to use as habitat for wildlife.

This soil is poorly suited to most urban uses. Depth to bedrock, shrinking and swelling with changes in moisture, and clayey texture are the most limiting factors. This soil is poorly suited to recreational uses because of depth to bedrock.

This Purves soil is in capability subclass IVe and is in the Shallow range site.

PyB—Purves cobbly clay, gently undulating. This soil is shallow and well drained. It is on the uplands. The surface is plane or convex. The slopes average about 2 percent but range from 1 to 5 percent. Cobble-size limestone fragments cover about 12 percent of the surface but range from 3 to 40 percent (fig. 16). The mapped areas are irregular in shape and range from 30 to more than 300 acres.

Figure 16.—This soil, Purves cobbly clay, gently undulating, is well suited to native range plants, and it is mainly used as rangeland.

Typically, this soil has a surface layer of dark grayish brown cobbly clay about 7 inches thick. The next layer, to a depth of 16 inches, is dark brown gravelly clay. The subsoil, to a depth of 19 inches, is brown very gravelly clay that contains limestone fragments coated with carbonates. Yellowish brown, coarsely fractured limestone bedrock is below the subsoil to a depth of 40 inches. This soil is moderately alkaline and calcareous throughout.

This soil is moderately slowly permeable. Runoff is slow. The available water capacity is very low. The root zone is shallow. Water erosion and soil blowing are slight hazards.

Included with this soil in mapping are some areas of Leeray, Mereta, Cho, and Palopinto soils. Also included are small areas of Purves clay soils. These included soils make up less than 20 percent of the map unit.

This Purves soil is mainly used as rangeland.

This soil is not suited to crops. Shallow depth and surface stoniness are the major restrictions.

This soil is well suited to native range plants. Low rainfall is the most limiting factor. Native range plants are mostly mid- and tall-grasses. In most rangeland areas are Texas wintergrass, sideoats grama, sand dropseed, Texas grama, curlymesquite, greenbrier, and some annual plants and mesquite, hackberry, and bumelia trees.

This soil is fairly suited to use as habitat for wildlife.

This soil is poorly suited to most urban uses. Depth to bedrock, large stones, shrinking and swelling with changes in moisture, and clayey texture are the most limiting factors. This soil is poorly suited to recreational uses because of depth to bedrock and surface stones.

This Purves soil is in capability subclass VIs and is in the Shallow range site.

RdA—Rowden clay loam, 0 to 2 percent slopes. This soil is moderately deep, nearly level to gently sloping, and well drained. It is on the upland ridges. The slopes are 0 to 2 percent and average about 1.2 percent. The mapped areas are irregular in shape to round and range from 15 to 200 acres.

Typically, this soil has a surface layer of neutral, dark brown clay loam about 8 inches thick. The subsoil, to a depth of 23 inches, is reddish brown clay. Reaction is mildly alkaline in the upper 10 inches of the subsoil and moderately alkaline in the lower part. Hard limestone bedrock is below the subsoil.

This soil is slowly permeable. Runoff is medium. The available water capacity is medium. The root zone is moderately deep, and the clayey lower layers restrict root penetration. The hazard of water erosion is moderate, and the hazard of soil blowing is slight.

Included with this soil in mapping are small areas of Hensley, Mereta, Palopinto, and Purves soils. Hensley soils are in similar positions on the landscape as Rowden soil. Mereta and Purves soils are in slightly elevated positions. Palopinto soils are near the slope breaks. Also included are some small areas of soils that have a stony surface layer and a soil that is similar to Rowden soil but has a light brown surface layer. These included soils make up about 35 percent of the map unit.

This Rowden soil is mainly used as rangeland. The climax plant community is grassland supporting mainly big and little bluestem, indiangrass, sideoats grama, forbs, and scattered live oak trees.

This soil is well suited to use as habitat for wildlife. Brush management in patterns enhances the habitat for deer and quail. Soil disturbance in strips provides annual weed seed production. Excessive grazing reduces the quality of the habitat for wildlife. Live oak trees are a major browse species for deer.

The suitability of this soil for cultivated crops, such as small grains and forage sorghum, is fair. Terraces and contour farming control erosion. Crop residue left on the surface helps to conserve moisture, reduces runoff, and maintains productivity. Kleingrass and King ranch bluestem are pasture grasses adapted to this soil.

The suitability of this soil for urban use is poor. Depth to bedrock and shrink-swell potential are the most limiting factors. This soil is well suited to recreational uses.

This Rowden soil is in capability subclass IIIe and is in the Clay Loam range site.

RoA—Rowena clay loam, 0 to 1 percent slopes. This soil is deep, nearly level, and well drained. It is on the broad upland plains. The slopes are 0 to 1 percent and average about 0.5 percent. The mapped areas are irregular in shape to oval and range from about 60 to 500 acres.

Typically, this soil has a surface layer of dark grayish brown clay loam about 6 inches thick. The upper part of the subsoil, to a depth of 11 inches, is dark grayish brown silty clay. The middle part, to a depth of 34 inches, is dark brown clay. The lower part, to a depth of 48 inches, is light brown clay loam that contains films, threads, soft masses, and concretions of calcium carbonate. The substratum to a depth of 60 inches is reddish yellow clay loam that contains about 50 percent calcium carbonate. This soil is moderately alkaline and calcareous throughout.

This soil is moderately slowly permeable. Surface runoff is slow. The available water capacity is high. The root zone is deep and is easily penetrated by plant roots. The hazard of soil blowing is slight. Water erosion is not a problem on this soil.

Included with this soil in mapping are some small areas of Leeray and Mereta soils. Also included are some small areas of Rowena soils that are gently sloping. These included soils make up less than 20 percent of the map unit.

This Rowena soil is mainly used as cropland. A few areas are used as rangeland. Cotton and grain sorghum are the main crops.

This soil is well suited to cultivated crops, such as wheat, cotton, and grain sorghum. Crop residue left on the soil surface helps to control soil blowing and conserves moisture. Contour farming and terraces also conserve moisture.

The suitability of this soil for native range plants is good. Low rainfall is the most limiting factor, but yields of short- and mid-grasses are good during favorable years.

This soil is well suited to use as habitat for wildlife.

The suitability of this soil for most urban uses is poor. Moderately slow permeability, high shrink-swell potential, low strength, and corrosivity to uncoated steel are the most restrictive features. These limitations can be overcome by special design and proper installation. The suitability of this soil for recreational uses is fair. Moderately slow permeability and clayey texture are the most restrictive features for recreational uses.

This Rowena soil is in capability subclass IIc and is in the Clay Loam range site.

RoB—Rowena clay loam, 1 to 3 percent slopes. This soil is deep, gently sloping, and well drained. It is on the upland plains. The surface is plane or weakly convex. The slopes average about 2 percent. The mapped areas are long and narrow and range from 15 acres to several hundred acres.

Typically, this soil has a surface layer of dark brown clay loam about 6 inches thick. The upper part of the subsoil, to a depth of 22 inches, is dark brown clay. The lower part, to a depth of 28 inches, is brown clay. The underlying material to a depth of 60 inches is pink clay loam that contains from 30 to about 60 percent calcium carbonate. This soil is moderately alkaline and calcareous throughout.

This soil is moderately slowly permeable. Surface runoff is medium. The available water capacity is high. The root zone is deep. The hazard of water erosion is moderate, and the hazard of soil blowing is slight.

Included with this soil in mapping are some small areas of Leeray and Mereta soils. Also included are some small areas of Rowena soils that are nearly level. These included soils make up less than 20 percent of the map unit.

This Rowena soil is mainly used as cropland. A few areas are used as rangeland. Cotton and grain sorghum are the main crops.

The suitability of this soil for cultivated crops, such as wheat, cotton, and grain sorghum, is good. Crop residue left on the surface helps to control water erosion and soil blowing and also conserves moisture. Contour farming, terraces, and grassed waterways also control water erosion.

The suitability of this soil for native range plants is good. Low rainfall is the most limiting factor, but yields of short- and mid-grasses are good during favorable years.

This soil is well suited to use as habitat for wildlife.

The suitability of this soil for most urban uses is poor. Moderately slow permeability, high shrink-swell potential, low strength, and corrosivity to uncoated steel are the most restrictive features. These limitations can be overcome by special design and proper installation. The suitability of this soil for recreational uses is fair. Moderately slow permeability and clayey texture are the most restrictive features for recreational uses.

This Rowena soil is in capability subclass IIe and is in the Clay Loam range site.

ThC—Throck clay, 1 to 5 percent slopes. This soil is deep, gently sloping, and well drained. It is on the uplands. The surface is convex. The slopes average about 3.5 percent. The mapped areas are irregular in shape and range from 10 to more than 300 acres.

Typically, this soil has a surface layer of dark grayish brown clay about 4 inches thick. The upper part of the subsoil, to a depth of 11 inches, is brown clay. The middle part, to a depth of 34 inches, is brown silty clay. The lower part, to a depth of 40 inches, is pale brown silty clay. The substratum to a depth of 98 inches is grayish brown, light brownish gray, and light gray, stratified shale and siltstone. This soil is moderately alkaline and calcareous throughout.

This soil is slowly permeable. Runoff is medium. The available water capacity is medium. The root zone is moderately deep. Water erosion and soil blowing are moderate hazards.

Included with this soil in mapping are some areas of Nukrum, Nuvalde, and Owens soils. Also included are small areas of Throck soils that have slopes of more than 5 percent. These included soils make up less than 15 percent of the map unit.

This Throck soil is mostly used as rangeland. In some areas, this soil is used as cropland. The main crops are small grains and forage sorghum.

This soil is poorly suited to use as cropland. Low rainfall, droughtiness, and slopes are the most limiting factors. Crop residue left on the surface helps to conserve moisture. Terraces and grassed waterways also control erosion.

This soil is well suited to native range plants. Low rainfall is the most limiting factor. Native range plants are mostly tall- and mid-grasses. In most rangeland areas are Texas wintergrass, sideoats grama, sand dropseed, Texas grama, curlymesquite, and some annual plants and mesquite trees.

This soil is fairly suited to use as habitat for wildlife.

This soil is poorly suited to most urban uses. Low strength as it affects streets and roads, shrinking and swelling with changes in moisture, and clayey texture are the most limiting factors. This soil is only moderately suited to recreational uses because of the clayey surface texture.

This Throck soil is in capability subclass IVe and is in the Clayey Slopes range site.

TPC—Throck-Palopinto association, undulating. The soils in this association are deep to very shallow and are well drained. These soils are on broad, convex ridges on the uplands. The slopes are complex and range from 1 to 8 percent. These soils are underlain by alternating layers of clayey shale and limestone bedrock. Limestone ledges outcrop with changing relief at vertical intervals of 10 to 50 feet. The mapped areas are irregular in shape and range from about 100 acres to several hundred acres. Throck soil is deep and clayey. It is on gently undulating ridgetops and sloping hillsides. This soil formed in shale and has a few floating stones and boulders on the surface. Palopinto soil is very shallow and loamy. It is on convex ridges and along ledges. This soil formed in limestone and has a few stones and boulders on the surface in addition to gravel and flagstones that are inherent to the soil (fig. 17).

Throck soil and closely similar soils make up about 50 percent, ranging from 40 to 75 percent, of the map unit; Palopinto soil makes up about 30 percent, ranging from 20 to 40 percent; and other soils and rock outcrop make up more than 20 percent. The areas of this map unit are large, and the composition is variable from delineation to delineation; however, the detail is adequate for the foreseeable uses of these soils, and their use and management are similar.

Typically, Throck soil has a surface layer that is grayish brown silty clay about 5 inches thick. The upper part of the subsoil, to a depth of 21 inches, is brown silty clay. The lower part, to a depth of 38 inches, is brown silty clay that contains about 3 percent soft masses and

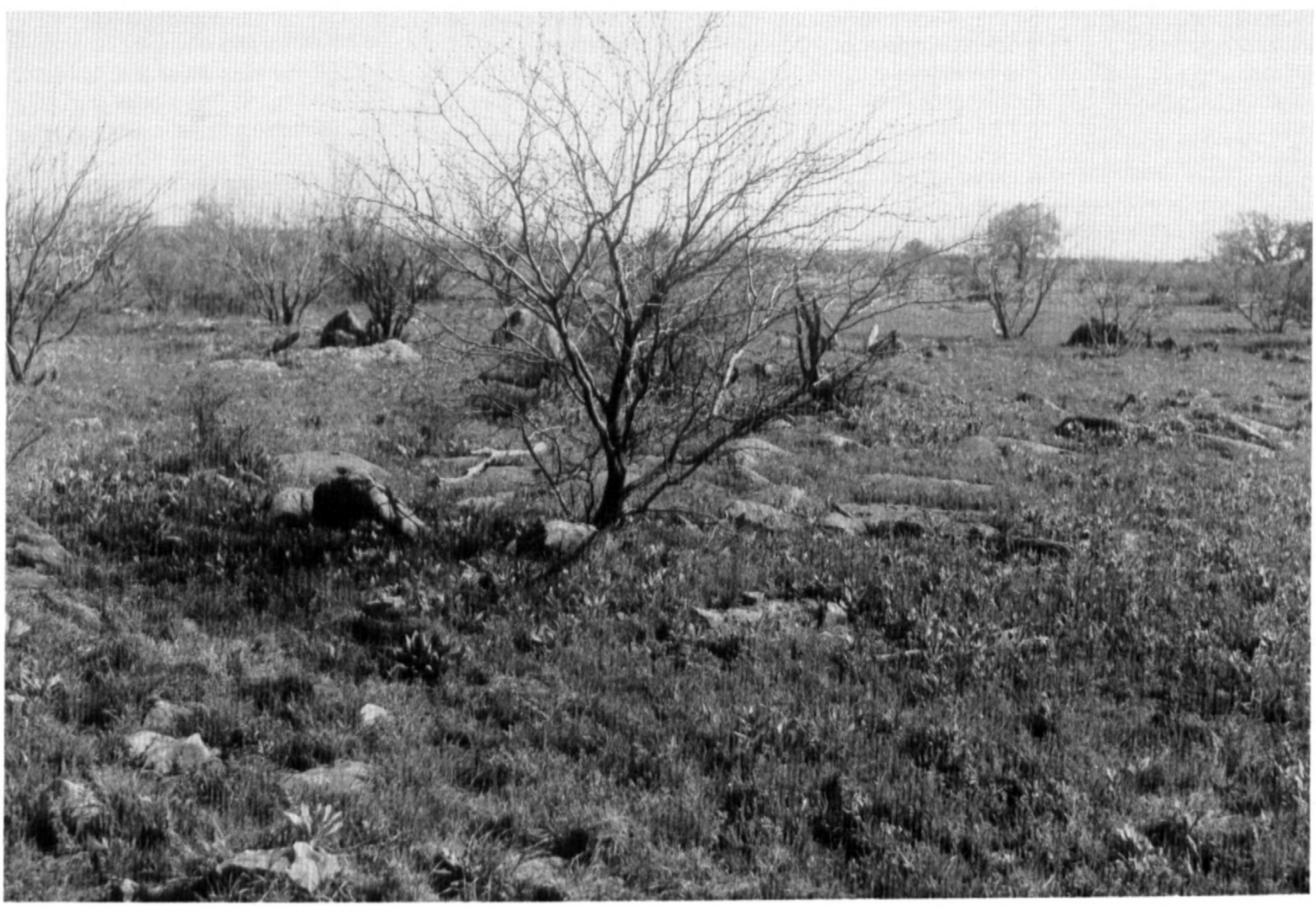


Figure 17.—The soils of the Throck-Palopinto association, undulating, are mainly used as rangeland. Stoniness and depth to bedrock are severe limitations for other uses.

concretions of calcium carbonate. Very pale brown shaly clay is below the subsoil to a depth of 54 inches. This soil is moderately alkaline and calcareous throughout.

Typically, Palopinto soil has a surface layer that is calcareous, dark grayish brown very flaggy clay loam about 7 inches thick. Hard, coarsely fractured limestone bedrock is below the surface layer. This soil has a few stones and boulders on the surface and many gravel and flagstone-size limestone rock on the surface and in the soil. Some of the Palopinto soils have a surface layer that is extremely flaggy clay loam, flaggy clay loam, silty clay loam, silt loam, or loam.

Throck soil is slowly permeable, and Palopinto soil is moderately permeable. Runoff is rapid. Internal drainage is slow in Throck soil and moderate in Palopinto soil. The available water capacity is medium in Throck soil, and it is very low in Palopinto soil. Water erosion is a severe hazard on these soils. Soil blowing is not a problem.

Included in mapping are areas of Owens and Purves soils. Also included are areas of a soil that is similar to Throck soil but contains more than 40 percent calcium carbonate equivalent; a soil that also is similar to Throck soil but has limestone bedrock at a depth of 30 to 60 inches; and rock outcrop, which is mainly thick limestone bedrock ledges that are 3 to 20 feet thick. The rock outcrop has a hardness of 3 or more on Mohs' scale, is coarsely fractured, massive, and tilts about 10 degrees to the west.

The soils in this association are used as rangeland and as habitat for wildlife.

These soils are not suitable for use as cropland because of stoniness and bedrock.

These soils are moderately suited to native range plants. Large stones limit overland travel by car or truck. Limited rainfall and excessive runoff limit yields. The climax plant community is mostly tall- and mid-grasses and mesquite trees. In most rangeland areas are Texas wintergrass, sideoats grama, tall dropseed, vine-mesquite, silver bluestem, and catclaw and mesquite trees.

These soils are fairly suited to use as habitat for most wildlife.

They provide a good habitat for quail but do not provide shrubs and forbs for deer and turkey. Antelope has been reintroduced in some areas. Nesting areas for quail, doves, and songbirds are plentiful.

These soils are poorly suited to most urban uses. Large limestone fragments, depth to bedrock, and slope are the most restrictive features. These soils are poorly suited to recreational uses. The most restrictive features for recreational uses are large stones and slope.

Throck soil is in capability subclass VIe and is in the Clayey Slopes range site. Palopinto soil is in capability subclass VIs and is in the Low Stony Hill range site.

TPG—Throck-Palopinto association, steep. The soils in this association are deep to very shallow and are well drained. These soils are on the uplands, mainly on the hillsides and below the escarpments. The slopes range from about 5 to 30 percent. These soils are underlain by alternating layers of clayey shale and limestone bedrock at vertical intervals of 10 to about 50 feet. The mapped areas are mostly long and narrow and range from about 100 acres to several hundred acres. Throck soil is deep and clayey. It is on sloping to deep hillsides. This soil formed in shale. Palopinto soil is very shallow and loamy. It is on sloping to moderately steep, convex ridges and beaches on the hillsides. This soil formed on limestone. Throck and Palopinto soils have floating limestone flagstones, stones, and boulders on and embedded in the surface (fig. 18). Rock outcrops occur along scarps and ledges.

Throck soil makes up about 45 percent of the map unit; Palopinto soil makes up about 38 percent; and other included soils and rock outcrop make up about 17 percent. The areas of this map unit are large, and the composition is variable from delineation to delineation; however, the detail is adequate for the foreseeable uses of these soils, and their use and management are similar.

Typically, Throck soil has a surface layer that is brown stony silty clay about 8 inches thick. The upper part of the subsoil, to a depth of 26 inches, is yellowish brown silty clay. The lower part, to a depth of 38 inches, is light yellowish brown clay that contains a few soft masses and concretions of calcium carbonate. Light yellowish brown shaly clay with alternating layers of weakly to strongly cemented calcareous sandstone is below the subsoil to a depth of 48 inches. About 5 percent of the surface layer is covered with floating and embedded limestone flagstones, stones, and boulders. In some areas, the surface layer is very dark grayish brown. Throck soil is moderately alkaline and calcareous throughout.

Typically, Palopinto soil has a surface that is moderately alkaline, dark grayish brown very flaggy clay loam about 6 inches thick. Below the surface layer is coarsely fractured, hard, limestone bedrock. About 20 percent of the surface layer is covered with a few stones and boulders and with gravel- and cobble-size flagstones. Some of the Palopinto soils have a surface layer that is extremely flaggy clay loam, flaggy clay loam, silty clay loam, silt loam, or loam.

Throck soil is slowly permeable. Palopinto soil is moderately permeable. Runoff is rapid. The available water capacity is medium in Throck soil and very low in Palopinto soil. Water erosion is a severe hazard on these soils. Soil blowing is not a problem.

Included in mapping are areas of Harpersville and Owens soils. These soils make up about 7 percent of the area. Also included are some areas of rock outcrop that is mainly limestone bedrock 3 to 20 feet thick. It has a hardness of 3 or more on Mohs' scale, is coarsely fractured, massive, and tilts about 10 degrees to the

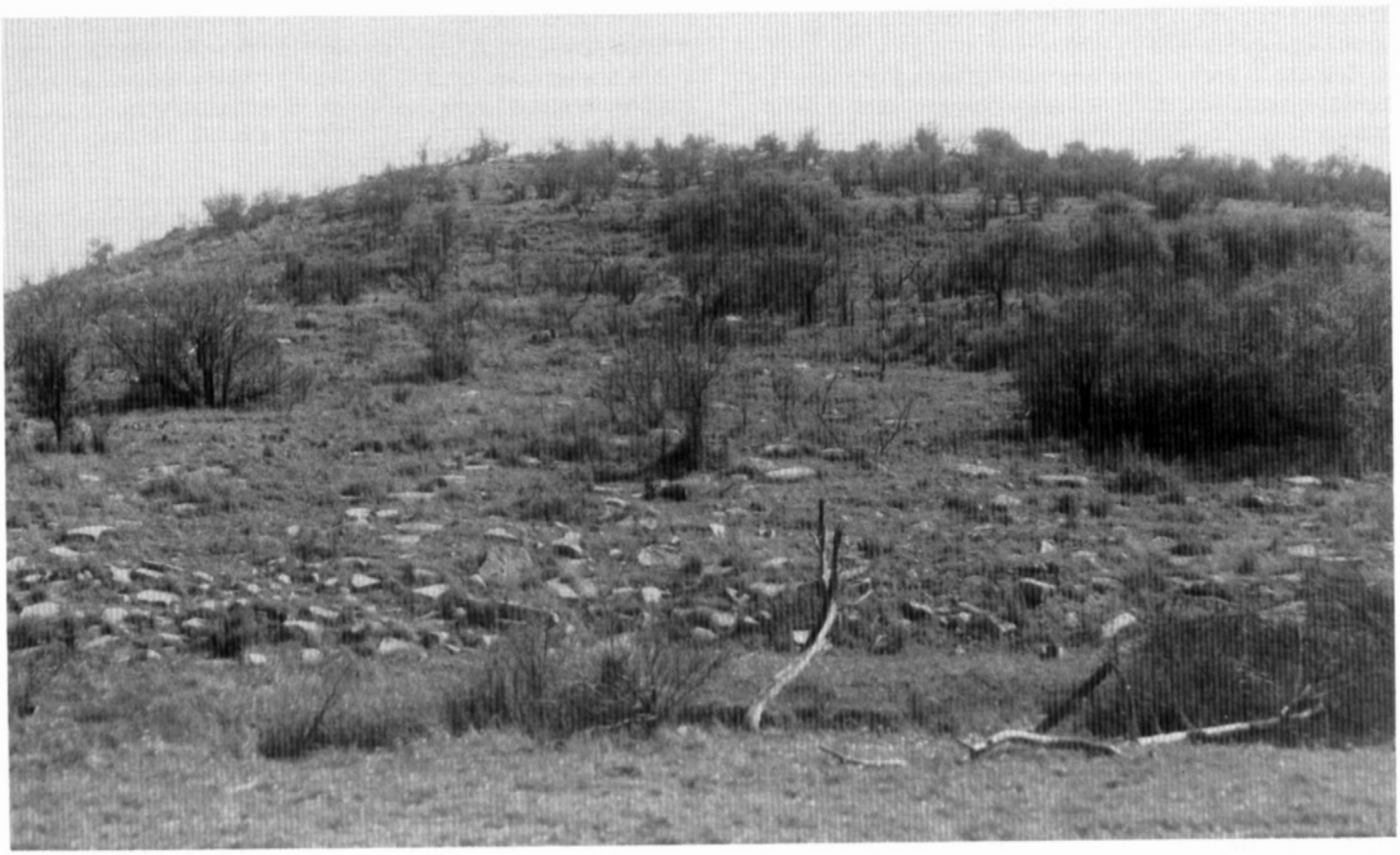


Figure 18.—These soils of the Throck-Palopinto association, steep, formed in shale and on limestone. These soils are mainly used as rangeland and as habitat for wildlife.

west. The rock outcrop makes up about 10 percent of the area.

The soils in this association are used as rangeland and as habitat for wildlife.

These soils are not suitable for use as cropland because of stoniness, bedrock, and steep slopes.

These soils are moderately suited to native range plants. Large stones limit overland travel by car or truck. Limited rainfall and excessive runoff limit yields. In most rangeland areas are Texas wintergrass, sideoats grama, tall dropseed, vine-mesquite grasses, and mesquite trees. Hackberry and greenbrier grow near and in the rock ledges.

These soils are fairly suited to use as habitat for wildlife, especially for deer, quail, turkey, and furbearing animals. Nesting areas for quail, doves, and songbirds are plentiful.

These soils are poorly suited to most urban uses. Large limestone fragments, depth to bedrock, and slope are the most restrictive features. These soils are poorly suited to recreational uses. The most restrictive features for recreational uses are large stones and slope.

Throck soil is in capability subclass VIIs and is in the Rocky Hills range site. Palopinto soil is in capability subclass VIIs and is in the Steep Rocky range site.

TrA—Thurber clay loam, 0 to 2 percent slopes. This soil is deep, nearly level to gently sloping, and moderately well drained. It is on the uplands. The surface is plane to weakly concave. The slopes average about 1 percent. The mapped areas are irregular in shape to oval and range from 30 to 120 acres.

Typically, this soil has a surface layer of mildly alkaline, dark brown clay loam about 5 inches thick. The upper part of the subsoil, to a depth of 16 inches, is moderately alkaline, noncalcareous, dark grayish brown clay. The next layer, to a depth of 36 inches, is moderately alkaline, calcareous, dark grayish brown clay. The next layer, to a depth of 51 inches, is moderately alkaline, calcareous, dark grayish brown clay that contains concretions of calcium carbonate. The lower part to a depth of 60 inches is moderately alkaline, calcareous, grayish brown clay that contains concretions of calcium carbonate.

This soil is very slowly permeable. Runoff is slow. The available water capacity is high. The root zone is deep, but the clayey subsoil restricts root penetration. Water erosion and soil blowing are slight hazards.

Included with this soil in mapping are some areas of Leeray, Truce, and Bluegrove soils. Also included are some small areas of soils that have a silty clay loam surface layer. These included soils make up less than 15 percent of the map unit.

This Thurber soil is mostly used as rangeland. In some areas, this soil is used as cropland. The main crops are small grains and forage sorghum.

This soil is moderately suited to use as cropland. Low rainfall limits some yields. Crop residue left on the surface helps to conserve moisture and to improve tilth. The surface layer becomes hard and massive when dry and causes poor tilth. Diversion terraces are needed in some fields to control runoff from higher slopes.

This soil is moderately suited to native range plants. The very slow permeability and the massive surface layer limit water infiltration into this soil. Native range plants are mostly mid- and short-grasses. In most rangeland areas are Texas wintergrass, sand dropseed, Texas grama, curlymesquite, and some annual plants and mesquite trees.

This soil is fairly suited to use as habitat for wildlife, especially for doves and quail.

This soil is poorly suited to most urban uses. Shrinking and swelling with changes in moisture and permeability are the most limiting factors. Foundations for roads, structures, and utilities need to be of special design and to be properly installed. This soil is moderately suited to recreational uses because of very slow permeability.

This Thurber soil is in capability subclass IIIs and is in the Claypan Prairie range site.

TuB—Truce fine sandy loam, 1 to 3 percent slopes. This soil is deep, gently sloping, and well drained. It is on the uplands. The surface is convex. The slopes average about 2 percent. The mapped areas are irregular in shape and range from 15 to more than 100 acres.

Typically, this soil has a surface layer of neutral, brown fine sandy loam about 7 inches thick. The upper part of the subsoil, to a depth of 26 inches, is neutral, reddish brown clay. The middle part, to a depth of 37 inches, is neutral, brown clay. The lower part, to a depth of 51 inches, is moderately alkaline, calcareous, light brown clay. The substratum to a depth of 60 inches is calcareous, pale brown shaly clay.

This soil is slowly permeable. Runoff is medium. The available water capacity is low. The root zone is deep, but the clayey subsoil restricts root penetration. Water erosion and soil blowing are moderate hazards.

Included with this soil in mapping are some areas of Bluegrove, Bonti, Owens, and Throck soils. Also included are a few areas of soils that are severely eroded and some areas of soils that have 15 to 25 percent sandstone fragments in the surface layer. These included soils make up less than 25 percent of the map unit.

This Truce soil is mostly used as rangeland. In some areas, this soil is used as cropland. The main crops are small grains and forage sorghum.

This soil is poorly suited to use as cropland. Poor tilth and droughtiness are the most limiting factors. The surface layer becomes hard and massive when dry and causes poor soil tilth. Crop residue left on the surface helps to conserve moisture, controls soil blowing, and improves tilth. Terraces and grassed waterways help to control water erosion.

This soil is moderately suited to native range plants. Droughtiness is the most limiting factor. Native range plants are mostly mid- and short-grasses. In most rangeland areas are Texas wintergrass, vine mesquite, tall dropseed, curlymesquite, and some annual plants and mesquite trees. Once native plants disappear they are difficult to reestablish.

This soil is well suited to use as habitat for wildlife, especially for doves and quail.

This soil is moderately suited to most urban uses. Slow permeability, shrinking and swelling with changes in moisture, low strength, and corrosivity to uncoated steel are the most restrictive features. This soil is well suited to recreational uses.

This Truce soil is in capability subclass IIIe and is in the Tight Sandy Loam range site.

TuC—Truce fine sandy loam, 3 to 5 percent slopes. This soil is deep, gently sloping, and well drained. It is on the uplands. The surface is convex. The slopes average about 3.8 percent. The mapped areas are irregular in shape and range from 15 to more than 100 acres.

Typically, this soil has a surface layer of neutral, brown fine sandy loam about 5 inches thick. The upper part of the subsoil, to a depth of 15 inches, is neutral, reddish brown clay. The next layer, to a depth of 34 inches, is neutral, strong brown clay. The next layer, to a depth of 52 inches, is moderately alkaline, strong brown clay. The lower part, to a depth of 56 inches, is moderately alkaline, calcareous, yellowish brown clay. Calcareous, pale brown shaly clay is below the subsoil.

This soil is slowly permeable. Runoff is medium. The available water capacity is low. The root zone is deep, but penetration by plant roots is difficult. The hazard of water erosion is severe, and the hazard of soil blowing is moderate.

Included with this soil in mapping are some areas of Bluegrove, Bonti, Owens, and Throck soils. Also included are some areas of soils that have 15 to 25 percent sandstone fragments in the surface layer and some soils that are in gullies that are severely eroded. These gullies are 1 to 3 feet deep and 5 to 15 feet wide. They occur about every 100 to 300 feet across the slope. Most of these gullies have formed in trails and watercourses. These included soils make up less than 25 percent of the map unit.

This Truce soil is mostly used as rangeland. In some areas, this soil is used as cropland. The main crops are small grains and forage sorghum.

This soil is poorly suited to use as cropland. Poor tilth and droughtiness are the most limiting factors. The surface layer becomes hard and massive when dry and causes poor tilth. Crop residue left on the surface conserves moisture and controls soil blowing and water erosion. Terraces and grassed waterways also control water erosion.

This soil is moderately suited to native range plants. Droughtiness is the most limiting factor. Native range plants are mostly mid- and short-grasses. In most rangeland areas are Texas wintergrass, vine-mesquite, tall dropseed, curlymesquite, and some annual plants and mesquite trees. Once native plants disappear they are difficult to reestablish.

This soil is well suited to use as habitat for wildlife, especially for doves and quail.

This soil is moderately suited to most urban uses. Permeability, shrinking and swelling with changes in moisture, low strength, and corrosivity to uncoated steel are the most restrictive features. This soil is well suited to recreational uses. Slow permeability is the most limiting factor for recreational uses.

This Truce soil is in capability subclass IVe and is in the Tight Sandy Loam range site.

VeC—Veal loam, 1 to 5 percent slopes. This soil is deep, gently sloping, and well drained. It is on the uplands. The surface is convex. The slopes average about 2 percent. The mapped areas are mostly long and narrow and range from 5 to 80 acres.

Typically, this soil has a surface layer of brown loam about 6 inches thick. The upper part of the subsoil, to a depth of 12 inches, is brown loam. The next layer, to a depth of 31 inches, is light brown loam that contains 30 percent visible carbonates. The next layer, to a depth of 35 inches, is light reddish brown loam that contains 30 percent visible carbonates. The lower part to a depth of about 60 inches is light reddish brown fine sandy loam that contains 10 percent visible carbonates. This soil is moderately alkaline and calcareous throughout.

This soil is moderately permeable. Runoff is medium. The available water capacity is medium. Water erosion and soil blowing are moderate hazards.

Included with this soil in mapping are some areas of Rowena and Mereta soils. Also included are some soils that have a surface layer of clay loam and fine sandy loam and some areas of soils that are similar to Veal soil but have caliche gravel throughout. These included soils make up less than 20 percent of the map unit.

This Veal soil is mostly used as cropland. In some areas, this soil is used as rangeland. The main crops are small grains and cotton.

This soil is poorly suited to most crops. Erosion hazard, droughtiness, and high calcium carbonate content are the most limiting factors. The high calcium carbonate content of this soil causes iron chlorosis in some crops. Crop residue left on the surface conserves moisture and helps to control water erosion and soil blowing. Terraces and grassed waterways also help control water erosion.

This soil is moderately suited to native range plants. Droughtiness and high carbonate content are the most limiting factors. Native range plants are mostly mid- and short-grasses. In most rangeland areas are Texas wintergrass, threeawn, sideoats grama, buffalograss, and curlymesquite.

This soil is fairly suited to habitat for wildlife, especially for doves and quail.

This soil is well suited to most urban uses. Low strength and corrosivity to uncoated steel are restrictive features. This soil is well suited to recreational uses.

This Veal soil is in capability subclass IVe and is in the Loamy range site.

WcA—Wichita clay loam, 0 to 1 percent slopes. This soil is deep, nearly level, and well drained. It is on terraces. The surface is plane to slightly convex. The slopes average about 0.5 percent. The mapped areas are irregular in shape and range from 10 to more than 100 acres.

Typically, this soil has a surface layer of mildly alkaline, dark brown clay loam about 5 inches thick. The upper part of the subsoil, to a depth of 24 inches, is mildly alkaline, reddish brown clay. The middle layer, to a depth of 36 inches, is moderately alkaline, reddish brown clay. The lower part to a depth of 60 inches is calcareous, reddish yellow clay loam that contains concretions and soft masses of calcium carbonate.

This soil is moderately slowly permeable. Runoff is slow. The available water capacity is high. The root zone is deep. Water erosion and soil blowing are slight hazards.

Included with this soil in mapping are some areas of Grandfield, Minwells, and Veal soils. Also included are a few areas of a soil that is similar to Wichita soil but has a very dark brown surface layer, some areas of a soil that is also similar to Wichita soil but is underlain by limestone bedrock, some small areas of similar soils that are gently sloping, and a few areas of similar soils that have a loamy surface layer. These included soils make up less than 15 percent of the map unit.

This Wichita soil is mostly used as cropland. In some areas, this soil is used as rangeland. The main crops are cotton, wheat, and grain sorghum.

This soil is well suited to nonirrigated and irrigated crops, such as cotton, wheat, and grain sorghum. Low rainfall is the most limiting factor. Crop residue left on the surface conserves moisture. This soil tends to form a dense plowpan below the plow layer, which reduces water infiltration and most root growth into the subsoil.

This soil is well suited to native range plants. Low rainfall is the most limiting factor. Native range plants are mostly mid- and short-grasses. In most rangeland areas are Texas wintergrass, sand dropseed, Texas grama, curlymesquite, and some annual plants and mesquite trees.

This soil is well suited to use as habitat for wildlife, especially for doves and quail.

This soil is moderately suited to most urban uses. Low strength as it affects streets and roads, shrinking and swelling with changes in moisture, and texture are the most limiting factors. This soil is well suited to recreational uses.

This Wichita soil is in capability subclass IIc and is in the Clay Loam range site.

WcB—Wichita clay loam, 1 to 3 percent slopes. This soil is deep, gently sloping, and well drained. It is on terraces. The surface is plane to slightly convex. The slopes average about 1.5 percent. The mapped areas are irregular in shape and range from 10 to more than 100 acres.

Typically, this soil has a surface layer of mildly alkaline, dark brown clay loam about 8 inches thick. The upper part of the subsoil, to a depth of 22 inches, is mildly alkaline, reddish brown clay. The next layer, to a depth of 40 inches, is moderately alkaline, reddish brown clay. The next layer, to a depth of 48 inches, is calcareous, yellowish red clay loam. The lower part to a depth of 60 inches is reddish yellow clay loam that contains about 15 percent calcium carbonate.

This soil is moderately slowly permeable. Runoff is medium. The available water capacity is high. The root zone is deep. The hazard of water erosion is moderate, and the hazard of soil blowing is slight.

Included with this soil in mapping are some areas of Grandfield, Minwells, and Veal soils. Also included are small areas of Wichita soils that are nearly level and some areas of soils that are similar to Wichita soil but have a very dark brown surface layer. These included soils make up less than 15 percent of the map unit.

This Wichita soil is mostly used as cropland. In some areas, this soil is used as rangeland. The main crops are cotton, wheat, and grain sorghum.

This soil is well suited to nonirrigated and irrigated crops, such as cotton, wheat, and grain sorghum. Sporadic summer rainfall limits yields. Crop residue left on the surface conserves moisture and helps to control soil blowing and water erosion. Terraces and grassed waterways also help control water erosion. Plowing these soils when they are wet causes a compacted plowpan, a few inches thick, to form at the base of the plowed layer.

This soil is well suited to native range plants. Low rainfall is the most limiting factor. Native range plants are mostly mid- and short-grasses. In most rangeland areas are Texas wintergrass, sand dropseed, Texas grama, curlymesquite, and some annual plants and mesquite trees.

This soil is well suited to habitat for wildlife, especially for doves and quail.

This soil is moderately suited to most urban uses. Low strength as it affects streets and roads, shrinking and swelling with changes in moisture, and texture are the most limiting factors. This soil is well suited to recreational uses.

This Wichita soil is in capability subclass IIe and is in the Clay Loam range site.

Prime Farmland

In this section, prime farmland is defined and discussed, and the prime farmland soils in Shackelford County are listed in table 5.

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the nation's short- and long-range needs for food and fiber. The acreage of high-quality farmland is limited, and the U.S. Department of Agriculture recognizes that government at local, state, and federal levels, as well as individuals, must encourage and facilitate the wise use of our nation's prime farmland.

Prime farmland soils, as defined by the U.S. Department of Agriculture, are soils that are best suited to producing food, feed, forage, fiber, and oilseed crops. Such soils have properties that are favorable for the economic production of sustained high yields of crops. The soils need only to be treated and managed using acceptable farming methods. The moisture supply, of course, must be adequate, and the growing season has to be sufficiently long. Prime farmland soils produce the highest yields with minimal inputs of energy and economic resources. Farming these soils results in the least damage to the environment.

Prime farmland soils may presently be in use as cropland, pasture, or woodland, or they may be in other uses. They either are used for producing food or fiber or are available for these uses. Urban or built-up land, public land, and water areas cannot be considered prime farmland. Urban or built-up land is any contiguous unit of land 10 acres or more in size that is used for such purposes as housing, industrial, and commercial sites, sites for institutions or public buildings, small parks, golf courses, cemeteries, railroad yards, airports, sanitary landfills, sewage treatment plants, and water control structures. Public land is land not available for farming in national forests, national parks, military reservations, and state parks.

Prime farmland soils usually get an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The acidity or alkalinity level of the soils is acceptable. The soils have few or no rocks and are permeable to water and air. They are not excessively erodible or saturated with water for long periods and are not subject to frequent flooding during the growing season. The slope ranges mainly from 0 to 5 percent.

About 207,220 acres in Shackelford County, or nearly 35 percent of the total acreage, meets the requirements for prime farmland soils. Areas of these soils are scattered throughout the county. General soil map units 3, 4, 5, 6, and 7 have the largest areas of prime farmland soils; general soil map units 2, 8, and 9 have substantial areas; and general soil map unit 1 has small scattered areas.

Crops grown on these soils are mainly cotton, grain sorghum, oats, wheat, and forage sorghum.

Table 5 lists map units, or soils, that make up prime farmland in Shackelford County. The location of each map unit is shown on the detailed soil maps at the back of this publication. The extent of each unit is given in table 4. The soil qualities that affect use and management are described in the section "Detailed Soil Map Units." This list does not constitute a recommendation for a particular land use.

Inadequate rainfall is a limitation on some soils. These soils may qualify as prime farmland if these limitations are overcome by irrigation. Onsite evaluation is necessary to determine if the corrective measures taken have been effective.

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 for predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland; 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 that is in harmony with nature.

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

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.

According to Soil Conservation Service statistics, about 47,600 acres in Shackelford County was used for crops in 1984. Of this total, about 2 percent was used for pasture and hayland. Crops were mainly cotton, grain sorghum, oats, and wheat.

Soil erosion is the major problem on nearly all of the cropland in the county. Water erosion is a hazard on nearly all of the cropland where slopes are more than 1 percent. Plant cover, contour farming, terraces, and grassed waterways reduce the risk of water erosion. Soil blowing is a hazard, especially during droughts and windstorms that occur during winter and spring. Cotton can provide adequate cover during the growing season but does not leave enough residue on the surface to protect and improve the soil. Rotating cotton with grain sorghum and small grains increases residue and minimizes soil blowing.

Loss of the surface layer through water erosion or soil blowing 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 if the soil is shallow. Secondly, water erosion on farmland results in sedimentation of streams. Controlling water erosion minimizes the pollution of streams by sediment and improves the quality of water for urban use, recreation, and wildlife. Erosion control practices should provide protective surface cover, reduce runoff, and increase water intake. A cropping system that keeps plant cover on the soil for long periods can hold soil erosion losses to amounts that do not reduce yields.

Residue management is an effective practice. A good litter of crop residue left on the surface protects against soil compaction during rains, reduces crusting, slows runoff, and reduces moisture evaporation. It shades the soil and thus reduces soil temperatures. In addition, it adds organic matter to the soil, improves tilth, and reduces packing by farm machinery. Crop residue should be protected from grazing and burning. Tillage equipment that keeps residue on the surface should be used.

The use of conservation tillage on the soils in Shackelford County is increasing. It is effective in reducing erosion on sloping land and can be adapted to most soils in the county.

Diversion terraces and field terraces reduce the length of slope and slow runoff. Terraces are most practical on deep and moderately deep soils that have smooth slopes. On the nearly level Abilene, Nuvalde, Rowena, and Wichita soils, terracing and contour farming are used to conserve moisture. All terraces require suitable outlets to dispose of excess water. If natural grassed drainageways are not available as outlets, grassed waterways should be constructed before terraces are built.

Information regarding the design of erosion control practices for each kind of soil is available from the local offices of the Soil Conservation Service.

Soil fertility is medium in most of the soils on the uplands. Nitrogen and phosphorus are the most deficient minerals. The soils on flood plains, such as Clairemont, Frio, and Gageby soils, are naturally higher in plant nutrients than most of the soils on the uplands.

Soil tilth is important in the germination of seeds and in the water intake rate. Soils that have good tilth are granular, porous, and friable. Tilth can be improved by adding large amounts of organic matter, such as cotton burs or crop residue.

The Leeray and Nukrum soils are clayey and sometimes remain wet until late in the spring. If they are wet when plowed, they tend to be cloddy when dry and good seedbeds are difficult to prepare. Fall plowing generally results in good tilth in spring, but soil blowing can be a concern if the soil is left bare of vegetation.

The latest information and suggestions for growing crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

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 6. 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 6 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 for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for use as cropland. 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 criteria used in grouping the soils do not include major, and generally expensive, landforming that would change slope, depth, or other characteristics of the soils, nor do they include 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 few limitations that restrict their use. (No Class I soils are in Shackelford County.)

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 they 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. (No Class VIII soils are in Shackelford County.)

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 a 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.

The soils in class V are subject to little or no erosion, but they have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation. Class V contains only the subclasses indicated by *w, s,* or *c*.

Rangeland

Bobby J. Waddell, range conservationist, Soil Conservation Service, helped prepare this section.

Rangeland is land on which native vegetation consists of a wide variety of grasses, grasslike plants, forbs, shrubs, and trees. The vegetative species are generally suitable for grazing, and the amount of vegetation is sufficient for grazing. Rangeland, or native grassland, receives no regular or frequent cultural treatment. The composition and production of the plant community are determined by soil, climate, topography, overstory canopy, and grazing management.

According to records of the local office of the Soil Conservation Service, about 532,000 acres, or 91 percent of the survey area, is rangeland. It originally produced a wide variety of grasses interspersed with an abundance of forbs. Much of the area has now been invaded by mesquite, brush, and weeds.

The vegetative community has changed drastically during the past 50 years. Heavy grazing has deteriorated most of the grasslands, and much of the high quality vegetation has been grazed out. A mixture of short- to mid-grasses and poor quality forbs is commonplace. However, remnants of the original plant species can still be found in protected areas, and in most cases, good grazing management makes it possible for high quality plants to reestablish themselves.

Although most of the local ranches and livestock farms are cow-calf operations, some are stocker calf enterprises. Many ranches supplement their herds with stockers. This practice provides flexibility so that the number of livestock to be cared for can be adjusted in periods of drought.

Protein supplement, hay, and grazing of small grains are used to supplement livestock feeding during the winter.

Approximately 75 percent of the annual forage production takes place in April, May, and June when spring rains and moderate temperatures are favorable for the growth of warm-season plants. A secondary growth period generally occurs in September and October when fall rains and gradually cooling temperatures are common.

Droughts of varying length are common in the survey area. Each year, short midsummer droughts normally occur. Frequently, longer periods of drought last for several months.

Three major land resource areas are in Shackelford County. They are commonly known as the Rolling Limestone Prairie Land Resource Area, the Rolling Plains Land Resource Area, and the Texas North Central Prairies Land Resource Area.

The *Rolling Limestone Prairie Land Resource Area* makes up a majority of the county. General soil map units 1, 2, 3, 5, 6, and 7 are in this major land resource area. One area of general soil map unit 4, located north of Albany, is also in this grouping. This major land resource area has the potential to produce mid- and tall-grasses. Currently, well managed pastures contain sideoats grama, Texas cupgrass, Texas wintergrass, and a variety of forbs. This part of the county was settled by large ranching units, many of which are still in operation.

The *Rolling Plains Land Resource Area* makes up only a small area in the western part of the county. It is characterized by general soil map unit 4 along the Jones-Shackelford county line. The grasses are mainly short- and mid-grasses, such as buffalograss, curlymesquite, sideoats grama, and a variety of forbs. The rangeland in this area is interspersed with cropland.

The *Texas North Central Prairies Land Resource Area* is along the eastern side of the county. General soil map units 8 and 9 are typical of the area. This is a post oak-blackjack oak savannah that is capable of supporting mid- and tall-grasses. Historically, this area has been in small ranching units that are generally more difficult to manage without overgrazing. This has resulted in a less favorable range condition than in other parts of the county.

Prior to settlement of the county, the area was an open grassland with trees located primarily along the ridges and streambanks. Wildfires, once a part of the natural rangeland ecosystem, repeatedly burned the vegetation over large areas. This helped control the encroachment of undesirable brush.

After settlement, a number of events caused a change in vegetation. Wildfires were suppressed and livestock numbers multiplied until the rangelands were overgrazed. This allowed mesquite, pricklypear, and other undesirable plants to invade the area and compete with the better vegetation for sunlight and moisture. The taller, more productive grasses were reduced in favor of more shade-tolerant and cool-season plants. For example, Texas wintergrass, a cool-season grass, has increased significantly.

In order to return the rangeland to its former natural productive state, brush management practices, such as planned burns, use of herbicides, and mechanical treatment, are necessary along with a sound grazing management program.

Range Sites and Condition Classes

Different kinds of soil vary in their capacity to produce grass and other plants for grazing. Soils that produce about the same kinds, amounts, and proportions of forage make up a range site.

Climax vegetation on the range site is the stabilized plant community that the site is capable of producing. It consists of the plants that were growing there when the region was first settled. This plant community reproduces itself and changes very little as long as the environment remains unchanged. If cultivated crops are not grown, the most productive combination of forage plants on a range site is generally the climax vegetation.

Decreasers are plants in the climax vegetation that tend to decrease in relative amount under close grazing. They generally are the tallest and most productive perennial grasses and forbs and are the most palatable to livestock.

Increasers are plants that increase in relative amount as the more desirable decreaser plants are reduced by close grazing. They are commonly shorter than decreasers and are generally less palatable to livestock.

Invaders are plants that increase in abundance as the decreasers and increasers decline. They cannot compete with plants in the climax plant community for moisture, nutrients, and light. Invaders have little value for grazing.

Range condition is judged according to the standards that apply to the particular range site. It expresses the present kind and amount of vegetation in relation to the potential climax plant community for the site.

Four range condition classes are used to indicate the degree of departure from the potential, or climax, vegetation. The classes show the present condition of the native vegetation on a range site as compared to the native vegetation that could grow there. A range is in excellent condition if 76 to 100 percent of the vegetation is of the same kind as that in the climax stand; in good condition if the percentage is 51 to 75; in fair condition if the percentage is 26 to 50; and in poor condition if the percentage is 25 or less.

Potential forage production depends on the range site. Current forage production depends on the range condition and the moisture available to plants during the growing season.

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 of the soils, vegetation, and water.

Table 7 shows, for each soil, the range site; the total annual production of vegetation in favorable, average, and unfavorable years. Only those soils that are used as rangeland or are suited to use as rangeland are listed. Explanation of the column headings in table 7 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, or proportion of range plants (fig. 19). 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.

Potential annual production is the amount of vegetation that can be expected to grow on well managed rangeland that is supporting the potential plant community. Potential annual production 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, but 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, average, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In an average year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture. Air-dry vegetation yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

Range management requires a knowledge of the kinds of soil and of the climax plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the climax plant community on a particular range site. The more closely the existing community resembles the climax 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.

A primary objective in range management is to keep the range in excellent or good condition. If the range is well managed, water is conserved, yields are improved, and the soils are protected. The main concern in management is recognizing important changes in the

Figure 19.—These soils of the Throck-Palopinto association, steep, are in the Rocky Hills and Steep Rocky range sites. These range sites are in good condition.

kind of cover on a range site. These changes take place gradually and can be misinterpreted or overlooked. Growth encouraged by heavy rainfall may lead to the conclusion that the range is in good condition, whereas actually the cover is weedy and the long-term trend is toward lower production. Otherwise, some rangeland that has been closely grazed for short periods under the supervision of a careful manager may have a degraded appearance that temporarily conceals its quality and ability to recover.

Following years of prolonged overuse of rangeland, seed sources of the desirable vegetation will be eliminated. Therefore, the vegetation needs to be reestablished for management to be effective. Brush control, range seeding, fencing, and development of water sites are methods that can be used to reestablish the stands of native plants. Thereafter, management practices of deferred grazing, proper grazing use, and a planned grazing system are needed to maintain and improve the range.

Good management generally results in optimum production of vegetation, 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.

Nineteen range sites are in the survey area. They are Clay Loam, Clayey Slopes, Clayey Upland, Claypan Prairie, Deep Sand, Loamy, Loamy Bottomland, Loamy Sand, Low Stony Hill, Redland, Rocky Hills, Sandstone Hill, Sandy Loam, Shallow, Shallow Clay, Shaly Hill, Steep Rocky, Tight Sandy Loam, and Very Shallow range sites.

Clay Loam range site. The main soils in this range site are Abilene soil (AbA), Nuvalde soil (NuA, NuB), Rowden soil (RdA), Rowena soil (RoA, RoB), and Wichita soil (WcA, WcB).

The potential plant community is an open short- to mid-grass prairie. Typically, sideoats grama makes up 25 percent of the plant community; vine-mesquite, Arizona cottontop, cane bluestem, and silver bluestem, 25 percent; buffalograss and blue grama, 15 percent; Texas wintergrass, western wheatgrass, and Canada wildrye, 15 percent; tall dropseed, meadow dropseed, plains bristlegrass, and Texas cupgrass, 10 percent; and forbs, such as Engelmann-daisy, heath aster, western ragweed, slender greenthread, dotted gayfeather, and gaura, 10 percent.

Vine-mesquite, sideoats grama, Arizona cottontop, and Engelmann-daisy are removed from the plant community through heavy grazing by livestock and are replaced by silver bluestem, buffalograss, and Texas wintergrass. If heavy grazing continues for many years, condalia, mesquite, pricklypear, threeawn, and broomweed will eventually dominate the site.

Mesquite and pricklypear encroach in many places. Cool-season grasses, such as Texas wintergrass and rescuegrass, naturally fill the voids left when the shade and moisture competition drive out the warm-season grasses. In reestablishing the formerly cropped areas, reseeding of desirable range grasses is necessary because a natural seed source is not available.

Clayey Slopes range site. Throck soil (ThC, TPC) is the main soil in this range site.

The potential plant community is an open mid-grass prairie. Typically, big bluestem makes up 30 percent of the plant community; little bluestem, 10 percent; indiangrass, vine-mesquite, tall dropseed, Arizona cottontop, switchgrass, and sideoats grama, 30 percent; buffalograss, meadow dropseed, white tridens, Texas wintergrass, slim tridens, and curlymesquite, 15 percent; Wright threeawn, hairy grama, Texas grama, and brome, 5 percent; forbs, such as heath aster, western ragweed, Engelmann-daisy, rosering gaillardia, globemallow, trailing ratany, eryngo, gray goldaster, dotted gayfeather, and primrose, 5 percent; and woody plants, such as hackberry, bumelia, elbowbush, dalea, skunkbush sumac, and vine ephedra, 5 percent.

Big bluestem, little bluestem, indiangrass, and switchgrass are removed from the plant community through heavy grazing by livestock and are replaced by Arizona cottontop, sideoats grama, vine-mesquite, and tall dropseed. If heavy grazing continues for many years, mesquite, pricklypear, threeawn, and broomweed will eventually dominate the site.

Clayey Upland range site. The main soils in this range site are Leeray soil (LeA, LeB) and Nukrum soil (NcB).

The potential plant community is an open mid-grass prairie. Typically, sideoats grama makes up 20 percent of the plant community; vine-mesquite, 20 percent; Texas wintergrass, 15 percent; tall dropseed, 15 percent; western wheatgrass, 10 percent; curlymesquite, 10 percent; Texas bluegrass, buffalograss, white tridens, silver bluestem, Arizona cottontop, and meadow dropseed, 5 percent; and forbs, such as catclaw sensitivebrier, heath aster, western ragweed, Engelmann-daisy, slender greenthread, dotted gayfeather, and gaura, 5 percent.

Vine-mesquite, white tridens, sideoats grama, Arizona cottontop, and Engelmann-daisy are removed from the plant community through heavy grazing by livestock and are replaced by silver bluestem, buffalograss, curlymesquite, and Texas wintergrass. If heavy grazing continues for many years, condalia, mesquite, pricklypear, threeawn, and broomweed will eventually dominate the site.

Mesquite and pricklypear encroach in many places. Cool-season grasses, such as Texas wintergrass and rescuegrass, naturally fill the voids left when the shade and moisture competition drive out the warm-season grasses. In reestablishing the formerly cropped areas, reseeding of desirable range grasses is necessary because a natural seed source is not available.

Claypan Prairie range site. Thurber soil (TrA) is the main soil in this range site.

The potential plant community is an open mid- and short-grass prairie. Typically, sideoats grama makes up 25 percent of the plant community; vine-mesquite, Arizona cottontop, tall dropseed, meadow dropseed, silver bluestem, and white tridens, 40 percent; buffalograss, Texas wintergrass, western wheatgrass, and vine-mesquite, 30 percent; and forbs, such as catclaw sensitivebrier, heath aster, western ragweed, Engelmann-daisy, slender greenthread, dotted gayfeather, and Mexican sagewort, 5 percent.

Sideoats grama is removed from the plant community through heavy grazing by livestock and is replaced by buffalograss and Texas wintergrass. If heavy grazing continues for many years, condalia, mesquite, pricklypear, threeawn, and brome will eventually dominate the site.

Deep Sand range site. Patilo soil (PoB) is the main soil in this range site.

The potential plant community is an open stand of post oak trees that have an understory of mid- and tall-grasses. Typically, little bluestem, indiangrass, and switchgrass make up 20 percent of the plant community; purpletop tridens, sand dropseed, and fringeleaf paspalum, 20 percent; red lovegrass, 5 percent; forbs, such as trailing wildbean, lespedeza, dayflower, eveningprimrose, and bundleflower, 15 percent; and woody plants, such as post oak, blackjack oak, bumelia, prickly-ash, skunkbush sumac, and greenbrier, 40 percent.

Tall grasses are removed from the plant community through heavy grazing by livestock and are replaced by leaving a remnant of sand dropseed and fringeleaf paspalum. If heavy grazing continues for many years, shin oak will eventually dominate the site.

Loamy range site. Veal soil (VeC) is the main soil in this range site.

The potential plant community is an open mid- to short-grass site. Typically, sideoats grama makes up 30 percent of the plant community; little bluestem, 5 percent; Texas wintergrass, 5 percent; buffalograss, silver bluestem, sand dropseed, meadow dropseed, plains bristlegrass, and tall dropseed, 35 percent; curlymesquite and threeawn, 5 percent; forbs, such as catclaw sensitivebrier, heath aster, globemallow, Engelmann-daisy, verbena, croton, dotted gayfeather, and gaura, 15 percent; and woody plants, such as condalia, bumelia, hackberry, algerita, and yucca, 5 percent.

Little bluestem and sideoats grama are removed from the plant community through heavy grazing by livestock and are replaced by silver bluestem, buffalograss, and Texas wintergrass. If heavy grazing continues for many years, condalia, yucca, pricklypear, threeawn, and broom snakeweed will eventually dominate the site.

Loamy Bottomland range site. The main soils in this range site are Clairemont soil (Cm, Cn), Clearfork soil (Co), Frio soil (Fr), and Gageby soil (Ga).

The potential plant community is a tall- and mid-grass site that supports an abundance of forbs and woody plants. Typically, indiangrass, switchgrass, big bluestem, sand bluestem, and little bluestem make up 40 percent of the plant community; vine-mesquite and sideoats grama, 15 percent; Canada wildrye, Texas wintergrass, western wheatgrass, and Texas bluegrass, 20 percent; forbs, such as catclaw sensitivebrier, heath aster, western ragweed, Engelmann-daisy, slender greenthread, Maximilian sunflower, and gaura, 10 percent; and woody plants, such as elm, cottonwood, hackberry, oak, pecan, western soapberry, greenbrier, and bumelia, 15 percent.

Indiangrass, switchgrass, big bluestem, little bluestem, and Engelmann-daisy are removed from the plant community through heavy grazing by livestock and are replaced by Texas wintergrass, buffalograss, and threeawn. If heavy grazing continues for many years, condalia, mesquite, pricklypear, threeawn, and broomweed will eventually dominate the site.

Mesquite and pricklypear encroach in many places. Cool-season grasses, such as Texas wintergrass and rescuegrass, naturally fill the voids left when the shade and moisture competition drive out the warm-season grasses.

Loamy Sand range site. The main soils in this range site are Bonti soil (BoB), Chaney soil (CaB, CeC), and Grandfield soil (GdB).

The potential plant community is a tall-grass prairie and scattered motts of oak. Typically, little bluestem makes up 30 percent of the plant community; big bluestem, sand bluestem, indiangrass, and switchgrass, 25 percent; sideoats grama and sand lovegrass, 10 percent; purpletop tridens and giant dropseed, 5 percent; Canada wildrye and Texas bluegrass, 5 percent; silver bluestem, Arizona cottontop, hooded windmillgrass, sand dropseed, sand paspalum, and Scribner panicum, 10 percent; forbs, such as Engelmann-daisy, eveningprimrose, prairie-clover, dotted gayfeather, sagewort, verbena, and western ragweed, 5 percent; and woody plants, such as post oak, hackberry, skunkbush sumac, bumelia, prickly-ash, shin oak, and greenbrier, 10 percent.

Little bluestem, big bluestem, sand bluestem, indiangrass, and switchgrass are removed from the plant community through heavy grazing by livestock and are replaced by purpletop tridens, sideoats grama, hooded windmillgrass, sand dropseed, and sand paspalum. If heavy grazing continues for many years, oaks and greenbrier increase to form dense stands. Mesquite encroaches in many places. Threeawn, fall witchgrass, sand dropseed, fringed signalgrass, tumble windmillgrass, gummy lovegrass, and sand paspalum will eventually dominate the site.

Low Stony Hill range site. Palopinto soil (PaC, TPC) is the main soil in this range site.

The potential plant community is a mid- and tall-grass prairie. Typically, big bluestem, little bluestem, and indiangrass make up 25 percent of the plant community; sideoats grama, 15 percent; Texas wintergrass, Canada wildrye, vine-mesquite, tall dropseed, and green sprangletop, 25 percent; buffalograss, curlymesquite, and hairy grama, 10 percent; forbs, such as Mexican sagewort, orange zexmenia, western ragweed, Engelmann-daisy, bushsunflower, dotted gayfeather, and perennial legumes, 10 percent; and woody plants, such as bumelia, buckeye, catclaw, condalia, and algerita, 15 percent.

Mid- and tall-grasses are removed from the plant community through heavy grazing by livestock and are replaced by curlymesquite, slim tridens, and Texas wintergrass. If heavy grazing continues for many years, condalia, pricklypear, catclaw, threeawn, and red grama will eventually dominate the site.

Mesquite and pricklypear encroach in many places.

Redland range site. Hensley soil (HeB, HsB) is the main soil in this range site.

The potential plant community is an oak savannah that has an understory of mid- and tall-grasses. Typically, little bluestem, indiangrass, and big bluestem make up 40 percent of the plant community; sideoats grama, tall dropseed, cane bluestem, silver bluestem, vine-mesquite, Texas cupgrass, purpletop tridens, green sprangletop, and plains lovegrass, 20 percent; Texas wintergrass, Canada wildrye, and tall witchgrass, 15 percent;

buffalograss and curlymesquite, 5 percent; forbs, such as catclaw sensitivebrier, heath aster, western ragweed, Engelmann-daisy, Maximilian sunflower, dotted gayfeather, Mexican sagewort, bundleflower, and scurfpea, 5 percent; and woody plants, such as live oak, post oak, elm, hackberry, redbud, bumelia, sumac, and elbowbush, 15 percent.

Big bluestem, little bluestem, indiangrass, and Engelmann-daisy are removed from the plant community through heavy grazing by livestock and are replaced by sideoats, Texas wintergrass, and silver bluestem. If heavy grazing continues for many years, buffalograss, threeawn, Texas grama, red grama, and hairy grama will eventually dominate the site.

Mesquite, pricklypear, and lotebush encroach in many places. Cool-season grasses, such as Texas wintergrass and rescuegrass, naturally fill the voids left when the shade and moisture competition drive out the warm-season grasses.

Rocky Hills range site. The main soils in this range site are Owens soil (OXF) and Throck soil (TPG).

The potential plant community is an open mid- and tall-grass prairie. Typically, big bluestem, little bluestem, indiangrass, and switchgrass make up 35 percent of the plant community; sideoats grama, 20 percent; Arizona cottontop, vine-mesquite, plains bristlegrass, Texas cupgrass, cane bluestem, silver bluestem, and tall dropseed, 25 percent; buffalograss, slim tridens, rough tridens, hairy grama, curlymesquite, Texas wintergrass, and threeawn, 10 percent; forbs, such as catclaw sensitivebrier, heath aster, sagewort, Engelmann-daisy, trailing ratany, gray goldaster, dotted gayfeather, and gaura, 5 percent; and woody plants, such as sumac, hackberry, plum, bumelia, elbowbush, catclaw, and condalia, 5 percent.

Tall grasses are removed from the plant community through heavy grazing by livestock and are replaced by little bluestem, sideoats grama, cane bluestem, silver bluestem, tall dropseed, and Texas wintergrass. If heavy grazing continues for many years, threeawn, grama, mesquite, pricklypear, catclaw, algerita, and broomweed will eventually dominate the site.

Sandstone Hill range site. Bluegrove soil (BgC) is the main soil in this range site.

The potential plant community is a mixture of mid- and tall-grasses and an open stand of post oak and other trees. Typically, little bluestem makes up 35 percent of the plant community; big bluestem, sand bluestem, indiangrass, and switchgrass, 20 percent; sideoats grama and sand lovegrass, 15 percent; cane bluestem, silver bluestem, hairy grama, hooded windmillgrass, Texas wintergrass, tall dropseed, and purpletop tridens, 10 percent; forbs, such as Engelmann-daisy, bushsunflower, bundleflower, prairie-clover, lespedeza, and western ragweed, 5 percent; and woody plants, such as post oak, elm, skunkbush sumac, bumelia, and prickly-ash, 15 percent.

As regression occurs, big bluestem, indiangrass, switchgrass, and sand lovegrass are first grazed out. Little bluestem and sideoats grama increase immediately. As these plants are grazed out, silver bluestem and hairy grama increase. Also an increase in skunkbush sumac occurs. Further regression results in a rapid increase of invaders, such as threeawn, red lovegrass, sand dropseed, and annual grasses. Also forbs, such as ragweed and silverleaf nightshade, begin to make up a larger percent of the composition. Post oak also increases with regression of grasses. Elm and greenbrier increase along with an invasion of mesquite and juniper. A combination of these woody plants will dominate when the site is in poor condition. Occasionally skunkbush sumac will dominate the site in the lower stages of regression.

Little bluestem, big bluestem, indiangrass, switchgrass, and Engelmann-daisy are removed from the plant community through heavy grazing by livestock and are replaced by silver bluestem, buffalograss, curlymesquite, and Texas wintergrass. If heavy grazing continues for many years, condalia, mesquite, pricklypear, threeawn, and broomweed will eventually dominate the site.

Sandy Loam range site. The main soils in this range site are Grandfield soil (GfC), Lusk soil (LuC), and Minwells soil (MnB).

The potential plant community is a live oak savannah that has an understory of mid- and tall-grasses. Typically, little bluestem makes up 20 percent of the plant community; big bluestem, sand bluestem, indiangrass, and switchgrass, 15 percent; sideoats grama, 10 percent; sand lovegrass, 10 percent; Arizona cottontop, cane bluestem, silver bluestem, vine-mesquite, plains bristlegrass, and Texas wintergrass, 20 percent; hairy grama, buffalograss, sand dropseed, hairy dropseed, and hooded windmillgrass, 5 percent; forbs, such as yellow neptunia, heath aster, western ragweed, Engelmann-daisy, scurfpea, dotted gayfeather, bundleflower, daleas, and gaura, 10 percent; and woody plants, such as live oaks, elm, prickly-ash, bumelia, elbowbush, skunkbush sumac, and hackberry, 10 percent.

As regression occurs, sand bluestem, indiangrass, switchgrass, and sand lovegrass are removed from the plant community by grazing. Little bluestem and sideoats grama increase immediately. With continued heavy grazing these plants are replaced by silver bluestem, hooded windmillgrass, and hairy grama. At this stage, an increase in skunkbush sumac is apparent. Further deterioration allows for a rapid increase in less desirable grasses, such as threeawn, dropseed, red lovegrass, and annual grasses. Ragweed and silverleaf nightshade become the dominant forb species, and mesquite and greenbrier invade the site.

Vine-mesquite, white tridens, sideoats grama, Arizona cottontop, and Engelmann-daisy are removed from the plant community through heavy grazing by livestock and are replaced by silver bluestem, buffalograss, curlymesquite, and Texas wintergrass. If heavy grazing continues for many years, condalia, mesquite, pricklypear, and threeawn will eventually dominate the site.

Shallow range site. The main soils in this range site are the Mereta soil (MeB) and Purves soil (PuB, PyB).

The potential plant community is a mid- and tall-grass prairie. Typically, big bluestem, little bluestem, indiangrass, and switchgrass make up 25 percent of the plant community; sideoats grama, cane bluestem, silver bluestem, 25 percent; slim tridens, rough tridens, Arizona cottontop, plains bristlegrass, and reverchon bristlegrass, 15 percent; buffalograss and curlymesquite, 15 percent; Texas wintergrass, Canada wildrye, and fall witchgrass, 10 percent; forbs, such as catclaw sensitivebrier, gaillardia, orange zexmenia, Engelmann-daisy, bushsunflower, greeneyes, and gaura, 5 percent; and woody plants, such as sumac, live oak, hackberry, bumelia, vine ephedra, and condalia, 5 percent.

Tall grasses are removed from the plant community through heavy grazing by livestock and are replaced by sideoats grama, cane bluestem, silver bluestem, and Texas wintergrass. If heavy grazing continues for many years, condalia, mesquite, pricklypear, threeawn, and low quality forbs will eventually dominate the site.

Shallow Clay range site. Owens soil (OXC) is the main soil in this range site.

The potential plant community is an open mid-grass site. Typically, big bluestem, little bluestem, and indiangrass make up 25 percent of the plant community; sideoats grama, Texas wintergrass, cane bluestem, silver bluestem, Arizona cottontop, and tall dropseed, 30 percent; sand dropseed, tridens, hairy grama, and meadow dropseed, 20 percent; buffalograss and curlymesquite, 10 percent; forbs, such as catclaw sensitivebrier, trailing ratany, western ragweed, prairie-clover, slender greenthread, dotted gayfeather, and verbena, 5 percent; and woody plants, such as vine ephedra, wolfberry, condalia, catclaw acacia, and algerita, 10 percent.

Tall grasses are removed from the plant community through heavy grazing by livestock and are replaced by sideoats, cane bluestem, silver bluestem, dropseed, and Texas wintergrass. If heavy grazing continues for many years, condalia, mesquite, pricklypear, threeawn, Texas grama, sand muhly, and broomweed will eventually dominate the site.

Shaly Hill range site. Harpersville soil (OXC, OXF) is the main soil in this range site.

The potential plant community is an open mid-grass prairie. Typically, sideoats grama makes up 30 percent of the plant community; Arizona cottontop, cane bluestem, and silver bluestem, 20 percent; Texas wintergrass, buffalograss, curlymesquite, and rough tridens, 20 percent; purple threeawn, hairy grama, and Texas grama, 15 percent; forbs, such as verbena and milkvetch, 5 percent; and woody plants, such as catclaw acacia, vine ephedra, condalia, and algerita, 10 percent.

Sideoats grama is removed from the plant community through heavy grazing by livestock and is replaced by Arizona cottontop, buffalograss, curlymesquite, and Texas wintergrass. If heavy grazing continues for many years, condalia, mesquite, pricklypear, threeawn, and grama will eventually dominate the site.

Surface crustiness and severe erosion on this site make revegetation difficult.

Steep Rocky range site. Palopinto soil (TPG) is the main soil in this range site.

The potential plant community is a mid- and tall-grass site. Typically, big bluestem, little bluestem, and indiangrass make up 25 percent of the plant community; sideoats grama, 20 percent; cane bluestem, silver bluestem, and pinhole bluestem, 15 percent; plains lovegrass, Texas cupgrass, and tall dropseed, 5 percent; Canada wildrye, Texas wintergrass, fall witchgrass, slim tridens, rough tridens, tall grama, threeawn, and sedges, 15 percent; forbs, such as catclaw sensitivebrier, bushsunflower, eveningprimrose, Engelmann-daisy, and orange zexmenia, 10 percent; and woody plants, such as sumac, hackberry, bumelia, prickly-ash, and wolfberry, 15 percent.

Big bluestem, little bluestem, and indiangrass are removed from the plant community through heavy grazing by livestock and are replaced by sideoats grama, Texas wintergrass, cane bluestem, and silver bluestem. If heavy grazing continues for many years, hairy tridens, red grama, threeawn, and condalia will eventually dominate the site.

Tight Sandy Loam range site. The main soils in this range site are the Bluegrove soil (BeB) and Truce soil (TuB, TuC).

The potential plant community is a scattered post oak savannah that has an understory of mid grass. Typically, sideoats grama makes up 25 percent of the plant community; vine-mesquite, Texas wintergrass, Arizona cottontop, cane bluestem, silver bluestem, and little bluestem, 45 percent; curlymesquite and buffalograss, 10 percent; sand dropseed, hairy grama, slim tridens, and rough tridens, 5 percent; purple threeawn and Wright threeawn, 5 percent; forbs, such as catclaw sensitivebrier, heath aster, western ragweed, Engelmann-daisy, sagewort, erect dayflower, dotted gayfeather, and gaura, 5 percent; and woody plants, such as post oak, prickly-ash, lotebush, skunkbush sumac, and catclaw acacia, 5 percent.

Vine-mesquite, little bluestem, sideoats grama, Arizona cottontop, and Engelmann-daisy are removed from the plant community through heavy grazing by livestock and are replaced by silver bluestem, buffalograss, and Texas wintergrass. If heavy grazing continues for many years, mesquite, buffalograss, curlymesquite, threeawn, and Texas grama will eventually dominate the site.

Mesquite and catclaw acacia and an understory of Texas grama, threeawn, and broomweeds will encroach this site if it is in a deteriorated condition. Revegetation is difficult because of very slow permeabilities and thick surface crusts. Reseeding to desirable grasses is generally necessary because a natural seed source is not available. When post oak has been removed from this site, it will not reestablish for long periods.

Very Shallow range site. The main soils in this range site are Cho soil (ChC), Pitzer soil (PtC), and Lueders soil (LrC).

The potential plant community is an open mid-grass prairie. Typically, sideoats grama makes up 35 percent of the plant community; little bluestem, 15 percent; Texas wintergrass, 5 percent; buffalograss, hairy grama, slim tridens, silver bluestem, and purple threeawn, 25 percent; forbs, such as plains blackfoot, trailing ratany, bushsunflower, sagewort, Engelmann-daisy, slender greenthread, dotted gayfeather, and gaura, 15 percent; and woody plants, such as hackberry, catclaw acacia, skunkbush sumac, and vine ephedra, 5 percent.

As regression occurs, the site is invaded by woody species, such as catclaw and mesquite. Understory vegetation is invaded by Texas grama, hairy tridens, red grama, croton, ragweed, and broom snakeweed. Perennial threeawn may also increase. Because of the shallow nature of the soils, this site will not support a dense stand of brush. Woody invaders have a stunted appearance. Severe deterioration is evident when extensive bare areas appear and gullies begin to form.

Vine-mesquite, white tridens, sideoats grama, Arizona cottontop, and Engelmann-daisy are removed from the plant community through heavy grazing by livestock and are replaced by silver bluestem, buffalograss, curlymesquite, and Texas wintergrass. If heavy grazing continues for many years, condalia, mesquite, pricklypear, and threeawn will eventually dominate the site.

Recreation

In table 8, the soils of the survey area are rated according to the 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 recreational 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 gentle 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, 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 and horseback riding 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

Willard E. Richter, biologist, Soil Conservation Service, prepared this section.

Shackelford County has ample habitat for many species of wildlife. Principal species are white-tailed deer, turkey, bobwhite and scaled quail, fox squirrels, doves, jackrabbits, and cottontail rabbits.

Nongame species, such as songbirds, hawks, owls, amphibians, and numerous species of reptiles are also throughout the county.

Furbearers include fox, raccoon, opossum, skunk, ringtail cat, nutria, bobcat, and coyote. The pronghorn antelope, which was once extinct in Shackelford County, has been restocked, and a fair number of these antelopes are once again on some of the larger ranches. Some ranches have stocked exotic big game species, such as black buck antelope, barbado, and mouflon sheep.

Fish resources in Shackelford County are in the Clear Fork of the Brazos River and Hubbard Creek. Catfish, black bass, sunfish, and several species of minnows are in these streams in sufficient numbers to support a sport fishery. Numerous livestock water ponds ranging from one-half acre to over 5 acres are throughout the county. These ponds have been stocked with catfish, bass, and sunfish and provide good fishing.

Waterfowl utilize the water resources as resting, feeding, and roosting sites during their fall and spring migrations.

The leasing of lands for hunting deer, turkey, quail, and dove is a common practice in Shackelford County. The income received from commercial hunting contributes significantly to the total agricultural income.

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 created, 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, and surface stoniness, and flooding is a hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, barley, and milo.

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, and slope, and flooding is a hazard. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, lovegrass, kleingrass, johnsongrass, bermudagrass, 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, and surface stoniness, and flooding is a hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestems, gramas, dropseeds, Texas wintergrass, crotons, bushsunflower, ragweed, orange zexmenia, and daleas.

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 skunkbush, kidneywood, littleleaf sumac, lotebush, mesquite, greenbrier, grape, dewberry, wild plum, and algerita.

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, meadowlark, field sparrow, cottontail, fox, turkey, deer, and antelope.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include antelope, deer, meadowlark, turkey, jackrabbit, coyote, bobcat, and bobwhite quail.

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, and 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 must 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: evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and 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 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. Depth to 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, depth to 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, depth to 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 that 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, depth to 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 filter the effluent effectively. 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, depth to 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, depth to a 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 and topsoil. They are rated as a probable or improbable source of 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 natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

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 releases a variety of plant-available nutrients as it decomposes.

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 the restrictive features that affect each soil for drainage, irrigation, 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 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.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

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 20.

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 Index Properties

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 Their 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 the content of particles coarser than sand is as much as 15 percent, 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 20.

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 ovendry 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, or component, 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 influence the soil's adsorption of cations, moisture retention, shrink-swell potential, permeability, 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.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of movement of water through the soil 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 in each major soil layer is stated in inches of water per inch of soil. 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. Losses are expressed in tons per acre per year. These 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 0.02 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 over a sustained period without affecting crop productivity. The rate is expressed 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 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 are assigned to one of three groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The three hydrologic soil groups are:

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 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 covering of the soil surface by flowing water, is caused by overflowing streams, by runoff from adjacent slopes, or by inflow from high tides. Shallow water standing or flowing for short periods after rainfall or snowmelt is not considered flooding. Standing water in swamps and marshes or in a closed depression is considered ponding.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely to occur.

Frequency, duration, and probable dates of occurrence are estimated. Frequency generally is expressed as *none, occasional,* or *frequent. None* means that flooding is not probable. *Occasional* means that flooding occurs infrequently under normal weather conditions (there is a

5 to 50 percent chance of flooding in any year). *Frequent* means that flooding occurs often under normal weather conditions (there is more than a 50 percent chance of flooding in any year). *Common* is used when classification as occasional or frequent does not affect interpretations. Duration is expressed as *very brief* (less than 2 days) and *brief* (2 to 7 days). The time of year that floods are most likely to occur is expressed in months. November-May, for example, means that flooding can occur during the period November through May. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information on flooding 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, which are characteristic of soils that are not subject to flooding.

Also considered are 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.

The two numbers in the "High water table-Depth" column indicate the normal range in depth to a saturated zone. Depth is given to the nearest half foot. The first numeral in the range indicates the highest water level. "More than 6.0" indicates that the water table is below a depth of 6 feet or that the water table exists for less than a month.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Cemented pans are cemented or indurated subsurface layers within a depth of 5 feet. Such pans cause difficulty in excavation. Pans are classified as thin or thick. A thin pan is less than 3 inches thick if continuously indurated, or less than 18 inches thick if discontinuous or fractured. Excavations can be made by trenching machines, backhoes, or small rippers. A thick pan is more than 3 inches thick if continuously indurated, or more than 18 inches thick if discontinuous or fractured. Such a pan is so thick or massive that blasting or special equipment is needed in excavation.

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 severely corrosive 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* and *moderate*. It is based on soil texture, acidity, and the amount of sulfates in the saturation extract.

Physical and Chemical Analyses of Selected Soils

The results of physical analysis of two typical pedons in the survey area are given in table 17, the results of chemical analysis in table 18, and clay mineralogy in table 19. 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 Their Morphology." Soil samples were analyzed by the National Soil Survey Laboratory, Lincoln, Nebraska.

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).

Carbonate clay—(fraction less than 0.002 mm) pipette extraction, weight percentages of materials less than 2 mm (3A1a).

Water retained—pressure extraction, percentage of oven-dry weight of less than 2 mm material; 1/3 or 1/10 (3/10) bar (4B1), 15 bars (4B2).

Moist bulk density—of less than 2 mm material, saran-coated clods (4A1).

Linear extensibility—change in clod dimension based on less than 2 mm material (4D).

Organic carbon—dichromate, ferric sulfate titration (6A1a).

Cation-exchange capacity—ammonium acetate, pH 7.0 (5A1a).

Reaction (pH)—1:1 water dilution (8C1a).

Reaction (pH)—calcium chloride (8C1e).
Carbonate as calcium carbonate—manometric (6E1b).
Electrical conductivity—saturation extract (8A1a).
Sodium-adsorption ratio (5E).

Engineering Index Test Data

Table 20 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 Their Morphology." The soil samples were tested by the Texas State Department of Highways and Public Transportation.

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); Specific gravity (Particle index) T100 (AASHTO), D653 (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 *(4)*. 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 on laboratory measurements. Table 21 shows the classification of the soils in the survey area. 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 Calciustolls (*Calci*, meaning calcareous, plus *ustoll*, the suborder of the Mollisols that have a dry 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 Calciustolls.

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-silty, mixed, thermic Typic Calciustolls.

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. There can be some variation in the texture of the surface layer or of the substratum within a series. An example is the Nuvalde series, which is a member of the fine-silty, mixed, thermic family of Typic Calciustolls.

Soil Series and Their 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 (3)*. Many of the technical terms used in the descriptions are defined in *Soil Taxonomy (4)*. Unless otherwise stated, colors in the descriptions are for moist 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 "Detailed Soil Map Units."

Abilene Series

The Abilene series consists of deep, nearly level to gently sloping, loamy soils. These soils are well drained and moderately slowly permeable. They are on ancient stream terraces and outwash plains on the uplands. They formed in calcareous, clayey and loamy sediment that is several feet thick. The slopes range from 0 to 2 percent. The soils in the Abilene series are fine, mixed, thermic Pachic Argiustolls.

Typical pedon of Abilene clay loam, 0 to 2 percent slopes; 18 miles west of Albany on U.S. Highway 180, 0.2 mile north on Texas Highway 6, 0.7 mile north on gravel road, 0.2 mile east on field road, 100 feet south, in cropland:

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; very hard, friable; few fine roots; few fine caliche fragments; few iron-manganese (FeMn) concretions; few quartz pebbles; noncalcareous; moderately alkaline; abrupt smooth boundary.

Bt1—6 to 16 inches; very dark grayish brown (10YR 3/2) clay, very dark brown (10YR 2/2) moist; moderate fine and medium angular blocky structure; very hard, very firm; few fine roots; common fine pores; continuous clay films on faces of peds; common distinct pressure faces; few quartz pebbles; noncalcareous; moderately alkaline; clear smooth boundary.

Bt2—16 to 22 inches; dark brown (10YR 4/3) clay, dark brown (10YR 3/3) moist; moderate fine and medium subangular blocky structure; very hard, very firm; few fine roots; few pores; continuous clay films on faces of peds; common pressure faces; few quartz pebbles; calcareous; moderately alkaline; clear smooth boundary.

Btk—22 to 36 inches; brown (7.5YR 5/4) clay, dark brown (7.5YR 4/4) moist; moderate fine and medium subangular blocky structure; very hard, very firm; few fine roots; few fine pores; darker surface material in filled cracks up to 1 centimeter wide; continuous clay films on faces of peds; few pressure faces; 10 percent, by volume, soft masses of calcium carbonate; few very fine iron-manganese (FeMn) concretions; calcareous; moderately alkaline; gradual smooth boundary.

BCk—36 to 60 inches; pink (7.5YR 7/4) clay loam, light brown (7.5YR 6/4) moist; massive, breaking to weak subangular blocky structure; very hard, very firm; few seams of yellowish brown clay loam; few fine roots between peds; about 60 percent, by volume, soft masses of calcium carbonate, decreasing to 40 percent in lower part; few iron-manganese (FeMn) concretions; few quartz pebbles; calcareous; moderately alkaline.

The thickness of the solum ranges from 40 to more than 60 inches. Depth to soft powdery calcium carbonate ranges from 20 to 28 inches. The mollic epipedon is 20 inches or more thick.

The A horizon is brown, dark brown, or dark grayish brown. Reaction ranges from neutral to moderately alkaline. This horizon is 6 to 12 inches thick.

The Bt1 and Bt2 horizons are brown, dark brown, dark grayish brown, or very dark grayish brown. Texture is clay or clay loam. The content of clay in these horizons is 35 to 45 percent. Reaction ranges from neutral to moderately alkaline. Coarse fragments range from none to about 5 percent, by volume, and consist of rounded quartz pebbles, calcium carbonate concretions, or broken limestone fragments.

The Btk horizon is brown, strong brown, light brown, grayish brown, or pale brown. Texture is clay or clay loam. The content of clay in this horizon is 35 to 45 percent. Reaction is moderately alkaline. This horizon is calcareous. It has common to many masses and concretions of calcium carbonate.

The BCk horizon is brown, reddish yellow, or pink. Texture is clay loam or loam. This horizon contains 30 to 60 percent soft masses of calcium carbonate.

Bluegrove Series

The Bluegrove series consists of moderately deep, gently sloping to undulating, loamy soils. These soils are well drained and moderately slowly permeable. They formed in material weathered from sandstone of Permian and Pennsylvanian age. These soils are on the uplands. The slopes range from 1 to 8 percent. The soils in the Bluegrove series are fine, mixed, thermic Udic Haplustalfs.

Typical pedon of Bluegrove loam, 1 to 3 percent slopes; 5 miles east of Albany on U.S. Highway 180, 0.6 mile northwest on Farm Road 2482, 7.25 miles northeast on gravel road, 0.7 mile southeast on gravel pasture road, 100 feet north, in rangeland:

A1—0 to 4 inches; reddish brown (5YR 4/4) loam, dark reddish brown (5YR 3/4) moist; weak fine granular structure and subangular blocky structure; slightly hard, friable; many fine roots; common medium pores; few sandstone fragments on the surface; neutral; abrupt smooth boundary.

Bt1—4 to 10 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; moderate medium blocky structure; extremely hard, very firm; common fine roots; common fine pores; continuous clay films on faces of peds; about 3 percent, by volume, platy sandstone fragments; common very fine iron-manganese (FeMn) concretions; neutral; gradual smooth boundary.

Bt2—10 to 19 inches; yellowish red (5YR 5/6) clay, yellowish red (5YR 4/6) moist; moderate medium subangular blocky structure; extremely hard, very firm; few fine roots; few fine pores; common patchy clay films on faces of peds; about 5 percent, by volume, sandstone fragments from 1 to 2 centimeters across; common very fine iron-manganese (FeMn) concretions; neutral; abrupt smooth boundary.

Bt/Cr—19 to 24 inches; reddish yellow (5YR 6/6) clay, yellowish red (5YR 5/6) moist; weak medium subangular blocky structure; very hard, very firm;

about 30 percent, by volume, weakly to strongly cemented sandstone fragments; patchy clay films on faces of peds; neutral; abrupt smooth boundary.

Cr—24 to 30 inches; weakly to strongly cemented yellowish brown sandstone, a few thin interbedded strata of yellowish red shale.

The thickness of the solum to sandstone ranges from 20 to 40 inches. The average content of clay in the control section ranges from 35 to 45 percent. Coarse flaggy sandstone fragments range from few to 35 percent, by volume, in the surface layer.

The A horizon is dark reddish brown, reddish brown, and brown. Texture ranges from loam to flaggy fine sandy loam. Reaction is slightly acid to neutral. This horizon is 4 to 9 inches thick.

The Bt horizon is reddish brown, yellowish red, reddish yellow, or red. Reaction is slightly acid or neutral. Texture of the Bt1 horizon is sandy clay loam or clay loam; and in the Bt2 horizon, it is clay, sandy clay, and clay loam. Some pedons have a Bt/Cr horizon that has strata of weakly cemented sandstone fragments and flagstones of strongly cemented sandstone.

The Cr horizon is weakly to strongly cemented sandstone interbedded with thin layers of yellowish brown, yellowish red, reddish yellow, and olive brown shale.

Bonti Series

The Bonti series consists of moderately deep, gently sloping, sandy soils. These soils are well drained and moderately slowly permeable. They formed in material weathered from sandstone. These soils are on the uplands. The slopes range from 1 to 3 percent. The soils in the Bonti series are fine, mixed, thermic Ultic Paleustalfs.

Bonti soils are considered taxadjuncts to the Bonti series because they have a slightly higher reaction than is typical for the series. However, this difference does not affect the use, management, or behavior of these soils.

Typical pedon of Bonti loamy fine sand, 1 to 3 percent slopes; from Texas Highway 6 in Moran; 1.15 miles east-northeast on Farm Road 576, 2.1 miles east, 1 mile north and 0.15 mile east on gravel road, 50 feet south, in pasture:

A—0 to 6 inches; brown (7.5YR 5/4) loamy fine sand, dark brown (7.5YR 4/4) moist; weak fine granular structure; slightly hard, very friable; many fine and medium roots; few very fine quartz pebbles; few sandstone fragments; slightly acid; abrupt smooth boundary.

Bt1—6 to 20 inches; red (2.5YR 5/6) clay, red (2.5YR 4/6) moist; moderate medium subangular blocky structure; extremely hard, very firm; common fine and medium roots; few fine pores; common thin clay films on faces of peds; few very fine quartz pebbles; slightly acid; clear smooth boundary.

Bt2—20 to 22 inches; yellowish red (5YR 5/6) clay, yellowish red (5YR 4/6) moist; few medium distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; extremely hard, very firm; common fine roots; few fine pores; few patchy clay films on faces of peds; common fine and very fine iron-manganese (FeMn) concretions; slightly acid; abrupt smooth boundary.

R—22 to 30 inches; slightly acid, strongly cemented yellowish brown (10YR 5/6) channel sandstone and conglomerate.

The thickness of the solum and depth to sandstone range from 20 to 40 inches.

The A horizon is 3 to 9 inches thick. It is light brown, brown, yellowish brown, dark yellowish brown, or dark brown. Sandstone fragments in the A horizon range from none to about 15 percent, by volume. They range in size from fine broken sandstone fragments to flagstones up to 50 centimeters across the long axis. Reaction ranges from medium acid to neutral.

Some pedons have an E horizon that is 3 to 6 inches thick. It is brown, reddish yellow, strong brown, light yellowish brown, or yellowish brown. Reaction ranges from medium acid to neutral.

The Bt horizon is reddish brown, light reddish brown, red, yellowish red, or reddish yellow. In some pedons, few red, brown, or yellow mottles are in the Bt2 horizon. Texture is clay, clay loam, or sandy clay. The content of clay ranges from 35 to 45 percent. Reaction is medium acid or slightly acid. Coarse fragments in the Bt horizon range from a few to about 20 percent, by volume. These fragments range from 1 to 50 centimeters across the long axis. In some pedons, the Bt1 horizon has a stone line of sandstone flagstones that are 2 to 10 centimeters thick. The flagstones range from 10 to 50 centimeters across the long axis. Base saturation is less than 75 percent.

The R layer is strongly cemented or indurated, slightly acid sandstone.

Chaney Series

The Chaney series consists of deep, nearly level to undulating, loamy and sandy soils. These soils are moderately well drained and slowly permeable. They formed in sandy and clayey material weathered from interbedded sandstone and shale. These soils are on the uplands. The slopes range from 0 to 8 percent. The soils in the Chaney series are fine, mixed, thermic Aquic Paleustalfs.

Typical pedon of Chaney loamy fine sand, 0 to 3 percent slopes; from Texas Highway 6 in Moran; 1.15 miles east-northeast on Farm Road 576, 2.1 miles east and 1 mile north on gravel road, 1.15 miles west on field road, and 50 feet south, in rangeland:

A—0 to 8 inches; brown (10YR 5/3) loamy fine sand, dark brown (10YR 4/3) moist; weak granular structure; slightly hard, very friable; common fine roots; neutral; abrupt smooth boundary.

E—8 to 19 inches; light brown (7.5YR 6/4) loamy fine sand, brown (7.5YR 5/4) moist; weak granular structure; slightly hard, very friable; common fine roots; slightly acid; abrupt smooth boundary.

Bt1—19 to 24 inches; yellowish red (5YR 5/6) clay, yellowish red (5YR 4/6) moist; few fine distinct brown (7.5YR 5/4) and few fine faint grayish brown (10YR 5/2) mottles; moderate coarse subangular blocky structure; extremely hard, very firm; few fine roots; common patchy clay films on faces of peds; few very fine iron-manganese (FeMn) concretions; slightly acid; clear wavy boundary.

Bt2—24 to 32 inches; yellowish brown (10YR 5/4) clay, dark yellowish brown (10YR 4/4) moist; common fine distinct light brownish gray (10YR 6/2), yellowish red (5YR 5/6), and brownish yellow (10YR 6/6) mottles; moderate coarse subangular blocky structure; extremely hard, very firm; few fine roots and pores; common patchy clay films on faces of peds; common very fine iron-manganese (FeMn) concretions; few thin vertical seams of surface material in filled cracks; mildly alkaline; clear wavy boundary.

Bt3—32 to 44 inches; mottled brownish yellow (10YR 6/6), white (10YR 8/2), and pale brown (10YR 6/3) clay; moderate medium subangular blocky structure; very hard, very firm; few patchy clay films on faces of peds; few very fine iron-manganese (FeMn) concretions; moderately alkaline; gradual smooth boundary.

BCk—44 to 52 inches; mottled very pale brown (10YR 7/3) and yellow (10YR 7/6) sandy clay; weak medium subangular blocky structure; very hard, very firm; few patchy clay films on faces of peds; few very fine iron-manganese (FeMn) concretions; about 5 percent soft masses and concretions of calcium carbonate; calcareous; moderately alkaline; abrupt wavy boundary.

Ck—52 to 60 inches; very pale brown (10YR 7/3) sandy clay loam, pale brown (10YR 6/3) moist; massive, breaking to weak granular structure; slightly hard, very friable; about 15 percent fine and very fine soft masses and concretions of calcium carbonate; calcareous; moderately alkaline.

The thickness of the solum ranges from 30 to 60 inches. The combined thickness of the A and E horizons ranges from 6 to 20 inches. When the soil is cultivated, the A and E horizons are normally mixed.

The A horizon is 4 to 10 inches thick. It is pale brown, dark brown, brown, or dark grayish brown. Texture is loamy fine sand or stony sandy loam. Reaction is slightly acid or neutral.

The E horizon is 4 to 14 inches thick. It is very pale brown, pale brown, brown, light brown, or light yellowish brown. Texture is loamy fine sand or stony sandy loam. Reaction is slightly acid or neutral.

The Bt horizon is 24 to 52 inches thick. It is yellowish red, dark yellowish brown, yellowish brown, reddish brown, red, dark red, strong brown, or yellow. Mottled colors include brownish yellow, white, pale brown, grayish brown, and very pale brown. Texture is sandy clay or clay. The content of clay in this horizon ranges from 35 to 50 percent. Reaction is slightly acid to moderately alkaline. In some pedons, the lower part of the Bt horizon is calcareous.

The BCk horizon is mottled in colors similar to those in the Bt horizon. Texture is sandy clay or sandy clay loam.

Texture of the Ck horizon ranges from sandy clay loam to shaly clay. In some pedons, the C horizon has layers of weakly cemented sandstone.

Cho Series

The Cho series consists of very shallow and shallow, undulating, loamy soils. These soils are well drained and moderately permeable. They formed in calcareous, loamy material of outwash plains. These soils are on the uplands. The slopes range from 1 to 8 percent. The soils in the Cho series are loamy, carbonatic, thermic, shallow Petrocalcic Calciustolls.

Typical pedon of Cho gravelly loam, undulating; from U.S. Highway 283 in Albany, 7 miles northwest on Farm Road 1084, 2.3 miles northwest on gravel road, 4.65 miles north-northwest on gravel road to ranch headquarters, 2 miles west on gravel road, 0.4 mile north and 0.4 mile west on pasture road, 100 feet south near gravel pit, in rangeland:

A—0 to 7 inches; dark brown (10YR 4/3) gravelly loam, dark brown (10YR 3/3) moist; moderate fine granular and subangular blocky structure; hard, friable; many fine roots; common fine pores; about 30 percent, by volume, limestone gravel; calcareous; moderately alkaline; abrupt smooth boundary.

Bkm—7 to 12 inches; indurated caliche; broken into plates 4 to 12 inches across and 1 to 2 inches thick; about 10 percent brown (10YR 5/3) loam between plates and in solution channels; clear wavy boundary.

Ck1—12 to 20 inches; white (10YR 8/2) clay loam, light gray (10YR 7/2) moist; massive, weakly cemented; about 50 percent weakly cemented calcium carbonate; solution channels 3 to 4 feet apart and 2 to 3 centimeters wide; calcareous; moderately alkaline; gradual wavy boundary.

Ck2—20 to 33 inches; yellow (10YR 7/6) clay loam; weakly cemented; massive; hard, friable; solution channels 3 to 4 feet apart and 2 to 3 centimeters wide that extend into the lower part; calcareous; moderately alkaline; clear smooth boundary.

C—33 to 54 inches; yellowish brown (10YR 5/6) clay loam; massive; very hard, very firm; calcareous; moderately alkaline.

The thickness of the solum and depth to the strongly cemented Bkm horizon range from 5 to 14 inches (fig. 20). Calcium carbonate equivalent is more than 40 percent in the whole soil smaller than 2 centimeters.

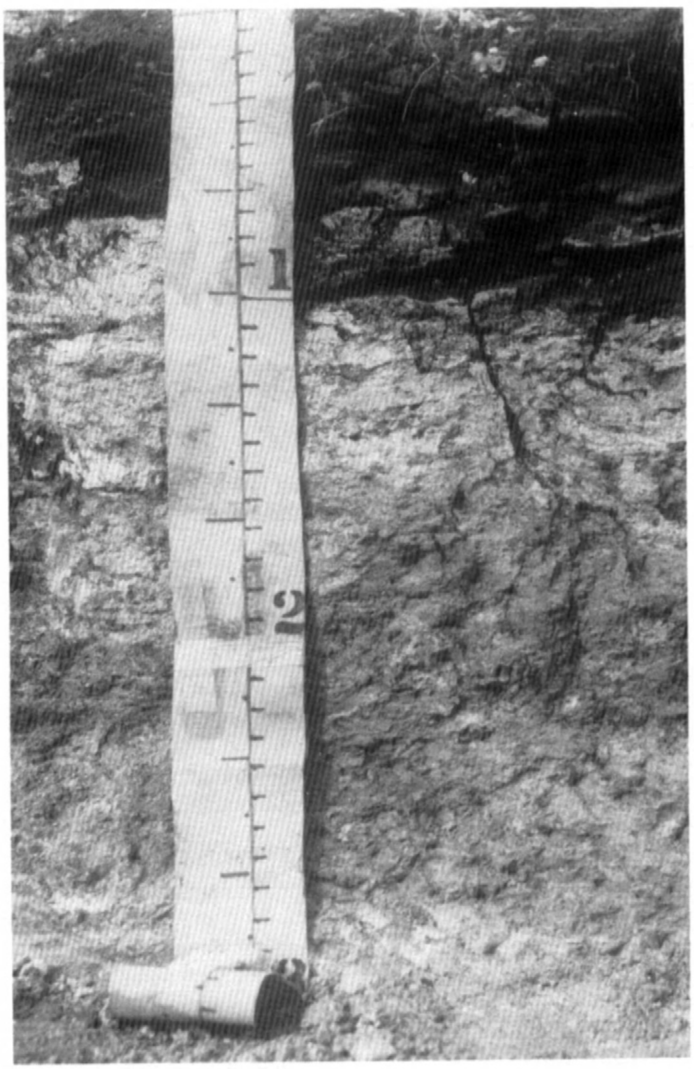


Figure 20.—Soil profile of Cho gravelly loam showing platy indurated caliche from a depth of 7 to 12 inches underlain by white, softer caliche.

The A horizon is dark brown and dark grayish brown. Coarse fragments of limestone pebbles and calcium carbonate concretions in this horizon range from 5 to 30 percent, by volume.

Some pedons have a Bw horizon that is 1 to 5 inches thick. This Bw horizon is one unit higher in chroma and value than in the A horizon.

The Bkm horizon is 2 to 6 inches thick. It is made up of plates 3 to 15 inches across and 1 to 2 inches thick.

The Ck horizon is calcareous, white, yellow, brownish yellow, or yellowish brown clay loam. It is massive and weakly cemented and contains from 35 to 70 percent soft calcium carbonate.

Clairemont Series

The Clairemont series consists of deep, nearly level to gently sloping, loamy soils. These soils are well drained and moderately permeable. They formed in calcareous, silty alluvial sediment along the Clear Fork of the Brazos River. These soils are on the bottom lands. The slopes range from 0 to 2 percent. The soils in the Clairemont series are fine-silty, mixed (calcareous), thermic Typic Ustifluvents.

Typical pedon of Clairemont silty clay loam, occasionally flooded; about 15 miles north of Albany on U.S. Highway 283 to south end of Brazos River bridge, 650 feet southwest on U.S. Highway 283, 100 feet south, in cropland:

Ap—0 to 7 inches; reddish brown (5YR 5/3) silty clay loam, reddish brown (5YR 4/3) moist; weak fine subangular blocky structure; slightly hard, friable; common roots; calcareous; moderately alkaline; abrupt smooth boundary.

C1—7 to 24 inches; reddish brown (5YR 4/4) silty clay loam, dark reddish brown (5YR 3/4) moist; massive, parting to weak fine and medium subangular blocky structure; hard, friable; few roots; few pores; calcareous; moderately alkaline; abrupt smooth boundary.

C2—24 to 36 inches; reddish yellow (5YR 6/6) silty clay loam, yellowish red (5YR 5/6) moist; alternating strata 4 inches thick of dark reddish brown (5YR 3/4) silty clay loam; massive; hard, friable to firm; few very fine roots; calcareous; moderately alkaline; abrupt smooth boundary.

C3—36 to 60 inches; reddish yellow (5YR 6/6) silt loam, yellowish red (5YR 5/6) moist; massive; alternating strata of silt loam of a darker color; evident bedding planes; hard, friable; few pores; few threads of calcium carbonate; calcareous; moderately alkaline.

The content of clay in the control section ranges from 18 to 35 percent but is mostly less than 25 percent.

The A horizon is reddish brown or brown. It is 4 to 12 inches thick.

The C horizon is stratified layers of reddish brown, reddish yellow, yellowish red, brown, or strong brown.

Texture of the various strata is silt loam, silty clay loam, loam, or very fine sandy loam. The thickness of each stratum ranges from 2 to 6 inches.

Clearfork Series

The Clearfork series consists of deep, nearly level, clayey soils. These soils are well drained and slowly permeable. They formed in calcareous, clayey and loamy alluvial sediments. These soils are on the flood plains of major streams. The slopes range from 0 to 1 percent. The soils in the Clearfork series are fine, mixed, thermic Cumulic Haplustolls.

Typical pedon of Clearfork silty clay, occasionally flooded; from U.S. Highway 180 in Albany; 7.9 miles north on U.S. Highway 283, about 7 miles northeast on gravel road, 0.55 mile west on field road, 50 feet west, in rangeland:

A1—0 to 10 inches; dark reddish gray (5YR 4/2) silty clay, dark reddish brown (5YR 3/2) moist; moderate very fine and fine blocky structure; very hard, firm, sticky; common fine roots; common fine pores and earthworm casts; cracks up to 1 centimeter wide at the surface, when dry; calcareous; moderately alkaline; clear smooth boundary.

A2—10 to 26 inches; reddish brown (5YR 4/3) silty clay, dark reddish brown (5YR 3/3) moist; moderate fine and medium blocky structure; extremely hard, very firm, sticky; common fine roots; common pores and earthworm casts; distinct dry weather cracks up to 1 centimeter wide; calcareous; moderately alkaline; clear smooth boundary.

Bw—26 to 36 inches; reddish brown (5YR 4/4) silty clay loam, dark reddish brown (5YR 3/4) moist; moderate fine and medium blocky structure; extremely hard, very firm, sticky; few fine roots; common pores and earthworm casts; common films and threads of calcium carbonate; weak bedding planes in lower 5 centimeters; calcareous; moderately alkaline; gradual smooth boundary.

C1—36 to 54 inches; reddish brown (5YR 5/4) silty clay loam; reddish brown (5YR 4/4) moist; massive; extremely hard, very firm, sticky; few fine roots in the upper part; few films and threads of calcium carbonate; few dark stains on ped faces; calcareous; moderately alkaline; gradual smooth boundary.

C2—54 to 60 inches; reddish brown (5YR 5/4) silty clay loam, reddish brown (5YR 4/4) moist; massive; very hard, very firm, sticky; few fine calcium carbonate concretions and films and threads of secondary carbonates; few weak bedding planes in the lower part; calcareous; moderately alkaline.

The A horizon is dark brown, reddish brown, dark reddish brown, or dark reddish gray. The content of clay in this horizon ranges from 35 to 45 percent. The thickness of the A horizon ranges from 20 to 34 inches.

The Bw and C horizons are reddish brown, yellowish red, dark brown, or strong brown. Texture is silty clay or silty clay loam. The content of clay ranges from 35 to 40 percent. Thin strata of more loamy or more clayey sediments are in most pedons.

Frio Series

The Frio series consists of deep, nearly level, clayey soils. These soils are well drained and moderately slowly permeable. They formed in loamy and clayey, calcareous alluvium. These soils are on the bottom lands of local streams. The slopes range from 0 to 1 percent. The soils in the Frio series are fine, montmorillonitic, thermic Cumulic Haplustolls.

Typical pedon of Frio silty clay, occasionally flooded; from U.S. Highway 283 in Albany; 11.9 miles east on U.S. Highway 180 into Stephens County, 1.1 miles southwest on gravel road back into Shackelford County, 150 feet west, in cropland:

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate fine granular and subangular blocky structure; very hard, very firm; few fine pores; calcareous; moderately alkaline; abrupt smooth boundary.

A1—5 to 24 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate medium granular and subangular blocky structure; very hard, very firm; few fine roots; few fine pores; few dry weather cracks 5 to 15 millimeters wide; few shiny ped faces; calcareous; moderately alkaline; clear smooth boundary.

A2—24 to 30 inches; dark brown (10YR 4/3) silty clay, dark brown (10YR 3/3) moist; moderate fine subangular blocky structure; very hard, very firm; few fine roots; few fine pores; common shiny pressure faces; few threads and films of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

A3—30 to 44 inches; dark brown (10YR 4/3) silty clay, dark brown (10YR 3/3) moist; moderate fine subangular blocky structure; very hard, very firm; few fine roots; common very fine pores; few films and threads of calcium carbonate; few thin strata of brown silt loam; few shiny pressure faces; calcareous; moderately alkaline; clear smooth boundary.

Bw—44 to 60 inches; brown (7.5YR 5/4) silty clay, dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; very hard, very firm; common fine and very fine pores; common films and threads of calcium carbonate; thin strata of light brown silty clay loam; calcareous; moderately alkaline.

The thickness of the mollic epipedon ranges from 24 to 50 inches. The content of clay in the 10- to 40-inch control section ranges from 35 to 50 percent. Calcium carbonate equivalent ranges from 15 to 40 percent.

The A horizon is dark grayish brown, brown, or dark brown. Dry weather cracks, 5 to 15 millimeters wide, occur in most pedons.

The Bw horizon is brown and dark brown silty clay that contains films and threads of calcium carbonate. Thin strata of light brown (7.5YR 6/4) silty clay loam is at varying depths and are 1 to 8 centimeters thick.

Gageby Series

The Gageby series consists of deep, nearly level, loamy soils. These soils are well drained and moderately permeable. They formed in loamy alluvium along local streams. These soils are on the bottom lands. The slopes range from 0 to 2 percent. The soils in the Gageby series are fine-loamy, mixed, thermic Cumulic Haplustolls.

Gageby soils are considered taxadjuncts to the Gageby series because they have a different plant community than is typical for the series. However, this difference does not affect the use, management, or behavior of these soils.

Typical pedon of Gageby sandy clay loam, occasionally flooded; from Texas Highway 6 in Moran; 1 mile northeast on Farm Road 576, 100 feet north, in cropland on the west side of Post Oak Creek:

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) sandy clay loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; hard, friable; many fine roots; moderately alkaline; abrupt smooth boundary.

A1—6 to 24 inches; very dark grayish brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; moderate fine and medium subangular blocky structure; hard, firm and friable; few fine roots; common very fine pores; moderately alkaline; abrupt smooth boundary.

A2—24 to 31 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular and subangular blocky structure; hard, firm and friable; many medium to very fine pores; few patchy films and threads of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

Bw1—31 to 48 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; moderate fine subangular blocky structure; common very fine pores; few films and threads of calcium carbonate; few fine roots; calcareous; moderately alkaline; clear smooth boundary.

Bw2—48 to 60 inches; dark brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; weak fine subangular blocky structure; hard, friable; few very fine pores; common threads and films of calcium carbonate; calcareous; moderately alkaline.

The thickness of the solum ranges from 40 to more than 60 inches. Depth to free carbonates is within 24 inches of the surface. The content of clay in the 10- to 40-inch control section is 18 to 35 percent.

The A horizon is very dark grayish brown, dark grayish brown, or brown. Reaction is mildly alkaline or moderately alkaline. The A horizon may be either noncalcareous or calcareous to a depth of 24 inches but is calcareous in the remainder of the A horizon. The thickness of the A horizon ranges from 20 to 35 inches.

The Bw horizon is brown, grayish brown, or yellowish brown. Texture is loam, silt loam, or clay loam.

Grandfield Series

The Grandfield series consists of deep, nearly level to gently sloping, loamy and sandy soils. These soils are well drained and moderately permeable. They formed in ancient alluvial sediment on river terraces. The slopes range from 0 to 5 percent. The soils in the Grandfield series are fine-loamy, mixed, thermic Udic Haplustalfs.

Typical pedon of Grandfield fine sandy loam, 1 to 5 percent slopes; 18 miles west of Albany on U.S. Highway 180, 2.4 miles north on Texas Highway 6, 0.28 mile north on Farm Road 142, 70 feet west, in cropland:

Ap—0 to 5 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; weak fine granular structure; slightly hard, friable; many fine roots; few very fine siliceous pebbles; mildly alkaline; clear smooth boundary.

Bt1—5 to 15 inches; reddish brown (2.5YR 4/4) sandy clay loam, dark reddish brown (2.5YR 3/4) moist; moderate fine and medium subangular blocky structure; hard, friable; few very fine roots; few pores and earthworm cast; patchy clay films on faces of peds; few very fine siliceous pebbles; neutral; gradual smooth boundary.

Bt2—15 to 38 inches; red (2.5YR 5/8) sandy clay loam, red (2.5YR 4/8) moist; weak fine and medium subangular blocky structure; hard, friable; few fine roots; patchy clay films on faces of peds; neutral; clear smooth boundary.

Bt3—38 to 49 inches; light red (2.5YR 6/8) fine sandy loam, red (2.5YR 5/8) moist; weak granular structure; slightly hard, friable; few very fine roots; patchy clay films on faces of peds; mildly alkaline; clear smooth boundary.

BC—49 to 60 inches; light red (2.5YR 6/8) fine sandy loam, red (2.5YR 5/8) moist; weak granular structure; slightly hard, very friable; few films and threads of calcium carbonate; few patchy clay films on faces of peds; few very fine siliceous pebbles; moderately alkaline.

The thickness of the solum is more than 60 inches.

The A horizon is 4 to 16 inches thick. It is reddish brown or brown. Texture is fine sandy loam or loamy fine sand. Reaction is neutral to mildly alkaline.

The Bt1 and Bt2 horizons are reddish brown, red, yellowish red, reddish yellow, and light reddish brown. Texture is sandy clay loam, loam, or clay loam. The content of clay is 18 to 30 percent. Reaction ranges from neutral to moderately alkaline.

The lower part of the Bt horizon and the BC horizon are red, reddish yellow, yellowish red, and light red. Texture is fine sandy loam or sandy clay loam which contains significantly less clay than the upper part of the Bt horizon. Reaction is mildly alkaline or moderately alkaline. A few threads and films of calcium carbonate occur in the BC horizon. In a few places, the solum is underlain by gravel deposits or limestone at a depth of more than 40 inches.

Harpersville Series

The Harpersville series consists of deep, undulating to hilly, clayey soils. These soils are well drained and very slowly permeable. These soils have thin sola that formed in shaly clay. They are on erosional uplands. The slopes range from 5 to about 30 percent. The soils of the Harpersville series are clayey, mixed (calcareous), thermic Ustic Torriorthents.

Typical pedon of Harpersville silty clay, in an area of Owens-Harpersville association, hilly, extremely stony; 9.2 miles north of Moran on Farm Road 576, 2 miles north on Farm Road 601, 1.4 miles southwest of Ibex on gravel road, 80 feet west to the Owens soil site, 30 feet north, in rangeland:

A—0 to 5 inches; light yellowish brown (10YR 6/4) silty clay, yellowish brown (10YR 5/4) moist; moderate medium subangular blocky structure; very hard, very firm, sticky and plastic; few fine roots; about 30 percent limestone and sandstone surface fragments, 1 to 100 centimeters across; calcareous; moderately alkaline; clear smooth boundary.

C1—5 to 17 inches; brownish yellow (10YR 6/8) and yellowish brown (10YR 5/8) shaly clay; few coarse distinct grayish brown (10YR 5/2) mottles; massive, breaking to weak coarse blocky structure; extremely hard, very firm, sticky and plastic; calcareous; moderately alkaline; abrupt smooth boundary.

C2—17 to 26 inches; light yellowish brown (10YR 6/4) shaly clay, yellowish brown (10YR 5/4) moist; massive, breaking to fine platy; extremely hard, very firm; few seams of grayish brown shale; matrix noncalcareous; moderately alkaline; gradual smooth boundary.

C3—26 to 60 inches; grayish brown (10YR 5/2) shale, dark grayish brown (10YR 4/2) moist; platy rock structure that has plates 1 to 6 centimeters thick; extremely hard, very firm; common seams of yellowish brown (10YR 5/4) shale; yellowish stains on faces of some plates; matrix noncalcareous; moderately alkaline.

The thickness of the solum to shaly clay ranges from 3 to 12 inches. Sandstone or limestone boulders and stones up to 6 feet across are on the surface. They range from a few to about 15 percent. Cobbles cover up to 45 percent of the surface.

The A horizon is 3 to 12 inches thick. The A horizon is brown, grayish brown, light brownish gray, light olive brown, yellowish brown, light yellowish brown, or olive yellow. Texture of the fine earth fraction is clay, silty clay, or clay loam. The content of clay ranges from 35 to 60 percent.

The C horizon is in shades of olive, brown, yellow, and gray, which are inherited from the underlying material. This material is stratified, weakly consolidated, shaly clay that can be excavated by a backhoe.

Hensley Series

The Hensley series consists of shallow, gently sloping to gently undulating, loamy soils. These soils are well drained and slowly permeable. They formed in residuum from Permian and Pennsylvanian limestone. These soils are on the uplands. The slopes range from 1 to 5 percent. The soils in the Hensley series are clayey, mixed, thermic Lithic Rhodustalfs.

Typical pedon of Hensley stony clay loam, gently undulating; from U.S. Highway 283 in Albany; 11.9 miles east on U.S. Highway 180 into Stephens County, 2.65 miles southwest on gravel road back into Shackelford County, 0.3 mile southeast on gravel road, 0.3 mile northeast and 0.2 mile east on pasture road, 50 feet south, (Site is about 0.25 mile west of the Stephens County line.) in rangeland:

A—0 to 4 inches; reddish brown (5YR 5/3) stony clay loam, dark reddish brown (5YR 3/3) moist; moderate medium subangular blocky structure; hard, firm or friable; many fine roots; common pores; about 3 percent limestone cobbles and stones on the surface; about 30 percent limestone gravel, cobbles and stones in the surface layer; noncalcareous; mildly alkaline; abrupt smooth boundary.

Bt—4 to 11 inches; reddish brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) moist; moderate medium subangular blocky structure; very hard, very firm; few fine roots; common clay films on faces of peds; about 10 percent, by volume, flat limestone fragments up to 50 centimeters across; noncalcareous; mildly alkaline; abrupt wavy boundary.

R—11 to 20 inches; indurated limestone bedrock; reddish brown (2.5YR 4/4) calcareous clay in fractures in upper few inches.

The thickness of the solum to limestone bedrock ranges from 10 to 16 inches. Coarse limestone fragments on the surface range from none to about 10 percent.

The A horizon is reddish brown or brown. Texture is clay loam or stony clay loam. This horizon is 4 to 8 inches thick. Reaction is slightly acid to mildly alkaline.

The Bt horizon is reddish brown or dark reddish brown. Texture is clay or clay loam. The content of clay in this horizon is 35 to 55 percent. Limestone fragments make up 0 to 10 percent of the Bt horizon. Reaction is neutral to moderately alkaline.

The R layer is coarsely fractured limestone bedrock.

Leeray Series

The Leeray series consists of deep, nearly level to gently sloping, clayey soils. They are well drained and very slowly permeable. These soils formed in calcareous clay. They are on the uplands. The slopes range from 0 to 3 percent. The soils of the Leeray series are fine, montmorillonitic, thermic Typic Chromusterts.

Typical pedon of Leeray clay, 0 to 1 percent slopes; from U.S. Highway 283 in Albany; 5.9 miles east on U.S. Highway 180, 40 feet south, (Site is 0.6 mile east of the junction of U.S. Highway 180 and Farm Road 2482.) in cropland:

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure and subangular blocky structure; very hard, very firm; calcareous; moderately alkaline; abrupt smooth boundary.

A1—7 to 28 inches; very dark grayish brown (10YR 3/2) clay, very dark brown (10YR 2/2) moist; strong fine angular blocky structure; very hard, very firm; few very fine quartz and limestone pebbles; pressure faces on peds; calcareous; moderately alkaline; clear wavy boundary.

A2—28 to 33 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; very hard, very firm; few very fine calcium carbonate concretions; distinct parallelepipeds tilted 30 degrees from horizontal; prominent grooved intersecting slickensides; few iron-manganese (FeMn) concretions; very dark grayish brown material in filled cracks; calcareous; moderately alkaline; clear wavy boundary.

Ak—33 to 48 inches; dark brown (10YR 4/3) clay, dark brown (10YR 3/3) moist; moderate medium blocky structure; very hard, very firm; common threads and films and very fine concretions of calcium carbonate; few fine iron-manganese (FeMn) concretions; dark grayish brown material in filled cracks; calcareous; moderately alkaline; clear wavy boundary.

Bk—48 to 60 inches; yellowish brown (10YR 5/4) silty clay, dark yellowish brown (10YR 4/4) moist; moderate medium subangular blocky structure; very hard, very firm; 10 percent soft masses and concretions of calcium carbonate; calcareous; moderately alkaline.

The thickness of the solum ranges from 40 to more than 80 inches. Reaction is mildly alkaline to moderately alkaline in the upper 10 inches and is moderately alkaline below that. Undisturbed areas have gilgai microrelief with microknolls that are 4 to 12 inches higher than the microdepressions. Cycles of knolls and depressions are repeated each 7 to 23 feet. Dry weather cracks, 1 to 3 inches wide, extend to a depth of more than 20 inches. The 10- to 40-inch control section is clay or silty clay. The content of clay is 40 to 60 percent.

The thickness of the A horizon is variable in the pedon. The A horizon is 6 to 20 inches thick on the microknolls and is about 20 to 60 inches thick in the microdepressions. Intersecting slickensides and pressure faces are at a depth of 15 to 24 inches. The A horizon is dark grayish brown, very dark grayish brown, dark brown, or very dark brown.

Some pedons have an Ak horizon that is 8 to 30 inches thick. Colors are the same as for the A horizon. Texture is clay or silty clay. Concretions, soft masses, and threads of calcium carbonate are common or many.

Some pedons have a Bk horizon that is brown, dark brown, light brownish gray, grayish brown, yellowish brown, or dark grayish brown. The Bk horizon contains from 5 to 20 percent calcium carbonate. The soil is underlain at a depth of more than 60 inches by shaly clay or limestone.

Lueders Series

The Lueders series consists of shallow and very shallow, undulating, loamy soils. These soils are well drained and moderately permeable. They formed in Permian limestone. These soils are on the uplands. The slopes range from 1 to 8 percent. The soils in the Lueders series are loamy-skeletal, carbonatic, thermic Lithic Calciustolls.

Typical pedon of Lueders very gravelly clay loam, undulating; 11.6 miles west of U.S. Highway 283 in Albany on U.S. Highway 180, 2 miles southwest on ranch road, 150 feet east, in rangeland:

A—0 to 6 inches; dark brown (10YR 4/3) very gravelly clay loam, dark brown (10YR 3/3) moist; moderate granular structure; hard, friable; about 40 percent limestone fragments, mostly gravel size and a few scattered cobbles and stones; calcareous; moderately alkaline; abrupt smooth boundary.

Bk—6 to 9 inches; dark brown (10YR 4/3) very gravelly clay loam, dark brown (10YR 3/3) moist; moderate granular structure; hard, friable; about 50 percent limestone fragments, mostly gravel size; fragments coated with secondary carbonates on undersides as pendants; calcareous; moderately alkaline; abrupt smooth boundary.

R—9 to 40 inches; fractured limestone bedrock, 6 inches to several feet thick, underlain by alternating beds of shale and calcareous marl.

The thickness of the solum and the depth to bedrock range from 7 to 15 inches. The control section is 35 to 80 percent limestone fragments that are less than 10 inches across. The content of clay ranges from 27 to 35 percent. The calcium carbonate equivalent is 40 to 75 percent in the whole soil that is smaller than 2 millimeters.

The A and Bk horizons are dark brown or very dark grayish brown. Fragments in the Bk horizon mostly are coated with calcium carbonate on the undersides as pendants.

The R layer is hard, coarsely fractured limestone. Calcium carbonate coatings are in the upper few inches of the fractures.

Lusk Series

The Lusk series consists of moderately deep, undulating, loamy soils. These soils are well drained and slowly permeable. They formed in gravelly alluvium. These soils are on ancient stream terraces on the uplands. The slopes range from 1 to 8 percent. The soils in the Lusk series are clayey-skeletal, mixed, thermic Typic Paleustalfs.

Typical pedon of Lusk gravelly fine sandy loam, undulating; from U.S. Highway 180 in Albany; 8 miles north on U.S. Highway 283, 11 miles north-northeast on gravel county road, 50 feet west, (Site is about 2.7 miles northeast on the county road from the Brazos River bridge and 0.9 mile south of the Throckmorton County line.) in rangeland:

A—0 to 5 inches; dark brown (7.5YR 4/4) gravelly fine sandy loam, dark brown (7.5YR 3/4) moist; hard, friable; many fine roots; common pores; 20 percent quartz gravel, 1 to 4 centimeters across; mildly alkaline; abrupt smooth boundary.

Bt1—5 to 10 inches; reddish brown (5YR 4/4) gravelly sandy clay, dark reddish brown (5YR 3/4) moist; moderate medium subangular blocky structure; very hard, firm; many fine and medium roots; common pores; common earthworm casts; few patchy clay films on faces of peds; 20 percent quartz gravel, mostly less than 1 centimeter across; neutral; abrupt smooth boundary.

Bt2—10 to 22 inches; reddish brown (2.5YR 4/4) very gravelly clay, dark reddish brown (2.5YR 3/4) moist; moderate fine granular structure; common roots; few patchy clay films on faces of peds; 65 percent quartz gravel, 2 to 30 millimeters across; neutral; abrupt smooth boundary.

Crk&Btk—22 to 27 inches; about 10 percent Btk horizon material of yellowish red (5YR 5/8) extremely gravelly clay loam fingering into the conglomerate; moderate fine granular structure; about 90 percent Crk horizon material of quartz gravel conglomerate, weakly to strongly cemented by calcium carbonate; pebbles, 2 to 20 millimeters across; porous; calcareous; gradual smooth boundary.

Crk—27 to 60 inches; yellowish red (5YR 5/8) extremely gravelly coarse sand; massive; porous; about 80 percent quartz sand and gravel conglomerate and 20 percent soft masses and calcium carbonate concretions; quartz pebbles, 2 to 20 millimeters across; conglomerate case hardens when exposed and dry; calcareous; moderately alkaline.

The thickness of the solum ranges from 20 to 40 inches. Coarse fragments of quartz gravel in the control section range from 35 to 70 percent, by volume. Secondary carbonates occur within 28 inches of the surface.

The A horizon is brown or dark brown. It is 4 to 12 inches thick. Texture is fine sandy loam that contains 5 to 20 percent, by volume, of quartz gravel, 1 to 4 centimeters across. Reaction ranges from slightly acid to mildly alkaline.

The Bt horizon is red or reddish brown. Reaction is neutral or slightly acid. The average texture of the Bt horizon is very gravelly clay, extremely gravelly clay loam, or very gravelly sandy clay, but some layers are also gravelly clay or gravelly sandy clay. The fine earth fraction is 35 to 50 percent clay.

The Crk horizon is yellowish red extremely gravelly loam to coarse sand that is weakly cemented by silica and calcium carbonate. Gravel is mostly quartz, 2 to 20 millimeters across. In a few pedons, the Crk horizon is underlain by strongly cemented conglomerate. In a few other pedons, it is underlain by beds of loose gravel or sand.

Mereta Series

The Mereta series consists of shallow, gently sloping, clayey soils. These soils are well drained and moderately slowly permeable. They formed in loamy, calcareous outwash. These soils are on the uplands. The slopes range from 1 to 3 percent. The soils in the Mereta series are clayey, mixed, thermic, shallow Petrocalcic Calciustolls.

Typical pedon of Mereta silty clay, 1 to 3 percent slopes; about 18 miles west of Albany on U.S. Highway 180, 2.4 miles north on Texas Highway 6, 6.4 miles north on Farm Road 142, 70 feet west, in cropland:

Ap—0 to 5 inches; dark brown (7.5YR 4/2) silty clay, dark brown (7.5YR 3/2) moist; moderate fine subangular blocky structure and granular structure; hard, firm; common roots; common pores; calcareous; moderately alkaline; abrupt smooth boundary.

A—5 to 14 inches; reddish brown (5YR 4/3) silty clay, dark reddish brown (5YR 3/3) moist; moderate fine granular structure; hard, firm; 5 percent, by volume, gravel-size limestone fragments and rounded pebbles; calcareous; moderately alkaline; abrupt smooth boundary.

Bk—14 to 16 inches; reddish brown (5YR 4/3) gravelly silty clay, dark reddish brown (5YR 3/3) moist; moderate fine granular structure; hard, firm; 20 percent, by volume, fine and very fine broken limestone fragments and concretions of calcium carbonate; calcareous; moderately alkaline; abrupt wavy boundary.

Bkm—16 to 20 inches; very pale brown (10YR 8/4) strongly cemented caliche plates; abrupt wavy boundary.

Ck—20 to 42 inches; reddish yellow (7.5YR 8/6) clay loam, reddish yellow (7.5YR 7/6) moist; massive; hard, friable; about 60 percent, by volume, soft masses and concretions of calcium carbonate; calcareous; moderately alkaline.

The thickness of the solum and depth to a strongly cemented petrocalcic horizon range from 14 to 20 inches. In some cultivated areas, part of the petrocalcic horizon has been broken by plowing and is on the surface layer and in the solum. The content of clay between 10 inches and the petrocalcic horizon ranges from 35 to 45 percent.

The A horizon is dark brown, dark grayish brown, or very dark grayish brown.

Some pedons have a thin Bk horizon that is reddish brown or dark brown. Texture of the fine-earth fraction is silty clay or clay loam.

The Bkm horizon ranges from strongly cemented to indurated. It is mostly platy with a laminar cap.

The Ck horizon is reddish yellow or strong brown clay loam. This horizon contains 40 to 70 percent soft masses and concretions of calcium carbonate.

Minwells Series

The Minwells series consists of deep, gently sloping, loamy soils. These soils are well drained and slowly permeable. They are on high ancient terraces. These soils formed in clayey and loamy sediments that have gravel and sand strata (fig. 21). The slopes range from 1 to 3 percent. The soils in the Minwells series are fine, mixed, thermic Udic Paleustalfs.

Typical pedon of Minwells loam, 1 to 3 percent slopes; 9.2 miles north of Moran on Farm Road 576, 2 miles north on Farm Road 601 to Ibex, 2.4 miles west-southwest on gravel road, 1.4 miles northwest on ranch road to a gravel pit on the east bank of Hubbard Creek, 500 feet northeast, in rangeland:

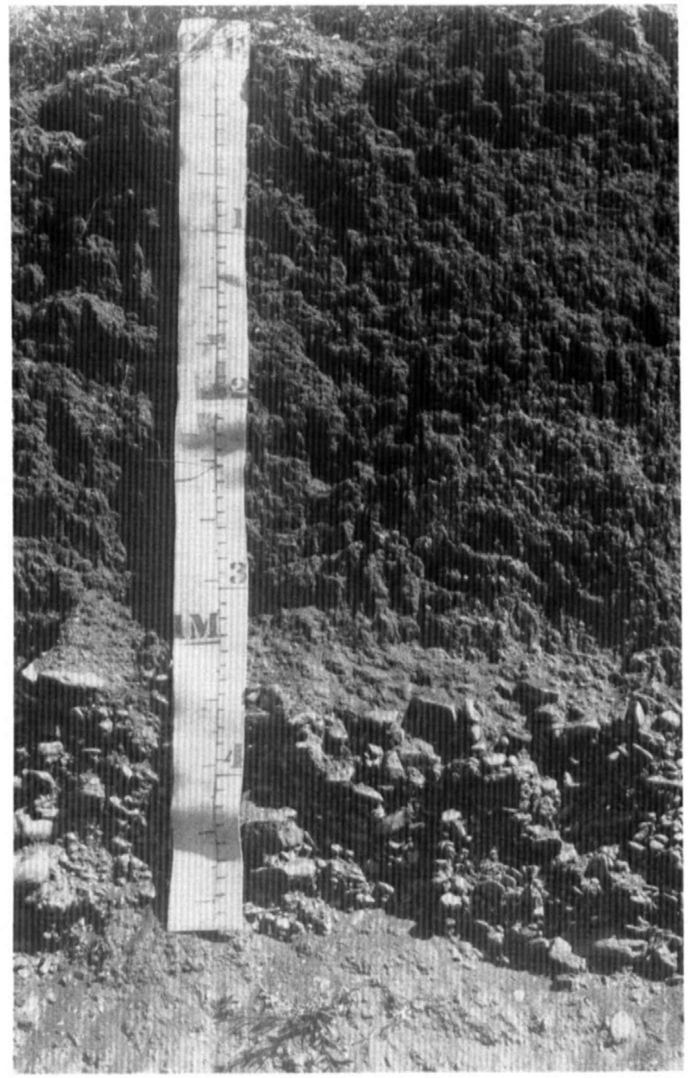


Figure 21.—Soil profile of Minwells loam showing a gravel layer 47 inches below the surface.

A—0 to 6 inches; brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) moist; weak fine granular structure and subangular blocky structure; hard, friable; many fine roots; common fine pores; few quartz pebbles; mildly alkaline; abrupt smooth boundary.

Bt1—6 to 15 inches; reddish brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; moderate coarse subangular blocky structure; very hard, firm and friable; common fine roots; few fine pores; few quartz pebbles, 3 to 10 millimeters across; common clay films on faces of peds; neutral; gradual smooth boundary.

Bt2—15 to 24 inches; yellowish red (5YR 5/6) clay, yellowish red (5YR 4/6) moist; moderate medium subangular blocky structure; very hard, firm; common fine roots; few pores; common clay films on faces of peds; few quartz pebbles, 3 to 10 millimeters across; mildly alkaline; gradual smooth boundary.

2Bk1—24 to 37 inches; yellowish red (5YR 5/6) gravelly sandy clay loam, yellowish red (5YR 4/6) moist; moderate medium subangular blocky structure; very hard, firm; common fine roots; 20 percent, by volume, quartz and limestone pebbles, 2 to 30 millimeters across; common films and threads of calcium carbonate; calcareous; moderately alkaline; clear wavy boundary.

2Bk2—37 to 47 inches; yellowish red (5YR 5/6) gravelly sandy clay loam, yellowish red (5YR 4/6) moist; moderate medium and fine subangular blocky structure; very hard, very firm; about 35 percent soft masses and concretions of calcium carbonate; about 20 percent limestone and quartz gravel and pebbles, 1 to 8 centimeters across; calcareous; moderately alkaline; abrupt smooth boundary.

3Ck—47 to 60 inches; yellowish red (5YR 5/6) very gravelly sandy loam, yellowish red (5YR 4/6) moist; massive, bed of well graded quartz and limestone gravel and pebbles, from 1 to 8 centimeters across; evident bedding planes; common soft masses and concretions of calcium carbonate; calcareous; moderately alkaline.

The thickness of the solum ranges from 40 to about 60 inches. Depth to beds of gravel ranges from 40 to about 50 inches.

The thickness of the A horizon is 4 to 12 inches. It is light reddish brown, reddish brown, light brown, or brown. Reaction is neutral or mildly alkaline.

The Bt1 horizon is 6 to 15 inches thick, and the Bt2 horizon is also 6 to 15 inches thick. These horizons are reddish brown, red, yellowish red, or reddish brown. Texture of these horizons is clay loam, sandy clay, or clay. The content of clay ranges from 35 to 45 percent. Reaction is neutral or mildly alkaline.

The Bk horizon is 10 to 20 inches thick. Some pedons have a Bt3 horizon that is also 10 to 20 inches thick. The Bk and Bt3 horizons are reddish brown, red, yellowish red, or reddish brown. Texture of these horizons is clay loam, sandy clay loam, and gravelly sandy clay loam.

The 2Bk horizon is 9 to 30 inches thick. Some pedons have a 3Ck horizon. These horizons are red, yellowish red, or reddish yellow. Texture is gravelly sandy clay loam, very gravelly sandy clay loam, very gravelly sandy loam, or very gravelly sand. Secondary carbonates occur as coatings, as threads or films, or as soft masses or concretions on the coarse fragments.

Nukrum Series

The Nukrum series consists of deep, gently sloping, clayey soils. These soils are well drained and slowly permeable. They formed in calcareous, clayey sediment from interbedded limestone and shale of Permian age. These soils are in filled valleys. The slopes range from 1 to 3 percent. The soils in the Nukrum series are fine, mixed, thermic Vertic Haplustolls.

Typical pedon of Nukrum clay, 1 to 3 percent slopes; 7.5 miles west of Albany on U.S. Highway 180, 9.1 miles southwest on Texas Highway 351, 0.25 mile south-southeast on private road, 900 feet east, (Site is about 5 miles northeast of intersection of Texas Highway 351 and Farm Road 604.) in rangeland:

A1—0 to 7 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure and granular structure; very hard, very firm; few very fine limestone fragments; calcareous; moderately alkaline; clear smooth boundary.

A2—7 to 24 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate medium and coarse subangular blocky structure; very hard, very firm; common roots; many fine pores; few pressure faces; few very fine limestone fragments; calcareous; moderately alkaline; clear wavy boundary.

Bw—24 to 48 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; very hard, very firm; common pressure faces; few threads of calcium carbonate; few limestone fragments; calcareous; moderately alkaline; gradual wavy boundary.

Bk—48 to 60 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate fine and medium subangular blocky structure; very hard, very firm; few common pressure faces; common threads and concretions of calcium carbonate; few gypsum threads; few iron concretions and soft masses; calcareous; moderately alkaline.

The thickness of the solum ranges from 48 to more than 60 inches. The soil, when dry, has cracks 1 inch to 2 inches wide that extend to a depth of 20 inches or more. The content of clay in the control section is 40 to 60 percent.

The A horizon is very dark grayish brown, dark grayish brown, or dark brown. The thickness of the A horizon ranges from 20 to 48 inches.

The Bw horizon is grayish brown, dark brown, or brown. Texture is clay or silty clay. Calcium carbonate concretions, soft masses, and threads and films range from a trace to 5 percent.

The Bk horizon is similar to the Bw horizon. The calcium carbonate in this horizon ranges from 5 to 15 percent.

In some pedons, limestone bedrock is at a depth of more than 60 inches.

Nuvalde Series

The Nuvalde series consists of deep, nearly level to gently sloping, loamy soils. These soils are well drained and moderately permeable. They formed in calcareous, ancient alluvial sediment. These soils are on outwash plains. The slopes range from 0 to 3 percent. The soils in the Nuvalde series are fine-silty, mixed, thermic Typic Calciustolls.

Nuvalde soils are considered taxadjuncts to the Nuvalde series because the calcium carbonate equivalent of the mineralogy control section in the Nuvalde soils is a few percent higher than is typical for the series, placing these soils into a carbonatic family. However, this difference does not affect the use, management, or behavior of these soils.

Typical pedon of Nuvalde silty clay loam, 0 to 1 percent slopes; from U.S. Highway 180 in Albany; 9.3 miles north on U.S. Highway 283, 300 feet northeast on gravel road, 1,000 feet southeast along fenceline, 50 feet north, in cropland:

Ap—0 to 4 inches; dark brown (7.5YR 4/2) silty clay loam, dark brown (7.5YR 3/2) moist; moderate, fine subangular blocky structure and granular structure; hard, firm and friable, sticky and plastic; many fine and medium roots; common worm casts; few fine limestone fragments; calcareous; moderately alkaline; abrupt smooth boundary.

A—4 to 10 inches; dark brown (7.5YR 4/2) silty clay loam, dark brown (7.5YR 3/2) moist; strong coarse subangular blocky structure parting to moderate medium subangular blocky structure; very hard, very firm, sticky and plastic; many fine roots; common medium pores; common worm casts; few quartz pebbles up to 1 centimeter across; few limestone fragments up to 5 millimeters across; dry weather cracks less than 1 centimeter wide; calcareous; moderately alkaline; clear smooth boundary.

Bw1—10 to 15 inches; dark brown (7.5YR 4/2) silty clay, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure; very hard, very firm, sticky and plastic; common fine roots; many medium pores; common worm casts; few limestone fragments up to 1 centimeter across; dry weather cracks less than 1 centimeter wide; thin brown (7.5YR 5/2) coatings on faces of peds; calcareous; moderately alkaline; clear wavy boundary.

Bw2—15 to 21 inches; dark brown (7.5YR 4/4) silty clay, dark brown (7.5YR 3/4) moist; strong medium subangular blocky structure; very hard, very firm, sticky and plastic; common fine roots; few fine pores; about 5 percent, by volume, very fine calcium carbonate concretions and limestone fragments; few worm casts; few dark brown (7.5YR 4/2) coatings on ped faces; calcareous; moderately alkaline; clear wavy boundary.

Bk1—21 to 34 inches; light brown (7.5YR 6/4) silty clay loam; brown (7.5YR 5/4) moist; moderate medium and fine subangular blocky structure and granular structure; few worm casts; common fine roots; few fine pores; about 40 percent disseminated calcium carbonate, about 5 percent calcium carbonate concretions, less than 3 centimeters across; few calcium carbonate coated limestone fragments; calcareous; moderately alkaline; gradual wavy boundary.

Bk2—34 to 44 inches; pink (7.5YR 7/4) silty clay loam, light brown (7.5YR 6/4) moist; moderate fine and medium subangular blocky structure and granular structure; hard, firm and friable, sticky and plastic; few medium and fine roots; few medium pores; few worm casts; about 50 percent soft masses and 10 percent concretions of calcium carbonate; calcareous; moderately alkaline; gradual diffuse boundary.

Bk3—44 to 60 inches; light brown (7.5YR 6/4) silt loam, brown (7.5YR 5/4) moist; weak fine and medium subangular blocky structure; few worm casts; few very fine roots; many fine pores; few fine weakly cemented iron-manganese (FeMn) concretions; about 50 percent, by volume, films, threads, and soft masses and 5 percent concretions of calcium carbonate; calcareous; moderately alkaline; diffuse wavy boundary.

Bk4—60 to 78 inches; reddish yellow (7.5YR 6/6) loam, strong brown (7.5YR 5/6) moist; weak medium and fine subangular blocky structure; hard, firm and friable, sticky and plastic; few fine roots; few medium pores; about 30 percent soft masses of calcium carbonate; few fine weakly cemented iron-manganese (FeMn) concretions; calcareous; moderately alkaline; gradual wavy boundary.

Ck—78 to 84 inches; reddish yellow (7.5YR 6/6) loam, strong brown (7.5YR 5/6) moist; massive, breaking to weak subangular blocky structure; many fine pores; common fine weakly cemented iron-manganese (FeMn) concretions; about 20 percent soft masses of calcium carbonate; calcareous; moderately alkaline.

The thickness of the solum ranges from 50 to more than 80 inches. The total content of clay in the 10- to 40-inch control section is 35 to 50 percent. Silicate clay ranges from 25 to 35 percent.

The thickness of the A horizon ranges from 10 to 20 inches. Dry weather cracks are common but are less than 1 centimeter wide. The A horizon is dark brown, dark reddish gray, or dark reddish brown.

The Bw horizon is 10 to 16 inches thick. It is dark brown or brown and has strong to moderate subangular blocky structure. Texture is silty clay loam, silty clay, clay, or clay loam.

The content of calcium carbonate, mostly soft masses, in the Bk horizon ranges from 40 to 60 percent. The Bk horizon is brown or strong brown. In some pedons, it is reddish yellow 60 inches below the surface. Texture is clay, silty clay, or silty clay loam. In some pedons, texture is loam and silt loam 40 inches below the surface.

The Ck horizon is strong brown (7.5YR 5/6, 4/6) or yellowish red (5YR 5/6, 5/8). Texture is loam or clay loam. The content of calcium carbonate ranges from 5 to 40 percent.

Owens Series

The Owens series consists of deep, undulating to hilly, clayey soils. They are well drained and very slowly permeable. These soils formed in clayey shale. They are on erosional uplands. The slopes range from 1 to 30 percent. The soils of the Owens series are clayey, mixed, thermic, shallow, Typic Ustochrepts.

Typical pedon of Owens clay, in an area of Owens-Harpersville association, hilly, extremely stony; 9.2 miles north of Moran on Farm Road 576, 2 miles north on Farm Road 601, 1.4 miles southwest of Ibex on gravel road, 80 feet west, in rangeland:

A—0 to 5 inches; light yellowish brown (10YR 6/4) clay, yellowish brown (10YR 5/4) moist; weak very fine subangular blocky structure; hard, firm to friable; many roots; many pores; common very fine and fine shale and limestone fragments; scattered limestone surface cobbles and stones; calcareous; moderately alkaline; abrupt smooth boundary.

Bk—5 to 18 inches; light yellowish brown (2.5Y 6/4) clay, light olive brown (2.5Y 5/4) moist; moderate medium subangular blocky structure and blocky structure; extremely hard, very firm; few roots; few pores; few films, threads, and very fine soft masses of calcium carbonate; few very fine limestone pebbles; calcareous; moderately alkaline; abrupt smooth boundary.

Ck—18 to 60 inches; light brownish gray (2.5Y 6/2) shaly clay, grayish brown (2.5Y 5/2) moist; massive, breaking to impervious coarse angular blocky structure; extremely hard, very firm; few seams of olive yellow (2.5Y 6/6) clay about 2 inches thick; few very fine calcium carbonate concretions; few threads, films, and very fine soft masses of calcium carbonate and root fractures in upper 12 inches; extremely hard, very firm; calcareous; moderately alkaline.

The solum is 14 to 30 inches thick. The soil is moderately alkaline; but in some pedons, the A horizon is noncalcareous.

The thickness of the A horizon ranges from 3 to 10 inches. It is olive, pale olive, olive brown, light olive brown, light yellowish brown, brown, grayish brown, light brownish gray, light reddish brown, or reddish brown.

The thickness of the Bk horizon ranges from 4 to 24 inches. It is olive, pale olive, olive brown, light olive brown, light yellowish brown, brown, grayish brown, light brownish gray, light reddish brown, or reddish brown. Texture is clay, silty clay, or clay loam. The content of clay ranges from 35 to 60 percent.

Texture of the Ck horizon ranges from olive to weak, red shaly clay, clay, very shaly clay, or shale.

Palopinto Series

The Palopinto series consists of very shallow and shallow, undulating to moderately steep, loamy and stony soils. These soils are well drained and moderately permeable. They formed in limestone. These soils are on erosional uplands. The slopes range from 1 to 20 percent. The soils in the Palopinto series are loamy-skeletal, mixed, thermic Lithic Haplustolls.

Typical pedon of Palopinto very flaggy silty clay loam, undulating; from U.S. Highway 283 in Albany; 4.35 miles west on U.S. Highway 180, 1.2 miles north-northwest on old paved road, 1,700 feet north on pasture road on ridge, 50 feet west, in rangeland:

A1—0 to 6 inches; dark brown (7.5YR 4/2) very flaggy silty clay loam, dark brown (7.5YR 3/2) moist; strong fine granular structure; hard, friable; 20 percent cobbly and flaggy limestone on the surface and 45 percent of similar fragments in the soil; noncalcareous; moderately alkaline; abrupt smooth boundary.

A2—6 to 10 inches; dark brown (7.5YR 4/2) very flaggy silty clay loam, dark brown (7.5YR 3/2) moist; strong fine granular structure; hard, friable; 50 percent limestone flagstones, 3 to 10 inches across; calcareous; moderately alkaline; abrupt smooth boundary.

R—10 to 20 inches; hard, coarsely fractured, slab limestone bedrock.

The thickness of the solum to hard limestone bedrock ranges from 6 to 18 inches. The solum contains 35 to 85 percent coarse fragments of flattened limestone rocks that are 1 to more than 1 meter across. Reaction is moderately alkaline. Typically, the soil ranges from calcareous to noncalcareous.

The A horizon is dark grayish brown or dark brown. It is very flaggy silty clay loam, extremely flaggy silty clay loam, very flaggy silt loam, or extremely flaggy silt loam.

The content of clay in the fine-earth fraction is 18 to 35 percent.

Patilo Series

The Patilo series consists of deep, gently undulating, sandy soils. These soils are moderately well drained and moderately slowly permeable. They formed in thick, sandy deposits that have been reworked by wind. These soils are on the uplands. The slopes range from 0 to 5 percent. The soils in the Patilo series are loamy, siliceous, thermic Grossarenic Paleustalfs.

Typical pedon of Patilo fine sand, 0 to 5 percent slopes; about 18 miles west of Albany on U.S. Highway 180, 0.35 mile north on Texas Highway 6, 0.35 mile west, in rangeland:

A—0 to 6 inches; pale brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; single grained; loose; common fine roots; neutral; clear smooth boundary.

E—6 to 54 inches; light yellowish brown (10YR 6/4) fine sand, yellowish brown (10YR 5/4) moist; single grained; loose; common fine roots in upper part; few thin lenses of yellowish brown (10YR 5/4) fine sand in lower part; slightly acid; abrupt smooth boundary.

Bt—54 to 66 inches; reddish yellow (10YR 7/6) sandy clay loam, reddish yellow (10YR 6/6) moist; common coarse light brown (7.5YR 6/4) mottles; weak medium blocky structure; slightly hard, friable; common very fine pores; thin patchy clay films on faces of peds; slightly acid.

The thickness of the solum ranges from 65 to more than 80 inches.

The A horizon is 4 to 8 inches thick. It is brown, grayish brown, dark grayish brown, pale brown, or yellowish brown. Reaction is neutral or mildly alkaline.

The E horizon is 38 to 72 inches thick. It is pale brown, very pale brown, brown, light brown, light yellowish brown, or light gray. Reaction is neutral to medium acid.

Texture of the Bt horizon is sandy clay loam or clay loam. It is light gray, light brownish gray, or reddish yellow and has varying amounts of gray, brown, yellow, and red mottles. The content of clay in this horizon is 27 to 35 percent. Reaction is slightly acid to strongly acid.

Pitzer Series

The Pitzer series consists of very shallow, undulating, loamy soils. These soils are well drained and moderately permeable. They formed on gravelly ancient terraces that were underlain by limestone and shale. These soils are on the uplands. The slopes range from 1 to 8 percent. The soils in the Pitzer series are loamy, mixed, thermic, shallow Petrocalcic Calciustolls.

Typical pedon of Pitzer gravelly clay loam, undulating; from U.S. Highway 180 in Albany; 0.75 mile north on U.S. Highway 283, 0.2 mile east on pasture road, 125 feet north near gravel pit, in rangeland:

A—0 to 5 inches; dark grayish brown (10YR 4/2) gravelly clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure and subangular blocky structure; hard, friable; many fine roots; common pores; about 20 percent, by volume, limestone pebbles, 2 millimeters to 8 centimeters across; calcareous; moderately alkaline; abrupt wavy boundary.

Bkm—5 to 11 inches; white (10YR 8/2) indurated caliche; fractured plates, 4 to 7 inches across and 1 to 4 inches thick, with calcium carbonate pendants on lower side of fractured plates and a laminar cap on the upper plates about 1 centimeter thick; common fine and medium roots in fractures; some embedded limestone and siliceous gravel; calcareous; moderately alkaline; abrupt wavy boundary.

Ck—11 to 54 inches; yellow (10YR 7/6) very gravelly sandy clay loam, brownish yellow (10YR 6/6) moist; massive; hard, friable; few roots in upper part; about 60 percent, by volume, carbonate concretions and limestone; few siliceous pebbles, 2 millimeters to 8 centimeters across; calcareous; moderately alkaline; clear wavy boundary.

2Ck—54 to 60 inches; light brownish gray (10YR 6/2) shaly clay, grayish brown (10YR 5/2) moist; massive; very hard, very firm; common soft masses and concretions of calcium carbonate; calcareous; moderately alkaline.

The A horizon is 4 to 12 inches thick. It is dark grayish brown or dark brown. Limestone gravel and limestone fragments in this horizon range from 15 to 35 percent.

The Bkm horizon is 4 to 10 inches thick. It varies in hardness from weakly cemented to hard, indurated caliche plates with laminar caps.

The Ck horizon is reddish yellow, yellow, or strong brown. Limestone and siliceous coarse fragments in this horizon range from 35 to 80 percent. The fine-earth fraction is sandy loam, loam, or sandy clay loam. In some pedons, the Ck horizon is not underlain by limestone bedrock or shaly clay.

Purves Series

The Purves series consists of shallow, gently sloping and gently undulating, clayey soils. These soils are well drained and moderately slowly permeable. They formed in limestone. These soils are on the uplands. The slopes range from 1 to 5 percent. The soils in the Purves series are clayey, montmorillonitic, thermic Lithic Calciustolls.

Typical pedon of Purves clay, 1 to 3 percent slopes; from U.S. Highway 180 in Albany; 4.7 miles southeast on

Texas Highway 6, 0.2 mile south on gravel road, 0.7 mile west on gravel road, 100 feet south, in rangeland:

A1—0 to 7 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; very hard, very firm; many roots; many pores; few very fine limestone fragments; calcareous; moderately alkaline; clear smooth boundary.

A2—7 to 12 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; very hard, very firm; common roots; many pores; common pressure faces on peds; few fine and very fine limestone fragments; calcareous; moderately alkaline; abrupt smooth boundary.

Bk—12 to 14 inches; dark brown (10YR 4/3) very gravelly clay, dark brown (10YR 3/3) moist; moderate fine granular structure; very hard, firm; common roots; about 50 percent limestone fragments, 1 to 9 centimeters across, coated with calcium carbonate; calcareous; moderately alkaline; abrupt wavy boundary.

R—14 to 20 inches; indurated, yellowish brown (10YR 5/4) coarse fractured limestone bedrock; thin carbonate coatings in upper few inches.

The solum is 10 to 20 inches thick and is underlain by limestone bedrock. Coarse fragments of limestone on the surface layer range from none to about 35 percent. Typically, the soil is moderately alkaline and is calcareous.

The A horizons are dark grayish brown, dark brown, or very dark grayish brown. Texture is clay or cobbly clay.

The Bk horizon is from 1 to 4 inches thick and is brown, dark brown, or very dark grayish brown. Texture is gravelly clay or very gravelly clay.

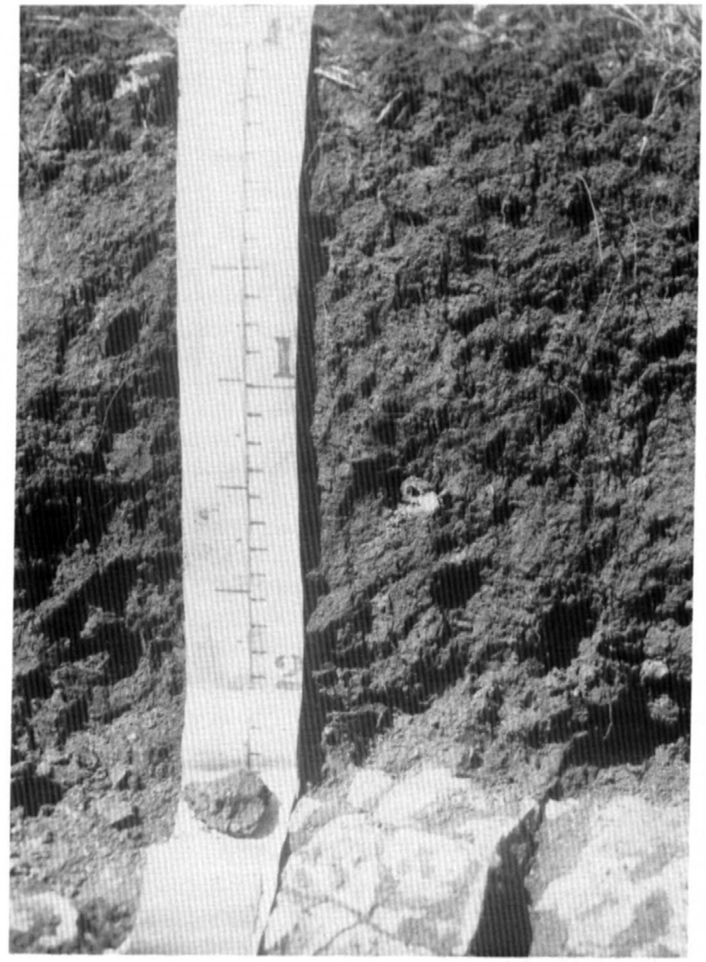


Figure 22.—Soil profile of Rowden clay loam showing limestone bedrock at a depth of 23 inches.

Rowden Series

The Rowden series consists of moderately deep, nearly level, and gently sloping, loamy soils. These soils are well drained and slowly permeable. They formed over hard limestone (fig. 22). These soils are on the uplands. The slopes range from 0 to 2 percent. The soils in the Rowden series are fine, mixed, thermic Typic Argiustolls.

Typical pedon of Rowden clay loam, 0 to 2 percent slopes; from U.S. Highway 180 in Albany; 7.5 miles north on U.S. Highway 283, 3.6 miles northeast on county road, 1.2 miles south on oil field road, 1 mile northeast on ranch trail, 100 feet north, in rangeland:

A—0 to 8 inches; dark brown (7.5YR 3/2) clay loam, very dark brown (7.5YR 2/2) moist; moderate medium subangular blocky structure; very hard, firm; many very fine roots; common worm casts; neutral; abrupt smooth boundary.

Bt1—8 to 18 inches; reddish brown (5YR 4/3) clay, dark reddish brown (5YR 3/3) moist; moderate medium blocky structure; very hard, very firm; common fine roots; common fine pores; common worm casts; continuous clay films on faces of peds; mildly alkaline; clear smooth boundary.

Bt2—18 to 23 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; moderate medium subangular blocky structure and granular structure; very hard, firm; few fine roots; common very fine pores; continuous clay films on faces of peds; noncalcareous; moderately alkaline; abrupt smooth boundary.

R—23 to 40 inches; indurated, coarsely fractured, limestone bedrock; thin calcium carbonate coatings on surface of bedrock and in fractures in upper few inches.

The thickness of the solum and the depth to limestone bedrock range from 20 to 40 inches. A few limestone pebbles and cobbles are on the surface. Coarse fragments range from 0 to about 10 percent.

The A horizon ranges from 5 to 12 inches thick. It is reddish brown, dark grayish brown, very dark grayish brown, dark brown, or dark reddish gray. Reaction is neutral to moderately alkaline.

The thickness of the Bt horizon ranges from 15 to 30 inches. The Bt1 horizon has the same colors as the A horizon. The Bt2 horizon is reddish brown or strong brown. The content of clay in the Bt horizon is 40 to 60 percent. Reaction is mildly alkaline or moderately alkaline.

The R layer is coarsely fractured, hard, limestone bedrock.

Rowena Series

The Rowena series consists of deep, nearly level to gently sloping, loamy soils. These soils are well drained and moderately slowly permeable. They formed in calcareous, loamy and clayey outwash material. These soils are on the broad uplands. The slopes range from 0 to 3 percent. The soils in the Rowena series are fine, mixed, thermic Vertic Calciustolls.

Typical pedon of Rowena clay loam, 0 to 1 percent slopes; about 18 miles west of Albany on U.S. Highway 180, 2.4 miles northwest on Texas Highway 6, 8.6 miles north on Farm Road 142, 0.4 mile east on a gravel road, 100 feet south, in cropland:

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; hard, friable, sticky and plastic; calcareous; moderately alkaline; abrupt smooth boundary.

Bw—6 to 11 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate fine and medium blocky structure; very hard, firm and friable, sticky and plastic; common very fine pores; few very fine concretions of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

Bk1—11 to 28 inches; dark brown (10YR 4/3) clay, dark brown (10YR 3/3) moist; moderate fine and medium blocky structure; very hard, very firm, sticky and plastic; dark grayish brown (10YR 4/2) clay loam material from surface layer in filled cracks; common threads and films and a few soft masses and concretions of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

Bk2—28 to 34 inches; dark brown (7.5YR 4/4) clay, dark brown (7.5YR 3/4) moist; moderate fine blocky structure; very hard, very firm, sticky and plastic; few very fine pores; a darker material in filled cracks; many threads and films and common soft masses and concretions of calcium carbonate; calcareous; moderately alkaline; abrupt smooth boundary.

Bk3—34 to 48 inches; light brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) moist; weak fine and medium subangular blocky structure; hard, friable, slightly sticky and plastic; many very fine pores; about 30 percent, by volume, soft masses and concretions of calcium carbonate; calcareous; moderately alkaline; abrupt smooth boundary.

Ck—48 to 60 inches; reddish yellow (7.5YR 6/6) clay loam, strong brown (7.5YR 5/6) moist; massive; hard, firm to friable; about 50 percent, by volume, soft masses and concretions of calcium carbonate; calcareous; moderately alkaline.

The solum is 40 to 60 inches thick. Secondary carbonates occur throughout the solum. The upper 20 inches of the Bw and Bk horizons have a coefficient of linear extensibility (COLE) of .07 or more. Depth to the distinct calcic horizon ranges from 10 to 30 inches.

The A horizon is 5 to 12 inches thick. It is dark brown, dark grayish brown, or very dark grayish brown.

The Bw, Bk1, and Bk2 horizons range from 20 to 34 inches thick. They are dark grayish brown, dark brown, or brown. Texture is clay loam, silty clay, or clay. The content of clay ranges from 35 to 50 percent. Some pedons do not have a Bw horizon.

The Bk3 and Ck horizons are brown, light brown, pink, or reddish yellow. Soft masses and concretions of calcium carbonate equivalent ranges from 20 to 60 percent. Texture is clay loam, silty clay, or clay.

Throck Series

The Throck series consists of deep, gently sloping to steep, clayey soils. These soils are well drained and slowly permeable. They formed in Permian shales. They are on erosional uplands. The slopes range from 1 to about 30 percent. The soils in the Throck series are fine, mixed, thermic, Typic Ustochrepts.

Typical pedon of Throck clay, 1 to 5 percent slopes; from U.S. Highway 283 in Albany; 4.35 miles west on U.S. Highway 180, 0.35 mile northwest on old paved road, 0.25 mile north on a private road, 500 feet northwest, in rangeland about 180 feet northeast of stock tank dam:

A—0 to 4 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate fine and medium granular structure; hard, firm; many fine roots; few worm casts; calcareous; moderately alkaline; clear smooth boundary.

Bw—4 to 11 inches; brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; weak coarse subangular blocky structure parting to moderate medium granular structure; hard, firm; many fine roots; few very fine pores; few worm casts; few iron-manganese (FeMn) concretions up to 2 millimeters across; few very fine soft masses of calcium carbonate in lower 4 centimeters; calcareous; moderately alkaline; clear wavy boundary.

Bk1—11 to 20 inches; brown (10YR 5/3) silty clay, dark brown (10YR 4/3) moist; moderate coarse and medium angular blocky structure; very hard, firm; common fine roots; few fine pores; few worm casts; common pressure faces on peds; few intersecting slickensides; few iron-manganese (FeMn) concretions up to 2 millimeters across; about 7 percent medium to very fine soft masses of calcium carbonate; calcareous; strongly alkaline; gradual smooth boundary.

Bk2—20 to 26 inches; brown (10YR 5/3) silty clay, dark brown (10YR 4/3) moist; thick, wedge-shaped peds tilted at 15 to 45 degrees from horizontal parting to moderate coarse blocky structure; extremely hard, very firm; few fine roots; common fine pores; few worm casts; few grayish brown stains on faces of peds; common iron-manganese (FeMn) concretions up to 2 millimeters across; about 3 percent fine and very fine soft masses of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

Bk3—26 to 34 inches; brown (10YR 5/3) silty clay, dark brown (10YR 4/3) moist; thick, wedge-shaped peds tilted 15 to 45 degrees from horizontal parting to moderate very coarse angular blocky structure; extremely hard, extremely firm, sticky; few very fine roots; few fine pores; few worm casts; few iron-manganese (FeMn) concretions up to 2 millimeters across; few threads and films and very fine soft masses and concretions of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

BC—34 to 40 inches; pale brown (10YR 6/3) silty clay, brown (10YR 5/3) moist; thick, weak, wedge-shaped peds 15 to 45 degrees from horizontal parting to weak coarse angular blocky structure; few fine roots; few very fine pores; common iron-manganese (FeMn) concretions up to 2 millimeters across; few very fine filaments and crystals of salt and gypsum on ped faces; few very fine soft masses and concretions of calcium carbonate; calcareous; moderately alkaline; clear wavy boundary.

C1—40 to 50 inches; grayish brown (2.5Y 5/2) interbedded fractured siltstone and shale, dark grayish brown (2.5Y 4/2) moist; weak thin to thick platy rock structure that has vertical fractures every 1 to 4 centimeters with weak angular blocky appearance and very fine cross-bedding planes with grayish brown to light brownish gray (2.5Y 6/2) lamella; few mesquite roots 1 to 10 millimeters across; many iron-manganese (FeMn) stains on ped faces; few very fine gypsum and salt crystals on ped surfaces and in cross-bedding planes; few very fine threads and films of calcium carbonate on ped faces; noncalcareous matrix; strongly effervescent ped faces; moderately alkaline; gradual smooth boundary.

C2—50 to 62 inches; light brownish gray (2.5Y 6/2) interbedded siltstone and shale, dark grayish brown (2.5Y 4/2) moist; vertical cracks 3 to 7 millimeters apart; carbonates, gypsum, and salts same as in above horizon; common iron-manganese (FeMn) stains on ped faces; noncalcareous matrix; strongly effervescent fracture faces; moderately alkaline; abrupt wavy boundary.

C3—62 to 69 inches; fractured shale; about 50 percent light brownish gray (10YR 6/2), 25 percent yellowish brown (10YR 5/6), 15 percent weak red (2.5YR 4/2), and 10 percent yellow (10YR 7/6), approximating bedding planes; carbonates, salts, and gypsum accumulations on fracture surfaces, percent of gypsum increases with depth; few iron-manganese (FeMn) stains on fracture faces; noncalcareous matrix; weakly to strongly effervescent fracture faces; mildly alkaline; clear wavy boundary with weak red material in fissures extending into C4 horizon.

C4—69 to 80 inches; light gray (10YR 6/1) fractured shale; 10 percent yellow (2.5Y 7/6) and 5 percent yellowish brown (10YR 5/4); few roots; carbonates, salts, and gypsum concentrated on fracture faces, few medium gypsum masses; few iron-manganese (FeMn) stains on fracture faces; noncalcareous matrix; weakly to moderately effervescent fracture faces; mildly alkaline; clear wavy boundary.

C5—80 to 98 inches; horizontally thinly bedded, finely foliated shaly materials with base color of grayish brown (2.5Y 5/2) and pale yellow (2.5Y 8/4) moist; few roots; few slickensides cutting transversely through material, few gypsum crystals; dark reddish gray (5YR 4/2) moist material 1 to 2 millimeters thick as interbedded zone and on vertical fracture surfaces; noncalcareous matrix; few threads and films of calcium carbonate along root channels; mildly alkaline.

The thickness of the solum ranges from 30 to about 60 inches. Texture of the fine-earth fraction in the control section is clay loam, silty clay loam, silty clay, or clay. The content of clay in the control section is 35 to about 50 percent.

The A horizon is 4 to 14 inches thick. It is grayish brown, brown, or dark grayish brown. Texture is clay or silty clay. Limestone fragments on the surface range from 1 to 15 percent.

The Bw horizon is 6 to 10 inches thick. It is brown, light olive brown, or yellowish brown. Limestone fragments in this horizon vary from a few to 30 percent, by volume. These fragments are mostly less than 3 inches across.

The Bk horizon is yellowish brown, brown, light olive brown, or strong brown. Soft masses of calcium carbonate in this horizon range from 3 to 15 percent, by volume.

Some pedons have a BC horizon that is similar to the Bk horizon in color and texture. In addition, it is also pale brown and grayish brown. Salt in the BC horizon is similar to that in the C horizon.

The C horizon is gray, grayish brown, light brownish gray, brown, yellowish brown, olive yellow, and light olive brown. Texture is shaly clay or shale. Interbedded strata of limestone, 4 to 24 inches thick, occur in most pedons at varying depths below 40 inches of the surface.

Thurber Series

The Thurber series consists of deep, nearly level to gently sloping, loamy soils. These soils are moderately well drained and very slowly permeable. They formed in calcareous, ancient outwash and alluvial sediment. These soils are on the uplands. The slopes range from 0 to 2 percent. The soils in the Thurber series are fine, montmorillonitic, thermic Typic Haplustalfs.

Typical pedon of Thurber clay loam, 0 to 2 percent slopes; from U.S. Highway 283 in Albany; 5 miles east on U.S. Highway 180, 0.6 mile northwest on Farm Road 2482, about 7.25 miles northeast on gravel road, 0.7 mile east on gravel ranch road, 0.4 mile north, in rangeland:

A—0 to 5 inches; dark brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure, parting to weak fine platy structure when moist and massive when dry; very hard, very firm; many fine roots; common pores; mildly alkaline; abrupt smooth boundary.

Bt1—5 to 16 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate coarse blocky structure; extremely hard, very firm; common fine roots; few pores; thin clay films on faces of peds; noncalcareous; moderately alkaline; gradual smooth boundary.

Bt2—16 to 36 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate medium blocky structure; extremely hard, very firm; common roots; few fine pores; thin clay films on faces of peds; few very fine iron-manganese (FeMn) concretions; few thin streaks of surface material in vertical cracks; few films and very fine concretions of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

Btk—36 to 51 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate medium blocky structure; very hard, very firm; few clay films on faces of peds; few very fine roots; few films and very fine soft masses and concretions of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

BCk—51 to 60 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; very hard, very firm; few very fine roots; few very fine soft masses and concretions of calcium carbonate; calcareous; moderately alkaline.

The thickness of the solum ranges from 40 to more than 60 inches. Depth to secondary carbonates ranges from 15 to 28 inches.

The A horizon is 4 to 12 inches thick. It is dark brown, dark grayish brown, or very dark grayish brown. Reaction is neutral to mildly alkaline.

The Bt horizon is dark grayish brown, dark brown, brown, or very dark grayish brown. Texture is dominantly clay. The content of clay ranges from 40 to 55 percent. Reaction ranges from mildly alkaline in the upper part of the Bt horizon to moderately alkaline in the lower part. These soils are noncalcareous in the upper part of the Bt horizon and are calcareous in the lower part.

The Btk horizon is dark grayish brown or dark brown. Calcium carbonate concretions range from few to about 10 percent.

The BCk horizon is grayish brown to yellowish brown clay or clay loam. Concretions and soft masses of calcium carbonates range from few to about 15 percent.

Truce Series

The Truce series consists of deep, gently sloping, loamy soils. These soils are well drained and slowly permeable. They formed in shale. These soils are on the uplands. The slopes range from 1 to 5 percent. The soils in the Truce series are fine, mixed, thermic Udic Paleustalfs.

Typical pedon of Truce fine sandy loam, 3 to 5 percent slopes; about 9.2 miles north of Moran on Farm Road 576 to intersection of Farm Road 601, continue 0.6 mile east on Farm Road 576, 1.1 miles north on gravel road, 1,200 feet east, in rangeland:

A—0 to 5 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak fine subangular blocky structure and granular structure; hard, very friable; many fine roots; neutral; abrupt smooth boundary.

Bt1—5 to 15 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; moderate medium subangular blocky structure; extremely hard, very firm; few fine roots; common thin clay films on faces of peds; few fine pores; neutral; clear smooth boundary.

Bt2—15 to 34 inches; strong brown (7.5YR 5/6) clay, strong brown (7.5YR 4/6) moist; few fine faint reddish brown and few medium distinct brown

(10YR 5/3) mottles; moderate coarse blocky structure; extremely hard, very firm; few fine roots; common thin clay films on faces of peds; common very fine iron-manganese (FeMn) concretions; neutral; gradual smooth boundary.

Bt3—34 to 52 inches; strong brown (7.5YR 5/6) clay, strong brown (7.5YR 4/6) moist; very hard, very firm; weak medium blocky structure; common medium brown (5YR 5/3) mottles; common fine and very fine weakly cemented iron-manganese (FeMn) concretions; few very fine roots; few patchy clay films on faces of peds; few very fine concretions of calcium carbonate; weakly calcareous; moderately alkaline; abrupt smooth boundary.

BCk—52 to 56 inches; yellowish brown (10YR 5/6) clay, dark yellowish brown (10YR 4/6) moist; moderate fine and medium subangular blocky structure; hard, firm and friable; about 10 percent fine and very fine soft masses and concretions of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

C—56 to 60 inches; pale brown (10YR 6/3) shaly clay; brown (10YR 5/3) moist; massive, parting to weak coarse angular blocky structure; very hard, very firm; few medium reddish brown mottles; few soft masses of calcium carbonate on fracture faces; few iron-manganese (FeMn) stains on fracture faces; calcareous; moderately alkaline.

The solum is 40 to 60 inches thick. Fragments of sandstone in the A horizon range from 0 to 15 percent, by volume. The sandstone fragments range from 2 to 450 millimeters across.

The A horizon is 2 to 10 inches thick. It is brown or dark brown. Reaction is slightly acid or neutral.

The Bt horizon is brown, dark brown, reddish brown, strong brown, or yellowish red. Some pedons have few or common, faint or distinct, fine or medium brown, grayish brown, reddish brown, or yellowish brown mottles. Texture is clay, sandy clay, or clay loam. The content of clay in this horizon ranges from 35 to about 50 percent. Reaction is neutral to moderately alkaline. Some pedons have secondary carbonates that are at a depth of more than 30 inches.

The BC or BCk horizons are light brown, yellowish brown, or yellowish red. Some pedons have faint reddish, yellowish, brownish, or olive mottling. Reaction ranges from neutral to moderately alkaline. The content of calcium carbonate in these horizons ranges from none to about 10 percent.

The C horizon is clayey shale, partially weathered shale, or brittle shaly clay. Colors are in shades of olive, yellow, brown, and gray. Reaction ranges from neutral to moderately alkaline. In some pedons, carbonates are in the fractures in the upper few inches of the C horizon.

Veal Series

The Veal series consists of deep, gently sloping, loamy soils. These soils are well drained and moderately permeable. They formed in calcareous, loamy, ancient alluvium and outwash. These soils are on the uplands. The slopes are 1 to 5 percent. The soils in the Veal series are fine-loamy, carbonatic, thermic Aridic Ustochrepts.

Typical pedon of Veal loam, 1 to 5 percent slopes; about 18 miles west of Albany on U.S. Highway 180, 2.4 miles northwest on Texas Highway 6, 2 miles north on Farm Road 142, 0.7 mile east on gravel road, 10 feet north, in rangeland:

A—0 to 6 inches; brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) moist; moderate fine and medium subangular blocky structure; hard, friable; few fine roots; few quartz pebbles; few caliche pebbles; calcareous; moderately alkaline; clear smooth boundary.

Bw—6 to 12 inches; brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) moist; weak coarse prismatic structure parting to weak medium subangular blocky structure; hard, friable; common fine pores; few fine roots; few quartz pebbles; common caliche pebbles; calcareous; clear smooth boundary.

Bk—12 to 31 inches; light brown (7.5YR 6/4) loam, strong brown (7.5YR 5/4) moist; weak coarse prismatic structure parting to moderate fine subangular blocky structure; hard, friable; few fine roots; few fine pores; about 30 percent, by volume, soft masses and concretions of calcium carbonate; few quartz pebbles; calcareous; moderately alkaline; clear smooth boundary.

2Bk—31 to 35 inches; light reddish brown (5YR 6/4) loam, reddish brown (5YR 5/4) moist; moderate fine subangular blocky structure; hard, friable; few fine roots; common quartz pebbles coated with carbonates; about 30 percent visible soft masses and concretions of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

3BCk—35 to 60 inches; light reddish brown (5YR 6/4) fine sandy loam, reddish brown (5YR 5/4) moist; massive, breaking to weak subangular blocky structure; hard, friable; about 15 percent, by volume, soft masses and concretions of calcium carbonate; few iron-manganese (FeMn) concretions; calcareous; moderately alkaline.

The thickness of the solum ranges from 40 to more than 60 inches. Calcium carbonate equivalent in the control section ranges from 40 to about 60 percent.

The thickness of the A horizon ranges from 5 to 10 inches. It is pale brown, light brown, or brown.

The Bw horizon is 5 to 14 inches thick. It is light brown, brown, pale brown, light yellowish brown, light reddish brown, or reddish brown. Texture is loam or clay loam.

The Bk horizon is pink, light reddish brown, pale brown, light yellowish brown, or light brown. Visible soft masses and concretions of calcium carbonate range from 20 to 40 percent, by volume. Texture is loam or clay loam.

The BCk horizon is light reddish brown, pink, very pale brown, light brown, or light yellowish brown. Texture is clay loam or loam. Soft masses and concretions of calcium carbonate range from 15 to 60 percent, by volume.

Wichita Series

The Wichita series consists of deep, nearly level to gently sloping, loamy soils. These soils are well drained and moderately slowly permeable. They formed in calcareous, ancient alluvial material. These soils are on terraces. The slopes range from 0 to 3 percent. The soils in the Wichita series are fine, mixed, thermic Typic Paleustalfs.

Typical pedon of Wichita clay loam, 1 to 3 percent slopes; about 18 miles west of Albany on U.S. Highway 180, 2.4 miles northwest on Texas Highway 6, 2.1 miles north on Farm Road 142, 0.2 mile east on gravel road, 100 feet south, in rangeland:

A—0 to 8 inches; dark brown (7.5YR 4/4) clay loam, dark brown (7.5YR 3/4) moist; moderate fine granular structure and subangular blocky structure; hard, friable; many fine roots; few fine pores; mildly alkaline; clear smooth boundary.

Bt1—8 to 22 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; moderate medium subangular blocky structure; very hard, firm; common fine roots; few fine pores; common clay films on faces of peds; mildly alkaline; gradual smooth boundary.

Bt2—22 to 40 inches; reddish brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; moderate medium blocky structure; very hard, firm; few fine roots; few very fine siliceous pebbles; common clay films on faces of peds; few very fine calcium carbonate concretions and few threads and films near concretions; noncalcareous matrix; moderately alkaline; clear smooth boundary.

Btk1—40 to 48 inches; yellowish red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; moderate medium subangular blocky structure; hard, firm; few very fine roots; common threads and films and few very fine concretions and soft masses of calcium carbonate; patchy clay films on faces of peds; calcareous; moderately alkaline; clear smooth boundary.

Btk2—48 to 60 inches; reddish yellow (5YR 6/6) clay loam, reddish yellow (5YR 5/6) moist; weak medium subangular blocky structure; many very fine pores; about 15 percent, by volume, concretions and soft masses of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 60 to more than 80 inches in thickness. Secondary carbonates begin at a depth of 8 to 28 inches. Calcic horizons are at a depth of 40 to 60 inches.

The A horizon is 5 to 10 inches thick. Reaction is neutral or mildly alkaline. It is reddish brown, brown, or dark brown.

The Bt1 horizon is 8 to 16 inches thick. It is reddish brown, yellowish red, or dark brown. The Bt2 horizon is 10 to 24 inches thick. It is reddish brown or yellowish red. The Bt horizon is clay or clay loam. The content of clay in the upper 20 inches of this horizon ranges from 35 to 45 percent. Reaction ranges from mildly alkaline to moderately alkaline.

The Btk horizon is reddish yellow, strong brown, or yellowish red. The content of calcium carbonate ranges from 5 to 20 percent.

Formation of the Soils

In this section the factors of soil formation are described and related to the soils in the survey area. The processes of soil formation are explained.

Time

A great length of time is required for the formation of soils that have distinct horizons. The difference in the length of time that parent materials have been in place is generally reflected in the degree of development of the soil profile.

The soils in Shackelford County range from young to old. The young soils have very little or no pedogenic horizon development, and the older soils have well expressed soil horizons. Clairemont, Frio, and Clearfork soils are examples of young soils that show little development. More development is evident in Nukrum and Abilene soils.

Some older soils are calcareous and have a prominent accumulation of calcium carbonate or have a calcic horizon in the lower part of the solum. Further aging leaches the calcium carbonate downward from the upper horizons to the lower horizons where it may become cemented or indurated. These horizons are petrocalcic horizons and require a great length of time for development, possibly millions of years. Pitzer and Mereta soils have petrocalcic horizons.

Relief

Relief, or topography, influences soil development through its effect on drainage and runoff. The topography of Shackelford County ranges from nearly level to steep.

The degree of profile development depends on the amount and depth of penetration of moisture if other factors of soil formation are equal. Soils on a nearly level landscape absorb more moisture and generally have better developed horizons than the more sloping soils. Many of the soils that have steeper slopes erode almost as fast as they form.

The soil that has the deepest solum is Leeray soil. Soils of intermediate depth are the nearly level Rowena and Rowden soils. Shallow development is exemplified by the more sloping Purves and Hensley soils, and the least development is in the undulating to steep, very shallow Lueders and Palopinto soils.

Plants and Animals

Plants, animals, insects, and micro-organisms are important in the formation of soils. Living organisms affect gains or losses in organic matter and plant nutrients. Structure and porosity are also affected by living organisms.

In Shackelford County, vegetation has had an effect on soil formation. The content of organic matter is low to high in the soils in Shackelford County. The content of organic matter is related to the amount of vegetation available for decomposition as the soil formed. Organic matter is formed from decaying leaves and stems. The content of organic matter is low in the Grandfield and Wichita soils. Insects, such as earthworms and termites, increase soil porosity by their activities of burrowing channels throughout the solum. Plant roots make voids and channels through the soil that also increase soil porosity.

Climate

The climate of Shackelford County is subhumid. It has had a definite effect on soil formation. Rainfall, evaporation, temperature, and wind are some of the influencing factors of climate. The limited rainfall has not been great enough to leach the minerals from the soils, and as a result, most of the soils have a layer that has an accumulation of calcium carbonate. The deep soils are seldom wet below the root zone. The climate in Shackelford County is fairly uniform. The average annual rainfall at Albany is 27.18 inches. Most rainfall occurs during the growing season.

Shackelford County has mild winters and hot summers, which contribute to the continuous decomposition of residue from plants and animals by micro-organisms. Some soils, such as Leeray, Nukrum, Nuvalde, and Rowena soils, have a high content of organic matter.

Parent Material

Parent material is the unconsolidated mass from which a soil is formed. It determines the limits of the chemical and mineralogical composition of the soil. Most of the soils in Shackelford County have developed from parent material of Permian and Quaternary geologic periods.

The Quaternary period is represented by deposits of Pleistocene and Recent Epochs.

Materials of the Permian period have had an influence on the soils throughout the county. The materials represent the eastern exposure of the Permian period on the western flank of the Bend Arch. The dominant sediments are gray shale and limestone and sandstone strata in various proportions. The limestone and sandstone strata have formed cuestas while shale is represented by nearly level to undulating topography.

Several formations are in Shackelford County. The major formations affecting soil development as they occur from the west to east are the Clear Fork, Lueders, Talpa, Grape Creek, Bead Mountain, Valera, Elm Creek, Admiral, Coleman Junction, Santa Anna, Sedwick, and Moran Formations.

The Clear Fork Formation is in the northwest and south-central part of the county. The Clear Fork Formation is covered almost entirely by a mantle of alluvium of the Quaternary period. Rowena, Nuvalde, Mereta, and Leeray soils are dominant in this formation.

The Lueders and Talpa Formations are in the western one-third of Shackelford County. Lueders and Cho soils are on ridges in the Lueders Formation. Nukrum and Leeray soils are in valleys in the Talpa Formation.

The Grape Creek Formation is on undulating to hilly topography that has thin beds of limestone and thick beds of soft shale. The Throck soils are dominant in this formation.

The Bead Mountain and Valera Formations are on the gently sloping uplands. These soils are underlain by thick beds of limestone at various depths. Throck, Purves, Nuvalde, and Palopinto soils are dominant in these formations.

The Elm Creek Formation outcrop is mainly on steep escarpments. The underlying material is a thick bed of yellowish brown limestone and thin beds of shale. Throck and Palopinto soils are dominant in this formation. Throck soils have developed from shale, and Palopinto soils are underlain by limestone.

The Admiral Formation is on nearly level to gently sloping topography. Local outwash remnants of limestone gravel and caliche form a mantle over most of the area. Purves, Leeray, Pitzer, and Throck soils are dominant in this formation.

The Coleman Junction Formation is on gently sloping to undulating topography. This formation has thin beds of limestone and sandstone and shale. Many of the soils are noncalcareous. Hensley, Bluegrove, Throck, and Truce soils are dominant in this formation.

The Sedwick Formation is on nearly level to gently sloping topography. The formation has thick beds of shale and thin strata of limestone. Leeray and Purves soils are dominant in this formation.

The Santa Anna and Moran Formations are on undulating to hilly topography. The formations have thick sandstone and shale layers and thin beds of limestone. Bluegrove, Bonti, Hensley, Thurber, and Truce soils are dominant in these formations. Some geologists consider the Moran Formation to be a member of the Pennsylvanian Period.

The Pleistocene deposits exist as terraces and eolian mantles from the Clear Fork of the Brazos River. Grandfield, Wichita, and Minwells soils are dominant on these terraces. They are underlain by calcareous, loamy sediment and quartz gravel. Eolian deposits are void of gravel and coarse fragments. Grandfield, Patilo, and Chaney soils have developed from these deposits.

The Recent Epoch sediments are in drainageways of local streams and on flood plains of the Clear Fork of the Brazos River. Frio soils are in local drainageways, and Clairemont and Clearfork soils are along the Clear Fork of the Brazos River.

References

(1) American Association of State Highway and Transportation Officials. 1982. Standard specifications for highway materials and methods of sampling and testing. Ed. 13, 2 vol., illus.

(2) American Society for Testing and Materials. 1985. Standard test method for classification of soils for engineering purposes. ASTM Stand. D 2487.

(3) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus. (Supplements replacing pp. 173-188 issued May 1962.)

(4) 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.

(5) United States Department of Agriculture. 1984. Procedures for collecting soil samples and methods of analysis for soil survey. Soil Surv. Invest. Rep. 1, 68 pp., illus.

Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well-aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

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.

Alkali (sodic) soil. Soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

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.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Broad-base terrace. A ridge-type terrace built to control erosion by diverting runoff along the contour at a nonscouring velocity. The terrace is 10 to 20 inches high and 15 to 30 feet wide and has gently sloping sides, a rounded crown, and a dish-shaped channel along the upper side. It may be nearly level or have a grade toward one or both ends.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds just beneath the solum, or it is exposed at the surface by erosion.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but that have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

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.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard compacted layers to a depth below normal plow depth.

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, i.e., clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

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. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) 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. The volume of soft soil decreases excessively 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. 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 resting grazingland for a prescribed period.

Dense layer. A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth to rock (in tables). 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 they are wet 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, such as fire, that exposes the surface.

Excess alkali. Excess exchangeable sodium is in the soil. The resulting poor physical properties restrict the growth of plants.

Excess fines (in tables). Excess silt and clay are in the soil. The soil is not a source of gravel or sand for construction purposes.

Excess lime. Excess carbonates in the soil restrict the growth of some plants.

Excess salts. Excess water-soluble salts in the soil restrict the growth of most plants.

Excess sulfur. An excessive amount of sulfur is in the soil. The sulfur causes extreme acidity if the soil is drained, and the growth of most plants is restricted.

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 movement of water into the soil is rapid.

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.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 37.5 centimeters) long.

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 that is not a grass or a sedge.

Fragile. The soil is easily damaged by use or disturbance.

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.

Gilgai. Commonly a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of Vertisols—clayey soils having a high coefficient of expansion and contraction with changes in moisture content.

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.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

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.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

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.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is, in part, a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as accumulation of clay, sesquioxides, humus, or a combination of these; prismatic or blocky structure; redder or browner colors than those in the A horizon; or 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 Arabic numeral 2 precedes the letter C.

R layer.—Consolidated rock (unweathered bedrock) beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

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.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

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 plants that are the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material. This contrasts 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.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

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.

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

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

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

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

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

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

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

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

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Large stones (in tables). Rock fragments that are 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

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.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

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.

Open space. A relatively undeveloped green or wooded area provided mainly within an urban area to minimize feelings of congested living.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash plain. A landform of mainly sandy or coarse-textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan.*

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.

Permafrost. Layers of soil, or even bedrock, occurring in arctic or subarctic regions, in which a temperature below freezing has existed continuously for a long time.

Permeability. The quality of the soil that enables water to move through the profile. Permeability is measured as the number of inches per hour that water moves through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 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, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping. Subsurface tunnels or pipelike cavities are formed 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.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

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 filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poor outlets. In these areas, 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 climax 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 the 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

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.
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.
Rippable. Rippable bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.
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). There is a 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 the growth of plants. A saline soil does not contain excess exchangeable sodium.
Salty water. Water is too salty for consumption by livestock.
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 adversely affects the specified use.
Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)
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 surface runoff.
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.
Silica. A combination of silicon and oxygen. The mineral form is called quartz.
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.
Slippage. The soil mass is susceptible to movement downslope when loaded, excavated, or wet.
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.
Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.
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 millimeters 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, E, 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 that 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.

Subsoiling. Breaking up a compact subsoil by pulling a special chisel through the soil.

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 organic matter content 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 layer. 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 on the contour or at a slight angle to the contour across sloping soils. The terrace intercepts surface runoff, so that water soaks into the soil or flows slowly to a prepared outlet.

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 loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). An otherwise suitable soil material that is 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.

Unstable fill. There is a 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 lowlands 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 by atmospheric agents in rocks or other deposits at or near the earth's surface. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of course 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. This contrasts with poorly graded soil.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Data recorded in the period 1951-81 at Albany, Texas]

Month	Temperature						Precipitation				
				2 years in 10 will have--				2 years in 10 will have--			
	Average daily maximum	Average daily minimum	Average daily	Maximum temperature higher than--	Minimum temperature lower than--	Average number of growing degree days*	Average	Less than--	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----	56.5	29.0	42.8	84	5	56	1.29	0.06	2.15	2	0.8
February---	61.0	32.6	46.8	87	12	82	1.31	0.41	2.04	3	1.2
March------	69.0	39.4	54.2	93	17	214	1.34	0.37	2.11	3	0.7
April------	78.6	50.4	64.5	97	29	441	2.96	1.24	4.44	4	0.0
May--------	85.3	58.1	71.7	102	39	673	3.70	1.60	5.48	5	0.0
June-------	93.4	66.6	80.0	105	51	900	2.36	0.67	3.71	4	0.0
July-------	97.9	70.1	84.0	108	59	1,054	2.30	0.33	3.81	3	0.0
August-----	97.6	68.3	83.0	108	55	1,023	2.97	0.46	4.85	3	0.0
September--	89.6	61.5	75.6	105	42	768	3.83	0.91	6.16	5	0.0
October----	79.9	50.2	65.1	98	31	468	2.62	0.80	4.12	4	0.0
November---	66.9	38.3	52.6	88	19	157	1.49	0.32	2.40	3	0.4
December---	60.2	32.0	46.1	84	11	46	1.01	0.18	1.64	2	0.2
Yearly:											
Average--	78.0	49.7	63.9	---	---	---	---	---	---	---	---
Extreme--	---	---	---	110	5	---	---	---	---	---	---
Total----	---	---	---	---	---	5,882	27.18	19.86	33.95	41	3.3

* 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).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Data recorded in the period 1951-81
at Albany, Texas]

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--	March 30	April 10	April 16
2 years in 10 later than--	March 22	April 4	April 11
5 years in 10 later than--	March 6	March 24	March 31
First freezing temperature in fall:			
1 year in 10 earlier than--	November 7	October 27	October 19
2 years in 10 earlier than--	November 14	November 3	October 25
5 years in 10 earlier than--	November 28	November 16	November 5

TABLE 3.--GROWING SEASON

[Data recorded in the period 1951-81
at Albany, Texas]

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	235	207	197
8 years in 10	246	217	204
5 years in 10	266	237	218
2 years in 10	287	256	232
1 year in 10	297	266	240

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
AbA	Abilene clay loam, 0 to 2 percent slopes	370	0.1
BeB	Bluegrove loam, 1 to 3 percent slopes	6,900	1.2
BgC	Bluegrove flaggy fine sandy loam, undulating	4,450	0.8
BoB	Bonti loamy fine sand, 1 to 3 percent slopes	710	0.1
CaB	Chaney loamy fine sand, 0 to 3 percent slopes	1,420	0.2
CeC	Chaney stony sandy loam, undulating	325	0.1
ChC	Cho gravelly loam, undulating	23,350	4.0
Cm	Clairemont silty clay loam, occasionally flooded	3,080	0.5
Cn	Clairemont silty clay loam, channeled	3,450	0.6
Co	Clearfork silty clay, occasionally flooded	3,000	0.5
Fr	Frio silty clay, occasionally flooded	36,800	6.3
Ga	Gageby sandy clay loam, occasionally flooded	2,780	0.5
GdB	Grandfield loamy fine sand, 0 to 5 percent slopes	1,550	0.3
GfC	Grandfield fine sandy loam, 1 to 5 percent slopes	4,970	0.8
HeB	Hensley clay loam, 1 to 3 percent slopes	1,200	0.2
HsB	Hensley stony clay loam, gently undulating	2,460	0.4
LeA	Leeray clay, 0 to 1 percent slopes	18,700	3.2
LeB	Leeray clay, 1 to 3 percent slopes	37,200	6.3
LrC	Lueders very gravelly clay loam, undulating	68,485	11.7
LuC	Lusk gravelly fine sandy loam, undulating	3,100	0.5
MeB	Mereta silty clay, 1 to 3 percent slopes	9,670	1.7
MnB	Minwells loam, 1 to 3 percent slopes	2,710	0.5
NcB	Nukrum clay, 1 to 3 percent slopes	44,950	7.7
NuA	Nuvalde silty clay loam, 0 to 1 percent slopes	7,410	1.3
NuB	Nuvalde silty clay loam, 1 to 3 percent slopes	12,650	2.2
Ow	Oil-waste land	835	0.1
OXC	Owens-Harpersville association, undulating, very stony	2,700	0.5
OXF	Owens-Harpersville association, hilly, extremely stony	3,360	0.6
PaC	Palopinto very flaggy silty clay loam, undulating	27,000	4.6
PoB	Patilo fine sand, 0 to 5 percent slopes	680	0.1
Ps	Pits	230	*
PtC	Pitzer gravelly clay loam, undulating	11,200	1.9
PuB	Purves clay, 1 to 3 percent slopes	9,080	1.5
PyB	Purves cobbly clay, gently undulating	5,540	0.9
RdA	Rowden clay loam, 0 to 2 percent slopes	8,900	1.5
RoA	Rowena clay loam, 0 to 1 percent slopes	5,020	0.9
RoB	Rowena clay loam, 1 to 3 percent slopes	3,220	0.5
ThC	Throck clay, 1 to 5 percent slopes	26,200	4.5
TPC	Throck-Palopinto association, undulating	100,450	17.1
TPG	Throck-Palopinto association, steep	54,160	9.2
TrA	Thurber clay loam, 0 to 2 percent slopes	11,140	1.9
TuB	Truce fine sandy loam, 1 to 3 percent slopes	2,350	0.4
TuC	Truce fine sandy loam, 3 to 5 percent slopes	1,760	0.3
VeC	Veal loam, 1 to 5 percent slopes	570	0.1
WcA	Wichita clay loam, 0 to 1 percent slopes	3,500	0.6
WcB	Wichita clay loam, 1 to 3 percent slopes	5,900	1.0
	Water	333	0.1
	Total	585,818	100.0

* Less than 0.1 percent.

TABLE 5.--PRIME FARMLAND

[Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name]

Map symbol	Soil name
AbA	Abilene clay loam, 0 to 2 percent slopes
BeB	Bluegrove loam, 1 to 3 percent slopes
CaB	Chaney loamy fine sand, 0 to 3 percent slopes (where irrigated)
Cm	Clairemont silty clay loam, occasionally flooded
Co	Clearfork silty clay, occasionally flooded
Fr	Frio silty clay, occasionally flooded
Ga	Gageby sandy clay loam, occasionally flooded
GfC	Grandfield fine sandy loam, 1 to 5 percent slopes (where irrigated)
LeA	Leeray clay, 0 to 1 percent slopes
LeB	Leeray clay, 1 to 3 percent slopes
NcB	Nukrum clay, 1 to 3 percent slopes
NuA	Nuvalde silty clay loam, 0 to 1 percent slopes
NuB	Nuvalde silty clay loam, 1 to 3 percent slopes
RdA	Rowden clay loam, 0 to 2 percent slopes (where irrigated)
RoA	Rowena clay loam, 0 to 1 percent slopes
RoB	Rowena clay loam, 1 to 3 percent slopes
WcA	Wichita clay loam, 0 to 1 percent slopes
WcB	Wichita clay loam, 1 to 3 percent slopes

TABLE 6.--LAND CAPABILITY CLASSES AND 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	Land capability	Cotton lint	Grain sorghum	Wheat	Pasture
		Lbs	Bu	Bu	AUM*
AbA----------------------- Abilene	IIe	275	35	25	5.0
BeB----------------------- Bluegrove	IIIe	250	20	25	3.0
BgC----------------------- Bluegrove	VIs	---	---	---	---
BoB----------------------- Bonti	IVe	---	25	20	4.0
CaB----------------------- Chaney	IIIe	---	25	20	5.5
CeC----------------------- Chaney	VIs	---	---	---	---
ChC----------------------- Cho	VIs	---	---	---	---
Cm------------------------ Clairemont	IIw	350	40	25	6.0
Cn------------------------ Clairemont	Vw	---	---	---	6.0
Co------------------------ Clearfork	IIw	325	30	30	6.0
Fr------------------------ Frio	IIw	450	50	30	6.0
Ga------------------------ Gageby	IIw	500	45	30	6.0
GdB----------------------- Grandfield	IVe	200	25	15	5.5
GfC----------------------- Grandfield	IIIe	250	30	20	5.0
HeB----------------------- Hensley	IVe	---	15	20	2.0
HsB----------------------- Hensley	VIs	---	---	---	---
LeA----------------------- Leeray	IIIs	300	45	25	4.0
LeB----------------------- Leeray	IIIe	250	40	25	4.0
LrC----------------------- Lueders	VIIs	---	---	---	---

See footnote at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Map symbol and soil name	Land capability	Cotton lint	Grain sorghum	Wheat	Pasture
		Lbs	Bu	Bu	AUM*
LuC: Lusk	VIs	---	---	---	---
MeB: Mereta	IIIe	150	20	15	2.0
MnB: Minwells	IIe	---	35	15	4.5
NcB: Nukrum	IIe	---	45	25	5.5
NuA: Nuvalde	IIc	300	40	20	4.5
NuB: Nuvalde	IIe	250	35	20	4.5
Ow: Oil-waste land	VIIIs	---	---	---	---
OXC:					
Owens	VIs	---	---	---	---
Harpersville	VIIs	---	---	---	---
OXF:					
Owens	VIIe	---	---	---	---
Harpersville	VIIs	---	---	---	---
PaC: Palopinto	VIs	---	---	---	---
PoB: Patilo	IVe	---	---	---	---
Ps: Pits	VIIIs	---	---	---	---
PtC: Pitzer	VIs	---	---	---	---
PuB: Purves	IVe	---	25	20	2.0
PyB: Purves	VIs	---	---	---	---
RdA: Rowden	IIIe	250	40	20	4.0
RoA: Rowena	IIc	250	45	25	5.0
RoB: Rowena	IIe	225	40	25	4.5
ThC: Throck	IVe	150	25	15	3.0

See footnote at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Map symbol and soil name	Land capability	Cotton lint	Grain sorghum	Wheat	Pasture
		Lbs	Bu	Bu	AUM*
TPC:					
Throck	VIe	---	---	---	---
Palopinto	VIs	---	---	---	---
TPG:					
Throck	VIIs	---	---	---	---
Palopinto	VIIs	---	---	---	---
TrA Thurber	IIIs	---	30	20	3.0
TuB Truce	IIIe	---	20	15	3.0
TuC Truce	IVe	---	15	10	2.5
VeC Veal	IVe	125	14	10	2.5
WcA Wichita	IIc	250	40	25	4.0
WcB Wichita	IIe	225	35	20	4.0

* 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.

TABLE 7.--RANGELAND PRODUCTIVITY

[Only the soils that support rangeland vegetation suitable for grazing are listed]

Map symbol and soil name	Range site	Potential annual production for kind of growing season		
		Favorable Lb/acre	Average Lb/acre	Unfavorable Lb/acre
AbA-----Abilene	Clay Loam-----	3,500	2,800	2,000
BeB-----Bluegrove	Tight Sandy Loam-----	3,500	2,700	2,000
BgC-----Bluegrove	Sandstone Hill-----	4,000	3,200	2,500
BoB-----Bonti	Loamy Sand-----	4,500	4,000	3,500
CaB, CeC-----Chaney	Loamy Sand-----	4,500	4,000	3,000
ChC-----Cho	Very Shallow-----	2,500	2,000	1,000
Cm, Cn-----Clairemont	Loamy Bottomland-----	5,000	3,500	2,800
Co-----Clearfork	Loamy Bottomland-----	6,000	3,500	2,500
Fr-----Frio	Loamy Bottomland-----	5,500	4,000	3,000
Ga-----Gageby	Loamy Bottomland-----	6,000	4,500	3,000
GdB-----Grandfield	Loamy Sand-----	4,000	3,500	2,500
GfC-----Grandfield	Sandy Loam-----	4,000	2,800	2,000
HeB, HsB-----Hensley	Redland-----	4,500	3,500	2,500
LeA, LeB-----Leeray	Clayey Upland-----	4,500	3,500	2,500
LrC-----Lueders	Very Shallow-----	2,500	1,500	1,000
LuC-----Lusk	Sandy Loam-----	3,000	2,400	1,600
MeB-----Mereta	Shallow-----	3,000	2,500	1,800
MnB-----Minwells	Sandy Loam-----	3,500	2,500	2,000
NcB-----Nukrum	Clayey Upland-----	4,500	3,500	2,500
NuA, NuB-----Nuvalde	Clay Loam-----	4,500	3,500	2,000

TABLE 7.--RANGELAND PRODUCTIVITY--Continued

Map symbol and soil name	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
OXC:				
Owens	Shallow Clay	2,500	2,000	1,000
Harpersville	Shaly Hill	1,600	1,200	800
OXF:				
Owens	Rocky Hills	2,000	1,500	1,000
Harpersville	Shaly Hill	1,500	1,000	500
PaC Palopinto	Low Stony Hill	3,500	3,000	1,000
PoB Patilo	Deep Sand	3,000	2,000	1,000
PtC Pitzer	Very Shallow	2,000	1,200	500
PuB, PyB Purves	Shallow	3,000	2,500	1,800
RdA Rowden	Clay Loam	4,500	3,500	2,500
RoA, RoB Rowena	Clay Loam	4,000	3,000	2,200
ThC Throck	Clayey Slopes	3,500	2,500	2,000
TPC:				
Throck	Clayey Slopes	3,500	2,500	2,000
Palopinto	Low Stony Hill	3,500	3,000	1,000
TPG:				
Throck	Rocky Hills	2,500	1,800	1,200
Palopinto	Steep Rocky	3,000	2,500	1,000
TrA Thurber	Claypan Prairie	3,500	3,000	2,000
TuB, TuC Truce	Tight Sandy Loam	4,000	3,000	2,000
VeC Veal	Loamy	2,800	2,100	1,400
WcA, WcB Wichita	Clay Loam	3,500	2,800	2,000

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
AbA: Abilene	Slight	Slight	Slight	Severe: erodes easily.	Slight.
BeB: Bluegrove	Slight	Slight	Moderate: slope, depth to rock.	Slight	Moderate: depth to rock.
BgC: Bluegrove	Moderate: large stones.	Moderate: large stones.	Severe: large stones.	Slight	Moderate: large stones, depth to rock.
BoB: Bonti	Slight	Slight	Moderate: slope, depth to rock.	Slight	Moderate: depth to rock.
CaB: Chaney	Slight	Slight	Slight	Slight	Slight.
CeC: Chaney	Slight	Slight	Moderate: large stones, slope, small stones.	Slight	Moderate: large stones.
ChC: Cho	Severe: cemented pan.	Severe: cemented pan.	Severe: small stones, cemented pan.	Slight	Severe: cemented pan.
Cm: Clairemont	Severe: flooding.	Slight	Moderate: flooding.	Severe: erodes easily.	Moderate: flooding.
Cn: Clairemont	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Severe: erodes easily.	Severe: flooding.
Co: Clearfork	Severe: flooding.	Moderate: too clayey.	Moderate: too clayey, flooding.	Moderate: too clayey.	Severe: too clayey.
Fr: Frio	Severe: flooding.	Moderate: too clayey.	Moderate: too clayey, flooding.	Moderate: too clayey.	Severe: too clayey.
Ga: Gageby	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
GdB: Grandfield	Slight	Slight	Slight	Slight	Slight.
GfC: Grandfield	Slight	Slight	Moderate: slope.	Slight	Slight.
HeB, HsB: Hensley	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Severe: depth to rock.
LeA: Leeray	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: too clayey, percs slowly.	Moderate: too clayey.	Severe: too clayey.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
LeB------------------ Leeray	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: slope, too clayey, percs slowly.	Moderate: too clayey.	Severe: too clayey.
LrC------------------ Lueders	Severe: depth to rock.	Severe: depth to rock.	Severe: small stones, depth to rock.	Moderate: large stones.	Severe: small stones, depth to rock.
LuC------------------ Lusk	Severe: small stones.	Severe: small stones.	Severe: small stones.	Slight----------	Severe: small stones.
MeB------------------ Mereta	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Moderate: too clayey.	Severe: cemented pan, too clayey.
MnB------------------ Minwells	Slight----------	Slight----------	Moderate: small stones.	Slight----------	Slight.
NcB------------------ Nukrum	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.	Severe: too clayey.
NuA------------------ Nuvalde	Slight----------	Slight----------	Slight----------	Slight----------	Slight.
NuB------------------ Nuvalde	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
Ow. Oil-waste land					
OXC:					
Owens----------------	Moderate: large stones, too clayey.	Moderate: large stones, too clayey.	Moderate: large stones, slope, too clayey.	Moderate: large stones, too clayey.	Moderate: large stones, droughty.
Harpersville---------	Severe: percs slowly.	Severe: percs slowly.	Severe: large stones, percs slowly.	Moderate: too clayey.	Severe: large stones, droughty.
OXF:					
Owens----------------	Severe: slope.	Severe: slope.	Severe: large stones, slope.	Moderate: large stones, slope, too clayey.	Severe: large stones, slope.
Harpersville---------	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: large stones, percs slowly, slope.	Moderate: too clayey, slope.	Severe: large stones, droughty, slope.
PaC------------------ Palopinto	Severe: large stones, depth to rock.	Severe: large stones, depth to rock.	Severe: large stones, depth to rock.	Slight----------	Severe: depth to rock.
PoB------------------ Patilo	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty, too sandy.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Ps. Pits					
PtC------------------ Pitzer	Severe: cemented pan.	Severe: cemented pan.	Severe: small stones, cemented pan.	Slight----------	Severe: thin layer.
PuB------------------ Purves	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight----------	Severe: depth to rock.
PyB------------------ Purves	Severe: depth to rock.	Severe: depth to rock.	Severe: large stones, small stones.	Moderate: too clayey.	Severe: depth to rock, too clayey.
RdA------------------ Rowden	Slight----------	Slight----------	Slight----------	Slight----------	Moderate: depth to rock.
RoA------------------ Rowena	Slight----------	Slight----------	Slight----------	Slight----------	Slight.
RoB------------------ Rowena	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
ThC------------------ Throck	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope.	Moderate: too clayey.	Severe: too clayey.
TPC:					
Throck--------------	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope.	Moderate: too clayey.	Severe: too clayey.
Palopinto-----------	Severe: large stones, depth to rock.	Severe: large stones, depth to rock.	Severe: large stones, depth to rock.	Slight----------	Severe: depth to rock.
TPG:					
Throck--------------	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: large stones, too clayey, slope.	Severe: slope, too clayey.
Palopinto-----------	Severe: large stones, depth to rock.	Severe: large stones, depth to rock.	Severe: large stones, slope, depth to rock.	Moderate: slope.	Severe: large stones, slope, depth to rock.
TrA------------------ Thurber	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: percs slowly.	Slight----------	Slight.
TuB, TuC------------- Truce	Slight----------	Slight----------	Moderate: slope.	Slight----------	Moderate: droughty.
VeC------------------ Veal	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.	Slight.
WcA------------------ Wichita	Slight----------	Slight----------	Slight----------	Slight----------	Slight.
WcB------------------ Wichita	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.

TABLE 9.--WILDLIFE HABITAT

[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	Shrubs	Openland wildlife	Rangeland wildlife
AbA: Abilene	Good	Good	Fair	Good	Good	Fair.
BeB: Bluegrove	Fair	Good	Good	Fair	Good	Fair.
BgC: Bluegrove	Poor	Poor	Good	Fair	Poor	Fair.
BoB: Bonti	Fair	Good	Good	Good	Good	Good.
CaB: Chaney	Fair	Good	Good	Good	Good	Good.
CeC: Chaney	Poor	Poor	Good	Good	Fair	Good.
ChC: Cho	Poor	Poor	Poor	Poor	Poor	Poor.
Cm: Clairemont	Good	Good	Fair	Good	Good	Fair.
Cn: Clairemont	Very poor	Poor	Fair	Good	Poor	Fair.
Co: Clearfork	Poor	Fair	Poor	Fair	Poor	Poor.
Fr: Frio	Good	Good	Fair	Good	Good	Fair.
Ga: Gageby	Good	Good	Fair	Good	Good	Fair.
GdB: Grandfield	Fair	Fair	Good	Good	Fair	Good.
GfC: Grandfield	Good	Good	Good	Good	Good	Good.
HeB, HsB: Hensley	Poor	Poor	Fair	Fair	Poor	Fair.
LeA, LeB: Leeray	Fair	Fair	Fair	Fair	Fair	Fair.
LrC: Lueders	Very poor	Very poor	Fair	Fair	Poor	Fair.
LuC: Lusk	Poor	Poor	Fair	Fair	Poor	Fair.
MeB: Mereta	Fair	Fair	Fair	Fair	Fair	Fair.
MnB: Minwells	Good	Good	Good	Good	Good	Good.

TABLE 9.--WILDLIFE HABITAT--Continued

Map symbol and soil name	Potential for habitat elements				Potential as habitat for--	
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Openland wildlife	Rangeland wildlife
NcB------------------ Nukrum	Good	Good	Fair	Fair	Good	Fair.
NuA, NuB------------ Nuvalde	Good	Good	Fair	Fair	Good	Fair.
Ow. Oil-waste land						
OXC:						
Owens--------------	Poor	Poor	Fair	Fair	Poor	Poor.
Harpersville-------	Very poor	Very poor	Fair	Fair	Very poor	Poor.
OXF:						
Owens--------------	Very poor	Very poor	Fair	Fair	Very poor	Poor.
Harpersville-------	Very poor	Very poor	Fair	Fair	Very poor	Poor.
PaC------------------ Palopinto	Poor	Poor	Fair	Fair	Fair	Fair.
PoB------------------ Patilo	Fair	Good	Fair	Fair	Fair	Fair.
Ps. Pits						
PtC------------------ Pitzer	Poor	Poor	Poor	Poor	Poor	Poor.
PuB------------------ Purves	Fair	Good	Poor	Fair	Fair	Poor.
PyB------------------ Purves	Fair	Good	Poor	Good	Fair	Fair.
RdA------------------ Rowden	Fair	Good	Good	Good	Fair	Good.
RoA, RoB------------ Rowena	Good	Good	Fair	Fair	Good	Fair.
ThC------------------ Throck	Fair	Good	Fair	Fair	Fair	Fair.
TPC:						
Throck-------------	Fair	Good	Fair	Fair	Fair	Fair.
Palopinto----------	Poor	Poor	Fair	Fair	Fair	Fair.
TPG:						
Throck-------------	Very poor	Very poor	Fair	Fair	Poor	Fair.
Palopinto----------	Very poor	Very poor	Fair	Fair	Poor	Fair.
TrA------------------ Thurber	Fair	Fair	Fair	Fair	Fair	Fair.

TABLE 9.--WILDLIFE HABITAT--Continued

Map symbol and soil name	Potential for habitat elements				Potential as habitat for--	
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Openland wildlife	Rangeland wildlife
TuB----------------- Truce	Good	Good	Good	Good	Good	Good.
TuC----------------- Truce	Fair	Good	Good	Good	Fair	Good.
VeC----------------- Veal	Fair	Fair	Fair	Fair	Fair	Fair.
WcA, WcB------------ Wichita	Good	Good	Fair	Fair	Good	Fair.

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. The information in this table indicates the dominant soil condition; it does not eliminate the need for onsite investigation]

Map symbol and soil name	Shallow excavations	Dwellings without basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
AbA--------------- Abilene	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
BeB--------------- Bluegrove	Moderate: depth to rock, too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Moderate: depth to rock.
BgC--------------- Bluegrove	Moderate: depth to rock, too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Moderate: large stones, depth to rock.
BoB--------------- Bonti	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: low strength.	Moderate: depth to rock.
CaB--------------- Chaney	Moderate: too clayey, dense layer.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
CeC--------------- Chaney	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Moderate: large stones.
ChC--------------- Cho	Severe: cemented pan.	Moderate: cemented pan.	Moderate: slope, cemented pan.	Moderate: cemented pan.	Severe: cemented pan.
Cm---------------- Clairemont	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
Cn---------------- Clairemont	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Co---------------- Clearfork	Moderate: too clayey, flooding.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, flooding, shrink-swell.	Severe: too clayey.
Fr---------------- Frio	Moderate: too clayey, flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Severe: too clayey.
Ga---------------- Gageby	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
GdB, GfC---------- Grandfield	Slight-----------	Slight-----------	Slight-----------	Slight-----------	Slight.
HeB, HsB---------- Hensley	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, low strength.	Severe: depth to rock.
LeA, LeB---------- Leeray	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
LrC: Lueders	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: small stones, depth to rock.
LuC: Lusk	Moderate: depth to rock, too clayey.	Slight	Moderate: slope.	Slight	Severe: small stones.
MeB: Mereta	Severe: cemented pan.	Moderate: shrink-swell, cemented pan.	Moderate: shrink-swell, cemented pan.	Severe: low strength.	Severe: cemented pan, too clayey.
MnB: Minwells	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
NcB: Nukrum	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
NuA, NuB: Nuvalde	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
Ow. Oil-waste land					
OXC:					
Owens	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Moderate: large stones, droughty.
Harpersville	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: large stones, droughty.
OXF:					
Owens	Severe: slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope, low strength.	Severe: large stones, slope.
Harpersville	Severe: slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength, slope.	Severe: slope, large stones, droughty.
PaC: Palopinto	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, low strength.	Severe: depth to rock.
PoB: Patilo	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: droughty, too sandy.
Ps. Pits					

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
PtC: Pitzer	Severe: cemented pan.	Moderate: cemented pan.	Moderate: slope, cemented pan.	Moderate: cemented pan.	Severe: thin layer.
PuB: Purves	Severe: depth to rock.	Severe: shrink-swell, depth to rock.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, low strength, shrink-swell.	Severe: depth to rock.
PyB: Purves	Severe: depth to rock.	Severe: shrink-swell, depth to rock.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, shrink-swell.	Severe: depth to rock, too clayey.
RdA: Rowden	Severe: depth to rock.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Moderate: depth to rock.
RoA, RoB: Rowena	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
ThC: Throck	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
TPC:					
Throck	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
Palopinto	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, low strength.	Severe: depth to rock.
TPG:					
Throck	Severe: slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: slope, too clayey.
Palopinto	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, low strength.	Severe: slope, depth to rock, large stones.
TrA: Thurber	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
TuB: Truce	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Moderate: droughty.
TuC: Truce	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Moderate: droughty.
VeC: Veal	Slight	Slight	Slight	Moderate: low strength.	Slight.
WcA, WcB: Wichita	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.

TABLE 11.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition; it does not eliminate the need for onsite investigation]

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
AbA: Abilene	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
BeB, BgC: Bluegrove	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey.
BoB: Bonti	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey.
CaB: Chaney	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
CeC: Chaney	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
ChC: Cho	Severe: cemented pan.	Severe: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.	Poor: cemented pan, small stones.
Cm, Cn: Clairemont	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
Co: Clearfork	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, too clayey.	Severe: flooding.	Poor: too clayey.
Fr: Frio	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, too clayey.	Severe: flooding.	Poor: too clayey, hard to pack.
Ga: Gageby	Severe: flooding.	Moderate: seepage.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
GdB, GfC: Grandfield	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Slight	Good.
HeB, HsB: Hensley	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
LeA: Leeray	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
LeB: Leeray	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
LrC: Lueders	Severe: depth to rock.	Severe: depth to rock, large stones.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock, small stones.

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
LuC----------------- Lusk	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, small stones.
MeB----------------- Mereta	Severe: cemented pan.	Severe: cemented pan.	Severe: too clayey.	Severe: cemented pan.	Poor: cemented pan, too clayey, hard to pack.
MnB----------------- Minwells	Severe: percs slowly.	Severe: seepage.	Severe: seepage.	Slight-----------	Fair: too clayey, thin layer.
NcB----------------- Nukrum	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
NuA----------------- Nuvalde	Moderate: percs slowly.	Moderate: seepage.	Severe: too clayey.	Slight-----------	Poor: too clayey.
NuB----------------- Nuvalde	Moderate: percs slowly.	Moderate: seepage, slope.	Severe: too clayey.	Slight-----------	Poor: too clayey.
Ow. Oil-waste land					
OXC: Owens---------------	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
Harpersville--------	Severe: percs slowly.	Moderate: slope, large stones.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
OXF: Owens---------------	Severe: percs slowly, slope.	Severe: slope.	Severe: slope, too clayey.	Severe: slope.	Poor: slope, too clayey, hard to pack.
Harpersville--------	Severe: percs slowly, slope.	Severe: slope.	Severe: slope, too clayey.	Severe: slope.	Poor: too clayey, hard to pack, slope.
PaC----------------- Palopinto	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: depth to rock, hard to pack, large stones.
PoB----------------- Patilo	Severe: percs slowly, poor filter.	Severe: seepage.	Severe: too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Ps. Pits					

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
PtC: Pitzer	Severe: cemented pan.	Severe: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.	Poor: area reclaim, small stones.
PuB: Purves	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock, hard to pack.
PyB: Purves	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
RdA: Rowden	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
RoA: Rowena	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
RoB: Rowena	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
ThC: Throck	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey.
TPC:					
Throck	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey.
Palopinto	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: depth to rock, hard to pack, large stones.
TPG:					
Throck	Severe: percs slowly, slope.	Severe: slope.	Severe: slope, too clayey.	Severe: slope.	Poor: too clayey, slope.
Palopinto	Severe: depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: depth to rock, hard to pack, large stones.
TrA: Thurber	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
TuB, TuC: Truce	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
VeC: Veal	Slight	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.

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
WcA------------------ Wichita	Severe: percs slowly.	Slight-----------	Severe: too clayey.	Slight-----------	Poor: too clayey.
WcB------------------ Wichita	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----------	Poor: too clayey.

TABLE 12.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition; it does not eliminate the need for onsite investigation]

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
AbA: Abilene	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
BeB, BgC: Bluegrove	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
BoB: Bonti	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
CaB: Chaney	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, too clayey.
CeC: Chaney	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, large stones.
ChC: Cho	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: cemented pan, small stones, area reclaim.
Cm, Cn: Clairemont	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Co: Clearfork	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Fr: Frio	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Ga: Gageby	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
GdB, GfC: Grandfield	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
HeB, HsB: Hensley	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, too clayey, small stones.
LeA, LeB: Leeray	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
LrC: Lueders	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones.
LuC: Lusk	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
MeB: Mereta	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: cemented pan, too clayey.
MnB: Minwells	Good	Probable	Probable	Poor: too clayey.
NcB: Nukrum	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
NuA, NuB: Nuvalde	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Ow. Oil-waste land				
OXC:				
Owens	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones.
Harpersville	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, large stones.
OXF:				
Owens	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope, small stones, too clayey.
Harpersville	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, large stones, slope.
PaC: Palopinto	Poor: depth to rock, low strength, large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: depth to rock, large stones.
PoB: Patilo	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Ps. Pits				
PtC: Pitzer	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
PuB: Purves	Poor: depth to rock, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
PyB------------------ Purves	Poor: depth to rock, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, too clayey, small stones.
RdA------------------ Rowden	Poor: depth to rock, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
RoA, RoB-------------- Rowena	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
ThC------------------ Throck	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
TPC:				
Throck---------------	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Palopinto------------	Poor: depth to rock, low strength, large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: depth to rock, large stones.
TPG:				
Throck---------------	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones, slope.
Palopinto------------	Poor: depth to rock, low strength, large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: depth to rock, large stones.
TrA------------------ Thurber	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
TuB, TuC-------------- Truce	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
VeC------------------ Veal	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
WcA, WcB-------------- Wichita	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.

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. The information in this table indicates the dominant soil condition; it does not eliminate the need for onsite investigation]

Map symbol and soil name	Limitations for--		Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Irrigation	Terraces and diversions	Grassed waterways
AbA Abilene	Slight	Moderate: hard to pack.	Erodes easily	Erodes easily	Erodes easily.
BeB Bluegrove	Moderate: depth to rock.	Severe: thin layer.	Depth to rock	Depth to rock, erodes easily.	Depth to rock, erodes easily.
BgC Bluegrove	Moderate: depth to rock, slope.	Severe: thin layer.	Depth to rock, slope.	Depth to rock	Depth to rock.
BoB Bonti	Moderate: depth to rock.	Severe: thin layer.	Fast intake, soil blowing.	Depth to rock, soil blowing.	Depth to rock.
CaB Chaney	Slight	Severe: hard to pack.	Fast intake, soil blowing.	Soil blowing, percs slowly.	Percs slowly, rooting depth.
CeC Chaney	Slight	Severe: hard to pack.	Slope, droughty.	Large stones, percs slowly.	Large stones, droughty, percs slowly.
ChC Cho	Severe: cemented pan, seepage.	Severe: thin layer.	Cemented pan, slope, droughty.	Cemented pan	Droughty, cemented pan.
Cm, Cn Clairemont	Moderate: seepage.	Severe: piping.	Erodes easily, flooding.	Erodes easily	Erodes easily.
Co Clearfork	Slight	Slight	Slow intake, erodes easily, flooding.	Erodes easily	Erodes easily.
Fr Frio	Slight	Moderate: hard to pack.	Slow intake, flooding.	Favorable	Favorable.
Ga Gageby	Moderate: seepage.	Moderate: piping.	Flooding	Favorable	Favorable.
GdB Grandfield	Severe: seepage.	Severe: piping.	Soil blowing	Soil blowing	Favorable.
GfC Grandfield	Severe: seepage.	Severe: piping.	Soil blowing, slope.	Soil blowing	Favorable.
HeB Hensley	Severe: depth to rock.	Severe: thin layer.	Percs slowly, depth to rock.	Depth to rock, erodes easily, percs slowly.	Erodes easily, depth to rock, percs slowly.
HsB Hensley	Severe: depth to rock.	Severe: thin layer.	Slope, droughty, percs slowly.	Depth to rock, erodes easily.	Erodes easily, droughty.
LeA, LeB Leeray	Slight	Severe: hard to pack.	Slow intake, percs slowly.	Percs slowly	Percs slowly.
LrC Lueders	Severe: depth to rock.	Severe: large stones.	Large stones, droughty, depth to rock.	Large stones, depth to rock.	Large stones, droughty.

TABLE 13.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Irrigation	Terraces and diversions	Grassed waterways
LuC: Lusk	Severe: seepage.	Severe: thin layer.	Slope, droughty, percs slowly.	Depth to rock, percs slowly.	Droughty, depth to rock, percs slowly.
MeB: Mereta	Severe: cemented pan, seepage.	Severe: thin layer.	Slow intake, cemented pan.	Cemented pan	Cemented pan.
MnB: Minwells	Severe: seepage.	Moderate: thin layer, piping.	Percs slowly	Percs slowly	Percs slowly.
NcB: Nukrum	Slight	Severe: hard to pack.	Slow intake, percs slowly.	Percs slowly	Percs slowly.
NuA, NuB: Nuvalde	Moderate: seepage.	Moderate: piping.	Favorable	Favorable	Favorable.
Ow. Oil-waste land					
OXC:					
Owens	Slight	Moderate: hard to pack.	Slope, droughty, slow intake.	Erodes easily	Erodes easily.
Harpersville	Moderate: slope.	Moderate: hard to pack, large stones.	Slope, droughty, slow intake.	Large stones, erodes easily.	Large stones, erodes easily.
OXF:					
Owens	Slight	Moderate: hard to pack, large stones.	Slope, droughty, slow intake.	Large stones, slope, erodes easily.	Large stones, slope, erodes easily.
Harpersville	Severe: slope.	Moderate: hard to pack, large stones.	Slope, droughty, slow intake.	Slope, large stones, erodes easily.	Slope, large stones, erodes easily.
PaC: Palopinto	Severe: depth to rock.	Severe: large stones.	Large stones, depth to rock, slope.	Large stones, depth to rock.	Large stones, depth to rock.
PoB: Patilo	Severe: seepage.	Severe: seepage, piping.	Droughty, fast intake.	Too sandy, soil blowing.	Droughty.
Ps. Pits					
PtC: Pitzer	Severe: cemented pan.	Severe: thin layer.	Droughty, cemented pan, slope.	Cemented pan	Droughty, cemented pan.
PuB: Purves	Severe: depth to rock.	Severe: thin layer.	Depth to rock	Depth to rock	Depth to rock.
PyB: Purves	Severe: depth to rock.	Severe: thin layer.	Slope, large stones, droughty.	Large stones, depth to rock.	Large stones, droughty.
RdA: Rowden	Moderate: depth to rock.	Severe: thin layer.	Percs slowly, depth to rock.	Depth to rock, percs slowly.	Depth to rock, percs slowly.

TABLE 13.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Irrigation	Terraces and diversions	Grassed waterways
RoA, RoB---------- Rowena	Slight------------	Moderate: hard to pack.	Favorable--------	Favorable--------	Favorable.
ThC--------------- Throck	Moderate: slope.	Slight------------	Slow intake, percs slowly, slope.	Percs slowly-----	Rooting depth, percs slowly.
TPC:					
Throck-----------	Moderate: slope.	Slight------------	Slow intake, percs slowly, slope.	Percs slowly-----	Rooting depth, percs slowly.
Palopinto--------	Severe: depth to rock.	Severe: large stones.	Large stones, depth to rock, slope.	Large stones, depth to rock.	Large stones, depth to rock.
TPG:					
Throck-----------	Severe: slope.	Slight------------	Slow intake, percs slowly, slope.	Slope, percs slowly.	Slope, rooting depth, percs slowly.
Palopinto--------	Severe: depth to rock.	Severe: large stones.	Large stones, depth to rock, slope.	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
TrA--------------- Thurber	Slight------------	Severe: hard to pack.	Percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
TuB--------------- Truce	Slight------------	Moderate: hard to pack.	Droughty, soil blowing, percs slowly.	Percs slowly, soil blowing, erodes easily.	Percs slowly, droughty, erodes easily.
TuC--------------- Truce	Slight------------	Moderate: hard to pack.	Slope, droughty, soil blowing.	Percs slowly, soil blowing, erodes easily.	Percs slowly, droughty, erodes easily.
VeC--------------- Veal	Moderate: seepage, slope.	Moderate: piping.	Slope------------	Favorable--------	Favorable.
WcA, WcB---------- Wichita	Slight------------	Slight------------	Favorable--------	Favorable--------	Favorable.

TABLE 14.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated. Some soils have Unified classifications and USDA textures that are supplementary to those shown. In general, the dominant classifications and textures are shown]

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	
AbA-------------- Abilene	0-6	Clay loam--------	CL	A-4, A-6	0	98-100	96-100	90-100	60-96	25-35	8-16
	6-36	Clay loam, clay	CL, CH	A-7, A-6	0	98-100	96-100	90-100	75-95	34-58	22-40
	36-60	Clay loam, loam	CL	A-6, A-7	0	90-100	88-100	80-98	60-95	35-50	19-32
BeB-------------- Bluegrove	0-4	Loam-------------	SC, SM-SC, CL, CL-ML	A-4, A-6	0	100	98-100	90-100	45-75	18-30	4-14
	4-24	Clay loam, clay, sandy clay.	CL	A-6, A-7	0-5	95-100	95-100	90-100	51-80	28-50	11-30
	24-30	Weathered bedrock	---	---	---	---	---	---	---	---	---
BgC-------------- Bluegrove	0-4	Flaggy fine sandy loam.	SM, ML, SC, CL	A-4, A-6	5-15	80-100	80-100	70-98	36-75	<30	NP-14
	4-21	Sandy clay, clay loam, clay.	CL	A-6, A-7	0-5	95-100	95-100	90-100	51-80	28-50	11-30
	21-48	Weathered bedrock	---	---	---	---	---	---	---	---	---
BoB-------------- Bonti	0-6	Loamy fine sand	SM, SM-SC	A-2-4	0-2	90-100	90-100	60-95	15-35	<25	NP-6
	6-22	Clay, clay loam, sandy clay.	CL, SC	A-6, A-7	0-4	80-100	80-100	70-100	41-75	30-45	15-25
	22-30	Weathered bedrock	---	---	---	---	---	---	---	---	---
CaB-------------- Chaney	0-19	Loamy fine sand	SM, SP-SM	A-2-4, A-4, A-3	0	80-100	80-100	65-98	7-45	<25	NP-4
	19-32	Clay, sandy clay	CL, CH, SC	A-6, A-7-6	0	90-100	90-100	90-100	43-85	39-60	24-42
	32-52	Sandy clay, clay, sandy clay loam.	CL, CH, SC	A-6, A-7-6, A-2	0	90-100	90-100	80-100	30-70	25-55	11-40
	52-60	Clay, sandy clay loam, sandy clay.	CL, CH, SC, SM-SC	A-6, A-7-6, A-2, A-4	0	90-100	90-100	80-100	25-85	25-60	6-40
CeC-------------- Chaney	0-13	Stony sandy loam	SM, SM-SC, SP-SM	A-2-4, A-4, A-3	5-25	80-100	80-100	65-98	7-45	<25	NP-4
	13-45	Clay, sandy clay	CL, CH	A-7	0-15	90-100	90-100	90-100	51-85	42-60	24-42
	45-65	Sandy clay, clay, sandy clay loam.	CL, CH, SC	A-6, A-7-6, A-2-6, A-2-7	0	90-100	90-100	80-100	30-70	25-55	11-40
	65-80	Clay, sandy clay loam, sandy clay, shaly clay.	CL, CH, SC, SM-SC	A-2-4, A-2-6, A-6, A-7	0	90-100	90-100	80-100	25-85	25-60	6-40
ChC-------------- Cho	0-7	Gravelly loam----	CL, SC, GC	A-6, A-7-6	0-5	60-85	55-80	50-80	40-70	30-50	11-26
	7-12	Cemented---------	---	---	---	---	---	---	---	---	---
	12-54	Gravelly loam, gravelly clay loam, clay loam.	SC, GC, GM-GC, SM-SC	A-2, A-4, A-6, A-7-6	0-5	50-85	35-80	20-25	15-60	24-47	5-22
Cm--------------- Clairemont	0-7	Silty clay loam	CL	A-4, A-6	0	100	98-100	95-100	80-95	25-40	8-20
	7-60	Silt loam, loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	98-100	95-100	65-95	20-40	4-20
Cn--------------- Clairemont	0-18	Silty clay loam	CL	A-4, A-6	0	100	98-100	95-100	80-95	25-40	8-20
	18-60	Silt loam, loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	98-100	95-100	65-95	20-40	4-20

TABLE 14.--ENGINEERING INDEX PROPERTIES--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	
Co----------------- Clearfork	0-26	Silty clay--------	CL	A-6, A-7-6	0	100	100	98-100	90-100	35-50	20-32
	26-60	Silty clay, silty clay loam.	CL	A-6, A-7-6	0	100	100	95-100	85-100	35-50	20-32
Fr----------------- Frio	0-30	Silty clay--------	CL, CH	A-6, A-7	0-2	90-100	85-100	85-100	69-96	36-59	17-34
	30-60	Silty clay, silty clay loam.	CL, CH	A-6, A-7	0-5	90-100	90-100	85-100	68-96	36-59	17-34
Ga----------------- Gageby	0-31	Sandy clay loam, loam.	CL	A-6	0	100	96-100	80-98	50-80	25-40	11-24
	31-48	Clay loam, loam, silt loam.	CL	A-6, A-7-6	0	100	96-100	80-100	55-85	25-45	11-28
GdB---------------- Grandfield	0-15	Loamy fine sand	SM, SP-SM	A-2-4	0	100	98-100	80-100	11-35	<20	NP-3
	15-36	Clay loam, loam, sandy clay loam.	SM, ML, SC, CL	A-4, A-6, A-2	0	100	98-100	85-100	30-55	<37	NP-16
	36-42	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4, A-6, A-2	0	100	98-100	85-100	30-55	<37	NP-16
	42-60	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4, A-2	0	100	98-100	85-100	28-55	<30	NP-10
GfC---------------- Grandfield	0-5	Fine sandy loam	SM, SM-SC	A-4, A-2-4	0	100	98-100	85-100	20-45	<26	NP-7
	5-38	Clay loam, loam, sandy clay loam.	SM, ML, SC, CL	A-4, A-6, A-2	0	100	98-100	85-100	30-55	<37	NP-16
	38-49	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4, A-6, A-2	0	100	98-100	85-100	28-55	<37	NP-16
	49-60	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4, A-2	0	100	98-100	85-100	28-55	<30	NP-10
HeB---------------- Hensley	0-4	Clay loam---------	CL	A-4, A-6	0-2	80-100	75-100	70-100	60-90	25-40	8-20
	4-16	Clay, clay loam	CL, CH	A-6, A-7	0-10	80-100	75-100	70-100	60-90	35-55	18-35
	16-20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
HsB---------------- Hensley	0-4	Stony clay loam	CL, CL-ML	A-4, A-6	5-20	80-100	75-100	70-100	60-90	20-40	5-20
	4-11	Clay, clay loam	CL, CH	A-6, A-7	0-10	80-100	75-100	70-100	65-95	35-55	18-35
	11-20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
LeA---------------- Leeray	0-33	Clay--------------	CH, CL	A-7-6	0-5	97-100	96-100	85-100	75-95	45-65	25-40
	33-48	Clay, silty clay	CH	A-7-6	0-5	95-100	95-100	85-100	75-95	51-70	30-45
	48-60	Clay, silty clay	CH, CL	A-7-6, A-6	0-5	95-100	95-100	85-100	70-95	33-60	19-40
LeB---------------- Leeray	0-18	Clay--------------	CH, CL	A-7-6	0-5	97-100	96-100	85-100	75-95	45-65	25-40
	18-36	Clay, silty clay	CH	A-7-6	0-5	95-100	95-100	85-100	75-95	51-70	30-45
	36-60	Clay, silty clay	CH, CL	A-7-6, A-6	0-5	95-100	95-100	85-100	70-95	33-60	19-40
LrC---------------- Lueders	0-9	Very gravelly clay loam.	CL, GC, SC	A-2, A-4, A-6, A-7	20-50	40-75	35-70	30-65	25-60	25-49	8-25
	9-40	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

TABLE 14.--ENGINEERING INDEX PROPERTIES--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	
LuC-------------- Lusk	0-5	Gravelly fine sandy loam.	SC, SM-SC	A-2-4, A-2-6, A-1-B	0-5	65-95	40-70	30-60	15-35	20-33	4-15
	5-27	Very gravelly clay, extremely gravelly clay loam, very gravelly sandy clay.	GC, GP-GC	A-2-7, A-7-6	0-5	25-60	15-40	15-40	12-40	41-60	20-32
	27-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
MeB-------------- Mereta	0-14	Silty clay-------	CL, CH	A-7-6	0-5	90-100	85-100	80-97	60-85	41-52	20-30
	14-16	Clay loam, silty clay, gravelly clay loam.	CL, CH	A-6, A-7-6	0-5	85-100	80-100	80-97	60-85	39-52	19-30
	16-20	Cemented---------	---	---	---	---	---	---	---	---	---
	20-42	Variable, marl---	---	---	---	---	---	---	---	---	---
MnB-------------- Minwells	0-6	Loam-------------	CL, CL-ML, SM-SC	A-4, A-6	0	96-100	95-100	85-98	45-75	20-33	5-16
	6-24	Clay, clay loam, sandy clay.	CL	A-7-6, A-6	0	95-100	90-100	85-98	50-80	32-50	15-32
	24-47	Clay loam, sandy clay loam, gravelly sandy clay loam.	CL, SC	A-6, A-7-6, A-4	0	85-100	80-100	65-98	45-80	23-45	8-25
	47-60	Very gravelly sand, very gravelly sandy loam, gravelly sandy clay loam.	SC, GM, SP-SM, GP-GM	A-1, A-2	0-5	15-75	10-60	5-50	5-30	<44	NP-28
NcB-------------- Nukrum	0-24	Clay-------------	CL, CH	A-7-6	0	95-100	90-100	90-100	80-95	45-68	27-45
	24-48	Silty clay, clay	CL, CH	A-7-6	0	95-100	90-100	90-100	70-95	45-68	27-45
	48-60	Silty clay, clay	CL, CH	A-7-6	0	85-100	75-100	70-95	65-95	41-60	25-40
NuA-------------- Nuvalde	0-10	Silty clay loam	CH, CL	A-7-6, A-6	0	95-100	95-100	90-100	80-96	38-60	20-38
	10-34	Clay loam, clay, silty clay, silty clay loam.	CH, CL	A-7-6, A-6	0	95-100	95-100	85-100	70-98	38-58	20-36
	34-84	Clay loam, silty clay loam, clay, silty clay, loam.	CL	A-6, A-7-6	0	85-100	85-100	75-98	65-90	30-50	14-30
NuB-------------- Nuvalde	0-11	Silty clay loam	CH, CL	A-7-6, A-6	0	95-100	95-100	90-100	80-96	38-60	20-38
	11-44	Clay loam, clay, silty clay, silty clay loam.	CH, CL	A-7-6, A-6	0	95-100	95-100	85-100	70-98	38-58	20-36
	44-60	Clay loam, silty clay loam, clay, silty clay, loam.	CL	A-6, A-7-6	0	85-100	85-100	75-98	65-90	30-50	14-30
Ow. Oil-waste land											

TABLE 14.--ENGINEERING INDEX PROPERTIES--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	
OXC:											
Owens-----------	0-5	Clay-------------	CL, CH	A-7-6	5-15	85-100	80-100	75-100	70-95	45-60	22-32
	5-18	Clay, clay loam, silty clay.	CL, CH	A-7-6	0-10	80-100	80-100	80-100	75-95	45-60	22-33
	18-60	Very shaly clay, shaly clay, clay, shale.	CL, CH	A-7-6	0-10	90-100	85-100	80-100	65-95	45-60	25-37
Harpersville----	0-5	Clay, silty clay, clay loam.	CL, CH	A-7-6	5-15	85-100	80-100	75-100	70-95	45-60	22-32
	5-60	Shaly clay, weathered bedrock.	CL, CH	A-7-6	0-10	90-100	85-100	80-100	65-95	45-60	25-37
OXF:											
Owens-----------	0-5	Clay-------------	CL, CH	A-7-6	15-35	80-100	75-100	70-100	65-95	45-60	22-32
	5-18	Clay, clay loam, silty clay.	CL, CH	A-7-6	0-10	80-100	80-100	80-100	75-95	45-60	22-33
	18-60	Very shaly clay, shaly clay, clay, shale.	CL, CH	A-7-6	0-10	90-100	85-100	80-100	65-95	45-60	25-37
Harpersville----	0-5	Clay, silty clay, clay loam.	CL, CH	A-7-6	5-45	85-100	80-100	75-100	70-95	45-60	22-32
	5-60	Shaly clay, weathered bedrock.	CL, CH	A-7-6	0-10	90-100	85-100	80-100	65-95	45-60	25-37
PaC-------------- Palopinto	0-6	Very flaggy silty clay loam.	CH, CL	A-7-6, A-6	10-25	85-100	85-100	75-100	70-95	39-58	17-31
	6-10	Extremely flaggy clay loam, extremely flaggy silty clay loam, extremely flaggy silt loam, very flaggy silty clay loam, very flaggy silt loam.	CH, CL	A-7-6, A-6	50-85	65-100	65-100	60-100	51-95	39-58	17-31
	10-20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
PoB-------------- Patilo	0-54	Fine sand--------	SM, SP-SM, SM-SC	A-2-4, A-3	0	100	95-100	85-100	8-28	<25	NP-5
	54-66	Sandy clay loam, clay loam.	SC	A-2, A-4, A-6	0	90-100	90-100	90-100	25-50	22-36	8-20
Ps. Pits											
PtC-------------- Pitzer	0-5	Gravelly clay loam.	CL, SC, GC	A-4, A-6	0-3	65-95	60-90	55-85	40-70	25-40	8-21
	5-11	Cemented---------	---	---	---	---	---	---	---	---	---
	11-54	Very gravelly sandy loam, very gravelly loam, very gravelly sandy clay loam.	GC, GP-GC	A-2	0-5	30-60	20-50	15-45	8-35	25-40	8-21
	54-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

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	
PuB----------- Purves	0-12	Clay-----------	CH	A-7-6, A-7-5	0-5	90-100	80-100	80-98	70-95	51-71	25-40
	12-14	Gravelly clay, very gravelly clay, gravelly clay.	CH, SC, GC	A-7-6	0-35	60-100	60-100	55-95	45-90	51-65	30-40
	14-20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
PyB----------- Purves	0-16	Cobbly clay------	CH	A-7-6	5-25	80-95	70-95	65-95	55-85	51-65	30-40
	16-19	Gravelly clay, very gravelly clay.	GC, CH, SC	A-7-6	5-35	55-95	55-95	45-90	36-65	51-65	30-40
	19-40	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
RdA----------- Rowden	0-8	Clay loam--------	CL	A-6, A-7-6	0-5	90-100	90-100	80-100	60-90	32-46	12-23
	8-23	Clay-------------	CH, CL	A-7-6	0-5	85-100	80-100	75-100	61-91	41-60	20-35
	23-40	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
RoA----------- Rowena	0-6	Clay loam--------	CL	A-6, A-7-6	0	99-100	98-100	90-100	70-90	30-50	12-30
	6-34	Clay, clay loam, silty clay.	CH, CL	A-7-6	0	98-100	96-100	90-100	75-98	41-60	25-40
	34-60	Clay, clay loam, silty clay loam.	CL	A-6, A-7-6	0	85-100	80-100	75-100	65-95	30-50	15-30
RoB----------- Rowena	0-6	Clay loam--------	CL	A-6, A-7-6	0	99-100	98-100	90-100	70-90	30-50	12-30
	6-28	Clay, clay loam, silty clay.	CH, CL	A-7-6	0	98-100	96-100	90-100	75-98	41-60	25-40
	28-60	Clay, clay loam, silty clay loam.	CL	A-6, A-7-6	0	85-100	80-100	75-100	65-95	30-50	15-30
ThC----------- Throck	0-4	Clay-------------	CL	A-6, A-7-6	0-2	95-100	95-100	90-100	70-98	35-50	18-31
	4-40	Silty clay, clay loam, silty clay loam, clay.	CL	A-6, A-7-6	0-2	80-100	80-100	75-100	70-98	35-50	18-31
	40-98	Clay, silty clay, shaly clay, shale.	CL	A-6, A-7-6	0	95-100	95-100	90-100	70-98	28-50	12-30
TPC: Throck----------	0-5	Silty clay-------	CL	A-6, A-7-6	0-2	95-100	95-100	90-100	70-98	35-50	18-31
	5-28	Silty clay, silty clay loam, clay.	CL	A-6, A-7-6	0-2	80-100	80-100	75-100	70-98	35-50	18-31
	28-54	Clay, silty clay, shaly clay.	CL	A-6, A-7-6	0	95-100	95-100	90-100	70-98	28-50	12-30
Palopinto-------	0-7	Very flaggy clay loam.	CH, CL	A-7-6, A-6	10-25	85-100	85-100	75-100	70-95	39-58	17-31
	7-40	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

TABLE 14.--ENGINEERING INDEX PROPERTIES--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	
TPG:											
Throck----------	0-8	Stony silty clay	CL	A-6, A-7-6	5-30	70-90	70-90	60-90	60-85	30-50	15-31
	8-38	Gravelly clay, gravelly silty clay, clay.	CL	A-6, A-7-6	0-5	70-99	60-99	60-99	60-90	35-50	18-31
	38-48	Clay, silty clay, shaly clay.	CL	A-6, A-7-6	0	95-100	95-100	90-100	70-98	28-50	12-30
Palopinto-------	0-6	Very flaggy clay loam.	CH, CL	A-7-6, A-6	25-55	85-100	85-100	75-100	70-95	39-58	17-31
	6-20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
TrA-------------- Thurber	0-5	Clay loam--------	CL	A-4, A-6	0	98-100	96-100	90-100	60-90	25-40	8-20
	5-51	Clay-------------	CL, CH	A-7-6, A-6	0	98-100	96-100	90-100	70-95	37-65	22-45
	51-60	Clay, clay loam	CL	A-6, A-7-6	0	95-100	85-100	75-100	50-85	35-50	20-35
TuB-------------- Truce	0-7	Fine sandy loam	CL-ML, SM-SC, SM, SC	A-4	0-2	90-100	85-100	75-100	40-70	20-30	3-10
	7-51	Clay, sandy clay, clay loam.	CL, CH	A-6, A-7-6	0	90-100	90-100	75-100	55-85	35-52	18-32
	51-60	Very shaly clay, shaly clay.	CL, CH	A-6, A-7-6	0	88-100	85-100	75-100	60-95	30-52	15-32
TuC-------------- Truce	0-5	Fine sandy loam	CL-ML, SM-SC, SM, SC	A-4	0-3	90-100	85-100	75-100	40-70	20-30	3-10
	5-56	Clay, sandy clay, clay loam.	CL, CH	A-6, A-7-6	0	90-100	90-100	75-100	55-85	35-52	18-32
	56-60	Very shaly clay, shaly clay.	CL, CH	A-6, A-7-6	0	88-100	85-100	75-100	60-95	30-52	15-32
VeC-------------- Veal	0-6	Loam-------------	CL	A-4, A-6	0	95-100	90-100	85-98	50-75	25-34	8-15
	6-12	Clay loam, loam	CL	A-6	0-2	95-100	90-100	85-98	50-75	25-40	11-24
	12-60	Clay loam, loam	CL	A-4, A-6	0-2	85-100	80-100	75-100	50-80	20-40	8-24
WcA-------------- Wichita	0-5	Clay loam--------	CL	A-6	0	98-100	96-100	90-100	70-90	28-40	11-20
	5-36	Clay loam, clay	CL	A-6, A-7-6	0	98-100	96-100	90-100	70-98	36-50	20-30
	36-60	Clay loam, clay	CL	A-6, A-7-6	0	96-100	90-100	80-100	65-95	30-50	15-30
WcB-------------- Wichita	0-8	Clay loam--------	CL	A-6	0	98-100	96-100	90-100	70-90	28-40	11-20
	8-48	Clay loam, clay	CL	A-6, A-7-6	0	98-100	96-100	90-100	70-98	36-50	20-30
	48-64	Clay loam, clay	CL	A-6, A-7-6	0	96-100	90-100	80-100	65-95	30-50	15-30

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE 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	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/cc	In/hr	In/in	pH	Mmhos/cm					Pct
AbA	0-6	28-35	1.30-1.65	0.6-2.0	0.17-0.20	6.6-8.4	<2	Moderate	0.37	5	6	1-3
Abilene	6-36	35-45	1.30-1.70	0.2-0.6	0.14-0.18	6.6-8.4	<2	Moderate	0.28			
	36-60	22-40	1.50-1.70	0.2-0.6	0.12-0.15	7.9-8.4	<2	Moderate	0.32			
BeB	0-4	15-25	1.35-1.45	0.6-2.0	0.14-0.19	6.1-7.3	<2	Low	0.37	2	5	<1
Bluegrove	4-24	35-45	1.40-1.60	0.2-0.6	0.15-0.20	6.1-7.3	<2	Moderate	0.32			
	24-30	---	---	---	---	---	---	---	---			
BgC	0-4	10-20	1.35-1.45	0.6-2.0	0.12-0.16	6.1-7.3	<2	Low	0.17	2	8	<1
Bluegrove	4-21	35-45	1.40-1.60	0.2-0.6	0.15-0.19	6.1-7.3	<2	Moderate	0.24			
	21-48	---	---	---	---	---	---	---	---			
BoB	0-6	5-15	1.40-1.70	2.0-6.0	0.07-0.10	5.6-7.3	<2	Very low	0.20	2	2	<1
Bonti	6-22	35-45	1.35-1.60	0.2-0.6	0.15-0.20	5.6-6.5	<2	Moderate	0.32			
	22-30	---	---	---	---	---	---	---	---			
CaB	0-19	5-15	1.78-1.87	2.0-6.0	0.05-0.10	6.1-7.3	<2	Very low	0.20	5	2	<1
Chaney	19-44	35-50	1.42-1.72	0.06-0.2	0.15-0.18	6.1-8.4	<2	Moderate	0.28			
	44-52	20-45	1.54-1.82	0.06-0.2	0.15-0.18	7.3-8.4	<2	Moderate	0.28			
	52-60	20-45	1.68-1.89	0.06-0.2	0.15-0.18	7.9-8.4	<2	Moderate	0.28			
CeC	0-13	5-15	1.50-1.65	2.0-6.0	0.04-0.08	6.1-7.3	<2	Very low	0.15	5	8	<1
Chaney	13-45	35-50	1.45-1.60	0.06-0.2	0.11-0.18	6.1-7.3	<2	Moderate	0.28			
	45-65	20-50	1.50-1.65	0.06-0.2	0.15-0.18	6.1-8.4	<2	Moderate	0.28			
	65-80	20-45	1.65-1.80	0.06-0.2	0.15-0.18	6.1-8.4	<2	Moderate	0.28			
ChC	0-7	20-35	1.30-1.50	0.6-2.0	0.07-0.12	7.9-8.4	<2	Low	0.17	1	8	1-2
Cho	7-12	---	---	---	---	---	---	---	---			
	12-54	20-35	1.40-1.60	0.6-2.0	0.05-0.10	7.9-8.4	<2	Low	0.15			
Cm	0-7	27-35	1.35-1.55	0.6-2.0	0.14-0.20	7.9-8.4	<2	Low	0.43	5	4L	<2
Clairemont	7-60	18-35	1.40-1.65	0.6-2.0	0.16-0.22	7.9-8.4	<2	Low	0.43			
Cn	0-18	27-35	1.35-1.55	0.6-2.0	0.14-0.20	7.9-8.4	<2	Low	0.43	5	4L	<2
Clairemont	18-60	18-35	1.40-1.65	0.6-2.0	0.16-0.22	7.9-8.4	<2	Low	0.43			
Co	0-26	35-45	1.35-1.55	0.2-0.6	0.14-0.18	7.9-8.4	<2	High	0.37	5	4	1-4
Clearfork	26-60	35-40	1.45-1.65	0.2-0.6	0.14-0.18	7.9-8.4	<2	High	0.37			
Fr	0-30	40-50	1.30-1.55	0.2-0.6	0.11-0.17	7.9-8.4	<2	Moderate	0.32	5	4	1-4
Frio	30-60	35-50	1.40-1.60	0.2-0.6	0.11-0.15	7.9-8.4	<2	Moderate	0.32			
Ga	0-31	18-30	1.40-1.55	0.6-2.0	0.15-0.20	7.4-8.4	<2	Moderate	0.28	5	5	1-4
Gageby	31-48	18-35	1.40-1.60	0.6-2.0	0.15-0.20	7.9-8.4	<2	Moderate	0.28			
GdB	0-15	5-10	1.35-1.50	2.0-6.0	0.07-0.11	6.6-7.8	<2	Low	0.20	5	2	<1
Grandfield	15-36	18-30	1.50-1.70	0.6-2.0	0.11-0.17	6.6-8.4	<2	Low	0.32			
	36-42	18-30	1.50-1.70	0.6-2.0	0.11-0.17	7.4-8.4	<2	Low	0.32			
	42-60	15-25	1.50-1.70	2.0-6.0	0.11-0.15	7.4-8.4	<2	Low	0.28			
GfC	0-5	10-18	1.30-1.60	2.0-6.0	0.11-0.15	6.6-7.8	<2	Low	0.24	5	3	<1
Grandfield	5-38	18-30	1.50-1.70	0.6-2.0	0.11-0.17	6.6-8.4	<2	Low	0.32			
	38-49	18-30	1.50-1.70	0.6-2.0	0.11-0.17	7.4-8.4	<2	Low	0.32			
	49-60	15-25	1.50-1.70	2.0-6.0	0.11-0.15	7.4-8.4	<2	Low	0.28			
HeB	0-4	27-30	1.30-1.45	0.2-0.6	0.12-0.20	6.1-7.8	<2	Low	0.37	1	6	<2
Hensley	4-16	35-55	1.35-1.60	0.06-0.2	0.10-0.20	6.6-8.4	<2	Moderate	0.32			
	16-20	---	---	---	---	---	---	---	---			

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	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/cc	In/hr	In/in	pH	Mmhos/cm					Pct
HsB	0-4	27-30	1.35-1.55	0.2-0.6	0.08-0.16	6.1-7.8	<2	Low	0.20	1	8	<2
Hensley	4-11	35-55	1.40-1.65	0.06-0.2	0.10-0.20	6.6-8.4	<2	Moderate	0.43			
	11-20	---	---	---	---	---	---	----------	----			
LeA	0-33	40-60	1.25-1.40	<0.06	0.12-0.18	7.4-8.4	<2	Very high	0.32	5	4	1-5
Leeray	33-48	40-60	1.30-1.45	<0.06	0.12-0.18	7.9-8.4	<2	Very high	0.32			
	48-60	40-60	1.35-1.50	<0.06	0.10-0.15	7.9-8.4	<2	High	0.32			
LeB	0-18	40-60	1.25-1.40	<0.06	0.12-0.18	7.4-8.4	<2	Very high	0.32	5	4	1-5
Leeray	18-36	40-60	1.30-1.45	<0.06	0.12-0.18	7.9-8.4	<2	Very high	0.32			
	36-60	40-60	1.35-1.50	<0.06	0.10-0.15	7.9-8.4	<2	High	0.32			
LrC	0-9	27-35	1.35-1.55	0.6-2.0	0.06-0.12	7.9-8.4	<2	Low	0.10	1	8	1-3
Lueders	9-40	---	---	---	---	---	---	----------	----			
LuC	0-5	10-20	1.45-1.60	0.2-2.0	0.08-0.12	6.1-7.8	<2	Low	0.15	2	8	<1
Lusk	5-27	35-50	1.45-1.60	0.06-0.2	0.07-0.12	6.1-8.4	<2	Low	0.10			
	27-60	---	---	---	---	---	---	----------	----			
MeB	0-14	35-45	1.25-1.45	0.2-0.6	0.15-0.20	7.9-8.4	<2	Moderate	0.32	1	4	1-3
Mereta	14-16	35-45	1.25-1.45	0.2-0.6	0.15-0.20	7.9-8.4	<2	Moderate	0.32			
	16-20	---	---	---	---	---	---	----------	----			
	20-42	---	---	---	---	---	---	----------	----			
MnB	0-6	12-22	1.35-1.60	2.0-6.0	0.12-0.16	6.1-7.8	<2	Low	0.32	5	5	<1
Minwells	6-24	35-45	1.35-1.60	0.06-0.2	0.11-0.16	5.6-7.3	<2	Moderate	0.32			
	24-47	20-35	1.35-1.60	0.2-0.6	0.10-0.16	7.9-8.4	<2	Moderate	0.32			
	47-60	3-25	1.35-1.60	2.0-6.0	0.01-0.09	7.9-8.4	<2	Low	0.15			
NcB	0-24	40-60	1.30-1.45	0.06-0.2	0.15-0.20	7.9-8.4	<2	High	0.32	5	4	1-3
Nukrum	24-48	40-60	1.35-1.50	0.06-0.2	0.15-0.20	7.9-8.4	<2	High	0.32			
	48-60	40-55	1.35-1.50	0.06-0.2	0.13-0.18	7.9-8.4	<2	High	0.32			
NuA	0-10	35-50	1.10-1.40	0.6-2.0	0.14-0.20	7.9-8.4	<2	High	0.28	5	4L	1-3
Nuvalde	10-34	35-50	1.20-1.45	0.6-2.0	0.12-0.18	7.9-8.4	<2	High	0.28			
	34-84	24-45	1.25-1.45	0.6-2.0	0.12-0.18	7.9-8.4	<2	Moderate	0.32			
NuB	0-11	35-50	1.10-1.40	0.6-2.0	0.14-0.20	7.9-8.4	<2	High	0.28	5	4L	1-3
Nuvalde	11-44	35-50	1.20-1.45	0.6-2.0	0.12-0.18	7.9-8.4	<2	High	0.28			
	44-60	24-45	1.25-1.45	0.6-2.0	0.12-0.18	7.9-8.4	<2	Moderate	0.32			
Ow. Oil-waste land												
OXC:												
Owens	0-4	40-60	1.35-1.55	<0.06	0.10-0.17	7.9-8.4	<2	High	0.17	1	8	<2
	4-18	35-60	1.45-1.65	<0.06	0.13-0.17	7.9-8.4	<4	High	0.32			
	18-60	35-60	1.60-1.75	<0.06	0.03-0.08	7.9-8.4	2-8	High	0.37			
Harpersville	0-5	35-60	1.35-1.55	<0.06	0.10-0.17	7.9-8.4	<2	High	0.17	1	8	<2
	5-60	35-60	1.60-1.75	<0.06	0.03-0.08	7.9-8.4	<2	High	0.37			
OXF:												
Owens	0-5	40-60	1.35-1.55	<0.06	0.10-0.17	7.9-8.4	<2	High	0.10	1	8	<2
	5-18	35-60	1.45-1.65	<0.06	0.13-0.17	7.9-8.4	<4	High	0.32			
	18-60	35-60	1.60-1.75	<0.06	0.03-0.08	7.9-8.4	2-8	High	0.37			
Harpersville	0-5	35-60	1.35-1.55	<0.06	0.10-0.17	7.9-8.4	<2	High	0.17	1	8	<2
	5-60	35-60	1.60-1.75	<0.06	0.03-0.08	7.9-8.4	<2	High	0.37			

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	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/cc	In/hr	In/in	pH	Mmhos/cm					Pct
PaC--------------	0-6	18-35	1.30-1.55	0.6-2.0	0.10-0.15	7.9-8.4	<2	Moderate	0.05	1	8	1-3
Palopinto	6-10	18-35	1.35-1.60	0.6-2.0	0.10-0.15	7.9-8.4	<2	Moderate	0.05			
	10-20	---	---	---	---	---	---	----------	----			
PoB--------------	0-54	2-8	1.50-1.65	6.0-20	0.05-0.08	5.6-7.8	<2	Very low	0.17	5	1	<1
Patilo	54-66	27-35	1.50-1.65	0.2-0.6	0.14-0.18	5.1-6.5	<2	Low--------	0.24			
Ps.												
Pits												
PtC--------------	0-5	27-35	1.45-1.60	0.6-2.0	0.10-0.15	7.9-8.4	<2	Low--------	0.15	1	8	1-3
Pitzer	5-11	---	---	---	---	---	---	----------	----			
	11-54	10-35	1.50-1.70	0.6-2.0	0.05-0.10	7.9-8.4	<2	Low--------	0.10			
	54-60	---	---	---	---	---	---	----------	----			
PuB--------------	0-12	40-55	1.35-1.55	0.2-0.6	0.12-0.18	7.9-8.4	<2	High-------	0.32	1	4L	1-3
Purves	12-14	40-55	1.35-1.55	0.2-0.6	0.08-0.18	7.9-8.4	<2	High-------	0.32			
	14-20	---	---	---	---	---	---	----------	----			
PyB--------------	0-16	40-55	1.35-1.50	0.2-0.6	0.08-0.15	7.9-8.4	<2	High-------	0.17	1	8	1-3
Purves	16-19	40-55	1.35-1.55	0.2-0.6	0.08-0.15	7.9-8.4	<2	High-------	0.17			
	19-40	---	---	---	---	---	---	----------	----			
RdA--------------	0-8	27-35	1.30-1.45	0.6-2.0	0.14-0.20	6.6-8.4	<2	Moderate	0.32	2	6	1-3
Rowden	8-23	40-60	1.35-1.50	0.06-0.2	0.12-0.20	6.6-8.4	<2	High-------	0.32			
	23-40	---	---	---	---	---	---	----------	----			
RoA--------------	0-6	35-40	1.35-1.50	0.2-0.6	0.15-0.20	7.9-8.4	<2	Moderate	0.32	5	4L	2-4
Rowena	6-34	35-50	1.35-1.50	0.2-0.6	0.14-0.18	7.9-8.4	<2	High-------	0.32			
	34-60	35-50	1.35-1.50	0.2-0.6	0.11-0.15	7.9-8.4	<2	High-------	0.32			
RoB--------------	0-6	35-40	1.35-1.50	0.2-0.6	0.15-0.20	7.9-8.4	<2	Moderate	0.32	5	4L	2-4
Rowena	6-28	35-50	1.35-1.50	0.2-0.6	0.14-0.18	7.9-8.4	<2	High-------	0.32			
	28-60	35-50	1.35-1.50	0.2-0.6	0.11-0.15	7.9-8.4	<2	High-------	0.32			
ThC--------------	0-4	40-60	1.45-1.65	0.06-0.2	0.12-0.20	7.9-8.4	<2	High-------	0.32	3	4	<2
Throck	4-40	35-60	1.55-1.70	0.06-0.2	0.12-0.20	7.9-9.0	<8	High-------	0.32			
	40-98	40-60	1.45-1.90	0.06-0.2	0.10-0.18	7.4-8.4	2-8	High-------	0.32			
TPC:												
Throck----------	0-5	40-60	1.45-1.65	0.06-0.2	0.12-0.20	7.9-8.4	<2	High-------	0.32	3	4	<2
	5-28	35-60	1.55-1.70	0.06-0.2	0.12-0.20	7.9-8.4	<8	High-------	0.32			
	28-54	40-60	1.45-1.90	0.06-0.2	0.10-0.18	7.9-8.4	2-8	High-------	0.32			
Palopinto-------	0-7	18-35	1.30-1.55	0.6-2.0	0.10-0.15	7.9-8.4	<2	Moderate	0.05	1	8	1-3
	7-40	---	---	---	---	---	---	----------	----			
TPG:												
Throck----------	0-8	40-55	1.45-1.60	0.2-0.6	0.10-0.18	7.9-8.4	<2	High-------	0.17	3	4	<2
	8-38	35-60	1.55-1.65	0.06-0.2	0.12-0.20	7.9-8.4	<8	High-------	0.32			
	38-48	40-60	1.50-1.80	0.06-0.2	0.10-0.18	7.9-8.4	2-8	High-------	0.32			
Palopinto-------	0-6	18-35	1.30-1.55	0.6-2.0	0.10-0.15	7.9-8.4	<2	Moderate	0.05	1	8	1-3
	6-20	---	---	---	---	---	---	----------	----			
TrA--------------	0-5	20-35	1.40-1.65	0.2-0.6	0.15-0.22	6.6-7.8	<2	Moderate	0.43	5	7	<2
Thurber	5-51	40-55	1.40-1.65	<0.06	0.12-0.18	7.8-8.4	<2	High-------	0.32			
	51-60	30-45	1.40-1.70	<0.06	0.12-0.18	7.9-8.4	<2	High-------	0.32			

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea-bility	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodi-bility group	Organic matter
									K	T		
	In	Pct	G/cc	In/hr	In/in	pH	Mmhos/cm					Pct
TuB--------------	0-7	8-20	1.45-1.62	0.6-2.0	0.07-0.12	6.1-7.3	<2	Low--------	0.37	4	3	<2
Truce	7-51	35-50	1.55-1.69	0.06-0.2	0.07-0.13	6.6-8.4	<2	Moderate	0.32			
	51-60	35-50	1.60-1.80	<0.06	0.05-0.09	6.6-8.4	<2	Moderate	0.28			
TuC--------------	0-5	8-20	1.45-1.62	0.6-2.0	0.07-0.12	6.1-7.3	<2	Low--------	0.37	4	3	<2
Truce	5-56	35-50	1.55-1.69	0.06-0.2	0.07-0.13	6.6-8.4	<2	Moderate	0.32			
	56-60	35-50	1.60-1.80	<0.06	0.05-0.09	6.6-8.4	<2	Moderate	0.28			
VeC--------------	0-6	15-25	1.35-1.50	0.6-2.0	0.12-0.18	7.9-8.4	<2	Low--------	0.28	4	4L	<1
Veal	6-12	20-35	1.40-1.55	0.6-2.0	0.10-0.18	7.9-8.4	<2	Low--------	0.28			
	12-60	20-35	1.45-1.60	0.6-2.0	0.10-0.15	7.9-8.4	<2	Low--------	0.28			
WcA--------------	0-5	28-35	1.30-1.45	0.6-2.0	0.15-0.20	6.6-7.8	<2	Moderate	0.32	5	6	<1
Wichita	5-36	35-45	1.30-1.45	0.2-0.6	0.15-0.20	7.4-8.4	<2	Moderate	0.32			
	36-60	35-45	1.35-1.50	0.2-0.6	0.12-0.18	7.9-8.4	<2	Moderate	0.32			
WcB--------------	0-8	28-35	1.30-1.45	0.6-2.0	0.15-0.20	6.6-7.8	<2	Moderate	0.32	5	6	<1
Wichita	8-48	35-45	1.30-1.45	0.2-0.6	0.15-0.20	7.4-8.4	<2	Moderate	0.32			
	48-64	35-45	1.35-1.50	0.2-0.6	0.12-0.18	7.9-8.4	<2	Moderate	0.32			

TABLE 16.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Map symbol and soil name	Hydro-logic group	Flooding			Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Duration	Months	Depth	Hardness	Depth	Thickness	Uncoated steel	Concrete
					In		In			
AbA: Abilene	C	None	---	---	>60	---	---	---	High	Low.
BeB, BgC: Bluegrove	C	None	---	---	20-40	Soft	---	---	Moderate	Low.
BoB: Bonti	C	None	---	---	20-40	Hard	---	---	High	Moderate.
CaB, CeC: Chaney	C	None	---	---	>60	---	---	---	High	Moderate.
ChC: Cho	C	None	---	---	>60	---	5-14	Thin	High	Low.
Cm: Clairemont	B	Occasional	Very brief	Apr-Oct	>60	---	---	---	Moderate	Low.
Cn: Clairemont	B	Frequent	Very brief	Apr-Oct	>60	---	---	---	Moderate	Low.
Co: Clearfork	D	Occasional	Brief	Apr-Oct	>60	---	---	---	High	Low.
Fr: Frio	B	Occasional	Brief	Apr-Oct	>60	---	---	---	High	Low.
Ga: Gageby	B	Occasional	Brief	Apr-Oct	>60	---	---	---	Moderate	Low.
GdB, GfC: Grandfield	B	None	---	---	>60	---	---	---	Low	Low.
HeB, HsB: Hensley	D	None	---	---	10-16	Hard	---	---	High	Low.
LeA, LeB: Leeray	D	None	---	---	>60	---	---	---	High	Low.
LrC: Lueders	C	None	---	---	7-15	Hard	---	---	Moderate	Low.
LuC: Lusk	C	None	---	---	20-40	Soft	---	---	High	Moderate.
MeB: Mereta	C	None	---	---	>60	---	14-20	Thin	High	Low.
MnB: Minwells	C	None	---	---	>60	---	---	---	High	Low.
NcB: Nukrum	D	None	---	---	>60	---	---	---	High	Low.
NuA, NuB: Nuvalde	B	None	---	---	>60	---	---	---	High	Low.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Map symbol and soil name	Hydro-logic group	Flooding			Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Duration	Months	Depth	Hardness	Depth	Thickness	Uncoated steel	Concrete
					In		In			
Ow. Oil-waste land										
OXC, OXF:										
Owens	D	None	---	---	>60	---	---	---	High	Low.
Harpersville	D	None	---	---	>60	---	---	---	High	Low.
PaC Palopinto	D	None	---	---	6-18	Hard	---	---	High	Low.
PoB Patilo	B	None	---	---	>60	---	---	---	High	Moderate.
Ps. Pits										
PtC Pitzer	C	None	---	---	>60	---	4-12	Thin	Low	Low.
PuB, PyB Purves	D	None	---	---	10-20	Hard	---	---	High	Low.
RdA Rowden	C	None	---	---	20-40	Hard	---	---	High	Low.
RoA, RoB Rowena	C	None	---	---	>60	---	---	---	High	Low.
ThC Throck	C	None	---	---	>60	---	---	---	High	Low.
TPC, TPG:										
Throck	C	None	---	---	>60	---	---	---	High	Low.
Palopinto	D	None	---	---	6-18	Hard	---	---	High	Low.
TrA Thurber	D	None	---	---	>60	---	---	---	High	Low.
TuB, TuC Truce	C	None	---	---	>60	---	---	---	High	Low.
VeC Veal	B	None	---	---	>60	---	---	---	Moderate	Low.
WcA, WcB Wichita	C	None	---	---	>60	---	---	---	Moderate	Low.

TABLE 17.--PHYSICAL ANALYSES OF SELECTED SOILS

Soil name and sample number	Horizon	Depth	Particle-size distribution: Sand: Very coarse (2-1 mm)	Sand: Coarse (1-0.5 mm)	Sand: Medium (0.5-0.25 mm)	Sand: Fine (0.25-0.1 mm)	Sand: Very fine (0.1-0.05 mm)	Sand: Total (2-0.05 mm)	Silt (0.05-0.002 mm)	Clay (<0.002 mm)	Clay: Carbonate mm	Coefficient of linear extensibility	Bulk density: 1/3 bar	Bulk density: Oven dry	Water content: 1/3 bar	Water content: 15 bar
		In	Percentage									Cm/cm	G/cc	G/cc	-Pct (wt)-	
Nuvalde: *, **																
83TX-417-001	Ap	0-4	0.5	0.4	0.8	3.5	9.4	14.6	52.6	32.8	---	0.053	1.25	1.46	26.9	17.5
	A	4-10	0.4	0.3	0.8	3.2	8.7	13.4	48.7	37.9	2	0.074	1.33	1.65	26.7	19.4
	Bw1	10-15	0.1	0.4	0.9	2.9	7.4	11.7	44.6	43.7	5	0.071	1.40	1.72	25.0	19.3
	Bw2	15-21	0.5	0.5	0.7	2.8	7.2	11.7	44.2	44.1	3	0.068	1.46	1.78	23.4	18.3
	Bk1	21-34	0.8	0.7	1.1	3.2	6.5	12.3	53.0	34.7	11	0.026	1.48	1.60	18.7	11.9
	Bk2	34-44	1.3	1.2	1.3	3.4	7.5	14.7	55.3	30.0	9	0.019	1.59	1.68	16.3	9.5
	Bk3	44-60	2.6	1.5	1.9	5.8	9.6	21.4	53.1	25.5	1	0.037	1.58	1.76	17.3	8.8
	Bk4	60-78	2.8	1.6	2.1	7.6	13.5	27.6	48.1	24.3	6	0.023	1.82	1.95	12.9	9.0
	Ck	78-84	0.3	0.8	7.4	14.8	13.8	37.1	39.3	23.6	2	---	1.70	---	---	9.9
Throck: *																
80TX-417-001	A	0-4	1.3	1.4	1.5	4.9	12.0	21.1	36.5	42.4	1	---	1.50	---	---	15.1
	Bw	4-11	0.9	1.5	1.3	3.4	9.8	16.9	38.1	45.0	2	0.053	1.59	1.86	20.3	14.8
	Bk1	11-20	0.5	1.1	1.1	2.5	7.8	13.0	41.2	45.8	2	0.065	1.57	1.90	20.9	14.6
	Bk2	20-26	0.4	0.5	0.6	1.6	6.2	9.3	44.6	46.1	2	0.070	1.64	2.01	20.7	14.7
	Bk3	26-34	0.3	0.4	0.4	1.3	4.6	7.0	44.1	48.9	1	0.073	1.66	2.05	20.2	14.9
	BC	34-40	0.6	0.7	0.6	1.3	7.1	10.3	49.2	40.5	---	0.053	1.66	1.94	19.4	13.4
	C1	40-50	0.5	0.3	0.2	1.2	17.7	19.9	50.1	30.0	---	0.037	1.91	2.13	14.7	9.4
	C2	50-62	0.5	0.3	0.2	0.9	11.4	13.3	54.9	31.8	---	0.041	1.81	2.12	15.8	10.4
	C3	62-69	1.0	1.4	0.9	0.9	4.2	8.4	48.7	42.9	---	0.079	1.60	2.01	23.9	13.4
	C4	69-80	0.1	0.2	0.1	0.1	1.5	2.0	37.5	60.5	---	0.122	1.46	2.06	30.6	20.1
	C5	80-98	0.4	0.4	0.3	0.3	0.8	2.2	26.8	71.0	---	---	---	---	---	19.3

* Location of pedon sample is the same as the pedon given as typical for series in "Soil Series and Their Morphology."
** Taxadjunct to the Nuvalde series. Mineralogy marginal into the carbonatic mineralogy family.

TABLE 18.--CHEMICAL ANALYSES OF SELECTED SOILS

[A dash indicates the element was not detected]

Soil name, report number, horizon, and depth (in inches)	Reaction		Extractable cations			Cation-exchange capacity	Ex-change-able sodium	Sodium ab-sorp-tion ratio	Or-ganic carbon	Calcium car-bonate equiv-alent	Elec-trical conduc-tivity
	H_2O (1:1)	CaCl2 1N (1:2)	Mg	K	Na	Ammonium acetate					
			-----Milliequivalents------ per 100 grams of soil				Pct		Pct	Pct	Mmhos
Nuvalde: *, **											
83TX-417-001											
Ap - - 0-4	7.9	7.6	2.1	1.6	T	31.7	---	---	1.84	6	0.76
A - - 4-10	7.9	7.6	1.9	1.2	T	31.0	---	---	1.69	8	0.66
Bw1 - - 10-15	8.0	7.6	1.6	0.9	T	29.3	---	---	1.27	14	0.53
Bw2 - - 15-21	8.1	7.6	1.5	0.8	0.1	27.5	---	---	1.00	21	0.43
Bk1 - - 21-34	8.2	7.5	1.2	0.4	0.1	16.2	---	---	0.53	52	0.21
Bk2 - - 34-44	8.2	7.6	1.1	0.3	0.1	12.6	---	---	0.35	57	0.18
Bk3 - - 44-60	8.1	7.6	1.3	0.3	0.2	11.5	---	---	0.15	53	0.18
Bk4 - - 60-78	8.1	7.7	1.6	0.3	0.2	11.7	---	---	0.11	49	0.18
Ck - - 78-84	8.1	7.7	1.9	0.3	0.2	12.3	---	---	0.08	40	0.18
Throck: *											
80TX-417-001											
A - - 0-4	8.1	7.8	3.4	1.1	T	23.3	T	T	1.91	11	0.54
Bw - - 4-11	8.3	8.0	6.5	0.6	0.7	24.8	---	---	0.97	16	0.24
Bk1 - - 11-20	8.5	8.1	9.4	0.5	1.5	22.5	5	4	0.62	18	0.95
Bk2 - - 20-26	8.3	8.1	10.8	0.4	3.3	21.1	11	8	0.50	13	2.94
Bk3 - - 26-34	8.1	8.0	11.1	0.4	5.4	19.9	15	11	0.34	8	5.65
BC - - 34-40	7.9	7.9	9.2	0.3	4.9	16.4	15	9	0.24	6	5.64
C1 - - 40-50	7.9	7.8	6.0	0.2	3.4	10.2	14	8	0.08	1	6.81
C2 - - 50-62	7.9	7.8	6.3	0.2	3.5	11.4	13	8	0.10	T	6.89
C3 - - 62-69	7.8	7.8	8.1	0.2	4.2	14.5	12	8	0.12	T	6.98
C4 - - 69-80	7.7	7.8	10.1	0.4	5.1	19.1	12	8	0.12	T	5.79
C5 - - 80-98	7.8	7.8	12.3	0.4	5.6	22.3	12	9	0.12	1	5.52

* Location of pedon sample is the same as the pedon given as typical for series in "Soil Series and Their Morphology."

** Taxadjunct to the Nuvalde series. Mineralogy marginal into the carbonatic mineralogy family.

TABLE 19.--CLAY MINERALOGY OF SELECTED SOILS

Soil name and sample number	Depth	Horizon	Clay minerals * X-ray <2U					
			Montmorillonite	Mica	Kaolinite	Quartz	Calcite	Vermiculite
	In		Pct	Pct	Pct	Pct	Pct	Pct
Nuvalde: **, ***								
83TX-417-001	0-4	Ap	---	---	---	---	---	---
	4-10	A	---	---	---	---	---	---
	10-15	Bw1	3	3	2	0	2	0
	15-21	Bw2	---	---	---	---	---	---
	21-34	Bk1	---	---	---	---	---	---
	34-44	Bk2	4	3	3	0	3	0
	44-60	Bk3	---	---	---	---	---	---
	60-78	Bk4	---	---	---	---	---	---
	78-84	Ck	4	3	3	1	0	0
Throck: ***								
80TX-417-001	0-4	A	---	---	---	---	---	---
	4-11	Bw	2	3	3	0	0	2
	11-20	Bk1	---	---	---	---	---	---
	20-26	Bk2	---	---	---	---	---	---
	26-34	Bk3	2	4	3	0	0	3
	34-40	BC	---	---	---	---	---	---
	40-50	C1	---	---	---	---	---	---
	50-62	C2	0	3	3	1	0	2
	62-69	C3	---	---	---	---	---	---
	69-80	C4	---	---	---	---	---	---
	80-98	C5	0	4	3	1	0	1

* Relative amounts: 5-Dominant; 4-Abundant; 3-Moderate; 2-Small; 1-Trace.

** Taxadjunct to the Nuvalde series. Mineralogy marginal into the carbonatic mineralogy family.

*** Location of pedon sample is the same as the pedon given as typical for series in "Soil Series and Their Morphology."

TABLE 20.--ENGINEERING INDEX TEST DATA

Soil name, map symbol, report number, horizon, and depth (in inches)	Classification		Grain-size distribution: Percentage passing sieve-- 1/						Liquid limit 2/	Plasticity index 2/	Specific gravity	Shrinkage		
	AASHTO	Unified	5/8 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200				Limit	Linear	Ratio
									Pct		G/cm^3	Pct	Pct	Pct
Bluegrove: 3/ BgC 81TX-417-001														
A1 ------ 0-4	A-6 (8)	CL	100	100	99	98	97	72	30	14	2.63	17.0	6.9	1.82
A2 ------ 4-9	A-6 (0)	SC	100	95	87	84	81	36	28	11	2.65	19.0	4.8	1.77
Bt ------ 9-21	A-7-6 (20)	CL	100	100	100	99	98	72	48	27	2.69	18.0	13.8	1.84
Cr ------ 21-48	A-6 (10)	CL	100	100	100	98	93	70	31	18	2.67	14.0	9.0	1.95
Grandfield: 4/ GdB 82TX-417-017														
A1 ------ 0-9	A-2-4 (0)	SP-SM	100	100	100	100	88	11	18	2	2.61	17.0	0.0	1.76
A2 ------ 9-19	A-2-4 (0)	SP-SM	100	100	100	99	84	11	18	3	2.61	18.0	0.0	1.78
Bt1 ------ 19-34	A-2-6 (0)	SC	100	100	100	99	91	31	29	13	2.63	18.0	5.8	1.79
Bt2 ------ 34-44	A-2-6 (0)	SC	100	100	100	100	92	33	29	13	2.61	9.0	5.5	1.80
Bt3 ------ 44-60	A-2-4 (0)	SC	100	100	100	100	92	30	26	10	2.64	20.0	3.2	1.74
Grandfield: 5/ GfC 82TX-417-016														
A ------ 0-7	A-2-4 (0)	SM-SC	100	100	100	100	87	21	18	5	2.62	16.0	1.2	1.88
Bt1 ------ 7-22	A-2-6 (1)	SC	100	100	99	99	87	32	30	14	2.59	17.0	7.0	1.83
Bt2 ------ 22-44	A-2-4 (0)	SC	100	100	100	100	95	34	26	10	2.64	18.0	4.3	1.76
Bt3 ------ 44-50	A-2-6 (0)	SC	100	100	99	98	88	29	30	13	2.66	18.0	6.2	1.79
2Bt ------ 50-54	A-2-7 (5)	SC	100	96	87	66	46	32	68	37	2.68	15.0	20.8	1.94
Hensley: 6/ HeB 81TX-417-014														
A ------ 0-4	A-4 (4)	CL	100	99	99	97	95	64	27	9	2.65	17.0	5.3	1.86
Bt ------ 4-13	A-7-6 (14)	CL	100	100	99	98	95	69	42	21	2.64	18.0	11.5	1.87
Lueders: 7/ LrC 81TX-417-010														
A ------- 0-6	A-7-6 (3)	SC	63	59	56	53	50	42	41	16	2.59	21.0	9.2	1.71
Nukrum: 8/ NcB 82TX-417-015														
A1 ------ 0-7	A-7-6 (32)	CH	100	100	99	98	97	90	59	31	2.63	17.0	17.8	1.86
A2 ------ 7-24	A-7-6 (32)	CH	100	99	99	98	95	89	60	31	2.66	16.0	18.2	1.91
Bw ------ 24-48	A-7-6 (45)	CH	100	100	99	98	97	94	66	41	2.68	17.0	19.8	1.94

See footnotes at end of table.

TABLE 20.--ENGINEERING INDEX TEST DATA--Continued

Soil name, map symbol, report number, horizon, and depth (in inches)	Classification		Grain-size distribution: Percentage passing sieve-- 1/						Liquid limit 2/	Plasticity index 2/	Specific gravity	Shrinkage		
	AASHTO	Unified	5/8 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200				Limit	Linear	Ratio
									Pct		G/cm³	Pct	Pct	Pct
Rowden: 9/ RdA														
82TX-417-013														
A ------ 0-5	A-6 (19)	CL	100	100	100	99	99	88	40	17	2.64	22.0	8.6	1.69
Bt1 ------ 5-18	A-7-6 (31)	CH	100	100	100	100	99	87	55	31	2.65	15.0	17.2	1.93
Throck: 10/ ThC														
80TX-417-002														
Bk1 ------ 11-20	A-7-6 (23)	CL	100	100	100	99	96	84	45	27	2.67	11.0	16.4	2.09
Bk3 ------ 26-34	A-7-6 (32)	CL	100	100	100	100	99	95	49	31	2.74	14.0	15.7	1.95
Thurber: 11/ TrA														
82TX-417-019														
A ------ 0-5	A-6 (9)	CL	100	100	100	99	99	74	33	15	2.58	15.0	9.2	1.90
Bt1 ------ 5-16	A-7-6 (27)	CH	100	100	100	100	100	84	52	31	2.63	13.0	17.2	1.98
Bt2 ------ 16-36	A-7-6 (27)	CH	100	100	100	100	99	86	50	29	2.67	13.0	16.9	2.01
Truce: 12/ TuC														
82TX-417-018														
A ------ 0-5	A-4 (1)	CL-ML	100	100	100	99	97	52	24	7	2.65	18.0	3.5	1.79
Bt1 ------ 5-15	A-7-6 (10)	CL	100	98	94	90	86	57	42	22	2.69	18.0	11.1	1.80
Bt2 ------ 15-34	A-7-6 (17)	CL	92	92	91	90	87	64	49	29	2.66	17.0	14.5	1.89
Bt3 ------ 34-52	A-7-6 (19)	CL	100	100	99	98	96	70	48	27	2.65	16.0	14.6	1.93
Bk ------ 52-56	A-6 (10)	CL	100	100	98	90	78	60	38	21	2.69	15.0	11.8	1.92

1/ For grain size larger than 3/8 inch, square mesh wire sieves were used that are slightly larger than equivalent round sleeves, but these differences do not seriously affect the data.

2/ Liquid limit and plasticity index values were determined by the AASHTO-89 and AASHTO-90 methods except that soil was added to water.

3/ Bluegrove - From U.S. Highway 283 in Albany; 1.5 miles southeast on Texas Highway 6; 9.0 miles east on Farm Road 601; 2 miles northeast on gravel road; 0.6 mile north on range road; 125 feet west; in rangeland. 30% rock fragments discarded from surface sample.

4/ Grandfield - From U.S. Highway 283 in Albany; 7 miles northwest on Farm Road 1084; 2.3 miles northwest on gravel road; 8.65 miles north on gravel road; 3 miles west and 2.4 miles north on pasture road; 250 feet northeast; in rangeland.

5/ Grandfield - From U.S. Highway 283 in Albany; 7 miles northwest on Farm Road 1084; 2.3 miles northwest on gravel road; 8.65 miles north on gravel road; 2.1 miles west; 0.9 mile southwest; 2.1 miles north; 0.3 mile northwest on pasture road; 50 feet south; in rangeland.

6/ Hensley - From U.S. Highway 283 in Albany; 8.3 miles east on U.S. Highway 180; 300 feet south on gravel road; 0.9 mile southeast on pasture road; 200 feet south; in rangeland.

7/ Lueders - From U.S. Highway 283 in Albany; 7.5 miles west on U.S. Highway 180; from Texas Highway 351 continue west 1.4 miles on U.S. Highway 180; 150 feet south; in rangeland.

8/ Nukrum - From U.S. Highway 283 in Albany; 7.5 miles west on U.S. Highway 180; from Texas Highway 351 continue west 1.2 miles on U.S. Highway 180; 600 feet south; in rangeland.

9/ Rowden - From Texas Highway 6 in Albany; 9.5 miles south on U.S. Highway 283; continue south 0.8 mile on gravel road; 150 feet east; in rangeland.

10/ Throck - Location of pedon sample is the same as the pedon given as typical for series in "Soil Series and Their Morphology."

11/ Thurber - From U.S. Highway 283 in Albany; 5 miles east on U.S. Highway 180; 0.6 mile northwest on Farm Road 2482; 7.25 miles northeast on gravel road; 0.85 mile southeast on gravel road; 0.6 mile northeast; in rangeland.

12/ Truce - From U.S. Highway 283 in Albany; 1.5 miles southeast on Texas Highway 6; 10.8 miles east and south on Farm Road 601; 0.3 mile east on gravel road; 1.1 mile south; 0.2 mile east; 430 feet northeast; in rangeland.

TABLE 21.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Abilene	Fine, mixed, thermic Pachic Argiustolls
Bluegrove	Fine, mixed, thermic Udic Haplustalfs
*Bonti	Fine, mixed, thermic Ultic Paleustalfs
Chaney	Fine, mixed, thermic Aquic Paleustalfs
Cho	Loamy, carbonatic, thermic, shallow Petrocalcic Calciustolls
Clairemont	Fine-silty, mixed (calcareous), thermic Typic Ustifluvents
Clearfork	Fine, mixed, thermic Cumulic Haplustolls
Frio	Fine, montmorillonitic, thermic Cumulic Haplustolls
*Gageby	Fine-loamy, mixed, thermic Cumulic Haplustolls
Grandfield	Fine-loamy, mixed, thermic Udic Haplustalfs
Harpersville	Clayey, mixed (calcareous), thermic Ustic Torriorthents
Hensley	Clayey, mixed, thermic Lithic Rhodustalfs
Leeray	Fine, montmorillonitic, thermic Typic Chromusterts
Lueders	Loamy-skeletal, carbonatic, thermic Lithic Calciustolls
Lusk	Clayey-skeletal, mixed, thermic Typic Paleustalfs
Mereta	Clayey, mixed, thermic, shallow Petrocalcic Calciustolls
Minwells	Fine, mixed, thermic Udic Paleustalfs
Nukrum	Fine, mixed, thermic Vertic Haplustolls
*Nuvalde	Fine-silty, mixed, thermic Typic Calciustolls
Owens	Clayey, mixed, thermic, shallow Typic Ustochrepts
Palopinto	Loamy-skeletal, mixed, thermic Lithic Haplustolls
Patilo	Loamy, siliceous, thermic Grossarenic Paleustalfs
Pitzer	Loamy, mixed, thermic, shallow Petrocalcic Calciustolls
Purves	Clayey, montmorillonitic, thermic Lithic Calciustolls
Rowden	Fine, mixed, thermic Typic Argiustolls
Rowena	Fine, mixed, thermic Vertic Calciustolls
Throck	Fine, mixed, thermic Typic Ustochrepts
Thurber	Fine, montmorillonitic, thermic Typic Haplustalfs
Truce	Fine, mixed, thermic Udic Paleustalfs
Veal	Fine-loamy, carbonatic, thermic Aridic Ustochrepts
Wichita	Fine, mixed, thermic Typic Paleustalfs

* The soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series.

☆ U.S. GOVERNMENT PRINTING OFFICE : 1990 O - 205-512 : QL 3

NRCS Accessibility Statement