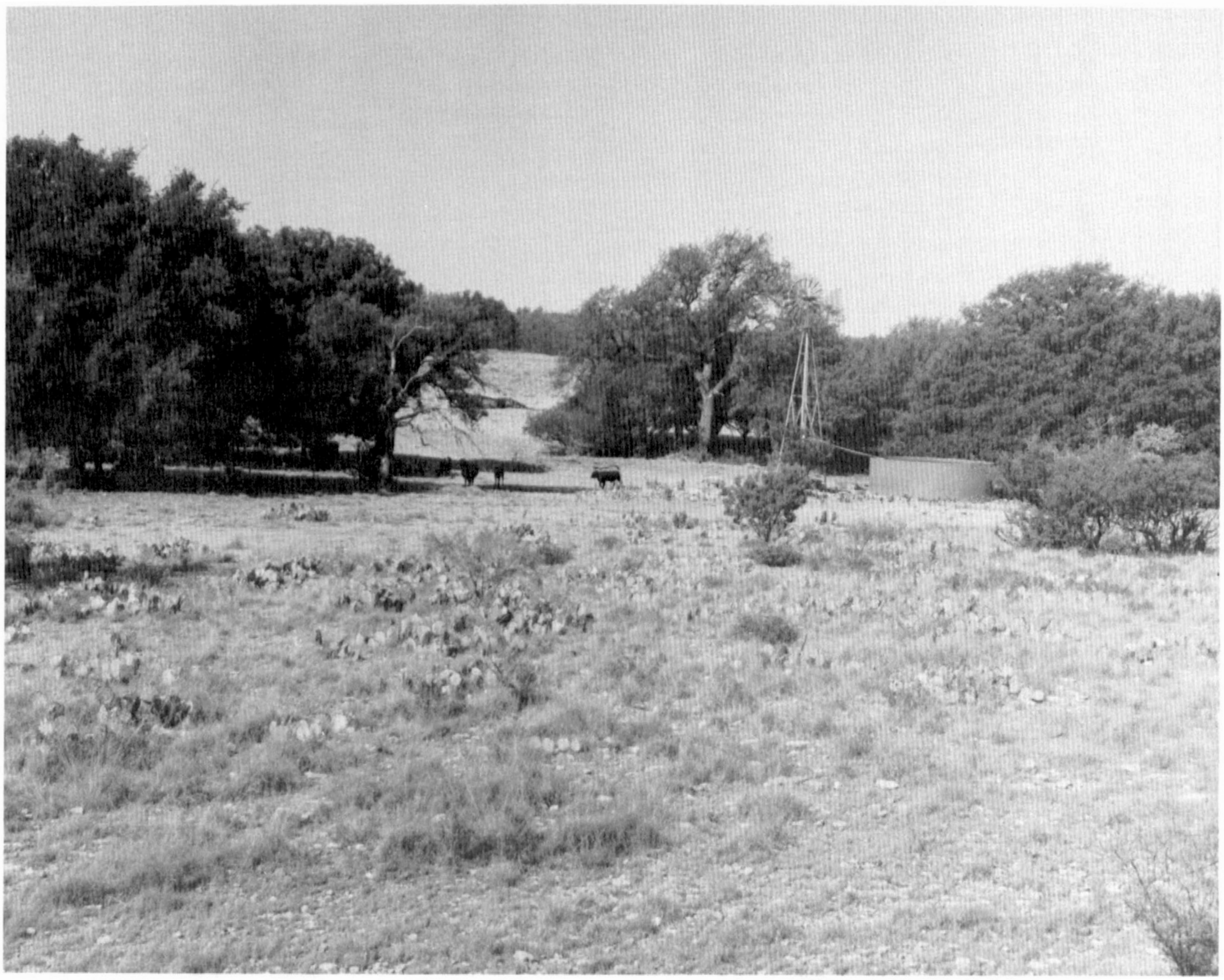
United States
Department of
Agriculture

Soil
Conservation
Service

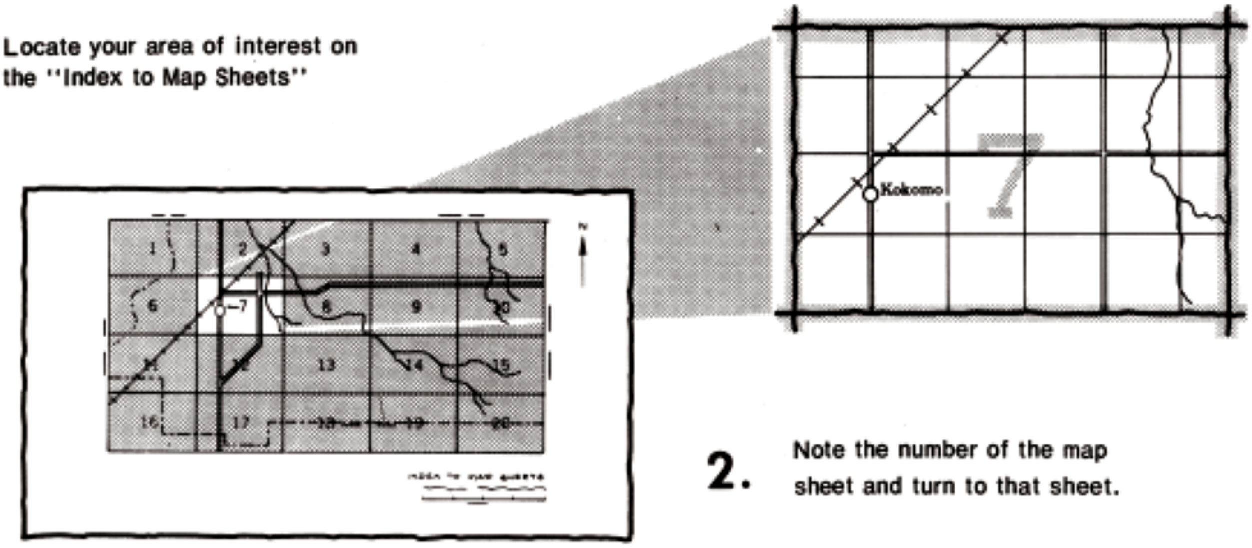
In cooperation with
Texas Agricultural
Experiment Station
and
Texas State Soil and Water
Conservation Board

Soil Survey of Concho County, Texas



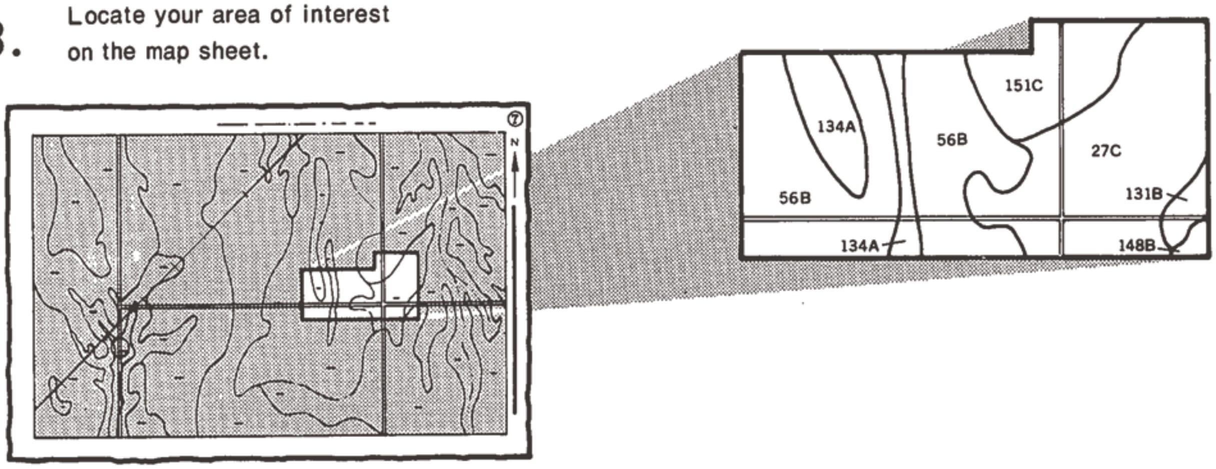
HOW TO USE

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

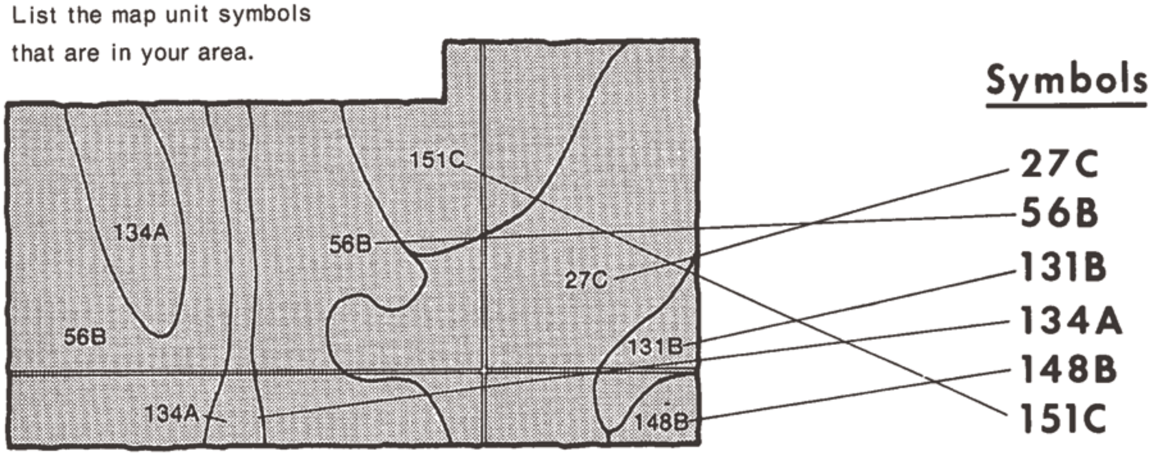


2. Note the number of the map sheet and turn to that sheet.

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

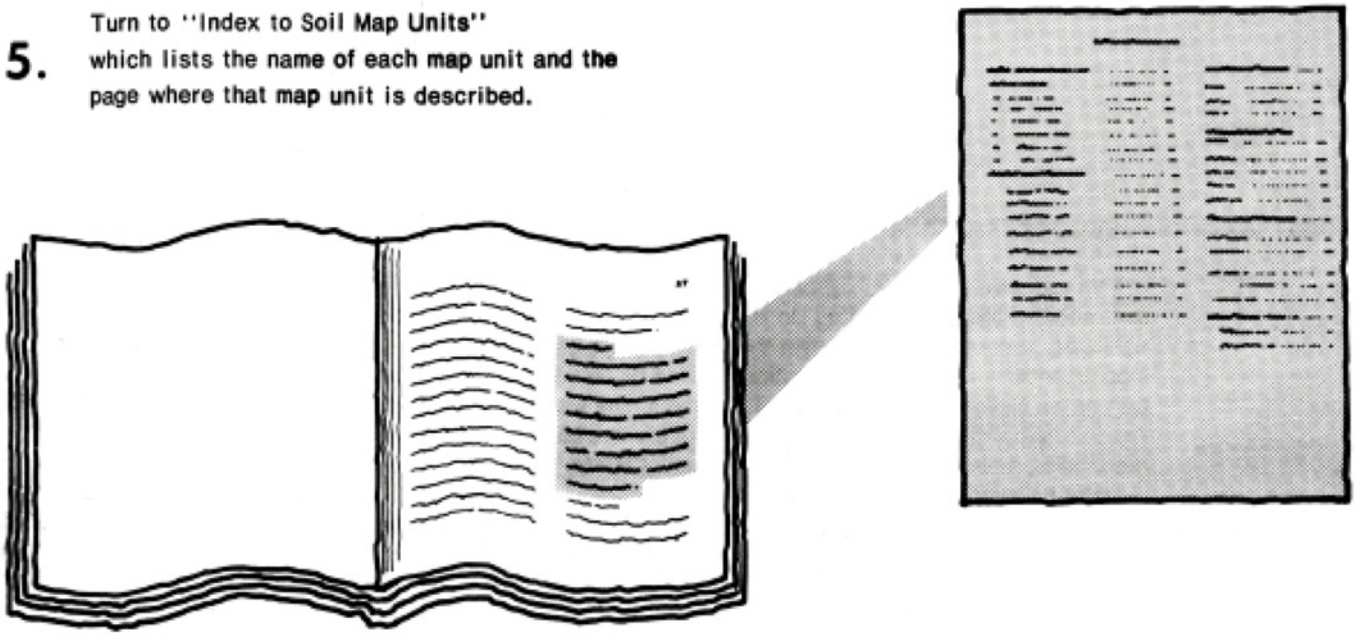


4. List the map unit symbols that are in your area.

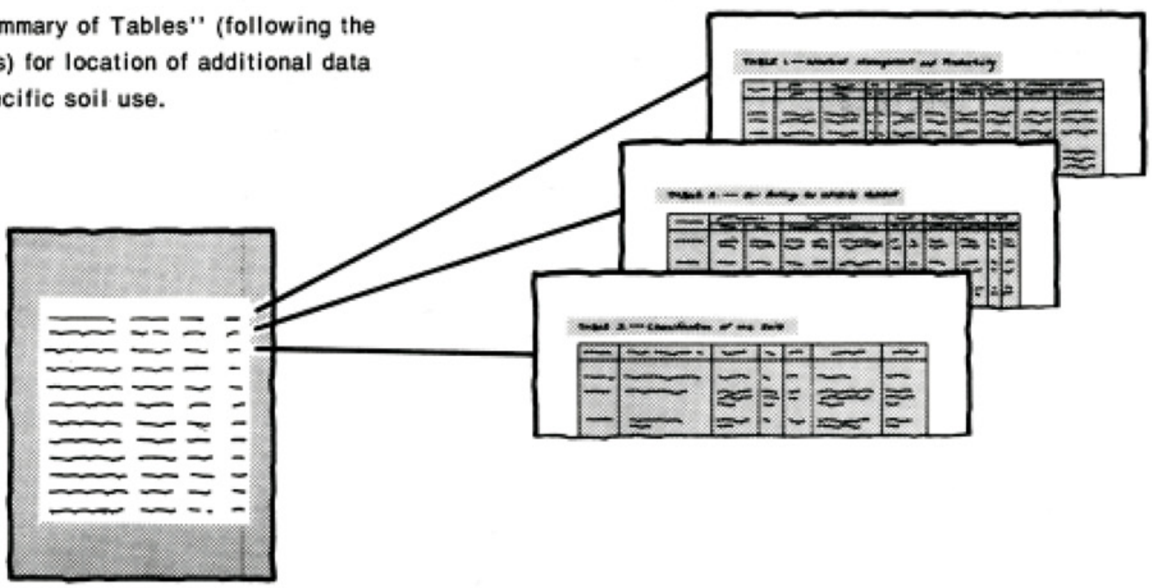


THIS SOIL SURVEY

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



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



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

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

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 1985. This soil survey was made cooperatively by the Soil Conservation Service and the Texas Agricultural Experiment Station and Texas State Soil and Water Conservation Board. It is part of the technical assistance furnished to the Concho 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.

Cover: About 75 percent of Concho County is rangeland. This range is in an area of Tarrant-Oplin-Kavett association, undulating.

Contents

Soil Series

Issued September 1988

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Summary of Tables

Foreword

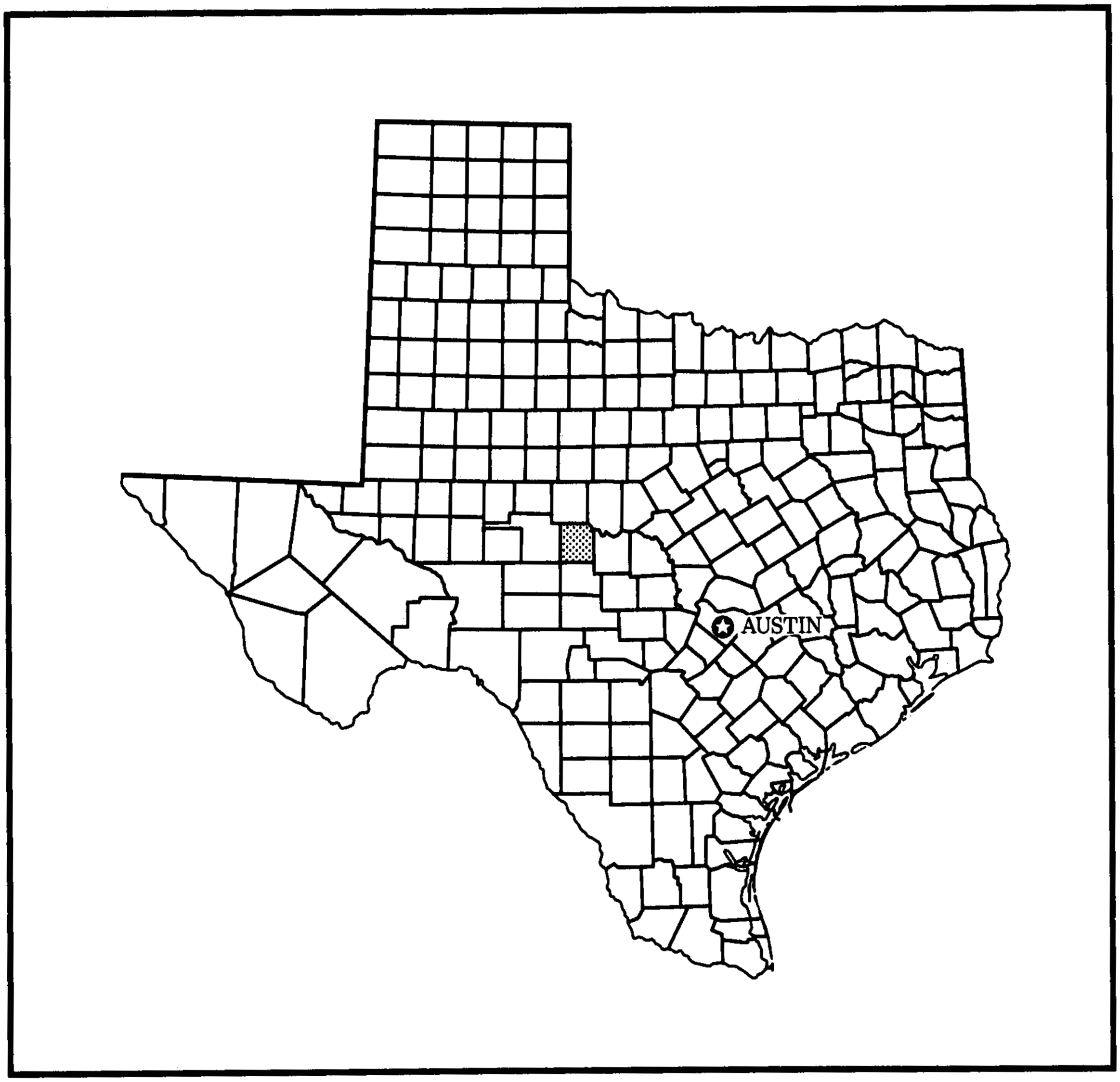
This soil survey contains information that can be used in land-planning programs in Concho County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact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

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

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

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

Coy A. Garrett
State Conservationist
Soil Conservation Service



Location of Concho County in Texas.

Soil Survey of Concho County, Texas

By Dennis F. Clower and G.S. Dowell, III,
Soil Conservation Service

Fieldwork by F.E. Baker, O.W. Bynum, D.F. Clower, G.S. Dowell, III,
and N.L. McCaleb, Soil Conservation Service

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

CONCHO COUNTY is in the west-central part of Texas. It has an area of 635,168 acres, or 992 square miles. The county is bordered on the north by Runnels and Coleman Counties, on the east by McCulloch County, on the south by Menard County, and on the west by Tom Green County. It extends about 30 miles from east to west and about 34 miles from north to south.

The county is divided into three land resource areas with distinct differences in relief, drainage, and vegetation. The southern part of the county is in the Edwards Plateau Land Resource Area. The soils in this area formed mainly under a live oak savannah. They are dominantly shallow and cobbly and are underlain by limestone. The North Central Prairie Land Resource Area is in the northeast part of the county. The soils in this area formed over limestone and caliche deposits. They are shallow, gravelly, and mostly gently rolling. The Rolling Plains Land Resource Area is in the northwestern part of the county. This section is locally called the "Lipan Flat." The soils are deep, smooth, and loamy. They drain into clayey playas or depressions.

The topography of Concho County is gently undulating to hilly. Elevation ranges from 1,400 feet along the Colorado River to 2,400 feet in the southwestern corner of the county. Average rainfall ranges from about 22 inches in the western part of the county to about 24 inches in the eastern part.

The Concho and Colorado Rivers cross the northern part of the county. The main tributaries that drain into these rivers are the Kickapoo, Duck, and Mustang Creeks. Brady Creek is the major stream in the southern part of the county.

About 75 percent of the soils in Concho County is used as rangeland; 25 percent, cropland and hayland; and 0.1 percent, urban land, farmsteads, roads, or water. Sheep, goats, and beef cattle are the principal ranching enterprise. Wheat, oats, cotton, grain, and forage sorghum are the main cultivated crops.

Descriptions, names, and delineations of soils in this soil survey do not fully agree with those on soil maps for adjacent counties. Differences are the result of better knowledge of soils, modifications in series concepts, intensity of mapping, or the extent of soil within the survey.

General Nature of the Survey Area

The climate, history, ranching and farming, and natural resources of the county are briefly described in this section.

Climate

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

Concho County has hot summers and fairly warm winters. Cold spells or snowfalls are rare. Rains are generally heaviest late in spring and early in fall. Rain in the fall is often associated with a dissipating tropical storm. Total annual precipitation is usually adequate for range vegetation, but because of the high rate of evapotranspiration, it often is not adequate for cotton, small grains, and sorghum without supplemental irrigation.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Eden, Texas, 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 49 degrees F, and the average daily minimum temperature is 35 degrees. The lowest temperature on record, which occurred at Eden on February 2, 1951, is -1 degrees. In summer the average temperature is 82 degrees, and the average daily maximum temperature is 96 degrees. The highest recorded temperature, which occurred on July 26, 1954, is 111 degrees.

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

Of the total annual precipitation, 16 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 6.85 inches at Eden on September 10, 1952. Thunderstorms occur on about 36 days each year, and most occur in summer.

The average seasonal snowfall is 4 inches. The greatest snow depth at any one time during the period of record was 8 inches. On an average, 1 day had at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 55 percent. Humidity is higher at night, and the average at dawn is about 85 percent. The sun shines 70 percent of the time possible in summer and 55 percent in winter. The prevailing wind is from the southeast. Average windspeed is highest, 11 miles per hour, in spring.

History

The area that is now Concho County was the hunting grounds of Comanche and Apache Indians. The first permanent settlers in Concho County came in the early 1870's. During the early period of settlement, ranching was the sole industry. Farming assumed considerable importance in the late 1890's after the free range period had ended.

Concho County was created in 1858 from land that was part of Bexar County. It was attached to San Saba County and later to McCulloch County for judicial purposes. The county was named for the Concho River, which flows through the northern part of the county. Spanish explorers named the river Concho, which means shell, because of the pink pearl-producing shells found only in this river.

The first county officials were elected on March 11, 1879. Paint Rock was named as the permanent county seat in an election on June 28, 1879. The town of Paint Rock was named after the "Painted Rocks" famed for 1,500 Indian pictographs, the largest collection known. The present county courthouse was built of native stone in 1886.

The major town in Concho County is Eden, which had a population of 1,294 in 1980. It was named for Fred Ede who deeded land for the townsite in 1881. Eden was situated at the intersection of the old San Antonio to Abilene and Austin to Fort Concho roads. Other towns in the county include Eola, Millersview, Vick, and Lowake.

The population of Concho County had increased to 7,645 by 1930. By 1980, the population had decreased to 2,915 mainly because of the Great Depression and droughts.

Ranching and Farming

Cattle ranching was the first agricultural enterprise in the county. The availability of inexpensive land and nutritious grasses made the area especially suitable for raising livestock. The major livestock are sheep, beef cattle, and goats. Many ranchers engage in commercial hunting leases for deer and turkey.

About 75 percent of the county is used as grazing lands. Livestock operations are mainly ewe-lamb or cow-calf type, or both. Concho County is fourth in Texas in sheep population. Supplemental feeding is generally heavy from December to late in February or March. Stocker lambs, steers, and heifers make up a significant percentage of some herds. Most herds are pastured on wheat and oat fields that are planted early in fall. The stocker sheep and cattle are taken off the wheat in sufficient time to make a grain crop.

Wheat, cotton, and grain sorghum are the main cash crops. About 156,513 acres of the county is cultivated. The soils are nearly level and gently sloping. About 2,500 acres is used for irrigated farming. The county has periods of drought in which supplemental irrigation is necessary for satisfactory yields. Normally, yields of cotton are more than doubled and yields of grain sorghum and wheat are nearly tripled in irrigated fields.

Brush control, range seeding, control of erosion, water conservation, deferred grazing, providing water for livestock, crossfencing, and control of pollution are the main conservation objectives.

Natural Resources

Soil is the most important natural resource in the county. Most people earn their living from the land by producing forage for livestock or food and fiber for market and home uses.

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

Water is another important natural resource. The Concho River, the Colorado River, and Brady Creek provide water for livestock and some irrigation. Many flood-retarding structures have been built, mainly in the southern and eastern parts of the county, to help prevent flood damage. Several of the lakes are used for recreation and as sources of water for livestock. Several wells in the northwestern part of the county supply water for supplemental irrigation of cotton and grain sorghum. Deep wells into the Hickory Sandstone Formation, which underlies the southeastern part of the county, provide water for the city of Eden.

Wildlife on the farms and ranches provide recreation and income for many landowners. Deer, turkey, quail, and dove are abundant throughout the county.

Concho County has an abundant supply of limestone and caliche that is used mainly in road construction.

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.

1. Kavett-Oplin-Tarrant

Shallow and very shallow, undulating, clayey and loamy soils, some of which are cobbly; on uplands

The landscape is nearly level and gently sloping. It consists of Kavett soils in shallow valleys, on low ridges, and on gentle foot slopes along drainageways; Oplin soils on ridges and shoulders of slopes; and Tarrant soils on low, irregular ridges and hillsides. The soils of this map unit are part of the Edwards Plateau. Slopes range from 0 to 8 percent.

This map unit makes up about 26 percent of the county. It is about 26 percent Kavett soils, 22 percent Oplin soils, 13 percent Tarrant soils, and 39 percent soils of minor extent.

Typically, the Kavett soils have a calcareous silty clay surface layer about 15 inches thick. It is dark grayish brown in the upper 7 inches and dark brown below that. The next layer is strongly cemented caliche to a depth of about 20 inches. The underlying material is fractured, strongly cemented limestone bedrock.

Typically, the Oplin soils have a calcareous, dark grayish brown surface layer about 14 inches thick. It is cobbly clay loam in the upper 7 inches and very flaggy clay loam below that. The underlying material is fractured, indurated and platy limestone bedrock.

Typically, the Tarrant soils have a calcareous clay surface layer about 13 inches thick. It is dark gray and cobbly in the upper 10 inches and dark brown and extremely flaggy below that. The underlying material is coarsely fractured limestone bedrock.

Of minor extent in this map unit are the Cho, Eola, Mereta, Nuvalde, Real, Rowena, and Valera soils. The Cho, Eola, and Mereta soils are on smooth ridges. They are very shallow and shallow, gently sloping and undulating, and loamy. The Nuvalde and Rowena soils are on terraces near major streams. They are deep, nearly level and gently sloping, and loamy. Real soils are along escarpments in a complex with Oplin soils and are very shallow and shallow, hilly, and loamy. The Valera soils are on uplands at steam drainage heads and foot slopes. They are moderately deep, gently sloping, and clayey. Also included are limestone bedrock outcrops.

The soils of this map unit are mainly used as rangeland and wildlife habitat. Most of these soils are not suited to use as cropland because of the very shallow to shallow soil depth and the coarse fragments on the surface. A few minor soils that are deep are cultivated and planted to small grains and forage sorghum.

Deer, turkey, dove, quail, squirrels, and furbearing animals are the main wildlife. Deer and turkey are plentiful, and most areas of this map unit are managed for hunting.

2. Rowena-Nuvalde-Mereta

Deep and shallow, nearly level and gently sloping, loamy soils; on uplands and terraces

The landscape is nearly level and gently sloping. It consists of Rowena soils on terraces and foot slopes near the flood plains of streams, Nuvalde soils on slightly higher slopes, and Mereta soils on low ridges. Slopes range from 0 to 3 percent.

This map unit makes up about 21 percent of the county. It is about 35 percent Rowena soils, 21 percent Nuvalde soils, 19 percent Mereta soils, and 25 percent soils of minor extent.

Typically, the Rowena soils have a dark grayish brown clay loam surface layer about 6 inches thick. The subsoil extends to a depth of 36 inches. It is dark brown clay between depths of 6 and 31 inches and reddish yellow silty clay loam below that. The underlying material to a depth of 60 inches is reddish yellow clay loam that contains many soft bodies of calcium carbonate. These soils are calcareous throughout.

Typically, the Nuvalde soils have a dark brown silty clay loam surface layer about 12 inches thick. The subsoil extends to a depth of 48 inches. It is dark brown silty clay to a depth of 22 inches, and below that, it is brown and light brown silty clay loam that has accumulations of calcium carbonate. The underlying material to a depth of 60 inches is pink silty clay loam. The soils are calcareous throughout.

Typically, the Mereta soils have a dark grayish brown, calcareous clay loam surface layer about 15 inches thick. The next layer is strongly cemented pinkish white caliche to a depth of about 18 inches. The underlying material is friable, pink limy earth several feet thick.

Of minor extent in this map unit are the Cho, Frio, Karnes, Kavett, Tobosa, and Valera soils. The Cho soils are on low ridges. They are very shallow and shallow, gently sloping and undulating, and loamy. The Frio soils are on flood plains of streams. They are deep, nearly level, and loamy. The Karnes soils are on terraces on slightly higher slopes than the major soils. They are deep, gently sloping, and loamy. The Kavett and Valera soils are on uplands and in shallow valleys. These soils are shallow and moderately deep, nearly level and gently sloping, and clayey. The Tobosa soils are on slightly lower slopes. They are deep, nearly level and gently sloping, and clayey.

The soils of this map unit are mainly used as cropland and rangeland. The crops are mainly wheat and oats, but some cotton, grain sorghum, and forage sorghum are also grown.

Deer, turkey, quail, and dove are the main wildlife. Many areas do not have cover for deer, but the deer graze the wheat and oats at night.

3. Cho-Lueders-Talpa

Shallow and very shallow, undulating, loamy soils, some of which are gravelly or cobbly; on uplands

The landscape consists of Cho soils on low smooth ridges, Lueders soils on shoulders of hills and ridges, and Talpa soils on ridgetops and benches. Slopes are mainly 1 to 8 percent, but range to 15 percent.

This map unit makes up about 20 percent of the county. It is about 22 percent Cho soils, 19 percent Lueders soils, 15 percent Talpa soils, and 44 percent soils of minor extent.

Typically, the Cho soils have a calcareous, dark brown gravelly loam surface layer about 8 inches thick. The next layer, to a depth of 17 inches, is pink indurated caliche. The underlying material is calcareous, pink loamy earth several feet thick.

Typically, the Lueders soils have a calcareous dark grayish brown surface layer about 10 inches thick. It is very cobbly loam in the upper part and extremely cobbly loam in the lower part. The underlying material is light gray fractured limestone bedrock.

Typically, the Talpa soils have a calcareous loam surface layer about 8 inches thick. It is dark grayish brown in the upper 4 inches and brown and gravelly below that. The underlying material is fractured limestone bedrock coated with calcium carbonate.

Of minor extent in this map unit are the Dev, Frio, Karnes, Kavett, Mereta, Nuvalde, Rowena, Speck, Throck, Tobosa, and Valera soils. The Dev and Frio soils are on flood plains of streams. They are deep, nearly level and gently sloping. The Karnes, Nuvalde, and Rowena soils are in valleys and on foot slopes. They are deep, nearly level to gently sloping, and loamy. The Mereta and Speck soils are on foot slopes and terraces. They are shallow and gently sloping. The Kavett and Valera soils are on uplands at stream drainage heads and in valleys. They are shallow and moderately deep, gently sloping and clayey. The Throck soils are on scarp faces in association with Lueders soils. Throck soils are deep, hilly, loamy, and stony. The Tobosa soils are lower on slopes than the major soils and in drainageways. They are deep, nearly level and gently sloping, and clayey.

The soils of this map unit are mainly used as rangeland. They are not suited to use as cropland because of very shallow to shallow soil depth to bedrock or caliche. Some of the minor soils that are deeper are used as cropland. The crops are mainly wheat and oats, but some forage sorghum is also grown.

Deer, turkey, quail, and dove are the main wildlife. Many areas of this map unit do not have cover or suitable browse for deer.

4. Cho-Mereta-Nuvalde

Very shallow, shallow, and deep, nearly level to undulating, loamy soils, some of which are gravelly; on uplands

The landscape is nearly level to undulating. It consists of Cho soils on low, smooth ridges; Mereta soils on foot slopes and stream drainage heads; and Nuvalde soils on foot slopes near the flood plains of streams. The Cho soils are undulating, and the Mereta and Nuvalde soils are nearly level and gently sloping. Slopes range from 0 to 8 percent.

This map unit makes up about 16 percent of the county. It is about 47 percent Cho soils, 16 percent Mereta soils, 10 percent Nuvalde soils, and 27 percent soils of minor extent.

Typically, the Cho soils have a calcareous, dark brown gravelly loam surface layer about 8 inches thick. The next layer, to a depth of 17 inches, is pink undurated caliche. The underlying material is calcareous, pink loamy earth several feet thick.

Typically, the Mereta soils have a dark grayish brown, calcareous clay loam surface layer about 15 inches thick. The next layer is strongly cemented, pinkish white caliche to a depth of about 18 inches. The underlying material is friable, pink limy earth several feet thick.

Typically, the Nuvalde soils have a dark brown silty clay loam surface layer about 12 inches thick. The subsoil extends to a depth of 48 inches. It is dark brown silty clay to a depth of 22 inches, and below that, it is brown and light brown silty clay loam that has accumulations of calcium carbonate. The underlying material to a depth of 48 to 60 inches is pink silty clay loam. The soils are calcareous throughout.

Of minor extent in this map unit are the Angelo, Frio, Karnes, Kavett, Lueders, Rowena, Talpa, and Valera soils. The Angelo, Karnes, and Rowena soils are on outwash plains and stream terraces, and the Frio soils are on flood plains of streams. These soils are deep, nearly level and gently sloping, and loamy. The Kavett and Valera soils are on foot slopes that overlie limestone. These soils are shallow to moderately deep and sloping. The Lueders and Talpa soils are on lower slopes where limestone outcrops. They are very shallow and shallow, undulating, and loamy.

The soils of this map unit are mainly used as rangeland and wildlife habitat. Some of the deeper soils are used as cropland. The crops are mainly wheat and oats, but some forage sorghum is also grown.

Deer, turkey, quail, and dove are the main wildlife. Many areas of these soils do not have cover for deer, but the deer graze the wheat and oats at night.

5. Angelo-Mereta

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

The landscape consists of Angelo soils on broad uplands and Mereta soils on low ridges. It is a broad outwash plain, locally called the Lipan Flat. Slopes range from 0 to 3 percent.

This map unit makes up about 11 percent of the county. It is about 51 percent Angelo soils, 25 percent Mereta soils, and 24 percent soils of minor extent.

Typically, the Angelo soils have a dark grayish brown clay loam surface layer about 14 inches thick. The subsoil extends to a depth of at least 62 inches. It is dark brown silty clay to a depth of 27 inches, and below that, it is reddish yellow silty clay loam and clay loam that contains accumulations of calcium carbonate. The soils are calcareous throughout.

Typically, the Mereta soils have a calcareous, dark grayish brown clay loam surface layer about 15 inches thick. The next layer is strongly cemented pinkish white caliche to a depth of about 18 inches. The underlying material is friable, pink limy earth several feet thick.

Of minor extent in this map unit are the Cho, Frio, Karnes, Lipan, Nuvalde, Rowena, and Tobosa soils. The Cho soils are on ridgetops. They are very shallow and shallow, undulating, and loamy. The Frio soils are on flood plains of streams. They are deep, nearly level, and loamy. The Karnes soils are on low ridges. They are deep, gently sloping, and loamy. The Nuvalde and Rowena soils are on stream terraces, generally on outer edges of this map unit. These soils are deep, nearly level and gently sloping, and loamy. The Lipan and Tobosa soils are in depressions and drainageways. These soils are deep, nearly level and gently sloping, and clayey.

The soils of the map unit are mainly used as cropland. In few areas, they are used as rangeland. The crops are mainly cotton, grain sorghum, and wheat.

Quail and dove are the main wildlife.

6. Eola-Kavett

Very shallow and shallow, undulating, loamy and clayey soils, some of which are gravelly; on uplands

The landscape consists of Eola soils on low smooth ridges and Kavett soils on foot slopes and in shallow valleys. The soils of this map unit are part of the Edwards Plateau. Slopes range from 1 to 5 percent.

This map unit makes up about 4.5 percent of the county. It is about 37 percent Eola soils, 37 percent Kavett soils, and 26 percent soils of minor extent.

Typically, the Eola soils have a calcareous, dark grayish brown very gravelly clay loam surface layer about 12 inches thick. The next layer, to a depth of 18 inches, is indurated caliche. The underlying material is alternating layers of soft and hard marl and limestone.

Typically, the Kavett soils have a calcareous, dark grayish brown silty clay surface layer about 14 inches thick. This layer has 5 to 10 percent gravel-size limestone fragments in the lower part. The next layer, to a depth of 17 inches, is strongly cemented caliche. The underlying material is a thick bed of hard limestone.

Of minor extent in this map unit are the Cho, Mereta, Oplin, Rowena, and Valera soils. The Cho soils are on slightly higher slopes than the major soils of this map unit. They are also very shallow and shallow, gently sloping and undulating, and loamy. The Mereta soils are on foot slopes. They are shallow, gently sloping, and loamy. Oplin soils are on ridges and shoulders of slopes. They are very shallow and shallow, undulating, and loamy. The Rowena soils are on uplands at stream drainage heads or in valleys. They are deep, gently sloping, and loamy. The Valera soils are on uplands at stream drainage heads. They are moderately deep, gently sloping, and clayey.

The soils of this map unit are mainly used as rangeland. Some of the deeper soils in a few small fields are planted in wheat.

Dove, quail, and songbirds are the main wildlife. Cover is not available for deer and turkey.

7. Frio-Gageby

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

The landscape consists of Frio soils on flood plains and nearly level Gageby soils on flood plains and low terraces near the Concho River. Slopes range from 0 to 2 percent.

This map unit makes up about 1 percent of the county. It is about 50 percent Frio soils, 40 percent Gageby soils, and 10 percent soils of minor extent.

Typically, the Frio soils have a surface layer about 45 inches thick. It is calcareous, dark grayish brown silty clay loam to a depth of about 21 inches and calcareous, dark brown silty clay below that. The subsoil is calcareous, brown silty clay to a depth of at least 60 inches.

Typically, the Gageby soils have a calcareous loam surface layer about 21 inches thick. It is brown in the upper 7 inches and dark grayish brown below that. The subsoil, to a depth of 56 inches, is calcareous, brown loam. The underlying material to a depth of 70 inches is calcareous, brown loam.

Of minor extent in this map unit are the Rioconcho soils. These soils are in concave areas on flood plains. They are deep, nearly level, and loamy.

The soils of this map unit are mainly used as cropland, rangeland, and for recreation uses. The Frio soils at lower elevations near the river channel are subject to flooding during rainstorms. The crops are mainly wheat and oats, but some grain and forage sorghum are also grown. Native pecan trees grow near the channel of the Concho River.

Deer, turkey, quail, dove, and squirrels are the main wildlife.

8. Yahola-Miles-Sagerton

Deep, nearly level and gently sloping, loamy soils; on bottom lands and terraces

The landscape consists of Yahola soils on the flood plain of the Colorado River and Miles and Sagerton soils on nearby high terraces. The Yahola soils are nearly level and gently sloping, and the Miles and Sagerton soils are gently sloping. Slopes range from 0 to 3 percent, but short, steep slopes are along the river channel. Some areas of Yahola soils near the river channel are subject to flooding following rainstorms.

This map unit makes up about 0.5 percent of the county. It is about 49 percent Yahola soils, 24 percent Miles soils, 19 percent Sagerton soils, and 8 percent soils of minor extent.

Typically, the Yahola soils have a brown fine sandy loam surface layer about 9 inches thick. The underlying material to a depth of 60 inches is light reddish brown fine sandy loam in the upper part and light reddish brown loam in the lower part. These soils are stratified with dark and light color layers of various textures and are calcareous throughout.

Typically, the Miles soils have a neutral, brown fine sandy loam surface layer about 6 inches thick. The subsoil extends to a depth of at least 80 inches. To a depth of 53 inches, it is neutral, reddish brown sandy clay loam. Below that, the subsoil is moderately alkaline, reddish yellow sandy clay loam. Soft masses of calcium carbonate are below a depth of 61 inches.

Typically, the Sagerton soils have a dark brown clay loam surface layer about 7 inches thick. The subsoil extends to a depth of at least 65 inches. It is dark reddish gray clay to a depth of 16 inches and reddish brown clay to a depth of 47 inches. Below that, the subsoil is yellowish red clay loam. It is mildly alkaline in the upper part and moderately alkaline in the lower part.

Of minor extent in this map unit are the Frio and Gageby soils. The Frio and Gageby soils are in concave positions on the flood plains. They are deep, nearly level, and loamy.

The soils of this map unit are mainly used as cropland, rangeland, and for recreation uses. The crops are mainly wheat and oats, but some forage sorghum is also grown. Native pecan trees grow near the channel of the Colorado River.

Deer, turkey, quail, dove, and squirrels are the main wildlife.

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, Kavett silty clay, 0 to 3 percent slopes, is one of several phases in the Kavett series.

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

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Talpa-Lueders-Cho complex, undulating, is an example.

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. Tarrant-Oplin-Kavett association, undulating, 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.

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.

AnA—Angelo silty clay loam, 0 to 1 percent slopes. This soil is deep, well drained, and nearly level. It is on ancient outwash plains and terraces. Slopes are smooth, and surfaces are slightly concave to plane. The areas are oblong to irregular in shape and range from 10 to several thousand acres.

Typically, the surface layer is dark grayish brown silty clay loam about 14 inches thick. The subsoil extends to a depth of at least 62 inches. It is dark brown silty clay to a depth of 27 inches, and below that, it is reddish yellow silty clay loam and clay loam that contains accumulations of calcium carbonate.

This soil is moderately alkaline and calcareous throughout. Surface runoff is slow. Permeability is moderately slow, and the available water capacity is high. Soil blowing is a moderate hazard, and water erosion is a slight hazard.

Included with this soil in mapping are small areas of Mereta, Rowena, and Tobosa soils. The included soils make up less than 15 percent of the map unit.

This Angelo soil is mainly used as cropland. In a few areas, this soil is used as rangeland.

Cotton, grain sorghum, and wheat are the main crops on this soil. Crop residue left on the surface helps control water erosion and soil blowing (fig. 1), conserves moisture, and improves soil tilth and water intake. Crops respond to nitrogen and phosphate fertilizers. Tilling when the moisture content is low improves aeration of soil and prevents the formation of large clods. Level terraces can be used for water conservation. If this soil is irrigated, a well designed irrigation system and proper application of water are essential. A sprinkler or surface irrigation system can be used.

Foundations for buildings, roads, and other structures can be easily designed and constructed to withstand the shrinking and swelling of this soil. Corrosion of underground steel pipe is rapid unless the pipe is protected. Septic tank absorption fields can be constructed to function properly in this soil, but the absorption field needs to be increased somewhat in size or modified in design. Some garden and landscaping plants exhibit iron chlorosis because of the high lime content of this soil. Although farm ponds can be easily built, seepage is a problem.

This soil can be used for recreational uses; however, vehicle traffic is restricted in unprotected areas because the soil is somewhat muddy following rains.

This soil supports a good habitat for rabbits, dove, and quail; however, lack of cover is a limiting factor.

This Angelo soil is in capability subclass IIIc and in the Clay Loam range site.

AnB—Angelo silty clay loam, 1 to 3 percent slopes. This soil is deep, well drained, and gently sloping. It is on ancient outwash plains and terraces. Slopes are smooth, slightly convex to plane, and average less than 2 percent. The areas are oblong to irregular in shape and range from 10 to several hundred acres.

Typically, the surface layer is silty clay loam about 13 inches thick. It is grayish brown in the upper part and dark grayish brown in the lower part. The subsoil extends to a depth of at least 65 inches. It is reddish brown clay to a depth of 30 inches. Below that, it is silty clay loam that is light brown in the upper part and pink in the lower part and contains accumulations of calcium carbonate.

This soil has medium surface runoff. Permeability is moderately slow, and the available water capacity is high. Water erosion and soil blowing are moderate hazards.

Included with this soil in mapping are areas of Mereta, Rowena, and Tobosa soils. Also included are a few areas of soils that have slopes of less than 1 percent.

Figure 1.—Angelo silty clay loam, 0 to 1 percent slopes, is subject to soil blowing unless the soil is protected by a vegetative cover.

The included soils make up less than 20 percent of the map unit.

This Angelo soil is mainly used as cropland. In a few areas, this soil is used as rangeland or improved pasture.

Cotton, grain sorghum, and wheat are the principal crops. Crops respond well to nitrogen and phosphate fertilizers. This soil has good tilth if the soil is cultivated when the moisture content is low. Terraces and contour farming help control water erosion and conserve moisture. Crop residue left on the surface helps maintain tilth and reduces soil blowing and water erosion.

Foundations for buildings, roads, and other structures can be designed and constructed to withstand the shrinking and swelling of this soil. Corrosion of underground steel pipe is rapid unless the pipe is protected. Septic tank absorption fields can be constructed to function properly in this soil. Some garden and landscaping plants exhibit iron chlorosis because of the high lime content. Although farm ponds can be easily built, seepage is a problem.

This soil can be used for recreational uses; however, vehicle traffic is restricted in unprotected areas because the soil is somewhat muddy following rains.

This soil supports a good habitat for rabbits, dove, and quail; however, lack of cover is a limiting factor.

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

ChB—Cho loam, 1 to 5 percent slopes. This soil is shallow, well drained, and gently sloping. It is on ancient outwash plains and stream terraces. Slopes are smooth to slightly convex. The areas are irregular in shape and range from 5 to about 100 acres.

Typically, the surface layer is dark grayish brown loam about 8 inches thick. The next layer is brown gravelly loam to a depth of 15 inches. It contains many very fine caliche pebbles. The underlying material extends to a depth of at least 60 inches. It is very pale brown indurated caliche to a depth of 19 inches, and below that, it is pink loamy earth that contains caliche gravels.

This soil is moderately alkaline and calcareous throughout. Surface runoff is medium. Permeability is moderate, and the available water capacity is very low. Water erosion and soil blowing are moderate hazards. In places, roots can penetrate the hardened caliche through cracks and filled-in prairie dog burrows.

Included with this soil in mapping are areas of Kavett, Mereta, and Nuvalde soils. Also included are areas of Cho gravelly loam that is mainly less than 10 inches thick. Many small areas of soils are now gravelly loam because chiseling has brought broken fragments to the surface. The included soils make up to 20 percent of the map unit.

This Cho soil is mainly used as rangeland. In some areas, this soil is used for such cultivated crops as wheat, oats, and forage sorghum.

Cool-season crops do better than warm-season crops on this droughty soil. Sorghum tends to turn yellow in areas where the caliche is near the surface. Crop residue left on the surface helps control water erosion and soil blowing and reduces soil temperature and evaporation. Implements used in deep tillage or terrace construction generally cut into the caliche and bring broken fragments to the surface.

Growth of native plants is limited because of the very low available water capacity during the growing season and the shallow rooting depth. Most rangeland is in threeawn, buffalograss, sideoats grama, sand dropseed, ephedra, pricklyash, yucca, mesquite, and agarito. Live oak trees are on sites in the southern part of the county.

Shallow depth to a cemented pan, high lime content, and very low available water capacity are the most limiting features for urban uses. Excavations for structures and utility lines are difficult. High lime causes chlorosis of yard and garden plants. Lawns and gardens must be watered frequently.

Depth to a cemented pan and small stones affect recreational uses. Slope also restricts the use of this soil for playgrounds.

This soil provides a fair habitat for deer, turkey, and furbearing animals. Nesting areas for dove and songbirds are plentiful.

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

COC—Cho gravelly loam, undulating. This soil is very shallow and shallow and well drained. It is on ancient outwash plains, stream terraces, and ridgetops of low hills. The areas are oval to irregular in shape and range from 5 to several hundred acres. Slopes are convex. They range from 1 to 8 percent, but average about 3 percent.

Typically, the surface layer is about 8 inches thick. It is dark brown gravelly loam that is 15 percent, by volume, caliche gravel. The next layer, to a depth of 17 inches, is pink undurated caliche. To a depth of 60 inches the underlying material is pink loamy earth that is about 50 percent, by volume, calcium carbonate.

This Cho soil has medium surface runoff. Permeability is moderate, and the available water capacity is very low. The root zone is very shallow to shallow, but in places, roots can penetrate the hardened caliche through cracks and filled-in prairie dog burrows.

Included with this soil in mapping are areas of Eola, Kavett, Karnes, Mereta, Nuvalde, and Valera soils. Eola, Mereta, Kavett, and Karnes soils are in positions similar to those of the Cho soil. Nuvalde and Valera soils are in natural drainageways at lower elevations. Also included are areas of the Cho soil that is not gravelly. Thin limestone ledges a few yards wide outcrop at a lower elevation in some areas where the outwash mantle has been removed by erosion. Areas of the included soils are 1 to 5 acres and make up less than 20 percent of the map unit.

This Cho soil is mainly used as rangeland. A few areas that include more suitable soils are used as cropland; however, the Cho soil generally is not suited to this use. Caliche is mined from some areas for roadfill.

Growth of native plants is limited because of the very low available water capacity during the growing season and the shallow rooting depth. Most rangeland is in threeawn, buffalograss, sideoats grama, sand dropseed, ephedra, pricklyash, yucca, mesquite, and agarito. Live oak trees are on sites in the southern part of the county only.

Shallow depth to a cemented pan, high lime content, and very low available water capacity are the most limiting features for urban uses. Lawns and gardens need to be watered frequently. Excavating for structures and utility lines is difficult. High content of lime causes chlorosis of yard and garden plants.

Small stones and depth to a cemented pan affect recreational uses. Slope also restricts use for playgrounds.

This soil provides fair habitat for deer, turkey, and furbearing animals. Nesting areas for dove and songbirds are plentiful.

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

DV—Dev gravelly loam, frequently flooded. This soil is deep, well drained, and nearly level to gently sloping. It is on bottom lands adjacent to stream channels. Slopes are irregular in shape and range from 0.5 to 3 percent. The areas are mostly long and narrow, about 100 to 600 feet wide, and range from 10 to about 200 acres. This soil is subject to flooding once or twice each year.

Typically, the surface layer is about 24 inches thick. It is dark grayish brown gravelly loam to a depth of about 10 inches and dark grayish brown extremely gravelly loam below that. The subsoil extends to a depth of at least 60 inches. It is brown extremely gravelly loam that contains threads and films of calcium carbonate.

This soil has slow to medium runoff. Permeability is moderately rapid. The available water capacity is low, but the soil receives extra water from adjacent soils.

Included with this soil in mapping are areas of Frio, Gageby, and Rioconcho soils. The stream channels are mostly limestone rubble underlain by limestone bedrock. A few small, elongated areas of gravelly soils are at a slightly higher elevation than the Dev soil. These soils are only occasionally subject to flooding. The included soils make up less than 20 percent of the map unit.

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

This soil produces a wide variety of native plants. Most rangeland is in Texas wintergrass, threeawns, buffalograss, vine-mesquite, dropseeds, silver bluestem, mesquite, western soapberry, elm, and pecan.

Flooding is a severe hazard and is very difficult to overcome for most urban uses. Flooding and small stones affect recreational uses.

This soil provides good habitat for deer, turkey, and furbearing animals. Several of the woody plants, forbs, and grasses provide good cover, browse, mast, and seeds for animals and game birds.

This Dev soil is in capability subclass VIw and in the Loamy Bottomland range site.

EKB—Eola-Kavett association, undulating. These soils are shallow and very shallow, well drained, and very gravelly and nongravelly. They are on broad uplands of the Edwards Plateau. Slopes are plane and range from 1 to 8 percent. The areas are irregular in shape and range from 50 to several hundred acres.

Eola soil is in all mapped areas and makes up about 50 percent of the association. Kavett soil is in all mapped areas and makes up about 36 percent of the association. The Eola soil is on gently sloping convex ridges and side slopes, and the Kavett soil is in weakly depressional areas and in shallow drainageways where slopes are less than 3 percent.

The areas of this map unit are much larger and the composition more variable than that of most other map units in the county. Mapping has been controlled well enough, however, for the anticipated use of the soils.

Typically, the Eola soil has a dark grayish brown very gravelly clay loam surface layer 12 inches thick. The next layer is indurated caliche to a depth of 18 inches. The underlying material to a depth of at least 35 inches is alternating layers of soft and hard marl and limestone.

This soil is moderately alkaline and calcareous throughout. Surface runoff is medium to rapid. Permeability is moderate, and the available water capacity is very low.

Typically, the Kavett soil has a dark grayish brown silty clay surface layer about 14 inches thick. The lower part of the surface layer contains 5 to 10 percent gravel-size limestone fragments. The next layer, to a depth of 17 inches, is strongly cemented caliche. This layer rests on a thick bed of hard limestone.

This soil is moderately alkaline and calcareous throughout. Surface runoff is slow to medium. Permeability is moderately slow, and the available water capacity is very low.

Included with these soils in mapping are areas of Cho, Mereta, and Oplin soils. Cho and Mereta soils are on convex ridgetops, and Oplin soils are in bands along side slopes where limestone bedrock outcrops. The included soils make up about 14 percent of the map unit.

The soils of this association are mainly used as rangeland. The Kavett soil could be cultivated if larger areas were available.

These soils have low potential for range plants. The very low available water capacity and the restricted rooting depth limit forage production. Most rangeland is in threeawn, sideoats grama, tridens, hairy grama, Texas wintergrass, pricklypear, catclaw, and mesquite. Trees are rare in this association.

Shallow depth to a cemented pan, high lime content, very low available water capacity, and small stones are the most limiting features for urban and recreational uses. Excavations for structures and utility lines are difficult.

These soils provide poor habitat for deer and turkey and poor nesting areas for birds because of inadequate cover.

The Eola soil is in capability subclass VIIs and in the Very Shallow range site. The Kavett soil is in capability subclass IIIs and in the Shallow range site.

Fo—Frio silty clay loam, occasionally flooded. This soil is deep, well drained, and nearly level. It is on flood plains along major streams. Slopes are smooth and range from 0 to 1 percent. Most of this soil is subject to flooding about once in every 3 to 10 years, but some areas are rarely flooded because they are protected by flood-prevention structures. The areas are mostly long and narrow and range from 10 to several hundred acres.

Typically, the surface layer is about 45 inches thick. It is dark grayish brown silty clay loam to a depth of about 21 inches, and below that, it is dark brown silty clay that contains a few threads and films of calcium carbonate. The subsoil extends to a depth of at least 60 inches. It is brown silty clay that contains a few threads and soft masses of calcium carbonate.

This soil is moderately alkaline and calcareous throughout. Surface runoff is slow. Permeability is moderately slow, and the available water capacity is high. The root zone is deep. Water erosion is a slight hazard, and soil blowing is a moderate hazard.

Included with this soil in mapping are small areas of Dev, Gageby, and Rioconcho soils along stream channels and Nuvalde and Rowena soils at a slightly higher elevation. The included soils make up to 20 percent of the map unit.

This Frio soil is used as cropland, pastureland, and rangeland.

Wheat, oats, and grain sorghum are the main cultivated crops on this soil. Kleingrass and improved bermudagrass are the main pasture grasses. Crop residue left on the surface helps control water erosion and soil blowing, conserves soil moisture, and improves soil tilth and water intake.

Frio soil is very productive for a wide variety of rangeland plants. Control of grazing is difficult because livestock prefer palatable grasses and nearly level areas. Most rangeland is in Texas wintergrass, dropseeds, sideoats grama, vine-mesquite, silver bluestem, threeawn, elm, western soapberry, mesquite, and pecan.

This soil is poorly suited to urban uses because of flooding, moderately slow permeability, and the clayey texture. Flooding also restricts some camping uses.

This soil supports a good habitat for deer, turkey, squirrel, and quail. Turkeys roost in the large trees that grow near the banks of streams. Wildlife is attracted to the mast, seed-producing forbs, winter annuals, and cover.

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

Fr—Frio silty clay loam, frequently flooded. This soil is deep and well drained. It is in low lying bottom land areas along streams and is subject to flooding after rains. The areas are generally long and narrow and range from 10 to more than 100 acres. Slopes are complex and range from 0 to 2 percent. The bottom lands are dissected by a channel or channels 2 to 8 feet deep and 5 to 30 feet wide. Channels along the Concho River can be 20 feet deep and 100 or more feet wide.

Typically, the surface layer is dark grayish brown silty clay loam about 41 inches thick. The subsoil extends to a depth of at least 60 inches. It is grayish brown silty clay loam that contains threads and films of calcium carbonate.

This soil is moderately alkaline and calcareous throughout. Surface runoff is slow. Permeability is moderately slow, and the available water capacity is high. The root zone is deep, and plant roots penetrate the soil without difficulty. Erosion is a slight hazard, but in places, scouring is a problem following floods. The frequency of flooding ranges from once every 2 years to twice or more each year. The duration is a few hours to 2 days.

Included with this soil in mapping are areas of Dev, Gageby, Nuvalde, and Rioconcho soils. In some mapped areas, limestone outcrops intermittently in the channels. A few small areas of Frio soil that is occasionally flooded are also included. The included soils make up as much as 20 percent of the map unit.

The Frio soil is mainly used as rangeland. Plant cover is needed to prevent localized scouring during periods of flooding.

This soil is not suited to use for crops. In a few areas, however, it has been planted to improved pasture grasses, such as coastal bermudagrass and kleingrass. Control of grazing is difficult because cattle tend to concentrate in these tracts, which offer shade, palatable forage, and easy movement. Native pecan trees are in some areas.

This soil is severely limited for most urban uses because of flooding. Local roads and bridges are sometimes damaged by brush and trees being swept downstream. Flooding is also a hazard for most recreational uses, such as campsites and playgrounds.

This soil provides good habitat for squirrels and deer and good nesting areas for doves, quail, turkeys, and songbirds. The trees, shrubs, and water attract furbearing animals to areas of this soil. Wildlife is attracted by the mast, seed-producing forbs, winter annuals, and cover.

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

Ga—Gageby loam, rarely flooded. This soil is deep, well drained, and nearly level. It is on low terraces and bottom lands along the Concho River. Slopes are plane to weakly concave and range from 0 to 1 percent. This soil is subject to flooding about once in every 10 to 20 years. Most areas of this soil have not flooded since upstream dams were built in the mid 1950's. The areas are long and narrow and range from 10 to several hundred acres. Some areas are remote, and access with farm machinery is difficult.

Typically, the surface layer is loam about 21 inches thick. It is brown in the upper 7 inches and dark grayish brown below that. The subsoil, to a depth of 56 inches, is brown loam. The underlying material to a depth of 70 inches is brown loam.

This soil is moderately alkaline and calcareous throughout. Surface runoff is slow. Permeability is moderate, and the available water capacity is high. The root zone is deep and easily penetrated by plant roots. Water erosion and soil blowing are slight hazards.

Included with this soil in mapping are small areas of Dev, Frio, Nuvalde, and Rioconcho soils and soils similar to Gageby soil except they have a silt loam surface layer. Also included are areas of soils that have a dark color A horizon less than 20 inches thick. The included soils make up as much as 15 percent of the map unit.

This Gageby soil is mainly used as dry and irrigated cropland and rangeland.

Wheat, oats, cotton, and grain and forage sorghums are the main crops. Some areas of this soil are planted to kleingrass. Crop residue left on the surface helps control water erosion and soil blowing, conserves moisture, and improves soil tilth and water intake. Erosion in overfall gullies is a concern in some places.

This soil produces a wide variety of native plants. Most rangeland is in Texas wintergrass, threeawns, buffalograss, vine-mesquite, dropseeds, silver bluestem, mesquite, western soapberry, elm, and pecan.

This Gageby soil is poorly suited to urban uses mainly because of flooding. This soil can be used for most recreational uses; however, the hazard of flooding and the dusty surface are limitations.

This soil provides good habitat for deer, turkey, and furbearing animals. Nesting areas for quail, dove, and songbirds are plentiful. Wildlife is attracted to areas of this soil because of the seed-producing forbs, winter annuals, cover, and mast, such as pecans and acorns. Deer and turkey also graze wheat and oat fields.

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

KaB—Karnes loam, 1 to 5 percent slopes. This soil is deep, well drained, and gently sloping. It is on terraces and foot slopes below limestone hills. Slopes are smooth or slightly convex. The areas are long and narrow to irregular in shape and range from 10 to 50 acres.

Typically, the surface layer is light yellowish brown loam about 7 inches thick. The subsoil extends to a depth of 43 inches. It is pink loam that contains accumulations of calcium carbonate. The underlying material to a depth of 60 inches is pink loam that contains accumulations of calcium carbonate.

This soil is moderately alkaline and calcareous throughout. Surface runoff is slow to medium. Permeability is moderately rapid, and the available water capacity is moderate. Water erosion and soil blowing are moderate hazards.

Included with this soil in mapping are small areas of Cho, Mereta, and Nuvalde soils. Also included is a soil similar to Karnes soil except that it has a silty clay loam subsoil. The included soils make up to 15 percent of the map unit.

Although this Karnes soil can be cultivated, it is mainly used as rangeland. Some areas are planted to kleingrass.

Wheat, oats, and forage sorghum are the principal crops on this soil. Excessive lime content causes nutrient imbalance and the yellowing of leaves in some crops. Crop residue left on the surface helps control soil blowing and water erosion and conserves moisture. Contour farming and terracing are needed in most areas to control water erosion.

This soil produces a wide variety of native plants. Most rangeland is in threeawn, sideoats grama, dropseeds, silver bluestem, Texas wintergrass, mesquite, and agarito.

This soil is suitable for most urban and recreational uses. Although farm ponds can be easily built, seepage is a problem.

This soil provides fair nesting areas for doves, quail, and songbirds. Lack of cover is a limitation for deer.

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

KtB—Kavett silty clay, 0 to 3 percent slopes. This soil is shallow, well drained, and nearly level and gently sloping. It is mainly along divides or shallow valleys on uplands. Slopes are smooth or slightly concave. The areas are irregular in shape and range from 10 to several hundred acres.

Typically, the surface layer is silty clay about 15 inches thick. It is dark grayish brown in the upper 7 inches and dark brown below that. The next layer is strongly cemented caliche to a depth of about 20 inches. It rests on a thick layer of fractured, strongly cemented limestone.

This soil is moderately alkaline and calcareous throughout. Surface runoff is medium. Permeability is moderately slow, and the available water capacity is very low. The root zone is shallow. Water erosion and soil blowing are moderate hazards.

Included with this soil in mapping are small areas of Cho, Mereta, Talpa, Tarrant, and Valera soils. In most areas a few limestone fragments as much as 6 inches wide are on the surface. Also included are small areas of a soil similar to the Kavett soil except it does not have a cemented caliche layer. The included soils make up less than 20 percent of the map unit.

This Kavett soil can be cultivated but it is mainly used as rangeland.

Wheat, oats, and forage sorghums are the main crops, but some areas are planted to kleingrass and King Ranch bluestem. Crop residue left on the surface helps control water erosion and soil blowing, conserves moisture, and improves soil tilth and water intake. Crops respond to nitrogen and phosphate fertilizers. This soil has good tilth if the soil is cultivated when the moisture content is low.

Growth of native plants is limited because of the very low available water capacity and the shallow rooting depth. Most rangeland is in buffalograss, curlymesquite, sideoats grama, Texas wintergrass, silver bluestem, threeawns, mesquite, pricklyash, and pricklypear. Live oak trees are on sites in the southern part of the county.

The shallow depth to a cemented pan and limestone and the high shrink-swell potential are the most limiting features for urban uses. Foundations for buildings, roads, and other structures can be placed on solid bedrock or caliche; however, excavating the rock is difficult. Corrosion of steel utility lines is rapid unless the lines are protected. Septic systems must be specially designed in order to function properly.

Depth to hard caliche or limestone and the silty clay surface layer restrict recreational uses. Vehicle traffic is restricted in unprotected areas because the soil is muddy following rains.

This soil provides a fair habitat for deer, turkey, rabbits, and furbearing animals. Nesting areas for dove, quail, and songbirds are plentiful.

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

KXB—Kavett-Cho-Oplin complex, undulating. This complex is made up of soils that are shallow and very shallow, well drained, and nongravelly, gravelly, or cobbly. These soils are mainly on the tops of plateaus and ridges. Slopes are dominantly 1 to 5 percent. The areas are irregular in shape and range from 30 to several hundred acres.

The complex is about 30 percent Kavett soil, about 27 percent Cho soil, about 20 percent Oplin soil, and about 23 percent other soils. The Kavett soil is on slightly concave to plane slopes, and the Cho soil is on slightly convex to plane slopes. The Oplin soil is on convex knolls and along outcropping ledges of limestone. Areas of this map unit are mostly large, and the composition is variable over short distances. The detail, however, is adequate for the foreseeable uses of these soils.

Typically, the Kavett soil has a very dark grayish brown and dark grayish brown silty clay surface layer about 13 inches thick. The lower part of the surface layer has a few platy, gravel-size caliche fragments. The content of cobbles on the surface is about 5 percent. Between depths of 13 and 20 inches, this soil is strongly cemented caliche that is fractured in the upper part. The underlying material is strongly cemented limestone.

This Kavett soil has medium surface runoff. Permeability is moderately slow, and the available water capacity is very low.

Typically, the Cho soil has a gravelly clay loam surface layer about 10 inches thick that is very dark grayish brown in the upper part and dark brown in the lower part. The content of flattened caliche fragments is about 20 percent in the upper part of the surface layer and about 30 percent in the lower part. Between depths of 10 and 18 inches, this soil is hard caliche. Below that, it is white powdery marl that becomes gravelly at a depth of about 48 inches. The soil is moderately alkaline and calcareous throughout.

Typically, the Oplin soil has a grayish brown cobbly clay loam surface layer about 14 inches thick. It is about 30 percent limestone cobbles, flagstones, and gravels in the upper part and about 85 percent in the lower part. The underlying material is fractured, indurated and platy, limestone bedrock.

The Cho and Oplin soils have medium to rapid surface runoff. Permeability is moderate, and the available water capacity is very low.

Included with this complex in mapping are areas of the Eola, Mereta, and Tarrant soils, and areas of rock outcrop. The Eola, Mereta, and Tarrant soils are shallow. Also included are areas of a soil similar to the Kavett soil except that it has more gravel and cobbles. The included soils make up about 20 percent of the map unit. About 3 percent of a mapped area can be deeper soils, mainly Nuvalde and Valera soils.

The soils in this complex are used as rangeland and are best suited to this use. These soils are generally not suited to cultivated crops nor to use as pasture because the soils are too cobbly, too shallow, or have limestone bedrock outcrops. In a few areas, the soils are arable, but these areas are so small and irregular in shape that cultivation is impractical.

Most rangeland is in threeawn, Texas wintergrass, silver bluestem, buffalograss, curly mesquite, dropseed, pricklypear, bushsunflower, live oak, and shin oak.

These soils provide habitat for deer and good nesting areas for doves, quail, turkey, and songbirds.

These soils have severe limitations for most urban and recreational uses. Depth to limestone bedrock and the coarse fragments on the surface are the most limiting features.

The soils of this complex are in capability subclass VIs. The Kavett soil is in the Shallow range site, the Cho soil is in the Very Shallow range site, and the Oplin soil is in the Low Stony Hills range site.

LpA—Lipan clay, ponded. This soil is deep, somewhat poorly drained, and nearly level. It is on uplands in depressions that are covered with water following periods of heavy rainfall. The areas are circular to oblong and range from 3 to about 100 acres. Areas of this soil are 3 to 15 feet lower than the surrounding soils. Ponding occurs about once in 3 years and lasts from a few days to several weeks.

Typically, this soil is gray clay to depth of about 52 inches. The underlying material to a depth of about 65 inches is light brownish gray clay.

This soil is moderately alkaline and calcareous. Water enters this soil rapidly when the soil is dry and cracked and very slowly when the soil is wet and the cracks are sealed. Permeability is very slow, and the available water capacity is high. Soil blowing is a moderate hazard.

Included with this soil in mapping are small areas of Tobosa soils. Tobosa soils are darker in color than the Lipan soil. The included soils make up less than 20 percent of the map unit.

This Lipan soil is mainly used as cropland. Wheat, cotton, and grain sorghum are the main cultivated crops. Crop residue left on the surface helps to maintain tilth, reduces soil temperature, and helps to control soil blowing. Tilling when the moisture content is low improves aeration of the soil and prevents the formation of large clods. Ponding in the fields after heavy rainfall makes cultivation and harvesting of crops difficult in some years, and occasionally crops are lost.

This soil has severe limitations for most urban uses because of ponding and shrinking and swelling as a result of changes in moisture content. Ponding and the clayey surface layer are also limitations for most recreational uses.

This soil provides only fair nesting areas for doves, quail, and songbirds. It has limited value for use as wildlife habitat because woody plants are not available to provide cover and food.

This Lipan soil is in capability subclass IIIw and in the Clay Flat range site.

LTE—Lueders-Throck association, hilly. These soils are very shallow to moderately deep, well drained, and cobbly and stony. They are on hillsides and generally occur as east-facing scarps. Slopes range from 5 to more than 30 percent but average about 15 percent. The areas are long and narrow to irregular in shape and range from 20 to several hundred acres.

Lueders soil is in all mapped areas and makes up about 60 percent of the association. Throck soil is in all mapped areas and makes up about 30 percent of the association. The Lueders soil is mainly on the upper slopes on convex ridges and escarpments over areas of hard limestone. Throck soil is on the hillsides below the escarpments.

The composition of this association is variable; however, use and management are similar and mapping has been controlled well enough for the anticipated uses of these soils.

Typically, the Lueders soil has a surface layer about 11 inches thick. It is dark grayish brown very cobbly clay loam that grades to extremely cobbly clay loam in the lower part. The surface layer rests abruptly on a thick layer of hard fractured limestone.

This soil is moderately alkaline and calcareous throughout. Runoff is rapid. Permeability is moderate, and the available water capacity is very low. The root zone is shallow.

Typically, the Throck soil has a brown stony clay loam surface layer about 4 inches thick. The subsoil, to a depth of 32 inches, is silty clay that is light olive brown in the upper part and pale yellow in the lower part. The underlying material to a depth of 40 inches is light brownish gray shaly clay.

This soil is moderately alkaline and calcareous throughout. Runoff is rapid. Permeability is slow, and the available water capacity is moderate.

Included with these soils in mapping are areas of rock outcrop and a few areas of Cho soils, Lueders stony clay loam, and soils similar to the Throck soil except they are loam and are very high in carbonates. The rock outcrop consists of exposures of limestone bedrock on ledges along hillsides. The included soils and rock outcrop make up about 10 percent of the map unit.

The soils of this association are mainly used as rangeland. They are not suited to use as cropland.

Growth of native range plants is medium on the Throck soil, but it is low on the Lueders soil because of the shallow rooting depth and low available water capacity. Most rangeland is in threeawns, buffalograss, sideoats grama, tridens, agarito, mesquite, yucca, pricklypear, ephedra, and hackberry.

The cobbly and stony surface, steep slopes, depth to bedrock, and high shrink-swell potential of these soils are the most limiting features for urban or recreational uses.

These soils provide a fair habitat for deer, turkey, and furbearing animals. Nesting areas for dove, quail, and songbirds are plentiful.

The Lueders and Throck soils are in capability subclass VIIs. Lueders soil is in the Very Shallow range site, and Throck soil is in the Rocky Hills range site.

MeA—Mereta clay loam, 0 to 1 percent slopes. This soil is shallow, well drained, and nearly level. It is mainly on outwash plains and ancient stream terraces on uplands. This soil is mostly on high, plane ridges. The areas are elongated to irregular in shape and range from 10 to more than 150 acres.

Typically, the surface layer is clay loam about 18 inches thick. It is dark brown in the upper part and reddish brown in the lower part. The next layer is strongly cemented, pinkish white caliche to a depth of about 26 inches. The underlying material to a depth of 60 inches is friable, pink and reddish yellow loam.

The soil is moderately alkaline and calcareous throughout. Surface runoff is slow. Permeability is moderately slow, and the available water capacity is very low. The root zone is shallow. Water erosion is a slight hazard, and soil blowing is a moderate hazard. In places, roots can penetrate the hardened caliche through cracks and filled-in prairie dog burrows.

Included with this soil in mapping are small areas of Angelo, Cho, Nuvalde, and Rowena soils. Also included are small areas of a soil that is similar to Mereta soil except it does not have a strongly cemented caliche layer within 20 inches of the surface. The included soils make up less than 25 percent of the map unit.

This Mereta soil is mainly used as cropland or rangeland.

Wheat, oats, and forage sorghum are the main crops on this soil. Cool-season crops do better than warm-season crops on this droughty soil. Some areas of this soil are planted to kleingrass and King Ranch bluestem. Crop residue left on the surface helps control water erosion and soil blowing, reduces soil temperature and evaporation, and improves tilth and water intake.

Growth of native plants is limited because of the very low available water capacity and the shallow rooting depth. Most rangeland is in buffalograss, curlymesquite, sideoats grama, Texas wintergrass, silver bluestem, threeawn, mesquite, pricklyash, and pricklypear. Live oak trees are on sites in the southern part of the county.

The shallow depth to a cemented pan of hard caliche and the high shrink-swell potential are the most limiting features for urban uses. Excavating for structures and utility lines is difficult. Lawns and gardens must be watered frequently.

Depth to hard caliche affects recreational uses.

This soil provides a fair habitat for deer and fair nesting areas for doves, quail, turkey, and songbirds.

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

MeB—Mereta clay loam, 1 to 3 percent slopes. This soil is shallow, well drained, and gently sloping. It is mainly on outwash plains and ancient stream terraces on uplands. This soil is mostly on high weakly convex to plane ridges in a gently undulating landscape. The areas are elongated to irregular in shape and range from 10 to several hundred acres.

Typically, the surface layer is dark grayish brown clay loam about 15 inches thick. The next layer is strongly cemented, pinkish white caliche to a depth of about 18 inches. The underlying material is friable, pink limy earth to a depth of about 60 inches.

This soil is moderately alkaline and calcareous throughout. Surface runoff is medium. Permeability is moderately slow, and the available water capacity is very low. The root zone is shallow. Water erosion and soil blowing are moderate hazards. In places, roots can penetrate the hardened caliche through cracks and filled-in prairie dog burrows.

Included with this soil in mapping are small areas of Angelo, Cho, Kavett, Nuvalde, Rowena, and Talpa soils. Also included are soils similar to the Mereta soil except they do not have a layer of strongly cemented caliche within 20 inches of the surface. Also included are a few areas of soils that have slopes of less than 1 percent. The included soils make up less than 20 percent of the map unit.

This Merta soil is mainly used as rangeland, but it can be cultivated. Some areas are planted to kleingrass and King Ranch bluestem.

Wheat, oats, and forage sorghum are the principal crops on this soil. Sorghum tends to turn yellow in areas where the caliche is near the surface. Crop residue left on the surface helps control water erosion and soil blowing, reduces soil temperature and evaporation, and improves tilth and water intake. Implements used in deep tillage or terrace construction generally cut into the caliche and bring broken fragments to the surface.

Growth of native plants is limited because of the very low available water capacity and the shallow rooting depth. Most rangeland is in buffalograss, curlymesquite, sideoats grama, Texas wintergrass, silver bluestem, threeawn, mesquite, ephedra, pricklyash, and pricklypear. Live oak trees are on sites in the southern part of the county.

The shallow depth to a cemented pan of hard caliche and the high shrink-swell potential are the most limiting features for urban uses. Excavating for structures and utility lines is difficult. Lawns and gardens must be watered frequently. The underlying caliche layer is used in places as base material for roads.

Depth to hard caliche affects recreational uses. Slope is a limiting factor for some playgrounds.

This soil provides a fair habitat for deer and fair nesting areas for doves, quail, turkey, and songbirds.

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

MfB—Miles fine sandy loam, 1 to 3 percent slopes. This soil is deep, well drained, and gently sloping. It is on high terraces bordering the Colorado River. Slopes are smooth or slightly convex. The areas are irregular in shape and range from 10 to about 80 acres.

Typically, the surface layer is brown fine sandy loam about 6 inches thick. The subsoil extends to a depth of at least 80 inches. It is reddish brown sandy clay loam to a depth of 53 inches and reddish yellow sandy clay loam to a depth of 61 inches. Below that, it is reddish yellow sandy clay loam that contains concretions and soft masses of calcium carbonate.

This soil is neutral in the surface layer and neutral to moderately alkaline in the subsoil. Surface runoff is slow to moderate. Permeability and the available water capacity are moderate. The root zone is deep, and air, water, and roots move through the soil easily. Soil blowing and water erosion are moderate hazards.

Included with this soil in mapping are small areas of Sagerton soils. Also included are small areas of soils similar to Miles soil; one is less than 60 inches thick, another has a gravelly sandy clay loam subsoil that is coated with calcium carbonate, and another has accumulations of lime at less than 28 inches below the soil surface. A few concave areas of soils that have a dark brown surface layer are included. The included soils make up less than 20 percent of the map unit.

This Miles soil is used as cropland or rangeland.

Wheat, oats, and forage sorghum are the main crops on this soil. Crop residue left on the surface helps control soil blowing and water erosion and conserves moisture. Crops respond to nitrogen and phosphate fertilizers. Terracing and contour farming help control water erosion and conserve moisture.

This soil produces a wide variety of native plants. Most rangeland is in sideoats grama, threeawn, hooded windmillgrass, buffalograss, hairy grama, sand dropseed, silver bluestem, mesquite, and pricklypear.

This soil can easily be used for most urban and recreational uses.

This soil supports a good habitat for quail, dove, and turkey. Inadequate cover is a limiting factor for habitat for deer; however, the deer graze oat and wheat fields at night.

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

NuA—Nuvalde silty clay loam, 0 to 1 percent slopes. This soil is deep, well drained, and nearly level. It is mainly on high terraces and in valleys on uplands. Slopes are smooth or slightly concave. The areas are oblong to irregular in shape and range from 10 to several hundred acres.

Typically, the surface layer is dark brown silty clay loam about 12 inches thick. The subsoil extends to a depth of about 48 inches. It is dark brown silty clay to a depth of 22 inches, and below that, it is silty clay loam that is brown in the upper part and light brown in the lower part. Accumulations of calcium carbonate are in the lower part of the subsoil. The substratum to a depth of 60 inches is pink silty clay loam.

This soil is moderately alkaline and calcareous throughout. Surface runoff is slow. Permeability is moderate, and the available water capacity is high. Water erosion is a slight hazard, and soil blowing is a moderate hazard. The root zone is deep, and air, water, and roots move through the soil easily.

Included with this soil in mapping are small areas of Frio, Mereta, and Rowena soils. The included areas make up to 15 percent of the map unit.

This Nuvalde soil is mainly used as cropland. In some areas, this soil is used as rangeland or pastureland. Low rainfall is the main limitation for most uses.

Wheat, oats, grain sorghum, and cotton are the main crops on this soil. Crop residue left on the surface helps control water erosion and soil blowing, reduces soil temperature and evaporation, and improves soil tilth and water intake. Crops respond to nitrogen and phosphate fertilizers. Tilling when the moisture content is low improves aeration of the soil and prevents the formation of large clods. A few areas have been planted to kleingrass and coastal bermudagrass.

Most rangeland is in sideoats grama, buffalograss, silver bluestem, Texas wintergrass, mesquite, and pricklypear. Live oak trees are on some sites in the southern part of the county.

Foundations for buildings, roads, and other structures can be easily designed and constructed to withstand the shrinking and swelling of the soil. Corrosion of underground steel pipe is rapid unless the pipe is protected. Septic tank absorption fields can be constructed to function properly in this soil. Some garden and landscaping plants exhibit iron chlorosis because of the high lime content. Although farm ponds can be easily built, seepage is a problem.

This soil can be used for recreational uses; however, vehicle traffic is restricted in unprotected areas because the soil is muddy following rains.

This soil supports a good habitat for quail, dove, and turkey. Inadequate cover is a limiting factor for deer; however, the deer graze oat and wheat fields at night.

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

NuB—Nuvalde silty clay loam, 1 to 3 percent slopes. This soil is deep, well drained, and gently sloping. It is mainly in the shallow valleys and on high terraces on uplands. Slopes are smooth or slightly concave. The areas are oblong to irregular in shape and range from 10 to several hundred acres.

Typically, the surface is dark brown silty clay loam about 11 inches thick. The subsoil extends to a depth of 33 inches. It is brown silty clay loam that has accumulations of calcium carbonate in the lower part. The substratum to a depth of 60 inches is pink silty clay loam that has accumulations of calcium carbonate.

This soil is moderately alkaline and calcareous throughout. Surface runoff is slow. Permeability is moderate, and the available water capacity is high. Water erosion and soil blowing are moderate hazards.

Included with this soil in mapping are small areas of Cho, Frio, Karnes, Mereta, and Rowena soils. Also included are areas of a soil that is closely similar to the Nuvalde soil except it does not have an accumulation of carbonates within 40 inches of the surface. The included soils make up to 20 percent of the map unit.

This Nuvalde soil is mainly used as cropland or rangeland. A few areas have been planted to kleingrass and improved bermudagrass.

Wheat and oats are the main crops on this soil, but cotton and forage and grain sorghum are also grown. Terracing and contour farming help to control water erosion (fig. 2). Crop residue left on the surface helps control water erosion and soil blowing, conserves soil moisture, and improves soil tilth and water intake.

Most rangeland is in sideoats grama, buffalograss, silver bluestem, Texas wintergrass, mesquite, and pricklypear. Live oak trees are on some sites in the southern part of the county.

Foundations for buildings, roads, and other structures can be easily designed and constructed to withstand the shrinking and swelling of the soil. Corrosion of underground steel pipe is rapid unless the pipe is protected. Septic tank absorption fields can be constructed to function properly in this soil. Some garden and landscaping plants exhibit iron chlorosis because of

Figure 2.—On Nuvalde silty clay loam, 1 to 3 percent slopes, grain sorghum is planted and cultivated on the contour parallel to terraces.

the high lime content. Although farm ponds can be easily built, seepage is a problem.

This soil can be used for recreational uses; however, vehicle traffic is restricted in unprotected areas because the soil is muddy following rains.

The soil supports a good habitat for quail, dove, and turkey. Inadequate cover is a limiting factor for deer; however, the deer graze oat and wheat fields at night.

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

ORE—Oplin-Real complex, hilly. This complex consists of soils that are shallow and very shallow, well drained, and cobbly and gravelly. These soils are on hillsides. Slopes range from 8 to 30 percent. The areas are mainly irregular bands that are 100 to 1,000 feet in width and can extend up to several miles in length. The soils in this complex formed along the escarpment of the northern edge of the Edwards Plateau Land Resource Area.

Oplin soil is in all mapped areas and makes up about 50 percent of the complex. Real soil is in all mapped areas and makes up 40 percent of the complex. The Oplin soil is mainly on the upper slopes and summits of hills, and the Real soil is mainly on the hillside slopes (fig. 3).

The areas of this map unit are much larger and the composition more variable than that of other map units in the county. Areas of Oplin and Real soils are too small to be mapped separately at the scale used for the maps in the back of this publication. Mapping has been

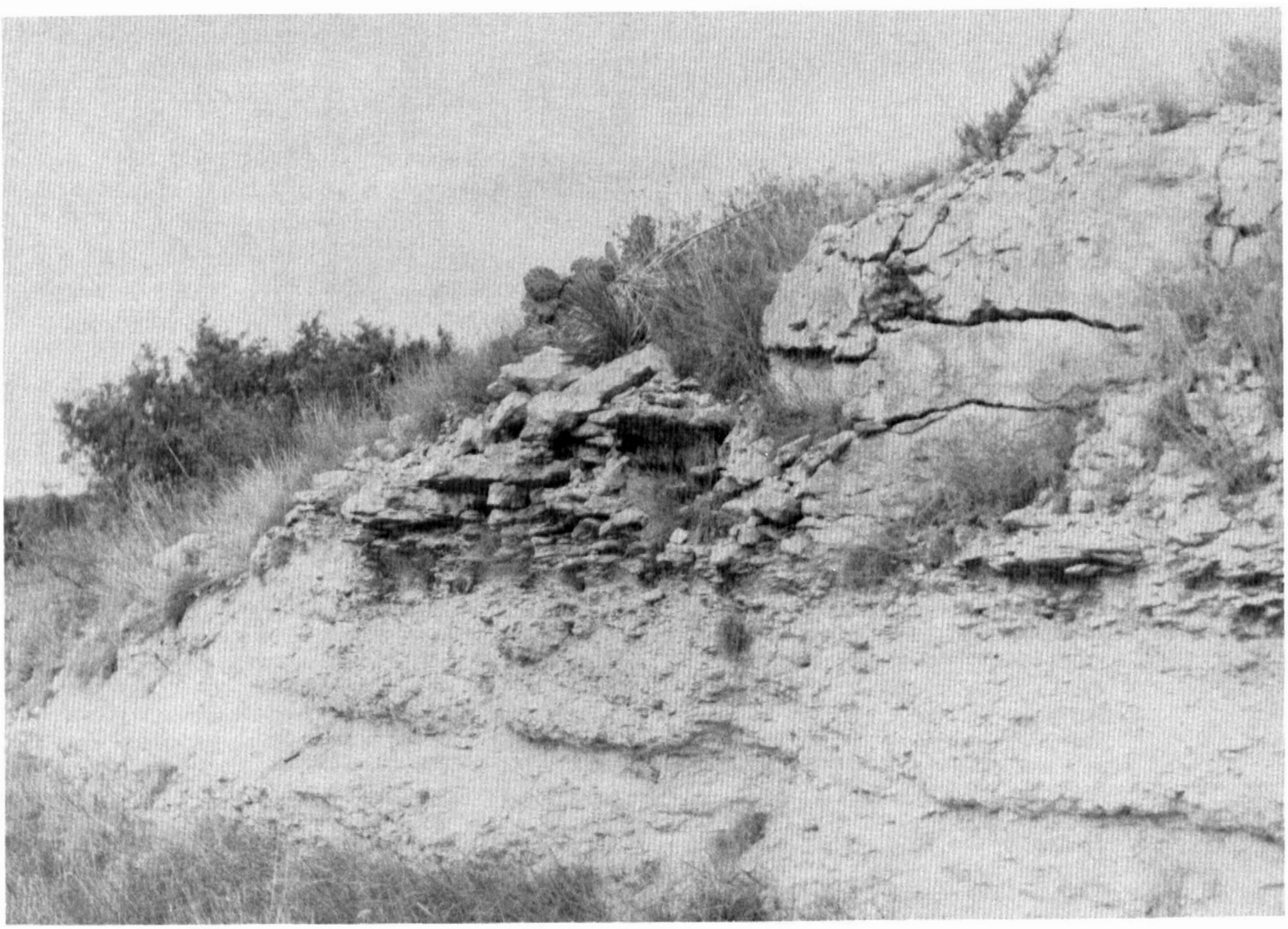


Figure 3.—A road cut in an area of Oplin-Real complex, hilly, reveals the hard limestone that underlies the Oplin soil. Real soil is in the lower part of the road cut. This soil developed in softer limestone and marl.

controlled well enough, however, for the anticipated use of the area involved.

Typically, the Oplin soil has a very dark grayish brown cobbly clay loam surface layer about 8 inches thick. It is about 65 percent gravels, channers, and cobbles of limestone. The underlying material is coarsely fractured, indurated and platy, limestone bedrock.

Typically, the Real soil has a very dark grayish brown surface layer about 12 inches thick. It is gravelly clay loam in the upper 4 inches and very gravelly clay loam below that. The underlying material is weakly cemented limestone that has dark grayish brown loam in the cracks and seams.

These soils are moderately alkaline and calcareous throughout. Surface runoff is rapid. Permeability is moderate, and the available water capacity is very low. The root zone is very shallow to shallow. Water erosion is a severe hazard.

Included with these soils in mapping are areas of Cho and Tarrant soils and rock outcrop. Also included are areas of Oplin and Tarrant soils that have stones and boulders on the surface. The included soils and rock outcrop make up about 10 percent of the map unit.

The soils of this complex are mainly used as rangeland or wildlife habitat. They are not suitable for use as cropland.

Growth of native range plants is low on these soils because of the shallow rooting depth and low available water capacity. Most rangeland is in threeawn, sideoats grama, slim tridens, silver bluestem, bushsunflower, agarito, pricklypear, live oak, and Texas oak. Cattle seldom graze the steeper slopes, but goats and sheep adapt well to the site.

Depth to bedrock, limestone cobbles, steep slopes, and very low available water capacity are the most limiting features for urban and recreational uses.

These soils provide fair habitat for deer and fair nesting areas for turkeys, quail, dove, and songbirds. The rough terrain attracts furbearing animals. The wide variety of vegetation is beneficial to wildlife. Maintaining a plant cover at all times is very important for wildlife and also helps to control erosion.

This complex is in capability subclass VIIs. The Oplin soil is in the Steep Rocky range site, and the Real soil is in the Steep Adobe range site.

Rc—Rioconcho clay loam, occasionally flooded. This soil is deep, moderately well drained, and nearly level. It is on flood plains in slightly depressional areas along major streams. Most areas of this soil are subject to flooding about once in each 3 to 10 years. Slopes are smooth and range from 0 to 1 percent. The areas are mostly long and narrow.

Typically, the surface layer is about 50 inches thick. It is dark grayish brown silty clay loam in the upper 5 inches. Below that, it is clay that is very dark grayish brown in the upper part and dark grayish brown in the lower part. The subsoil is brown clay loam to a depth of at least 60 inches.

This soil is moderately alkaline and calcareous throughout. Surface runoff is slow. Permeability is slow, and the available water capacity is high. Water erosion is a slight hazard, and soil blowing is a moderate hazard.

Included with this soil in mapping are areas of Frio, Gageby, and Rowena soils. The included soils make up about 20 percent of the map unit.

This Rioconcho soil is mostly used as cropland. In a few areas, it is used as rangeland or pastureland. Cotton, grain sorghum, and small grains are the main cultivated crops.

This soil is suited to wheat, oats, forage sorghum, cotton, and grain sorghum. Crop residue left on the surface helps to conserve moisture, control soil blowing, and maintain tilth and productivity.

Most rangeland is in curlymesquite, buffalograss, hairy dropseed, Texas wintergrass, white tridens, Texas grama, tobosagrass, and mesquite and hackberry.

This soil produces good habitat for deer and good nesting for dove, quail, turkey, and songbirds. The nearby trees, shrubs, and water attract furbearing animals.

This soil has severe limitations for most urban uses because of flooding, slow permeability, and the clayey texture. Flooding is also a hazard for most recreational uses, such as campsites and playgrounds.

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

RoA—Rowena clay loam, 0 to 1 percent slopes. This soil is deep, well drained, and nearly level. It is on outwash plains and in valleys on uplands. Slopes are smooth, and the surface is slightly concave to plane. The areas are oblong to irregular in shape and range from 10 to several hundred acres.

Typically, the surface layer is dark grayish brown clay loam about 6 inches thick. The subsoil extends to a depth of about 41 inches. It is dark brown clay to a depth of 29 inches. Below that, it is brown clay loam that has a few soft masses and concretions and many threads of calcium carbonate. The substratum is reddish yellow clay loam that has soft bodies of calcium carbonate.

This soil is calcareous and moderately alkaline throughout. Surface runoff is slow. Permeability is moderately slow, and the available water capacity is high. Water erosion is a slight hazard, and soil blowing is a moderate hazard.

Included with this soil in mapping are small areas of Angelo, Frio, Mereta, Nuvalde, Valera, and Tobosa soils. The included soils make up to 20 percent of the map unit.

This Rowena soil is mainly used as cropland. In a few areas, this soil is used as rangeland or pastureland. Low rainfall is the main limitation for most uses.

Wheat, oats, forage and grain sorghum, and cotton are the main crops on this soil. Crop residue left on the surface helps control water erosion and soil blowing, reduces soil temperature and evaporation, and improves soil tilth and water intake. Contour farming, terraces, and grassed waterways also help control erosion and conserve water. Tilling when the moisture content is low improves aeration of the soil and prevents the formation of large clods. A few areas have been planted to kleingrass and coastal bermudagrass.

Most rangeland is in sideoats grama, buffalograss, silver bluestem, Texas wintergrass, mesquite, and pricklypear. Live oak trees are on some sites in the southern part of the county.

Foundations for buildings, roads, and other structures can be designed and constructed to withstand the shrinking and swelling of the soil. Corrosion of underground steel pipe is rapid unless the pipe is protected. Septic tank absorption fields must be increased in size or modified in design in order to function properly in this soil. Although farm ponds can be easily built, seepage is a problem.

This soil can be used for recreational uses; however, vehicle traffic is restricted in unprotected areas because the soil is muddy following rains.

This soil supports a good habitat for quail, dove, and turkey. Inadequate cover is a limiting factor for habitat for deer; however, the deer graze oat and wheat fields at night.

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

RoB—Rowena clay loam, 1 to 3 percent slopes. This soil is deep, well drained, and gently sloping. It is mainly on outwash plains on uplands and old stream terraces in valleys. Slopes are smooth to slightly concave. The areas are oblong to irregular in shape and range from 10 to several hundred acres.

Typically, the surface layer is dark grayish brown clay loam about 6 inches thick. The subsoil extends to a depth of 36 inches. It is dark brown clay between depths of 6 and 31 inches and reddish yellow silty clay loam between depths of 31 and 36 inches. Common soft masses of calcium carbonate are in the lower part of the subsoil. The underlying material to a depth of 60 inches is reddish yellow clay loam that contains many soft masses of calcium carbonate.

This soil is calcareous and moderately alkaline throughout. Surface runoff is medium. Permeability is moderately slow, and the available water capacity is high. Water erosion and soil blowing are moderate hazards.

Included with this soil in mapping are areas of Angelo, Mereta, Nuvalde, Tobosa, and Valera soils. Also included are areas of Rowena soils that have slopes of 0 to 1 percent. The included soils make up to 20 percent of the map unit.

This Rowena soil is mainly used as cropland or rangeland. A few areas have been planted to kleingrass, King Ranch bluestem, and coastal bermudagrass.

Wheat, oats, cotton (fig. 4), and forage and grain sorghum are the main crops on this soil. Terracing and contour farming help control water erosion and conserve moisture. Crop residue left on the surface improves soil tilth and water intake, reduces soil temperature and evaporation, and helps control water erosion and soil blowing.

Most rangeland is in sideoats grama, buffalograss, silver bluestem, Texas wintergrass, mesquite, and pricklypear. Live oak trees are on some sites in the southern part of the county.

Foundations for buildings, roads, and other structures can be designed and constructed to withstand the shrinking and swelling of the soil. Corrosion of underground steel pipe is rapid unless the pipe is protected. Septic tank absorption fields must be increased in size or modified in design in order to function properly in this soil. Although farm ponds can be easily built, seepage is a problem.

This soil can be used for recreational uses; however, foot and vehicle traffic is restricted in unprotected areas because this soil is muddy following rains.

This soil supports a good habitat for quail, dove, and turkey. Inadequate cover is a limiting factor for habitat for deer; however, the deer graze wheat and oat fields at night.

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

SaB—Sagerton clay loam, 1 to 3 percent slopes. This soil is deep, well drained, and gently sloping. It is on high terraces along the Colorado River. Slopes are smooth or slightly concave. The areas are oblong to irregular in shape and range from 5 to about 100 acres.

Typically, the surface layer is dark brown clay loam about 7 inches thick. The subsoil extends to a depth of at least 65 inches. It is dark reddish gray clay to a depth of 16 inches and reddish brown clay to a depth of 47 inches. Below that, it is yellowish red clay loam.

This soil is mildly alkaline in the upper part and moderately alkaline in the lower part. Surface runoff is medium. Permeability is moderately slow, and the available water capacity is high. Water erosion is a moderate hazard, and soil blowing is a slight hazard.

Included with this soil in mapping are small areas of Miles, Nuvalde, Rowena, and Yahola soils. Also included are areas of Sagerton soils that are nearly level and a few areas of Sagerton loam. The included soils make up to 20 percent of the map unit. About 30 percent of this map unit is soils that are closely similar to the Sagerton soil, but are less than 50 inches deep, have a significant clay decrease, or have brownish colors at a depth of 60 inches.

Figure 4.—Cotton on Rowena clay loam, 1 to 3 percent slopes, is planted on the contour parallel to terraces to help control erosion and conserve moisture.

This Sagerton soil is mainly used as cropland. In some areas, it is used as rangeland.

Wheat, oats, and forage sorghum are the main crops. Terracing and contour farming help to control water erosion and conserve moisture. Crop residue left on the surface helps maintain thilth and control erosion.

Foundations for buildings, roads, and other structures can be designed and constructed to withstand the moderate shrinking and swelling of the soil. Corrosion of underground steel pipe is rapid unless the pipe is protected. Septic tank absorption fields must be increased in size or modified in design in order to function properly in this soil.

This soil can be used for recreational uses; however, foot and vehicle traffic is restricted in unprotected areas because the soil is muddy following rains.

The soil supports a good habitat for quail, dove, and turkey. Inadequate cover is a limiting factor for deer; however, the deer graze wheat and oat fields at night.

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

SpB—Speck cobbly clay loam, undulating. This soil is shallow, well drained, and gently sloping. It is mainly along slightly convex limestone ridges on uplands. Slopes are smooth and average about 2 percent but range from 1 to 5 percent. The areas are irregular in shape and range from 10 to 200 acres.

Typically, the surface layer is dark brown cobbly clay loam about 4 inches thick. The subsoil is reddish brown clay that extends to a depth of 14 inches. The underlying material is strongly cemented, fractured limestone.

This soil is neutral in the surface layer and mildly alkaline in the subsoil. Surface runoff is medium. Permeability is slow, and the available water capacity is very low. The root zone is shallow.

Included with this soil in mapping are small areas of Cho, Kavett, Lueders, and Talpa soils and small areas of soils similar to the Speck soil except they are deeper than 20 inches over limestone. These included soils make up less than 20 percent of the map unit. Also included are some soils that are not stony or that are gravelly and are underlain by conglomerate limestone and caliche. Small areas of Speck soils that are nearly level make up as much as 15 percent of a few mapped areas.

This Speck soil is mainly used as rangeland. Growth of native plants is limited because of the very low available water capacity and the shallow rooting depth. Most rangeland is in Texas wintergrass, buffalograss, sideoats grama, silver bluestem, ragweed, mesquite, tasajillo, and pricklypear.

Shallow depth to bedrock and coarse fragments are the most limiting features for urban and recreational uses. Excavations for structures and utility lines are difficult.

This soil provides a fair habitat for deer, turkey, and small nongame animals. Nesting areas for quail and dove are plentiful.

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

TAC—Talpa-Lueders-Cho complex, undulating. This complex is made up of soils that are well drained, nongravelly, gravelly, and very cobbly. These soils are mainly on plateaus and ridges on uplands. They formed from limestone of Permian age. Slopes are dominantly 1 to 8 percent. The areas are irregular in shape and range from 20 to several hundred acres.

This complex is about 30 percent Talpa soil and similar soils, about 30 percent Lueders soil and similar soils, about 15 percent Cho soil and similar soils, and about 25 percent other soils. Areas of this map unit are large, and the composition is variable over short distances. The detail, however, is adequate for the foreseeable uses of these soils.

The Talpa soil is mainly on the gently sloping ridgetops and side slopes. Typically, the surface layer is 8 inches thick. It is dark grayish brown loam in the upper 4 inches and dark brown gravelly loam below that. The surface layer rests abruptly on a thick layer of fractured limestone bedrock that is coated with calcium carbonate.

The Lueders soil is on moderately sloping side slopes and outcropping knolls. Typically, the surface layer is about 10 inches thick. It is dark grayish brown very cobbly loam that grades to extremely cobbly clay loam. The surface layer rests abruptly on a thick layer of fractured limestone.

The Cho soil is on gently sloping side slopes and ridgetops. Typically, the surface layer is dark grayish brown gravelly loam about 7 inches thick. The next layer extends to a depth of 15 inches. It is hard caliche. The underlying material to a depth of 47 inches is white and pink loamy earth. It rests abruptly on a thick layer of very coarsely fractured limestone.

The soils in this complex are calcareous and moderately alkaline throughout. Runoff is rapid. Permeability is moderate, and the available water capacity is very low.

Included with this complex in mapping are areas of Kavett, Mereta, Nuvalde, and Throck soils and areas of rock outcrop. The Kavett and Mereta soils are shallow, and the Nuvalde and Throck soils are deep. Also included are areas of a soil similar to the Lueders soil except it is clayey and less cobbly. Small areas of the Lueders soil that is strongly sloping are also included. The included soils make up about 20 percent of the map unit.

The soils of this complex are generally not suited to cultivated crops or pastures because they are too cobbly or too shallow. A few acres of these soils are arable, but the areas are so small and irregular in shape that cultivation is impractical. These soils are best suited to use as rangeland and this is the major use (fig. 5).

Most rangeland is in threeawn, Texas wintergrass, silver bluestem, buffalograss, curlymesquite, dropseed, pricklypear, perennial croton, agarito, pricklyash, ephedra, and mesquite.

These soils provide habitat for deer and good nesting areas for doves, quail, turkey, and songbirds.

These soils have severe limitations for most urban and recreational uses. Depth to limestone bedrock and coarse fragments on the surface are the most limiting features.

The soils in this complex are in capability subclass VIIs and in the Very Shallow range site.

TKC—Tarrant-Oplin-Kavett association, undulating. These soils are well drained and are mainly on low, rounded hills and convex ridges on cobbly uplands. Slopes range from 1 to 8 percent but average about 5 percent. The areas are irregular in shape and range from 20 to several thousand acres.

This association is about 33 percent Tarrant soil, about 30 percent Oplin soil, about 17 percent Kavett soil and soils that have a petrocalcic horizon underlain by limestone, and about 20 percent other soils and rock outcrop. The areas of this map unit are large, and the

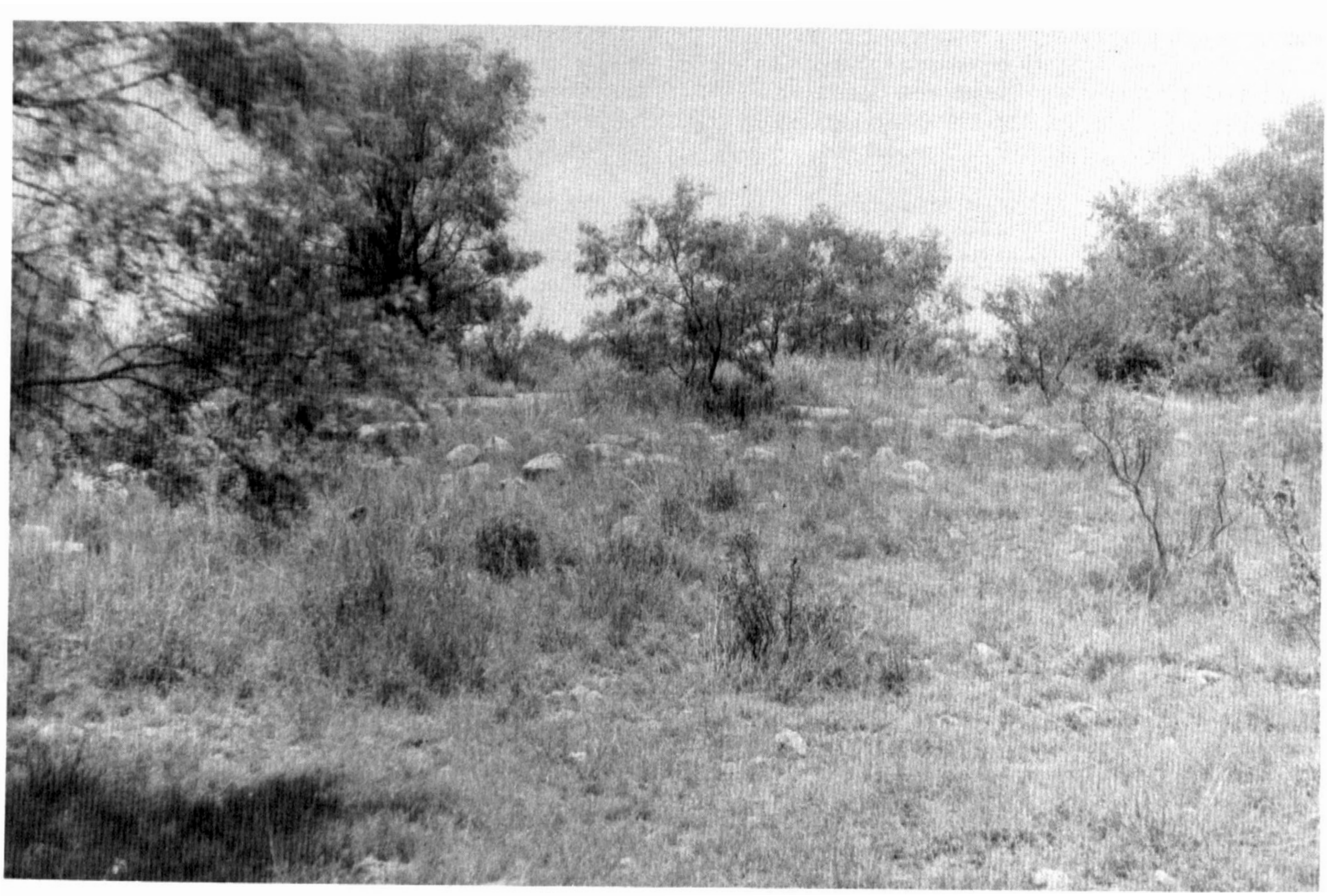


Figure 5.—The soils in the Talpa-Lueders-Cho complex, undulating, are used mainly as rangeland and are in the Very Shallow range site.

composition is variable. The detail, however, is adequate for the foreseeable uses of the soils.

The Tarrant soil is mainly on small knolls and in steeper sloping areas where limestone has outcropped and fractured, allowing live oak trees to become established. Typically, the surface layer is about 13 inches thick. It is dark gray cobbly clay in the upper 10 inches and dark brown extremely flaggy clay below that. The surface layer rests abruptly on a thick layer of coarsely fractured limestone.

Tarrant soil is calcareous and moderately alkaline throughout. Surface runoff is medium to rapid. Permeability is moderately slow, and the available water capacity is very low.

The Oplin soil is on ridgetops and in open, less sloping areas between limestone outcrops. Typically, the surface layer is dark grayish brown and is about 14 inches thick. It is cobbly clay loam in the upper 7 inches and very flaggy clay loam below that. The surface layer rests abruptly on a thick layer of coarsely fractured limestone.

Oplin soil is calcareous and moderately alkaline throughout. Surface runoff is medium to rapid. Permeability is moderate, and the available water capacity is very low.

The Kavett soil is mainly in slight depressions and along drainageways. Typically, the surface layer is dark grayish brown clay about 11 inches thick. A few scattered stones and cobbles are on the surface. The subsoil is strongly cemented, pinkish white caliche to a depth of about 17 inches. It is underlain by a thick layer of fractured, strongly cemented limestone.

Kavett soil is calcareous and moderately alkaline throughout. Surface runoff is slow to medium. Permeability is moderately slow, and the available water capacity is very low.

Included with these soils in mapping are areas of Cho and Mereta soils. These soils are in bands along side slopes between limestone outcrops and on concave ridgetops. Mesquite, agarita, and short grasses typify these areas. Also included are some areas of Tarrant and Oplin soils that have stones and boulders on the surface. Small areas of rock outcrop are at the outer edges of ridges and along steeper side slopes.

The Tarrant, Oplin, and Kavett soils are too shallow and cobbly to be cultivated. They are best suited to use as rangeland.

Potential for growing native plants is low. Low available water capacity and restricted rooting depth limit forage production. The climax plant community consists of a mixture of tall and mid grasses, forbs, and live oak trees (fig. 6). Proper management includes acceptable stocking rates, controlled grazing, and brush control.

These soils provide good habitat for deer and good nesting areas for dove, quail, turkey, and songbirds. Furbearing animals are also attracted to areas of these soils.

These soils have severe limitations for most urban and recreational uses because of the depth to limestone bedrock, the cobbly surface layer, and the corrosivity to uncoated steel.

Tarrant and Oplin soils are in capability subclass VIIs and in the Low Stony Hills range site. Kavett soil is in capability subclass IVe and in the Shallow range site.

ToA—Tobosa clay, 0 to 1 percent slopes. This soil is deep, well drained, and nearly level. It is in broad, flat drainageways on uplands. Slopes are smooth or slightly concave. The areas are broad to irregular in shape and range from 10 to more than 500 acres. Undisturbed rangeland areas have gilgai microrelief that consists of knolls and depressions that are repeated in cycles of 12 to 24 feet. Evidence of gilgai is destroyed after a few years of cultivation.

Typically, the surface layer is dark grayish brown clay 30 inches thick. The subsoil, to a depth of 56 inches, is grayish brown clay. Slickensides are common in the subsoil. The substratum to a depth of 65 inches is pale brown clay.

This soil is moderately alkaline and calcareous throughout. Surface runoff is slow. When this soil is dry, it has wide surface cracks that extend deep into the

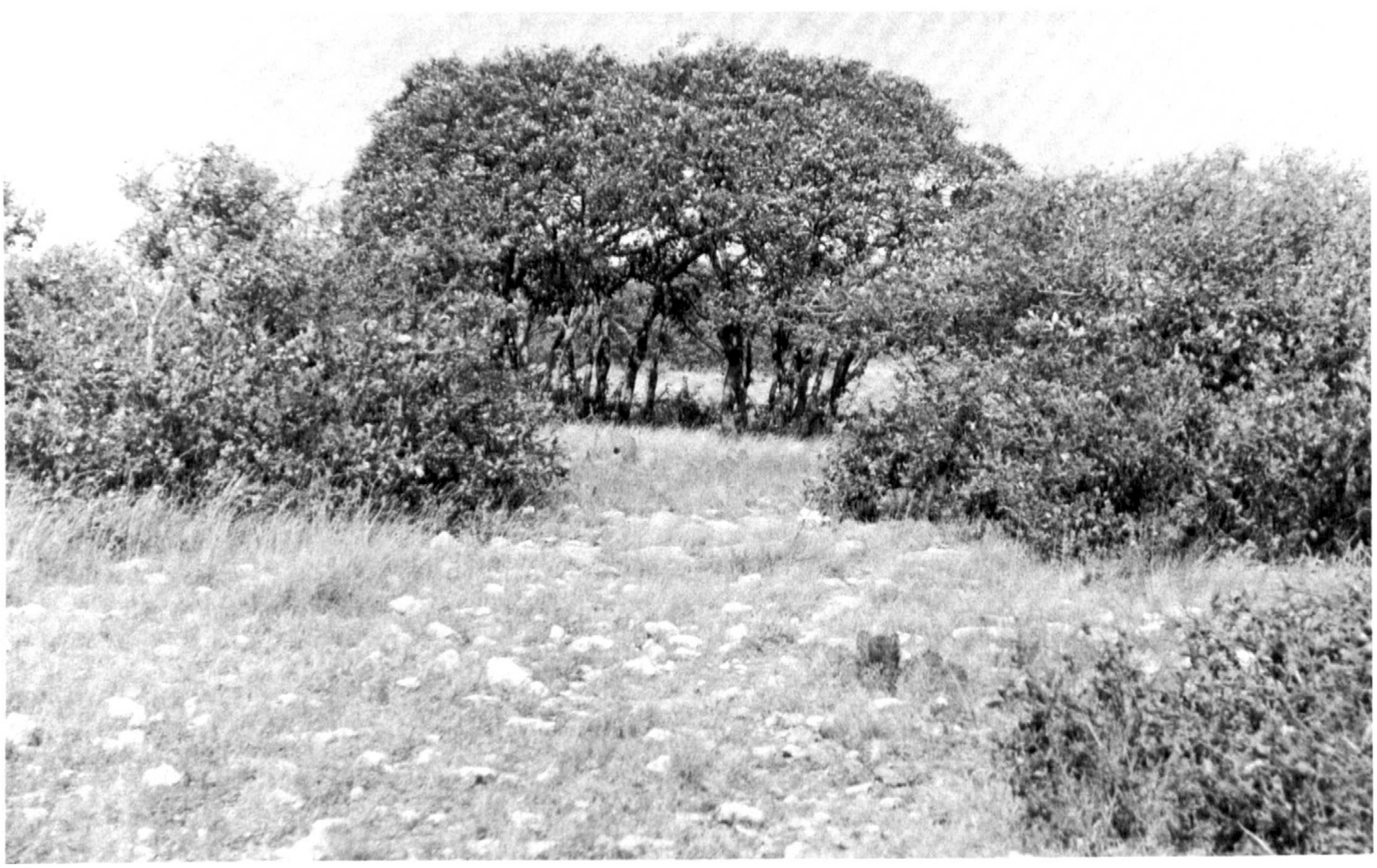


Figure 6.—Rangeland in the Tarrant-Oplin-Kavett association, undulating, provides cover and a wide variety of browse plants for wildlife.

Figure 7.—Cracks that are often several feet deep form in Tobosa clay, 0 to 1 percent slopes, when the soil is dry.

subsoil (fig. 7). Water enters the dry, cracked soil rapidly; but it enters the wet soil very slowly because the soil swells and the cracks are closed. Permeability then becomes very slow. The available water capacity is high. Soil blowing is a moderate hazard, and water erosion is a slight hazard.

Included with this soil in mapping are small areas of Angelo, Lipan, Rowena, and Valera soils. Also included are areas of soils similar to the Tobosa soil except they do not have slickensides in the subsoil. The included soils make up to 20 percent of the map unit.

This Tobosa soil is used as cropland or rangeland. A few areas have been planted to kleingrass.

Wheat, oats, cotton, and grain sorghum are the main crops on this soil. Crop residue left on the surface helps control water erosion and soil blowing, conserves soil moisture, and improves soil tilth and water intake.

Most rangeland is in buffalograss, curlymesquite, vine-mesquite, Texas wintergrass, silver bluestem, and dropseeds. Mesquite trees have increased in most areas and are a major management problem.

Foundations for buildings, roads, and other structures must be constructed to withstand the shrinking and swelling of the soil. Corrosion of underground steel pipe is rapid unless the pipe is protected. Septic tank filter fields must be very large because the infiltration rate is very slow. Sewage lagoons function well on this soil.

This soil is suited to most recreational uses; however, foot and vehicle traffic is restricted in unprotected areas because the soil is wet, sticky, and muddy following rains.

This soil supports a fair habitat for dove and quail. Inadequate cover is a limiting factor for deer; however, the deer graze wheat and oat fields at night.

This Tobosa soil is in capability subclass IIIs and in the Clay Flat range site.

ToB—Tobosa clay, 1 to 3 percent slopes. This soil is deep, well drained, and gently sloping. It is on uplands. Slopes are smooth to slightly convex. The areas are irregular in shape and range from 10 to 500 acres. In undisturbed areas, the surface of this soil has weak gilgai microrelief that is made up of microknolls and microdepressions. The microknolls are 1 to 10 inches higher than the microdepressions. Cycles are repeated every 12 to 24 feet. Evidence of Gilgai microrelief is destroyed after a few years of cultivation.

Typically, the surface layer is 25 inches thick. It is dark grayish brown clay in the upper 9 inches and grayish brown clay below that. The subsoil, to a depth of 50 inches, is grayish brown clay that has soft masses of calcium carbonate. The underlying material to a depth of 60 inches is light gray clay that has soft masses of calcium carbonate.

This soil is moderately alkaline and calcareous throughout. Surface runoff is medium. When this soil is dry, it has wide surface cracks. Water enters the dry, cracked soil rapidly; but it enters the wet soil very slowly because the soil swells and the cracks are closed. Permeability then becomes very slow. The available water capacity is high. Water erosion and soil blowing are moderate hazards.

Included with this soil in mapping are small areas of Angelo, Lipan, Rowena, and Valera soils. Also included are a few small areas of a soil that is similar to the Tobosa soil except it has limestone bedrock at a depth of about 40 inches. The included soils make up to 20 percent of the map unit.

This Tobosa soil is used as cropland or rangeland. A few areas have been planted to kleingrass and King Ranch bluestem.

Wheat, oats, grain and forage sorghum, and cotton are the main crops on this soil. Crop residue left on the surface helps control water erosion and soil blowing, conserves soil moisture, and improves soil tilth. Terracing and contour farming help control water erosion and conserve moisture. Grassed waterways provide good outlets for terrace systems where excess water is a concern.

Most rangeland is in buffalograss, curlymesquite, vine-mesquite, Texas wintergrass, silver bluestem, and dropseeds. Mesquite trees have increased in most areas and are a major management problem.

Foundations for buildings, roads, and other structures must be constructed to withstand the shrinking and swelling of the soil. Corrosion of underground steel pipe is rapid unless the pipe is protected. Septic tank filter fields must be very large because the infiltration rate is very slow.

This soil is suited to most recreational uses; however, foot and vehicle traffic is restricted in unprotected areas because the soil is wet, sticky, and muddy following rains. Slope is a limiting factor for some playgrounds.

This soil supports a fair habitat for dove and quail. Inadequate cover is a limiting factor for deer; however, the deer graze wheat and oat fields at night.

This Tobosa soil is in capability subclass IIIe and in the Clay Flat range site.

VaB—Valera silty clay, 1 to 3 percent slopes. This soil is moderately deep, well drained, and gently sloping. It is mainly in shallow valleys on uplands, but some areas of this soil are on plateaus or benches. The areas are irregular in shape and range from 10 to about 150 acres.

Typically, the surface layer is dark grayish brown silty clay about 36 inches thick. It contains about 8 percent limestone fragments between depths of 18 and 36 inches. The subsoil is strongly cemented, pink calcium carbonate that contains many small fragments of limestone. The underlying material is fractured limestone.

This soil has medium surface runoff. Permeability is moderately slow, and the available water capacity is moderate. Soil blowing and water erosion are moderate hazards.

Included with this soil in mapping are areas of Kavett, Mereta, Rowena, and Tobosa soils. Also included are a few areas of soils that have slopes of less than 1 percent. The included soils make up to 20 percent of the map unit.

This Valera soil is used as cropland or rangeland. A few areas have been planted to kleingrass or King Ranch bluestem.

Wheat, oats, grain sorghum and forage sorghum are the main crops on this soil (fig. 8). Terracing and contour farming help control water erosion and conserve moisture. Cutting into strongly cemented caliche is a hazard if cuts or excavations exceed a depth of 20 inches. Crop residue left on the surface helps to conserve soil moisture, controls water erosion and soil blowing, and maintains soil tilth.

Most rangeland is in buffalograss, Texas wintergrass, vine-mesquite, threeawn, and mesquite. Live oak trees are on sites in the southern part of the county.

Foundations for buildings, roads, and other structures must be constructed to withstand the shrinking and swelling of the soil. Corrosion of underground steel pipe is rapid unless the pipe is protected. Septic tank absorption fields must be increased in size or modified in design in order to properly function in this soil. Limestone bedrock is a problem when excavating deeper than 40 inches.

Figure 8.—Winter wheat is one of the main crops grown on Valera silty clay, 1 to 3 percent slopes.

This soil is suited to most recreational uses; however, foot and vehicle traffic is restricted in unprotected areas because the soil is wet, sticky, and muddy following rains. Slope is a limiting factor for some playgrounds.

This soil supports a good habitat for dove, quail, and rabbits. Inadequate cover is a limiting factor for deer; however, the deer graze oat and wheat fields at night.

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

Ya—Yahola fine sandy loam, rarely flooded. This soil is deep, well drained, and nearly level to gently sloping. It is on flood plains of the Colorado River. Slopes are smooth to weakly convex and range from 0 to 2 percent. The areas are oblong to elongated and range from 10 to a few hundred acres. This soil ranges from 30 to 40 feet above the normal stream flow.

Typically, the surface layer is brown fine sandy loam about 9 inches thick. The underlying material to a depth of 36 inches is light reddish brown fine sandy loam. To a depth of 60 inches it is light reddish brown loam. Stratifications of various textures occur throughout.

This soil is calcareous and moderately alkaline throughout. Surface runoff is slow. Permeability is moderately rapid, and the available water capacity is moderate. In the past, flooding has been rare, averaging about once every 15 to 25 years. This soil has not flooded, however, since large flood-control reservoirs were installed. Soil blowing and water erosion are moderate hazards.

Included with this soil in mapping are small areas of Gageby soils. Also included are small areas of a soil similar to the Yahola soil except it is silty clay loam or is stratified with clay loam throughout. The included soils make up less than 15 percent of the map unit.

This Yahola soil is mainly used as cropland. In a few areas, it is used as rangeland or improved pasture.

Oats, wheat, and forage sorghum are the main crops on this soil. A few areas have been planted to kleingrass. Crop residue left on the surface helps to control soil blowing and water erosion. Crops respond to nitrogen and phosphate fertilizer.

This soil is not suited to urban uses because of the risk of flooding, but it is suited to most recreational uses.

This soil supports a good habitat for deer, quail, dove, turkey, and songbirds.

This Yahola soil is in capability subclass IIe and in the Loamy Bottomland range site.

YC—Yahola fine sandy loam, channeled. This soil is deep, well drained, and nearly level to gently sloping. It is on bottom lands along the Colorado River. The landscape is a succession of slopes and benches. The steps range from nearly vertical banks of old streambanks to nearly level benches. The height from the bottom of the river channel to the highest levels in the map unit averages about 30 feet, but in some places the range is from 20 to 40 feet. The bottom lands are dissected in places by river channels, gullies, and by small drainageways. Most areas range from 200 to 600 feet in width, 0.25 mile to several miles in length, and are 30 to a few hundred acres. The areas form a nearly continuous, elongated band along the Colorado River and extend for short distances up tributaries.

Typically, the surface layer is reddish yellow and brown fine sandy loam about 6 inches thick. The underlying material to a depth of 60 inches is reddish yellow fine sandy loam that has strata of various textures.

This soil is calcareous and moderately alkaline throughout. It is flooded for brief periods at least once annually in low areas, but flooding is less frequent on the higher benches. Scouring and deposition take place with each flood. Surface runoff is slow to medium. Permeability is moderately rapid, and the available water capacity is moderate. The root zone is deep, and the soil is easily penetrated by plant roots. Soil blowing and water erosion are moderate hazards.

Included with this soil in mapping are small areas of soils similar to the Yahola soil except they are stratified sandy clay loam and silty clay throughout or they have stratified sandy underlying material. Also included in the river bed are areas of soils that are gravelly throughout. The included soils make up as much as 20 percent of the map unit.

Flooding and short steep slopes below benches limit this Yahola soil to use as rangeland and wildlife habitat.

This soil is well suited to native range plants. Native plants are mostly mid and tall grasses that produce high amounts of forage during favorable years. Most rangeland is in hooded windmillgrass, tumble windmillgrass, Canada wildrye, sand dropseed, and pecan, elm, and hackberry trees. Erosion in overfall gullies is a concern in some places.

Flooding is a severe hazard for urban development. This Yahola soil is poorly suited to most recreational uses because of flooding.

This soil provides good habitat for squirrels, turkeys, deer, and quail. The trees, shrubs, and water attract furbearing animals. Wildlife is attracted to this site mainly because of the mast, seed-producing forbs, winter annuals, and cover. Turkeys commonly roost in the large trees. Many songbirds frequent the areas for food, cover, and nesting.

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

Prime Farmland

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

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 182,368 acres, or nearly 29 percent of the acreage in Concho County, meets the requirements for prime farmland soils. Areas of these soils are scattered throughout the county, but general soil map units 2, 5, and 7 have the largest areas of prime farmland soils. Map units 4 and 8 have substantial areas, and map units 1, 3, and 6 have small scattered areas of prime farmland.

Crops grown on these soils are mainly cotton, grain sorghum, oats, wheat, and forage sorghum. Some pecans are produced on bottom land soils during favorable years.

The following map units, or soils, make up prime farmland in Concho County. Small areas of these soils, however, are urban or built-up land. 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.

AnA Angelo silty clay loam, 0 to 1 percent slopes
AnB Angelo silty clay loam, 1 to 3 percent slopes
Fo Frio silty clay loam, occasionally flooded
Ga Gageby loam, rarely flooded
NuA Nuvalde silty clay loam, 0 to 1 percent slopes
NuB Nuvalde silty clay loam, 1 to 3 percent slopes
Rc Rioconcho siltly clay loam, occasionally flooded
RoA Rowena clay loam, 0 to 1 percent slopes
RoB Rowena clay loam, 1 to 3 percent slopes
SaB Sagerton clay loam, 1 to 3 percent slopes
ToA Tobosa clay, 0 to 1 percent slopes
ToB Tobosa clay, 1 to 3 percent slopes

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 and woodland; 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 records of the local office of the Soil Conservation Service, about 156,513 acres in Concho County was used for crops in 1984. Of this, 65,971 acres was used for row crops; 72,448 acres for close-growing crops, mainly wheat and oats; and the rest was idle cropland or cropland for conservation use.

Soil erosion is the major problem on nearly all of the cropland. Water erosion is a hazard in the larger areas of nearly level soils and on the more sloping Angelo, Mereta, Nuvalde, Rowena, and Tobosa soils. Runoff can damage these soils unless they are protected. Plant cover, contour farming, terraces, and grassed waterways minimize the risk of water erosion. Soil blowing is a hazard especially during periods of drought and during windstorms that occur in winter or spring. Cotton can provide adequate cover during the growing season, but it does not leave enough residue for soil protection and improvement. Rotation crops of cotton with grain sorghum and wheat increase residue and minimize soil blowing.

Loss of the surface layer through water erosion or soil blowing reduces productivity 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 or the depth of the root zone is limited by a layer, such as the indurated caliche layer in Kavett or Mereta soils.

Water erosion on farmland also results in sedimentation of streams. Controlling water erosion minimizes the pollution of streams by sediment and improves the quality of water for urban and recreation uses and for use by wildlife. Erosion control practices need to provide protective surface cover, reduce runoff, and increase water intake. A cropping system that keeps a plant cover on the soil for long periods can hold soil erosion losses to amounts that do not reduce yields.

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

Conservation tillage for grain sorghum, which is common on an increasing acreage, 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 of water. Terraces are most practical on deep and moderately deep soils that have smooth slopes. On the nearly level Angelo, Nuvalde, and Rowena 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 need to be constructed before terraces are built.

Information regarding the design of erosion control practices for the soils in Concho County is available in local offices of the Soil Conservation Service.

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

Soil tilth is important in the germination of seeds and in the rate of water intake. 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 Lipan and Tobosa soils are clayey and often remain wet until late in spring. If these soils are wet when plowed, they tend to be cloddy when they dry. Good seedbeds are difficult to prepare in a cloddy soil. 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 crops commonly grown in Concho County are cotton, grain sorghum, wheat, oats, barley, millet, hay, and forage sorghums.

Special crops include mainly vegetables and fruit trees. Soils that are deep, have good natural drainage, and that warm up early in the spring are especially well suited to many vegetables. Production is limited mainly by the amount of rainfall or the availability of irrigation water.

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

Water for irrigation is scarce, and the demand for water for irrigation is increasing. The energy needed to pump water is becoming more expensive; therefore, efficient irrigation is essential. Irrigation should be used only on the best soils. It should be applied uniformly, without water loss, in amounts and at intervals that promote adequate plant growth. Proper irrigation wets the entire root zone so that most of the water is below the rapid evaporation area.

Sprinkler irrigation is less efficient in hot, dry areas. On some windy summer days, 40 percent of the water pumped is lost to evaporation before it soaks into the soil. Some sprinkler systems wet only the surface layer where evaporation loss is great. Because sprinklers require water under pressure, pumping costs are greater than for surface irrigation. The advantage of sprinkler irrigation is that little land leveling is required.

Row irrigation or border irrigation, if the system is properly designed and used, is generally the most efficient in Concho County. However, more labor and land leveling may be required than for other irrigation methods.

The best soils for irrigation are nearly level and have a deep root zone and high available water capacity. The best soils in Concho County are the Angelo, Frio, Gageby, Nuvalde, Rioconcho, Tobosa, and Rowena soils.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that insures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils 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.

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.

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.

There are no subclasses in class I because the soils of this class have few limitations. 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.*

The capability classification of each map unit is given in the section "Detailed Soil Map Units," and in table 5.

Rangeland

John A. Wright, range conservationist, Soil Conservation Service, assisted in preparing this section.

About 473,751 acres, or 75 percent of all land in Concho County, is rangeland. Raising livestock is a major enterprise in the county. The main source of forage for livestock is rangeland. Income from hunting leases and other recreational enterprises on rangeland is becoming increasingly important.

Most ranchers are managing for a cow-calf or ewe-lamb operation, or both. Some also raise angora goats. Stocker steers or heifers make up a significant part of some herds. Several ranchers specialize in breeding and selling purebred or crossbred cattle.

On many ranches, forage produced on rangeland is supplemented by tame pasture, forage sorghums, crop stubble, and small grains. In winter, the native forage is generally supplemented with protein concentrate. Creep feeding of calves and lambs to increase market weight is practiced on a few ranches.

The desirable native vegetation in many parts of the survey area has been mostly depleted by continued excessive use. Much of the acreage that was once open grassland is now covered with mesquite brush, cactus, and weeds. The amount of forage presently produced may be less than half of that originally produced. Productivity of the range can be increased by using management practices that are effective for specific kinds of soils and range sites.

Three distinct types of rangeland exist in the county. The more extensive type is very shallow and shallow, undulating soils that are underlain by limestone. This rangeland is mainly in the southern half of the county (general soil map unit 1). The soils support short and mid grasses and some tall grasses interspersed with a variety of forbs, shrubs, and live oak trees. Potential productivity is low to medium.

Throughout the northern half of the county are tracts of rangeland that are generally open prairies. This rangeland is very shallow and shallow, undulating soils that are underlain mainly by caliche and some limestone (general soil map units 3, 4, and 6). The soils support mid and tall grasses. Potential production is low to medium.

Scattered throughout the county are valleys and plains. This rangeland is shallow to deep soils that formed in valley fill and outwash plains material (general soil map units 2 and 5). The soils support mainly mid grasses. Mesquite has invaded most areas because of the lack of brush management. Potential productivity is medium to high.

Deep soils along the Concho and Colorado Rivers are highly productive. The soils support mid and tall grasses and a variety of trees and shrubs.

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 6 shows for each soil, the range site and the potential annual production of vegetation in favorable, normal, and unfavorable years. The characteristic vegetation and the average percentage of each species is shown in table 7. Only those soils that are used as rangeland or are suited to use as rangeland are listed. Explanation of the column headings in table 6 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from climax plant communities on other range sites in kind, amount, or proportion of range plants. The relationship between soils and vegetation was established during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Potential annual production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the climax plant community. This 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, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre of air-dry vegetation. 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.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the climax plant community on each soil—is listed by common name on table 7. The expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the 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 potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only. It does not have a specific meaning that pertains to the present plant community in a given use.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the climax plant community for that site. Such management generally results in the optimum production of vegetation, reduction of undesirable brush species, 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.

Table 7 lists the percent of plants in the characteristic vegetation of each range site that occurs in Concho County. Composition is expressed as a percentage of total production on the air-dry basis. In each column, percentages followed by the same letter are grouped together to equal the indicated percentage. Example: If three plants each are identified with a 10a percentage, the three plants together equal 10 percent of the total composition in the climax state.

In Concho County, 11 range sites have been identified. They are the Clay Flat, Clay Loam, Loamy Bottomland, Low Stony Hills, Redland, Rocky Hills, Sandy Loam, Shallow, Steep Adobe, Steep Rocky, and Very Shallow range sites.

Clay Flat range site. The Lipan and Tobosa soils (map units LpA, ToA, ToB) are in this range site.

Sideoats grama, vine-mesquite, white tridens, and Engelmann-daisy are grazed out by domestic livestock. These plants are replaced by Texas wintergrass, buffalograss, purple threeawns, and curlymesquite. If heavy grazing continues for many years, lotebush, mesquite, tasajillo, and pricklypear invade with an understory of such plants as Texas grama, red grama, and hairy tridens.

Clay Loam range site. The Angelo, Karnes, Nuvalde, Rowena, Sagerton, and Valera soils (map units AnA, AnB, KaB, NuA, NuB, RoA, RoB, SaB, VaB) are in this range site.

Sideoats grama, Texas cupgrass, Canada wildrye, cane bluestem, vine-mesquite, white tridens, and Engelmann-daisy are grazed out by domestic livestock. These plants are replaced by buffalograss, Texas wintergrass, and silver bluestem. If heavy grazing continues for many years, mesquite, lotebush, tasajillo, and pricklypear invade and form a dense stand with an understory of such plants as red grama, Texas grama, hairy tridens, threeawns, western ragweed, and broomweed.

Loamy Bottomland range site. The Dev, Frio, Gageby, Rioconcho, and Yahola soils (map units DV, Fo, Fr, Ga, Rc, Ya, YC) are in this range site.

Big bluestem, little bluestem, switchgrass, Canada wildrye, Engelmann-daisy, bushsunflower, and sensitivebrier are grazed out by domestic livestock. These plants are replaced by sideoats grama, vine-mesquite, silver bluestem, meadow dropseed, and Texas wintergrass. If heavy grazing continues for many years, mesquite, agarito, lotebush, tasajillo, and pricklypear invade and form a dense stand with an understory of such plants as buffalograss, curlymesquite, red grama, hairy tridens, threeawns, silver bluestem, rescuegrass, western ragweed, and broomweed.

Low Stony Hills range site. The Oplin and Tarrant soils (map units KXB, TKC) are in this range site.

Little bluestem, sideoats grama, indiangrass, Canada wildrye, green sprangletop, Engelmann-daisy, and bushsunflower are grazed out by domestic livestock. These plants are replaced by silver bluestem, plains lovegrass, Halls panicum, Texas wintergrass, and orange zexmenia. If heavy grazing continues for many years, ash juniper, pricklyash, agarito, catclaw, and shinoak invade with an understory of such plants as Texas grama, curlymesquite, red grama, hairy tridens, tasajillo, and pricklypear.

Redland range site. The Speck soils (map unit SpB) are in this range site.

Big bluestem, little bluestem, sideoats grama, and Engelmann-daisy are grazed out by domestic livestock. These plants are replaced by Texas wintergrass, buffalograss, curlymesquite, and Halls panicum. If heavy grazing continues for many years, mesquite, catclaw, pricklyash, and lotebush invade with an understory of such plants as Texas grama, red grama, threeawns, pricklypear, and tasajillo.

Rocky Hills range site. The Throck soils (map unit LTE) are in this range site.

Big bluestem, little bluestem, and Texas cupgrass are grazed out by domestic livestock. These plants are replaced by sideoats grama, silver bluestem, Texas wintergrass, curlymesquite, slim tridens, and hairy dropseed. If heavy grazing continues for many years, mesquite, elbowbush, lotebush, catclaw acacic, tasajillo, and pricklypear invade with an understory of such plants as hairy tridens, threeawns, Texas grama, and queensdelight.

Sandy Loam range site. The Miles soils (map unit MfB) are in this range site.

Little bluestem, sand lovegrass, indiangrass, and Engelmann-daisy are grazed out by domestic livestock. These plants are replaced by buffalograss, sideoats grama, Texas wintergrass, and hooded windmillgrass. If heavy grazing continues for many years, mesquite, whitebrush, lotebush, catclaw acacia, and tasajillo invade and form a dense stand with an understory of sand dropseed, hooded windmillgrass, sand paspalum, gummy lovegrass, and threeawns.

Shallow range site. The Kavett and Mereta soils (map units EKB, KtB, KXB, MeA, MeB, TKC) are in this range site.

Sideoats grama, cane bluestem, little bluestem, and bushsunflower are grazed out by domestic livestock. These plants are replaced by buffalograss, curlymesquite, sand dropseed, slim tridens, orange zexmenia, and agarito. If heavy grazing continues for many years, mesquite, catclaw acacia, lotebush, yucca, and pricklyash invade with an understory of such plants as hairy tridens, red grama, threeawns, and tasajillo.

Steep Adobe range site. The Real soils (map unit ORE) are in this range site.

Indiangrass, sideoats grama, and little bluestem are grazed out by domestic livestock. These plants are replaced by silver bluestem, hairy dropseed, slim tridens, and live oak. If heavy grazing continues for many years, ash juniper invades and forms a dense stand with an understory of Texas grama, red grama, hairy tridens, threeawns, and queensdelight.

Steep Rocky range site. The Oplin soils (map unit ORE) are in this range site.

Green sprangletop, sideoats grama, and little bluestem are grazed out by domestic livestock. These plants are replaced by tall dropseed, Texas wintergrass, rough tridens, and elbowbush. If heavy grazing continues for many years, ash juniper, pricklyash, Texas persimmon, mesquite, Mexican buckeye, and lotebush invade and form a dense stand with a sparse understory of such plants as cedar, sedge, hairy tridens, and threeawns.

Very Shallow range site. The Cho, Eola, Lueders, and Talpa soils (map units ChB, COC, EKB, KXB, LTE, TAC) are in this range site.

Little bluestem, cane bluestem, and sideoats grama are grazed out by domestic livestock. These plants are replaced by buffalograss, curlymesquite, fall witchgrass, sand dropseed, and Texas wintergrass. If heavy grazing continues for many years, sacahuista, pricklypear, yucca, pricklyash, catclaw, red grama, and hairy tridens invade.

Windbreaks and Environmental Plantings

Edward Holcombe, forester, Soil Conservation Service, assisted in writing this section.

Woody plants serve several purposes in Concho County. Trees and shrubs reduce wind erosion on cropland and are used for farmstead protection. They screen dwellings for privacy and reduce noise pollution. These plants provide livestock and feedlot protection, and they are used by wildlife for food and cover. Esthetics is also a consideration as woody plants are used to beautify areas.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to retain moisture in the soil, and provide food and cover for wildlife.

Farmstead and feedlot windbreaks are designed to protect homes and other buildings and livestock from harsh winds both in winter and summer. Windbreaks have a definite effect on fuel savings, and they are also used for noise abatement. Plantings made close to busy highways can reduce noise pollution for nearby dwellers.

Environmental planting helps to beautify and screen houses and other buildings. Evergreen trees and shrubs give year-long environmental protection and add color to the landscape during winter.

To insure survival, healthy planting stock should be used, planting should be made on a well prepared site, and the plants should be maintained in good condition. Water is essential to good survival during the first 2 or 3 years after establishment.

Woody plants are essential to the needs of wildlife. Trees and shrubs provide food and cover for game birds, songbirds, and animals. The amount of wildlife almost always increases where trees and shrubs are planted. Species of woody plants should be selected that provide food and cover for wildlife in addition to other benefits.

Additional information regarding the use of woody plants, including planning, sources of supply, and planting and care, can be obtained from the local offices of the Soil Conservation Service or the Cooperative Extension Service.

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

John A. Wright, range conservationist, Soil Conservation Service, assisted in preparing this section.

Antelope, buffalo, prairie chickens, and prairie dogs were once abundant in Concho County but were eliminated about the time the county was settled.

Concho County has good deer and turkey populations. The Concho and Colorado Rivers in the northern part of the county have several miles of fishing streams. The game species in the county are white-tailed deer, turkey, bobwhite quail, scaled quail, mourning dove, squirrels, and ducks. Furbearers common to this county are raccoon, fox, skunk, opossum, and ringtail. Nutria are along some water courses. Coyote and bobcat are the most common predators.

Numerous songbirds are in Concho County. Cardinal, titmouse, chickadee, mockingbird, meadowlark, and house finch are common year-round residents; the loggerhead shrike, sparrow hawk, and scrub jay are common winter residents. Numerous species of owls and hawks, including the great horned owl, barn owl, screech owl, red-tailed hawk, harris hawk, and red-shouldered hawk, are yearlong residents.

Leasing lands for recreational hunting is becoming more common and is a major source of income for many landowners. Several species of oak provide habitat and mast for most species of game, especially in the southern half of the county and along the Concho River in the northern part of the county.

The Concho and Colorado Rivers and Brady Creek provide excellent habitat for catfish, largemouth bass, and several species of sunfish. Waterfowl populations on stock ponds and perennial streams are largest during fall and spring migration periods.

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, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are grain sorghum, wheat, oats, millet and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are johnsongrass, switchgrass, kleingrass, lovegrass, clover, vetch, winter peas, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are vine-mesquite, croton, ragweed, sunflower, and sideoats grama.

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 agarito, bumelia, hackberry, oak, sumac, greenbrier, and ephedra.

Wetland plants are annual and perennial, wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, switchgrass, willows, cattails, panicums, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are ponds and intermittent lakes and streams.

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 and scaled quail, dove, meadowlark, field sparrow, cottontail, badger, jackrabbit, and fox.

Habitat for wetland wildlife consists of open, shallow water areas. Some of the wildlife attracted to such areas are ducks, herons, shore birds, and frogs.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include deer, turkey, meadowlark, and 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. 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, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, 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, 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, and sodium 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 60 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to 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 high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill 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 nutrients for plant growth.

Water Management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees. 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 17.

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 17.

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.

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 determine the ability of the soil to adsorb cations and to retain moisture. They influence 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 earthmoving 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 downward 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.

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 four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have 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 depreciation 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, rare, occasional,* or *frequent. None* means that flooding is not probable. *Rare* means that flooding is unlikely but possible under unusual weather conditions (there is a near 0 to 5 percent chance of flooding in any year). *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), *brief* (2 to 7 days), *long* (7 days to 1 month), and *very long* (more than 1 month). 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.

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

Engineering Index Test Data

Table 17 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 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); 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 *(5)*. 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 18 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 *ustolls*, 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 (4)*. Many of the technical terms used in the descriptions are defined in *Soil Taxonomy (5)*. Unless otherwise stated, colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Angelo Series

The Angelo series consists of deep, well drained, moderately slowly permeable soils on ancient stream terraces or outwash plains. These soils formed in calcareous, loamy and clayey sediment several feet thick. These soils are on nearly level and gently sloping uplands. Slopes range from 0 to 3 percent. The soils of the Angelo series are fine-silty, mixed, thermic Aridic Calciustolls.

Typical pedon of Angelo silty clay loam, 0 to 1 percent slopes; from Farm Road 765 in Eola, 0.95 mile south on Farm Road 381, 1.1 miles west and 0.9 mile south on a county road, 55 feet west on turn row, and 30 feet north, in cultivated field:

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; hard, firm; few fine roots; calcareous, moderately alkaline; clear smooth boundary.

A—9 to 14 inches; dark grayish brown (10YR 4/2) silty clay loam, dark brown (10YR 3/2) moist; moderate fine subangular blocky structure; hard, firm; few fine roots; common worm casts; calcareous, moderately alkaline; gradual wavy boundary.

Bw—14 to 27 inches; dark brown (7.5YR 4/4) silty clay, dark brown (7.5YR 3/4) moist; moderate medium subangular blocky structure; very hard, firm; few fine roots; few dark streaks; few worm casts; few fine concretions of calcium carbonate; calcareous, moderately alkaline; gradual wavy boundary.

Bk1—27 to 47 inches; reddish yellow (7.5YR 7/6) silty clay loam, strong brown (7.5YR 5/6) moist; weak fine subangular blocky structure; hard, firm; about 30 percent, by volume, films, soft masses, and concretions of calcium carbonate; calcareous, moderately alkaline; gradual smooth boundary.

Bk2—47 to 62 inches; reddish yellow (7.5YR 6/6) clay loam, strong brown (7.5YR 5/6) moist; few fine faint brown mottles; weak fine subangular blocky structure; hard, firm; common films, soft masses, and concretions of calcium carbonate; calcareous, moderately alkaline.

The solum ranges in thickness from 60 to more than 80 inches. Distinct calcium carbonate accumulation begins at a depth of 24 to 40 inches. The COLE ranges from 0.07 to 0.10 in the A and Bw horizons and from 0.02 to 0.07 in the Bk horizon. The silicate clay content of the 10- to 40-inch control section is 28 to 35 percent; total clay content ranges from 35 to 50 percent.

The A horizon is brown, dark brown, very dark grayish brown, dark grayish brown, or grayish brown. It is 10 to 20 inches thick.

The Bw horizon is dark brown, brown, dark grayish brown, or reddish brown. The texture is silty clay, clay, or silty clay loam. This horizon is 8 to 30 inches thick.

The Bk horizon is reddish brown, light reddish brown, yellowish red, reddish yellow, brown, strong brown, light brown, or pink. The texture is clay, clay loam, or silty clay loam. The calcium carbonate equivalent ranges from 15 to 60 percent (fig. 9).

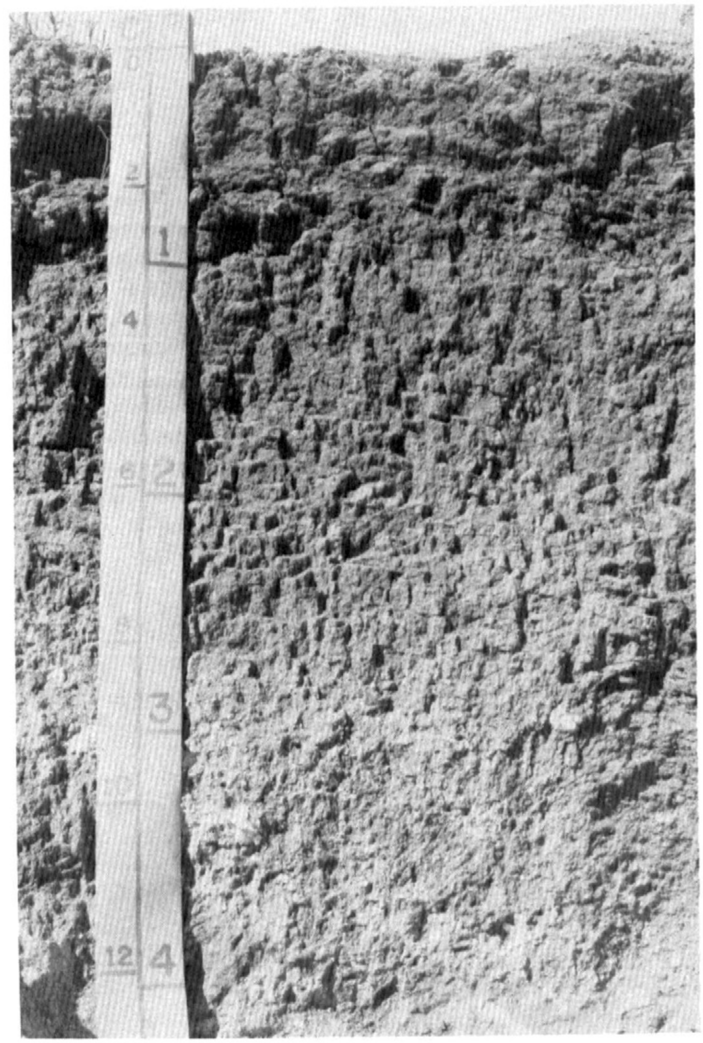


Figure 9.—Angelo silty clay loam, 1 to 3 slopes, has blocky structure in the upper part of the subsoil and accumulations of calcium carbonates in the lower part. To determine depth in centimeters, multiply the figure on the left by 10. The figure on the right is in feet.

Cho Series

The Cho series consists of shallow and very shallow, well drained, moderately permeable soils on ancient outwash plains and stream terraces. These soils formed in calcareous, loamy sediment several feet thick. They are on gently sloping and undulating uplands that have slopes ranging from 1 to 8 percent. The soils of the Cho series are loamy, carbonatic, thermic, shallow Petrocalcic Calciustolls.

Typical pedon of Cho gravelly loam, undulating; about 12 miles north of Eden from U.S. Highway 83, 2.9 miles west on Farm Road 765, and 110 feet south, in rangeland:

A—0 to 8 inches; dark brown (10YR 4/3) gravelly loam, dark brown (10YR 3/3) moist; weak fine granular and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; few fine pores; about 2 percent small caliche fragments on the surface and 15 percent in horizon; calcareous, moderately alkaline; abrupt wavy boundary.

Bkm—8 to 17 inches; pink (7.5YR 8/4) indurated caliche, fractured into plates about 8 inches across and 1 inch to 2 inches thick; about 5 percent brown loam in cracks of upper part; clear wavy boundary.

Ck—17 to 60 inches; pink (7.5YR 8/4) loamy calcareous earth; massive; hard, friable; estimated more than 50 percent, by volume, calcium carbonate; about 30 percent weakly cemented calcium carbonate concretions; few hard cemented fragments; moderately alkaline.

The solum ranges in thickness from 7 to 20 inches and corresponds to the depth to the strongly cemented or indurated caliche horizon.

The A horizon is brown, dark brown, grayish brown, dark grayish brown, or very dark grayish brown. The texture of the fine earth fraction is loam or clay loam. Gravel and channers of caliche make up 5 to 30 percent, by volume; and cobbles and flagstones of caliche make up 0 to about 14 percent, by volume (fig. 10). Calcium carbonate equivalent of the soil that is less than 2 centimeters in size ranges from 40 to 65 percent. Calcium carbonate equivalent of the fine earth fraction ranges from 20 to 40 percent.

The Bkm horizon is platy or massive. It is 2 to 12 inches thick.

The Ck horizon ranges from pinkish white and very pale brown to pink. The texture of the fine earth fraction is loam or clay loam. Caliche and limestone gravel are 2 to about 35 percent, by volume. Thickness ranges from a few to several feet.

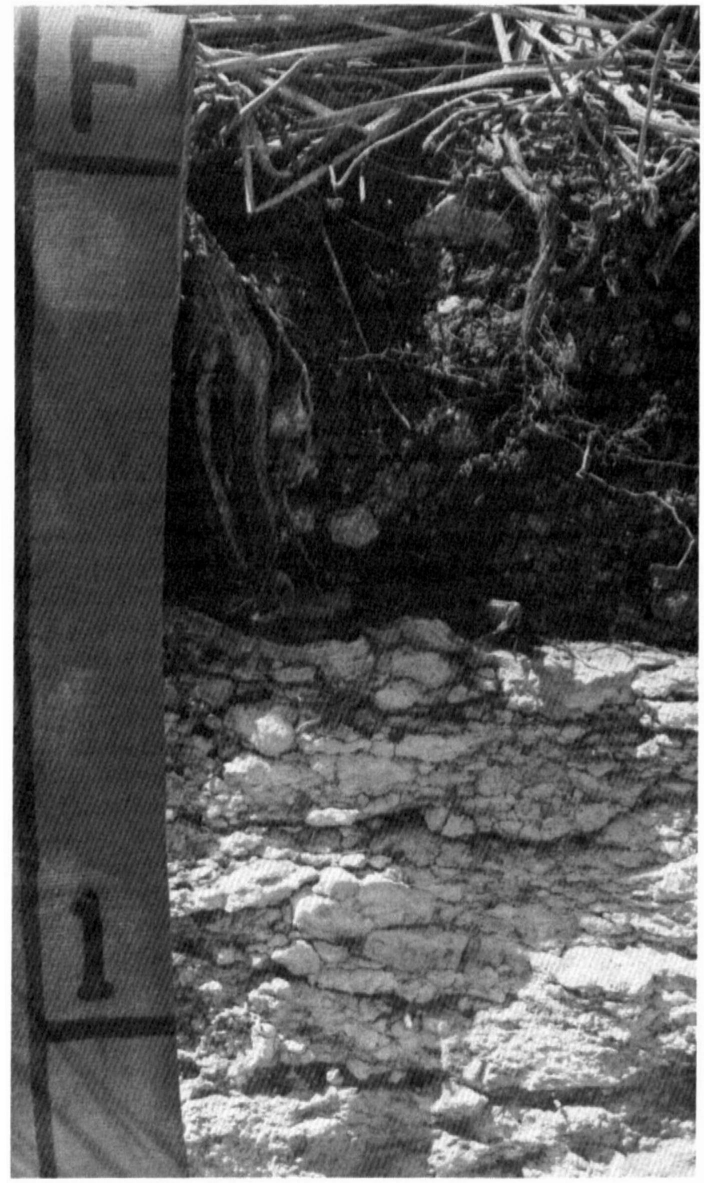


Figure 10.—Cho gravelly clay loam, undulating, has a petrocalcic horizon (platy cemented caliche) at a depth of about 7 inches. The caliche material is used locally in the construction of roadbeds.

Dev Series

The Dev series consists of deep, well drained, moderately rapidly permeable soils. These soils are on nearly level and gently sloping flood plains. The soils formed in calcareous, loamy and gravelly alluvial sediment. Slopes range from 0.5 to about 3 percent. The soils of the Dev series are loamy-skeletal, carbonatic, thermic Cumulic Haplustolls.

Typical pedon of Dev gravelly loam, frequently flooded; 5.4 miles west of the courthouse in Paint Rock on Farm Road 380, 2 miles south on a county road, 1.6 miles east on a county road, in road cut on northeast bank of creek:

A1—0 to 10 inches; dark grayish brown (10YR 4/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; weak very fine subangular blocky and granular structure; hard, friable; many fine roots; common worm casts; 15 percent, by volume, rounded limestone gravel; calcareous, moderately alkaline; clear smooth boundary.

A2—10 to 24 inches; dark grayish brown (10YR 4/2) extremely gravelly loam, very dark grayish brown (10YR 3/2) moist; weak very fine subangular blocky and granular structure; hard, friable; few fine and coarse roots; 65 percent, by volume, rounded limestone gravel; few cobbles and stones; calcareous, moderately alkaline; clear smooth boundary.

Bk—24 to 60 inches; brown (10YR 5/3) extremely gravelly loam, dark brown (10YR 4/3) moist; weak very fine subangular blocky structure; hard, friable; 80 percent, by volume, rounded limestone pebbles; few cobbles and stones; few fine threads and films of calcium carbonate; calcareous, moderately alkaline.

The A horizon ranges from 20 to 40 inches in thickness. The 10- to 40-inch control section is 35 to 85 percent, by volume, gravel less than 3 inches in diameter (fig. 11). The gravel is mostly limestone. A few cobbles and stones are in some pedons.

The A horizon is very dark grayish brown, dark grayish brown, grayish brown, brown, or dark brown.

The Bk horizon is brown, grayish brown, light brownish gray, light brown, or pale brown. The texture of the fine earth fraction within the 10- to 40-inch control section ranges from loam to clay loam. Carbonates in the whole soil smaller than 2 centimeters range from 40 to 70 percent, by volume.

Eola Series

The Eola series consists of very shallow and shallow, well drained, undulating soils on gravelly uplands. Permeability is moderate. These soils formed in loamy sediment over caliche (fig. 12), marl, and soft limestone. Slopes range from 1 to about 8 percent. The soils of the Eola series are loamy-skeletal, carbonatic, thermic, shallow Petrocalcic Calciustolls.

Typical pedon of Eola gravelly clay loam, in an area of Eola-Kavett association, undulating; 3.1 miles northwest on Farm Road 2402 from U.S. Highway 83 in the north part of Eden, 525 feet north on the city dump road, and 60 feet east, in rangeland:

A—0 to 6 inches; dark grayish brown (10YR 4/2) very gravelly clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; hard, friable; common fine roots; common worm casts; about 10 percent limestone and caliche flagstones and cobbles; about 25 percent gravel caliche fragments; about 50 percent caliche and limestone fragments mainly less than 2 cm across on surface; calcareous, moderately alkaline; abrupt irregular boundary.

Ak—6 to 12 inches; dark grayish brown (10YR 4/2) very gravelly clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; hard, friable; common very fine roots; common worm casts; about 65 percent, by volume, gravelly and channery limestone and caliche fragments; fragments coated with carbonates, pendants of calcium carbonate on lower sides; about 17 percent calcium carbonate equivalent in fine earth fraction; calcareous, moderately alkaline; abrupt wavy boundary.

Bkm—12 to 18 inches; pinkish white (7.5YR 8/2) and white (10YR 8/2) caliche; indurated brownish laminar cap about 2 cm thick and continuous horizontally; strongly cemented below; clear wavy boundary.

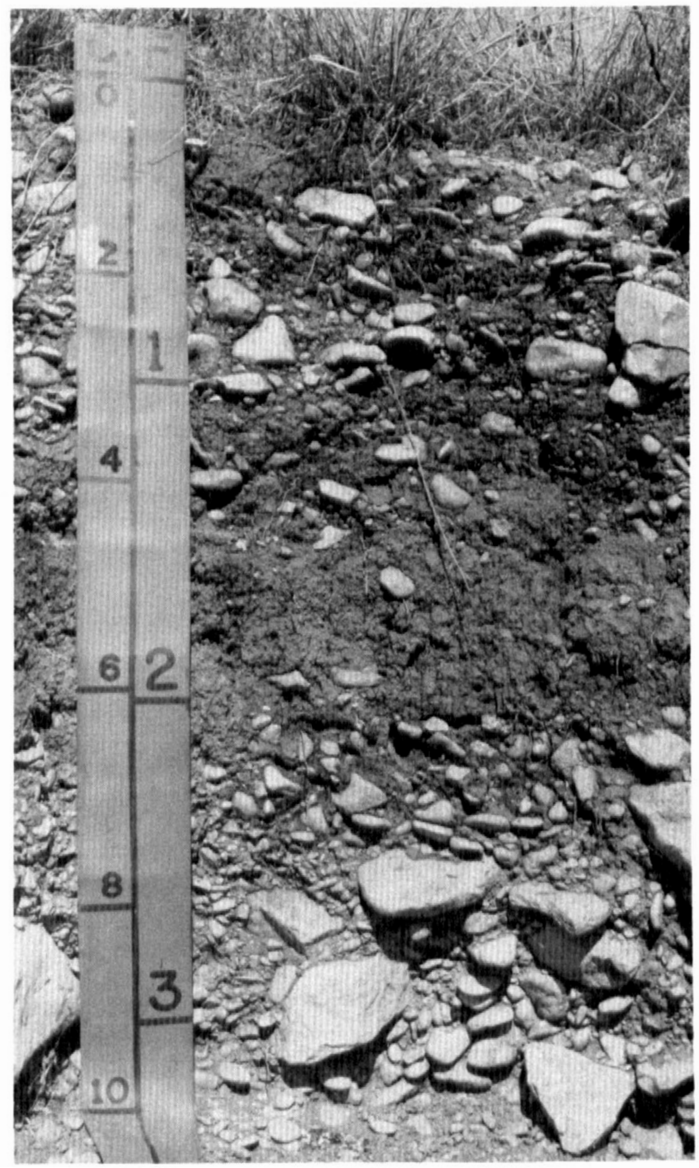


Figure 11.—Dev gravelly loam, frequently flooded, is more than 35 percent gravel. To determine depth in centimeters, multiply the figure on the left by 10. The figure on the right is in feet.

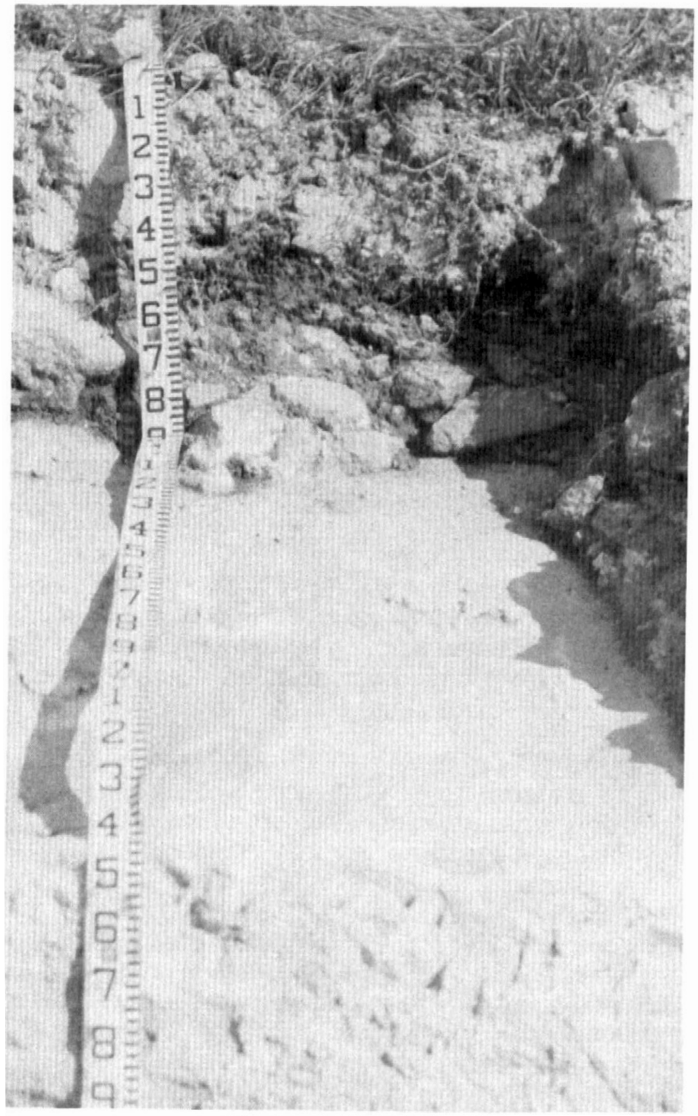


Figure 12.—Eola gravelly clay loam, in an area of Eola-Kavett association, undulating, has an extremely hard caliche layer at a depth of about 12 inches. This layer seals off the underlying marl and limestone.

Crk—18 to 22 inches; pink (7.5YR 8/4) interbedded weakly cemented marly earth and thin discontinuous layers of soft brittle limestone; massive; few nodular concretions of calcium carbonate; calcareous, moderately alkaline; abrupt smooth boundary.

Cr—22 to 35 inches; very pale brown (10YR 7/3) weakly cemented limestone; few thin strata of pink marly earth.

Depth to the petrocalcic horizon ranges from 4 to 16 inches. The coarse fragment content of caliche and limestone in the control section ranges from 35 to about 75 percent. Calcium carbonate equivalent is 40 to 60 percent in the fraction less than 2 centimeters.

The A and Ak horizons are brown, dark brown, grayish brown, dark grayish brown, or very dark grayish brown. Coarse fragments range from 15 to 45 percent in the A horizon and from 50 to 80 percent in the Ak horizon.

The Bkm horizon has colors in shades of white, pink, or brown. The upper 3 centimeters or less of the Bkm horizon is laminar, and cementation ranges from strong to indurated, Moh's hardness of 3 to 5. This horizon is 1 inch to 10 inches thick.

The Crk horizon is platy, brittle marly earth and soft limestone or massive caliche. It is up to 15 inches thick. Some pedons do not have a Crk horizon.

The Cr layer consists of beds of soft, very pale brown, chalky limestone or light gray limestone that can be chipped or dug with a spade and backhoe. Some pedons are strongly cemented in the upper part and weakly cemented and massive below. An R layer of limestone is below a depth of 40 inches in some pedons.

Frio Series

The Frio series consists of deep, well drained, nearly level and gently sloping soils that formed in loamy and clayey calcareous alluvium (fig. 13). These soils are on flood plains of major streams. Permeability is moderately slow. Slopes range from 0 to 2 percent. The soils of the Frio series are fine, montmorillonitic, thermic Cumulic Haplustolls.

Typical pedon of Frio silty clay loam, occasionally flooded; from U.S. Highway 83 in Eden, 0.6 mile east on U.S. Highway 87 to Barnett Street, 2.3 miles south and east on street and county road, and 130 feet north, in cropland:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; hard, friable; common fine roots; few gravel-size chert and limestone fragments; calcareous, moderately alkaline; abrupt smooth boundary.

A1—8 to 21 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; hard, friable; few fine pores; few fine roots; few threads and films of calcium carbonate; few very dark brown streaks and spots; calcareous, moderately alkaline; gradual smooth boundary.

A2—21 to 45 inches; dark brown (10YR 4/3) silty clay, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; hard, firm; common very fine concretions of calcium carbonate; few threads and films of calcium carbonate; calcareous, moderately alkaline; gradual smooth boundary.

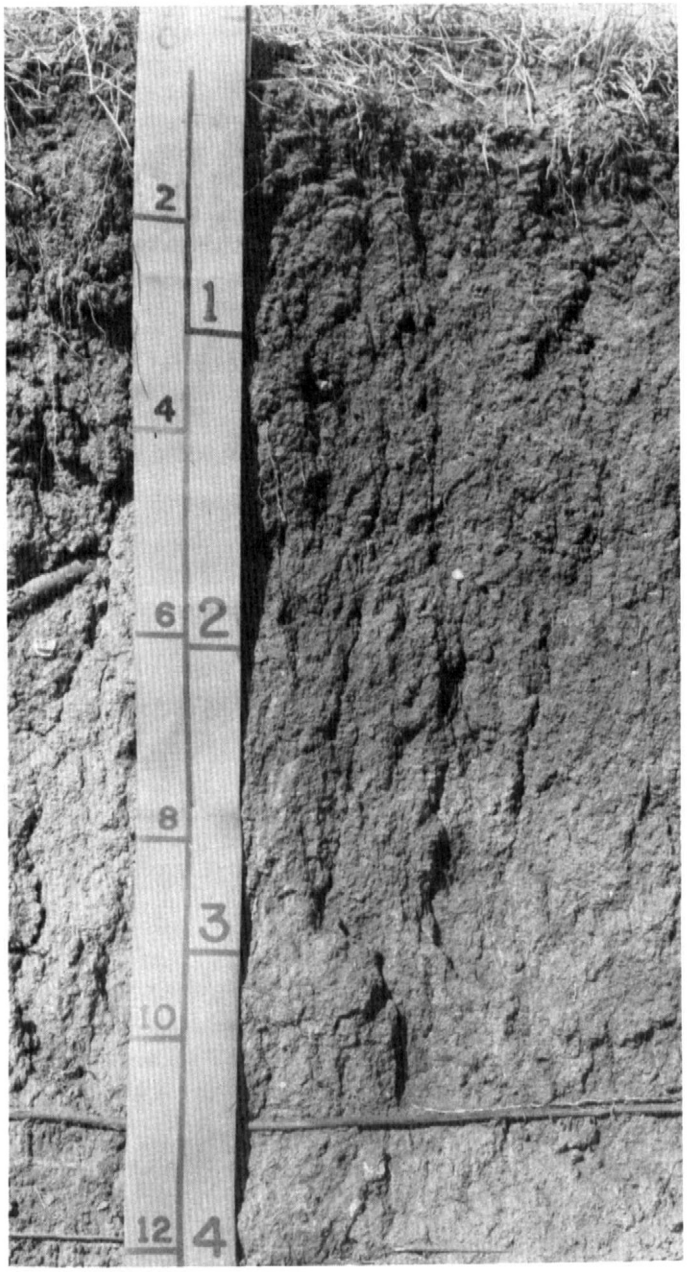


Figure 13.—Frio silty clay loam, occasionally flooded, is deep and fertile. To determine depth in centimeters, multiply the figure on the left by 10. The figure on the right is in feet.

Bw—45 to 60 inches; brown (10YR 5/3) silty clay, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; hard, firm; calcareous, moderately alkaline.

The texture of the 10- to 40-inch control section is clay loam, silty clay loam, or silty clay, and the clay content ranges from 35 to 45 percent. The calcium carbonate equivalent of the control section ranges from 10 to 40 percent.

The A horizon is brown, dark brown, grayish brown, dark grayish brown, or very dark grayish brown.

Most pedons have a B horizon that has higher value or chroma than the A horizon. The B horizon is below a depth of 22 inches and typically below the control section.

Gageby Series

The Gageby series consists of deep, well drained, moderately permeable soils that formed in loamy alluvial sediment. These soils are on nearly level, low terraces and bottom lands. Slopes are 0 to 1 percent. The soils of the Gageby series are fine-loamy, mixed, thermic Cumulic Haplustolls.

Typical pedon of Gageby loam, rarely flooded; 8 miles north of Millersview on Farm Road 2134, 4.5 miles west on Farm Road 1929 to Concho, 0.7 mile west on a county road, 120 feet north on a private road, and 20 feet east of road, in rangeland on flood plain of Concho River:

A1—0 to 7 inches; brown (10YR 5/3) loam, very dark grayish brown (10YR 3/2) moist; weak subangular blocky structure; hard, very friable; many fine roots; common worm casts; calcareous, moderately alkaline; clear smooth boundary.

A2—7 to 21 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; hard, very friable; many fine roots and worm casts; few insect tunnels; calcareous, moderately alkaline; clear smooth boundary.

Bk—21 to 56 inches; brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; hard, friable; few fine roots and worm casts; common fine pores; few films and threads of calcium carbonate; calcareous, moderately alkaline; gradual wavy boundary.

C—56 to 70 inches; brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) moist; massive; hard, friable; few threads of calcium carbonate; calcareous, moderately alkaline.

The texture of the 10- to 40-inch control section is loam or clay loam. Coarse fragments range from 0 to 5 percent.

The A horizon is grayish brown, dark grayish brown, very dark grayish brown, brown, or dark brown. It is 20 to 40 inches thick.

The B horizon is light brownish gray, pale brown, light yellowish brown, brownish yellow, grayish brown, brown, yellowish brown, dark grayish brown, dark brown, dark yellowish brown, pinkish gray, light brown, or reddish brown.

The C horizon has the same color range as that of the B horizon. The texture is loam, clay loam, or silt loam. Gravel content ranges from 0 to 40 percent.

Karnes Series

The Karnes series consists of deep, well drained, moderately rapidly permeable soils on gently sloping stream terraces. These soils formed in calcareous loamy sediment. Slopes range from 1 to 5 percent. The soils of the Karnes series are coarse-loamy, carbonatic, thermic Typic Ustochrepts.

Typical pedon of Karnes loam, 1 to 5 percent slopes; from the intersection of Farm Road 2134 and Farm Road 1929 about 8 miles north of Millersview, 0.1 mile south of Farm Road 2134, 2.1 miles east on a county road, 0.5 mile north on a county road, and 800 feet west, in rangeland:

A—0 to 7 inches; light yellowish brown (10YR 6/4) loam, yellowish brown (10YR 5/4) moist; moderate fine subangular blocky and granular structure; hard, friable; many fine roots; many worm casts; few fine caliche pebbles; calcareous, moderately alkaline; clear smooth boundary.

Bk—7 to 43 inches; pink (7.5YR 7/4) loam, light brown (7.5YR 6/4) moist; moderate fine subangular blocky structure; hard, friable; common fine roots; common worm casts; common fine pores; common concretions, films, and threads of calcium carbonate increasing with depth; calcareous, moderately alkaline; gradual smooth boundary.

Ck—43 to 60 inches; pink (7.5YR 8/4) loam, pink (7.5YR 7/4) moist; massive; hard, friable; few fine pores; many concretions, films, and threads of calcium carbonate decreasing with depth; calcareous, moderately alkaline.

The solum ranges in thickness from 34 to about 50 inches. Calcium carbonate content ranges from 40 to 60 percent.

The A horizon is brown, pale brown, very pale brown, or light yellowish brown. It is 5 to 20 inches thick.

The Bk horizon is pale brown, very pale brown, light brown, light yellowish brown, or pink. The texture of the Bk horizon is dominantly loam. Total clay content ranges from 18 to 30 percent. Noncarbonate clay ranges from 10 to 18 percent.

The Ck horizon is loam or clay loam in pink or shades of white or brown.

Kavett Series

The Kavett series consists of shallow, well drained, moderately slowly permeable soils that formed in calcareous clayey material underlain by strongly cemented caliche and hard limestone. These soils are on nearly level and gently sloping uplands. Slopes range from 0 to 3 percent. The soils of the Kavett series are clayey, montmorillonitic, thermic, shallow Petrocalcic Calciustolls.

Typical pedon of Kavett silty clay, 0 to 3 percent slopes; from U.S. Highway 87 in Eden, about 2.75 miles south on U.S. Highway 83, and 100 feet west, in rangeland:

A1—0 to 7 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; very hard, firm; common fine roots; calcareous, moderately alkaline; gradual smooth boundary.

A2—7 to 15 inches; dark brown (7.5YR 4/2) silty clay, dark brown (7.5YR 3/2) moist; moderate medium and fine blocky structure; very hard, firm; few fine roots and pores; calcareous, moderately alkaline; abrupt smooth boundary.

Bkm—15 to 20 inches; pinkish white (7.5YR 8/2) indurated caliche, fractured into laminar-capped plates 6 to 12 inches across; dark brown (7.5YR 4/2) silty clay in cracks; calcareous, moderately alkaline; abrupt wavy boundary.

R—20 to 30 inches; indurated limestone, coarsely fractured, cemented carbonates plugging cracks.

The solum ranges in thickness from 10 to 20 inches and corresponds to the depth to the petrocalcic horizon. Coarse fragments of limestone range from few up to 15 percent, by volume.

The A horizon is grayish brown, dark grayish brown, very dark grayish brown, dark brown, or brown. The texture of the A horizon is silty clay, clay, silty clay loam, or the stony or cobbly counterparts. Clay content ranges from 35 to 50 percent. Structure ranges from moderate to strong and from granular to subangular and angular blocky in very fine to medium sizes.

The Bkm horizon ranges from strongly cemented to indurated. In some pedons, this horizon has a laminar cap in the upper 0.25 to 1 inch. The Bkm horizon is 1 to 6 inches thick.

The R layer ranges from indurated limestone to interbedded limestone, chalks, and marls.

Lipan Series

The Lipan series consists of deep, somewhat poorly drained, very slowly permeable soils on uplands. These soils formed in calcareous clayey sediment. They are on nearly level old alluvial plains in slightly depressional playas. Slopes range from 0 to 1 percent. The soils of the Lipan series are fine, montmorillonitic, thermic Entic Pellusterts.

Typical pedon of Lipan clay, ponded; from Farm Road 381 west of Lowake, 0.2 mile west on Farm Road 1929, 450 feet northeast, in depression in cropland:

Ap—0 to 7 inches; gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; weak fine granular structure; hard, firm; few fine roots; calcareous, moderately alkaline; abrupt smooth boundary.

A—7 to 29 inches; gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; weak fine subangular blocky structure; very hard, very firm; few fine roots; few intersecting slickensides in lower part; calcareous, moderately alkaline; gradual wavy boundary.

Bk—29 to 52 inches; gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; weak medium angular blocky structure; few intersecting slickensides; very hard, very firm; few pebbles and fine concretions of calcium carbonate; calcareous, moderately alkaline; gradual wavy boundary.

Ck—52 to 65 inches; light brownish gray (10YR 6/2) clay, dark grayish brown (10YR 4/2) moist; massive; very hard, very firm; few threads and films of calcium carbonate; few fine faint brownish mottles; few fine pebbles; calcareous, moderately alkaline.

The solum ranges in thickness from 40 to 66 inches. When the soil is dry, cracks 1 inch to 3 inches wide extend downward 30 to 50 inches. In areas that have never been plowed, gilgai microrelief consists of rounded pits 20 to 60 feet apart. The pits are about 2 to 10 inches deeper than areas between pits.

The A horizon is gray or dark gray. It is 15 to 30 inches thick.

The B horizon is gray, grayish brown, light brownish gray, brown, or pale brown. The texture is clay or silty clay.

The Ck horizon is clay or silty clay in shades of gray or brown. Calcium carbonate makes up from 2 to 35 percent, by volume, of the C horizon.

Lueders Series

The Lueders series consist of shallow or very shallow, well drained, moderately permeable soils on uplands. These soils formed over fractured limestone bedrock. Slopes range from 1 to 30 percent but are dominantly 1 to 8 percent. The soils of the Lueders series are loamy-skeletal, carbonatic, thermic Lithic Calciustolls.

Typical pedon of Lueders very cobbly loam, in an area of Talpa-Lueders-Cho complex, undulating; from U.S. Highway 87 in Eden, 10.1 miles north on U.S. Highway 83 to gate on east side of road, 0.15 mile east on ranch road to crossroad, south on road 200 feet, and 135 feet west, in rangeland:

A—0 to 7 inches; dark grayish brown (10YR 4/2) very cobbly loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, very friable; common fine roots; about 40 percent limestone and caliche fragments, 10 percent cobble size; limestone cobbles on about 10 percent of surface; calcareous, moderately alkaline; clear irregular boundary.

Ak—7 to 10 inches; dark grayish brown (10YR 4/2) extremely cobbly loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; slightly hard, very friable; few fine roots; common fine roots in fractures; 85 percent limestone and caliche fragments less than 10 inches across, coated with calcium carbonate on lower sides; calcareous, moderately alkaline; abrupt wavy boundary.

R—10 to 20 inches; fractured limestone bedrock, secondary carbonate coatings in upper part.

The solum ranges in thickness from 7 to 20 inches and corresponds to depth to bedrock.

The A and Ak horizons are grayish brown, dark grayish brown, very dark grayish brown, brown, or dark brown. The fine earth fraction is silty clay loam, loam, or clay loam. Clay content ranges from 20 to 35 percent. Limestone and caliche fragments make up from 10 to 50 percent of the A horizon and from 60 to 90 percent of the Ak horizon. Most fragments within the Ak horizon have pendants of carbonates on the lower sides.

The R layer is limestone that is layered and fractured and has calcium carbonate coatings in the upper part.

Mereta Series

The Mereta series consists of shallow, well drained, moderately slowly permeable soils on uplands. These soils formed in calcareous, old alluvial sediment. They are on nearly level and gently sloping outwash plains and ancient stream terraces. Slopes range from 0 to 3 percent. The soils of the Mereta series are clayey, mixed, thermic, shallow Petrocalcic Calciustolls.

Typical pedon of Mereta clay loam, 1 to 3 percent slopes; from Farm Road 380 in Paint Rock, 2.7 miles north on U.S. Highway 83, and 80 feet east of right-of-way, in rangeland:

A1—0 to 6 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; hard, friable; many fine roots; calcareous, moderately alkaline; gradual smooth boundary.

A2—6 to 15 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; hard, friable; common fine roots; few caliche gravels in lower part; calcareous, moderately alkaline; abrupt wavy boundary.

Bkm—15 to 18 inches; pinkish white (7.5YR 8/2) caliche; strongly cemented; clear wavy boundary.

Ck—18 to 60 inches; pink (7.5YR 8/4) limy earth; massive; soft, friable; few concretions and common soft masses of calcium carbonate; calcareous, moderately alkaline.

The soil is 14 to 20 inches thick to a strongly cemented or indurated petrocalcic horizon (fig. 14). The texture between a depth of 10 inches and the petrocalcic horizon is clay loam, silty clay, or clay. It is about 35 to 45 percent clay. Some pedons contain as much as 10 percent, by volume, hard angular caliche.

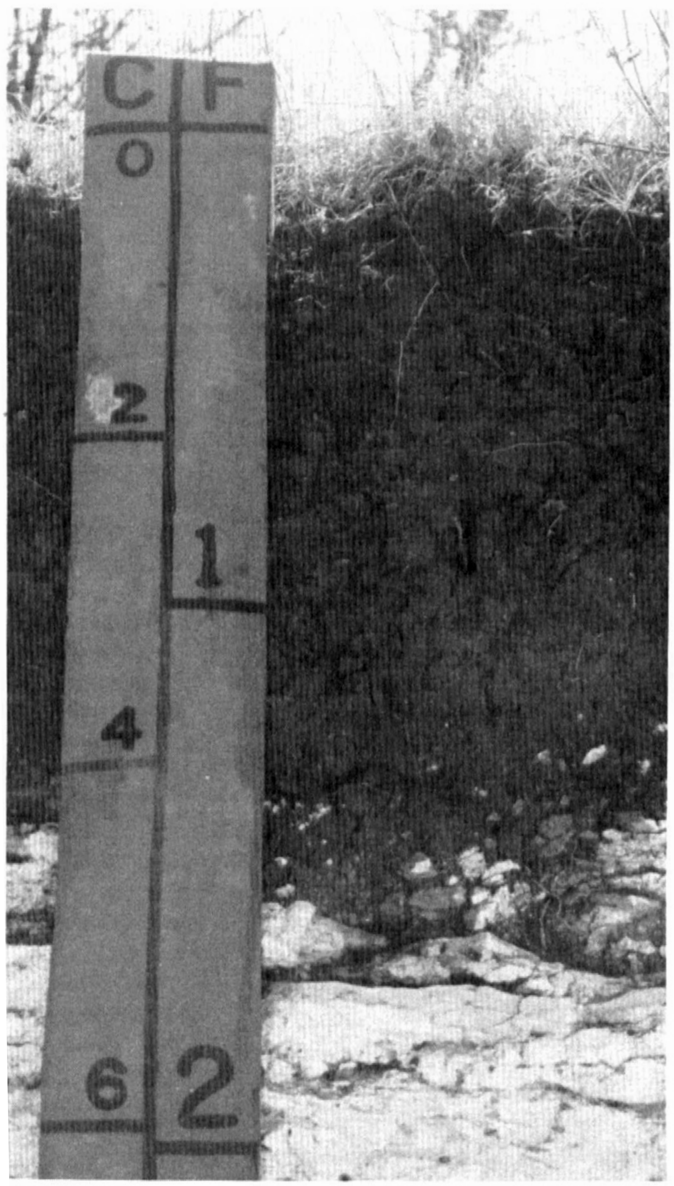


Figure 14.—Mereta clay loam, 1 to 3 percent slopes, has platy cemented caliche at a depth of about 18 inches.

The A horizon is dark brown, very dark grayish brown, or dark grayish brown. In some pedons, it is reddish brown in the lower few inches. The texture is clay in the lower part of the A horizon in some pedons.

The Bkm horizon is strongly cemented or indurated. It is 3 to 12 inches thick.

The Ck horizon is loamy, limy earths, high in calcium carbonate. It is white, pinkish white, pink, pinkish gray, light brown, very pale brown, strong brown, or reddish yellow. Caliche pebbles and gravel make up 2 to about 15 percent, by volume.

Miles Series

The Miles series consists of deep, well drained, gently sloping soils on uplands. These soils formed in loamy alluvium on old high terraces. Permeability is moderate. Slopes range from 1 to 3 percent. The soils of the Miles series are fine-loamy, mixed, thermic Udic Paleustalfs.

Typical pedon of Miles fine sandy loam, 1 to 3 percent slopes; from the Colorado River Bridge in the northeast part of Concho County, 0.7 mile southwest on Farm Road 2134, 1,600 feet south along field fence, and 270 feet east of fence, in cropland:

Ap—0 to 6 inches; brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) moist; weak subangular blocky structure; slightly hard, very friable; common fine roots; few fine siliceous pebbles; neutral; clear smooth boundary.

Bt1—6 to 23 inches; reddish brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; moderate fine and medium subangular blocky structure; hard, friable; common fine roots; few fine pores; many worm casts; few very fine siliceous pebbles; neutral; gradual smooth boundary.

Bt2—23 to 53 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; moderate fine and medium subangular blocky structure; hard, friable; few fine roots; common very fine pores; thin clay films on faces of peds; few very fine siliceous pebbles; neutral; gradual smooth boundary.

Bt3—53 to 61 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 5/6) moist; weak coarse prismatic structure; hard, friable; few pockets of clean sand grains 2 to 6 mm in diameter in a matrix of bridged and coated sand grains in the upper part; few concretions, films, and threads of calcium carbonate in lower part; mildly alkaline; gradual smooth boundary.

Bk—61 to 80 inches; reddish yellow (5YR 7/6) sandy clay loam, reddish yellow (5YR 6/6) moist; weak coarse prismatic structure; hard, friable; many fine and very fine pores; about 15 percent weakly cemented concretions, films, and threads of calcium carbonate; calcareous, moderately alkaline.

The solum ranges in thickness from 60 to more than 80 inches. Depth to secondary lime is 36 to 60 inches.

The A horizon is reddish brown, light reddish brown, light brown, or brown. It is slightly acid to mildly alkaline. This horizon is 6 to 14 inches thick.

The Bt horizon is reddish brown or yellowish red. It is sandy clay loam or clay loam; the clay content is 20 to 35 percent. The upper part of the Bt horizon is neutral or mildly alkaline. The lower part is mildly alkaline or moderately alkaline and is calcareous in some pedons.

The Bk horizon has similar characteristics as those of the Bt horizon except that it is calcareous and has secondary carbonates.

The C or Ck horizon ranges from fine sandy loam to sandy clay loam and from reddish yellow to pink.

Nuvalde Series

The Nuvalde series consists of deep, well drained, moderately permeable soils on outwash plains and ancient stream terraces. These soils formed in calcareous, loamy, old alluvial sediment several feet thick. They are on nearly level and gently sloping uplands. Slopes range from 0 to 3 percent. The soils of the Nuvalde series are fine-silty, mixed, thermic Typic Calciustolls.

Typical pedon of Nuvalde silty clay loam, 0 to 1 percent slopes; from U.S. Highway 83 in Eden, 10.2 miles northwest on Farm Road 2402, 0.7 mile north on road to ranch headquarters, 350 feet west along field fence, and 10 feet south, in rangeland:

A—0 to 12 inches; dark brown (7.5YR 4/2) silty clay loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; slightly hard, friable, sticky; many fine roots; few fine limestone pebbles; calcareous, moderately alkaline; gradual smooth boundary.

Bw—12 to 22 inches; dark brown (7.5YR 4/4) silty clay, dark brown (7.5YR 3/4) moist; moderate medium subangular blocky structure; hard, firm, sticky; common fine roots; few fine pores; few fine limestone pebbles; few worm casts; calcareous, moderately alkaline; gradual smooth boundary.

Bk1—22 to 34 inches; brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/4) moist; moderate fine subangular blocky structure; hard, friable, sticky; few fine roots; common fine pores; common worm casts; common fine concretions and soft bodies of calcium carbonate; calcareous, moderately alkaline; gradual smooth boundary.

Bk2—34 to 48 inches; light brown (7.5YR 6/4) silty clay loam, brown (7.5YR 5/4) moist; weak fine subangular blocky structure; hard, friable, sticky; few fine roots; few concretions and many soft bodies of calcium carbonate; calcareous, moderately alkaline; clear wavy boundary.

Ck—48 to 60 inches; pink (7.5YR 7/4) silty clay loam, light brown (7.5YR 6/4) moist; common concretions and few soft bodies of calcium carbonate; calcareous, moderately alkaline.

The solum ranges in thickness from 20 to 50 inches. The weighted average of the total clay content of the 10- to 40-inch control section is 35 to 50 percent. The silicate clay content ranges from 25 to 35 percent.

The A horizon is dark grayish brown, grayish brown, dark brown, or brown. It is 7 to 16 inches thick.

The Bw and Bk horizons are brown, pale brown, dark brown, or light brown. The texture is clay loam, silty clay loam, or silty clay. The amount of visible carbonates in the form of soft bodies ranges from 1 to 10 percent.

The Ck horizon ranges from pink to white. The texture is clay loam, silty clay loam, or silty clay.

Oplin Series

The Oplin series consists of very shallow and shallow, well drained, moderately permeable soils on uplands. These soils formed in loamy material from fractured limestone bedrock of the Cretaceous Period. They are undulating to hilly. Slopes range from 1 to 30 percent but are dominantly 1 to 8 percent. The soils of the Oplin series are loamy-skeletal, carbonatic, thermic Lithic Calciustolls.

Typical pedon of Oplin cobbly clay loam, in an area of Tarrant-Oplin-Kavett association, undulating; from U.S. Highway 83 in Eden, 5 miles west on U.S. Highway 87, 2.5 miles north on a county road, 0.6 mile northeast on a ranch road past headquarters to gate, 0.25 mile west on side road, and 50 feet north, in rangeland:

A—0 to 7 inches; dark grayish brown (10YR 4/2) cobbly clay loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure parting to moderate granular; hard, friable; many fine roots; common fragments, 30 percent cobble and flagstone size; about 12 percent cobbles and about 30 percent gravel on surface; calcareous, moderately alkaline; clear wavy boundary.

Ak—7 to 14 inches; dark grayish brown (10YR 4/2) very flaggy clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; hard, friable; common fine roots; common worm casts; about 85 percent limestone and caliche fragments, 20 percent cobbles and flagstone size; pendants and coatings of secondary carbonates on lower sides of fragments; calcareous, moderately alkaline; abrupt wavy boundary.

R—14 to 20 inches; coarsely fractured limestone.

The solum ranges in thickness from 7 to 20 inches over limestone bedrock. The control section contains from 35 to 80 percent fragments of limestone that are mostly less than 10 inches across the long axis.

The A horizon is dark brown, brown, very dark grayish brown, dark grayish brown, or grayish brown. The fine earth fraction is clay loam; clay content is 28 to 35 percent. Coarse fragments range from 15 to 65 percent in the A horizon and from 50 to 80 percent in the Ak horizon. Most fragments in the Ak horizon have pendants of calcium carbonate on the lower side. Calcium carbonate content in the whole soil smaller than 2 centimeters is 40 to 60 percent. In the fine earth fraction, it is 10 to 30 percent.

The R layer is indurated limestone. It is layered and coarsely fractured and has secondary calcium carbonate coatings in the upper part.

Real Series

The Real series consists of shallow, well drained, moderately permeable soils that formed in weakly cemented Cretaceous limestone and chalk. In many areas, the limestone and chalk are interbedded with thin layers of marl and indurated limestone. These soils are on strongly sloping to hilly uplands. Slopes range from 8 to 30 percent. The soils of the Real series are loamy-skeletal, carbonatic, thermic, shallow Typic Calciustolls.

Typical pedon of Real gravelly clay loam, in an area of Oplin-Real complex, hilly; from U.S. Highway 87 in Eden, about 6.2 miles north on U.S. Highway 83, and 10 feet west of highway right-of-way, in rangeland:

A—0 to 4 inches; very dark grayish brown (10YR 3/2) gravelly clay loam, very dark brown (10YR 2/2) moist; moderate fine and very fine granular structure; hard, friable; many fine roots; 20 percent, by volume, weakly cemented limestone fragments; calcareous, moderately alkaline; clear wavy boundary.

Ak—4 to 12 inches; very dark grayish brown (10YR 3/2) very gravelly clay loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; hard, friable; many fine roots; 55 percent, by volume, weakly cemented limestone fragments; calcareous, moderately alkaline; abrupt wavy boundary.

Crk—12 to 21 inches; soft fractured white limestone, yellow (10YR 8/8) mottles in limestone; platy; dark grayish brown (10YR 4/2) clay loam in fractures and seams; clear wavy boundary.

Cr—21 to 60 inches; weakly cemented white and yellow limestone; massive.

The solum ranges in thickness from 8 to 20 inches, which corresponds to the depth to a paralithic contact. Coarse fragments are 35 to 85 percent of the solum. The calcium carbonate equivalent ranges from 40 to 70 percent in the whole soil smaller than 2 centimeters.

The A and Ak horizons are very dark gray, dark gray, very dark grayish brown, grayish brown, dark grayish brown, brown, or dark brown.

Rioconcho Series

The Rioconcho series consist of deep, moderately well drained, slowly permeable soils that formed in calcareous, clayey alluvial sediment. These soils are on nearly level flood plains and in valleys. Slopes range from 0 to 1 percent. The soils of the Rioconcho series are fine, mixed, thermic Vertic Haplustolls.

A typical pedon of Rioconcho silty clay loam, occasionally flooded; from southwest corner of courthouse in Paint Rock, 2 blocks east, 1 block south, 1 block east to metal gate, 450 feet east of gate, and 30 feet north of a field road, in cropland:

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak fine granular and subangular blocky structure; hard, friable; few fine roots; few cracks; calcareous, moderately alkaline; abrupt smooth boundary.

A1—5 to 15 inches; very dark grayish brown (10YR 3/2) clay, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; very hard, firm; few fine roots follow pressure faces; calcareous, moderately alkaline; clear wavy boundary.

A2—15 to 50 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate medium angular blocky structure; hard, firm; common very dark brown streaks in upper part; few fine roots; calcareous, moderately alkaline; gradual wavy boundary.

Bk—50 to 60 inches; brown (7.5YR 5/2) clay loam, dark brown (7.5YR 4/2) moist; weak fine subangular blocky structure; hard, friable; few threads and films of calcium carbonate; calcareous, moderately alkaline.

The solum ranges in thickness from 34 to more than 60 inches. Depth to limestone or gravel generally ranges from 6 to 20 feet. The texture of the 10- to 40-inch control section is clay loam, silty clay loam, clay, or silty clay; the clay content ranges from 35 to 55 percent. Calcium carbonate equivalent in the 10- to 40-inch control section ranges from 5 to 30 percent. COLE in the control section ranges from 0.07 to 0.09. Organic carbon has an irregular distribution with depth.

The A horizon is very dark grayish brown, dark brown, dark grayish brown, grayish brown, or brown. It is 20 to 60 inches thick.

The B horizon is grayish brown, light brownish gray, very pale brown, pale brown, brown, or light brown.

Rowena Series

The Rowena series consists of deep, well drained, moderately slowly permeable soils that formed in calcareous, loamy or clayey, old alluvial sediment. These soils are on nearly level and gently sloping uplands. Slopes range from 0 to 3 percent. The soils of the Rowena series are fine, mixed, thermic Vertic Calciustolls.

Typical pedon of Rowena clay loam, 1 to 3 percent slopes; from Farm Road 765 in Millersview, 5.2 miles south on Farm Road 2134, 0.9 mile west on a county road, 90 feet south of corner of county road, 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 granular structure; hard, friable; common fine roots and worm casts; calcareous, moderately alkaline; abrupt smooth boundary.

Bw—6 to 21 inches; dark brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; moderate medium blocky structure; very hard, very firm; common fine roots; dark grayish brown streaks in filled cracks; few very fine caliche pebbles; calcareous, moderately alkaline; gradual wavy boundary.

Bk1—21 to 31 inches; dark brown (7.5YR 4/4) clay, dark brown (7.5YR 3/4) moist; moderate medium blocky and angular blocky structure; very hard, very firm; few dark streaks in upper part; few caliche pebbles and soft masses of calcium carbonate in lower part; calcareous, moderately alkaline; clear wavy boundary.

Bk2—31 to 36 inches; reddish yellow (7.5YR 6/6) silty clay loam; strong brown (7.5YR 5/6) moist; hard, friable; few fine roots; common soft masses of calcium carbonate; calcareous, moderately alkaline; clear wavy boundary.

Ck—36 to 60 inches; reddish yellow (7.5YR 6/6) clay loam; strong brown (7.5YR 5/6) moist; structureless; hard, friable; many soft masses and few cemented concretions of calcium carbonate; calcareous, moderately alkaline.

The solum ranges in thickness from 22 to 60 inches. Distinct calcium carbonate accumulation begins at a depth of 24 to 40 inches (fig. 15). The COLE exceeds 0.07. When the soil is dry, cracks 1 to 3 centimeters wide extend from the surface to a depth of 20 to 30 inches.

The A horizon is grayish brown, brown, dark grayish brown, very dark grayish brown, or dark brown. It is 5 to 12 inches thick.

The Bw horizon has the same colors as those of the A horizon. The texture is clay loam, silty clay, or clay. Clay content ranges from 35 to 50 percent. The Bw horizon is 8 to 20 inches thick.

The Bk horizon is grayish brown, dark grayish brown, brown, dark brown, reddish yellow, or reddish brown. The texture is clay loam, silty clay, or clay.

The Ck horizon is pink, light reddish brown, light brown, reddish yellow, or yellowish red. The texture is silty clay loam, clay loam, or clay. Calcium carbonate equivalent of the Ck horizon is 20 to 60 percent.

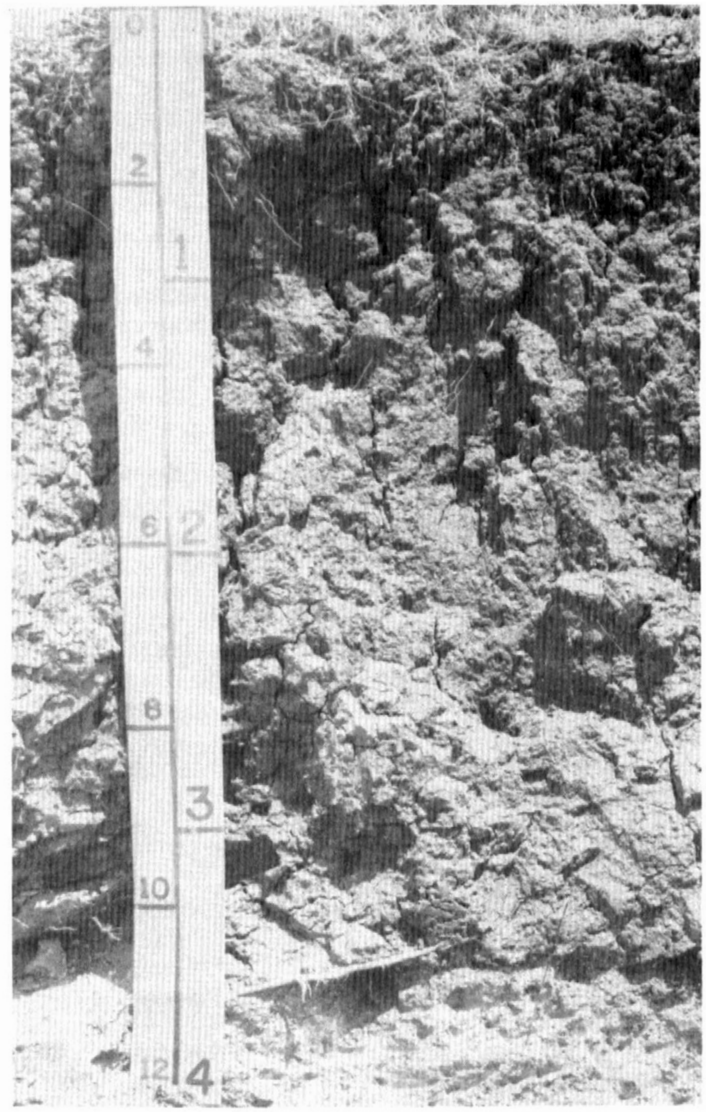


Figure 15.—Rowena clay loam, 0 to 1 percent slopes, has accumulations of lime (calcium carbonate) at a depth of 3 to 4 feet. This soil shrinks and cracks when it is dry.

Sagerton Series

The Sagerton series consists of deep, well drained, moderately slowly permeable soils on gently sloping uplands. These soils formed in calcareous, loamy and clayey sediments on high ancient terraces near the Colorado River. Slopes range from 1 to 3 percent. The soils of the Sagerton series are fine, mixed, thermic Typic Paleustolls.

Typical pedon of Sagerton clay loam, 1 to 3 percent slopes; from Farm Road 765 in Millersview, 2.3 miles north on Farm Road 2134, 2.6 miles east on a county road, 2.5 miles north on a county road to ranch headquarters, 3.1 miles east and northeast on a ranch road to metal field gate, 250 feet northeast, in cropland:

Ap—0 to 7 inches; dark brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; weak fine subangular blocky structure; hard, friable; few fine roots; few worm casts; few fine siliceous pebbles; mildly alkaline; abrupt smooth boundary.

Bt1—7 to 16 inches; dark reddish gray (5YR 4/2) clay, dark reddish brown (5YR 3/2) moist; moderate medium subangular blocky structure; very hard, firm; common fine roots; common worm casts; clay films on faces of peds; few fine siliceous pebbles; moderately alkaline; gradual smooth boundary.

Bt2—16 to 28 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; moderate medium subangular blocky structure; very hard, very firm; few fine roots; common worm casts; continuous clay films; few iron manganese concretions; few fine siliceous and caliche pebbles; moderately alkaline; gradual smooth boundary.

Btk1—28 to 47 inches; reddish brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; hard, firm; few fine roots; patchy clay films; few films and threads of calcium carbonate; few fine siliceous and chert pebbles; moderately alkaline; gradual smooth boundary.

Btk2—47 to 65 inches; yellowish red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; hard, firm; common fine pores; about 35 percent soft bodies and concretions of calcium carbonate; calcareous, moderately alkaline.

The solum ranges in thickness from 60 to more than 80 inches. Depth to secondary carbonates ranges from 20 to 28 inches. Distinct calcic horizons are at a depth of 30 to 60 inches. The mollic epipedon is 11 to 20 inches thick.

The A horizon is dark reddish brown, reddish brown, dark reddish gray, brown, dark brown, or grayish brown. Reaction is neutral or mildly alkaline. This horizon is 5 to 12 inches thick.

The Bt horizon is clay or clay loam throughout. The average clay content in the upper 20 inches of the Bt horizon ranges from about 35 to 45 percent. Reaction is neutral to moderately alkaline in the upper part of the Bt horizon and moderately alkaline in the lower part. The Bt1 horizon has colors similar to those of the A horizon. This horizon is 6 to 12 inches thick. The Bt2 and Bt3 horizons are reddish brown, yellowish red, or brown. Some pedons do not have a Bt3 horizon. The Btk horizon is pink or is in shades of red. The calcic horizon is estimated to have 20 to 50 percent calcium carbonate equivalent, mostly in the form of soft masses and concretions.

Speck Series

The Speck series consists of shallow, well drained, undulating soils on ridges. These soils formed over hard limestone. Permeability is slow. Slopes range from 1 to 5 percent. The soils of the Speck series are clayey, mixed, thermic Lithic Argiustolls.

Typical pedon of Speck cobbly clay loam, undulating; from Farm Road 2134 in Millersview, 8.2 miles east on Farm Road 765, 4.1 miles north on a county road, 0.8 mile west on county and private road, 0.25 mile north to gate, 0.65 mile north on a pasture road to field, 110 feet west of field gate, and 45 feet south of fence, in rangeland:

A—0 to 4 inches; dark brown (7.5YR 4/2) cobbly clay loam, dark brown (7.5YR 3/2) moist; weak fine and medium subangular blocky structure; hard, firm; common fine roots; about 20 percent, by volume, limestone cobbles; few stones; neutral; clear smooth boundary.

Bt—4 to 14 inches; reddish brown (5YR 4/3) clay, dark reddish brown (5YR 3/3) moist; moderate fine and medium blocky structure; very hard, very firm; common fine roots; thin clay films on faces of peds; few small cobbles; mildly alkaline; abrupt irregular boundary.

R—14 to 17 inches; fractured limestone bedrock.

Thickness of the solum and depth to limestone bedrock range from 14 to 20 inches. Reaction is neutral or mildly alkaline. Coarse fragments of limestone cover as much as 15 percent of the surface and make up as much as 20 percent of the soil volume. The mollic epipedon ranges from 8 to 19 inches thick.

The A horizon is very dark grayish brown, dark grayish brown, dark brown, brown, or reddish brown. It is 4 to 9 inches thick.

The Bt horizon is reddish brown, dark reddish brown, or brown. It is clay or clay loam; clay content ranges from 35 to 60 percent. In some pedons, secondary lime is in the Bt horizon as concretions or as coatings on the surface of fragments and in fractures of the bedrock.

The R layer is limestone bedrock or limestone conglomerate. In some pedons, soil and secondary carbonates are in the fractures.

Talpa Series

The Talpa series consist of shallow and very shallow, well drained, undulating soils on uplands. These soils formed over fractured limestone bedrock. Permeability is moderate. Slopes range from 1 to 8 percent. The soils of the Talpa series are loamy, mixed, thermic Lithic Calciustolls.

Typical pedon of Talpa loam, in an area of Talpa-Lueders-Cho complex, undulating; from U.S. Highway 87 in Eden, 10.1 miles north on U.S. Highway 83 to gate on east side of road, 0.15 mile east on ranch road to crossroad, 110 feet south on road, and 15 feet east, in rangeland:

A—0 to 4 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; hard, friable; many fine roots; few worm casts; few fine limestone and caliche fragments; calcareous, moderately alkaline; clear smooth boundary.

Ak—4 to 8 inches; dark brown (10YR 4/3) gravelly loam, dark brown (10YR 3/3) moist; weak fine granular structure; hard, friable; few fine roots and worm casts; about 25 percent caliche and limestone gravel coated with secondary carbonates; calcareous, moderately alkaline; abrupt smooth boundary.

R—8 to 15 inches; coarsely fractured indurated limestone.

The solum ranges in thickness from 5 to 14 inches, which corresponds to the depth to bedrock. It contains 10 to 35 percent limestone pebbles, cobbles, and stones. Secondary calcium carbonate coatings on the limestone range from less than 1 inch to about 2 inches thick. Carbonate content is less than 40 percent of the whole soil, excluding fragments coarser than 2 centimeters.

The A horizon is grayish brown, dark grayish brown, very dark grayish brown, brown, or dark brown. The texture is clay loam, silty clay loam, loam, or silt loam; clay content is 25 to 35 percent.

Tarrant Series

The Tarrant series consists of very shallow and shallow, well drained, moderately slowly permeable soils on undulating uplands. These soils formed in residuum from fractured limestone bedrock of the Cretaceous Period. Slope ranges from 1 to 8 percent. The soils of the Tarrant series are clayey-skeletal, montmorillonitic, thermic Lithic Calciustolls.

Typical pedon of Tarrant cobbly clay, in an area of Tarrant-Oplin-Kavett complex, undulating; from U.S. Highway 83 in Eden, 8.15 miles west on U.S. Highway 87, and 400 feet north of fence, in rangeland:

A—0 to 10 inches; dark gray (10YR 4/1) cobbly clay, very dark gray (10YR 3/1) moist; moderate fine granular structure; hard, very friable; many fine roots; common platy limestone and caliche fragments, 20 percent channers, 10 percent cobbles, and 10 percent gravel; about 40 percent cobbles and about 30 percent gravel fragments on surface; calcareous, moderately alkaline; clear wavy boundary.

Ak—10 to 13 inches; dark brown (10YR 4/3) extremely flaggy clay, dark brown (10YR 3/3) moist; weak fine granular structure; hard, very friable; common fine roots; common worm casts; about 80 percent limestone and caliche fragments, 50 percent flagstone and 30 percent cobble and gravel; pendants and coatings of secondary carbonates on lower sides of fragments; calcareous, moderately alkaline; abrupt wavy boundary.

R—13 to 20 inches; coarsely fractured limestone.

The soil ranges in thickness from 6 to 20 inches over limestone bedrock. It contains from 35 to 85 percent coarse fragments of limestone and caliche that are mostly less than 10 inches across the long axis.

The A and Ak horizons are dark brown, brown, very dark grayish brown, dark grayish brown, or dark gray. Clay content of the fine earth fraction is 40 to 60 percent. Coarse fragments range from 10 to 60 percent in the A horizon and from 60 to 90 percent in the Ak horizon. Most fragments in the Ak horizon have pendants of calcium carbonate on the lower side.

The R layer is indurated limestone. It is layered and fractured and has secondary calcium carbonate coatings in the upper part. In some pedons, marly material is interbedded with hard limestone.

Throck Series

The Throck series consists of deep, well drained, slowly permeable soils on hilly uplands. These soils formed in clayey marl and shaly clay. Slopes range from 8 to 30 percent. The soils of the Throck series are fine, mixed, thermic Typic Ustochrepts.

Typical pedon of Throck stony clay loam, in an area of Lueders-Throck association, hilly; from Farm Road 2134 in Millersview, about 8.5 miles east on Farm Road 765, 0.3 mile north on a county road, and 80 feet east of road, in rangeland:

A—0 to 4 inches; brown (10YR 5/3) stony clay loam, dark brown (10YR 4/3) moist; moderate fine granular structure; hard, friable; common fine roots; common fine limestone and siltstone pebbles; about 20 percent limestone fragments and stones 3 to 15 inches in diameter on surface; calcareous, moderately alkaline; clear smooth boundary.

Bw—4 to 15 inches; light olive brown (2.5Y 5/4) silty clay, olive brown (2.5Y 4/4) moist; moderate fine and very fine subangular blocky structure; hard, firm; common fine roots; common fine limestone pebbles; calcareous, moderately alkaline; clear wavy boundary.

Bk—15 to 32 inches; pale yellow (2.5Y 7/4) silty clay, light yellowish brown (2.5Y 6/4) moist; common distinct brownish yellow and gray mottles; moderate fine and medium subangular blocky structure; hard, firm; common fine shale fragments and brown siltstone pebbles; common films and threads of calcium carbonate; calcareous, moderately alkaline; clear wavy boundary.

C—32 to 40 inches; light brownish gray (2.5Y 6/2) shaly clay; massive, breaking into thin platy fragments; calcareous, moderately alkaline.

The solum ranges in thickness from 30 to 50 inches. Clay content of the control section is 35 to 45 percent. Most pedons are calcareous throughout.

The A horizon is grayish brown or brown. In most pedons, fragments of limestone make up about 1 to 15 percent, by volume. This horizon is 4 to 9 inches thick.

The Bw horizon is pale brown, yellowish brown, brown, light yellowish brown, or light olive brown. The texture is silty clay loam, clay loam, silty clay, or clay. Fragments of limestone vary from a few to 30 percent, by volume, and are mostly less than 3 inches in diameter. The Bw horizon is 5 to 15 inches thick.

The Bk horizon is light yellowish brown, yellowish brown, pale brown, pale yellow, olive yellow, or very pale brown. The texture is clay loam, silty clay loam, silty clay, or clay. Content of calcium carbonate is 15 to 40 percent.

The C or Ck horizon is olive gray, olive, light yellowish brown, light brownish gray, or light gray shaly clay or silty clay. Interbedded strata of limestone 2 to 24 inches thick are in most pedons at a depth of 40 to 80 inches.

Tobosa Series

The Tobosa series consists of deep, well drained, very slowly permeable soils on uplands. These soils formed in calcareous, clayey sediment. They are nearly level and gently sloping and are in wide valleys and on plains. Slopes range from 0 to 3 percent. The soils of the Tobosa series are fine, montmorillonitic, thermic Typic Chromusterts.

Typical pedon of Tobosa clay, 0 to 1 percent slopes; from U.S. Highway 83 in Eden, 6.1 miles east on U.S. Highway 87, 1.5 miles south on a county road, and 38 feet west, in a field:

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; very hard, very firm, sticky and plastic; calcareous, moderately alkaline; clear smooth boundary.

A—7 to 30 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate medium angular blocky structure; common wedge-shaped peds; very hard, very firm, sticky and plastic; common intersecting slickensides in the lower part; calcareous, moderately alkaline; gradual wavy boundary.

Bw—30 to 56 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 3/2) moist; moderate medium angular blocky structure; common wedge-shaped peds; extremely hard, very firm, very sticky and plastic; common intersecting slickensides; calcareous, moderately alkaline; gradual wavy boundary.

Ck—56 to 65 inches; pale brown (10YR 6/3) clay, dark brown (10YR 4/3) moist; massive; extremely hard, very firm, very sticky and plastic; about 5 percent, by volume, soft masses of calcium carbonate; calcareous, moderately alkaline.

The solum ranges in thickness from 40 to 70 inches. When the soils are dry, cracks 1 inch to 3 inches wide extend from the surface to a depth of 20 inches or more. Intersecting slickensides begin at a depth of 14 to 30 inches. The texture is clay or silty clay throughout. In undisturbed areas, the soils have gilgai microrelief. The microdepressions are 1 to 10 inches deep and 2 to 12 feet across. Cycles of knolls and depressions are repeated each 12 to 24 feet.

The A horizon is grayish brown, dark grayish brown, brown, dark brown, or very dark grayish brown. It is 14 to 50 inches thick and is variable within the cyclic distances of 12 to 24 feet.

The Bw or Bk horizon is dark grayish brown, dark brown, brown, grayish brown, pale brown, light brown, or light brownish gray. Visible calcium carbonate ranges from none to common.

The Ck horizon is pink, pinkish gray, reddish yellow, pale brown, very pale brown, or yellowish brown. In some pedons, the Ck horizon is thin, and some pedons do not have a Ck horizon. Some pedons are underlain by limestone below a depth of 40 inches.

Valera Series

The Valera series consists of moderately deep, well drained, moderately slowly permeable soils on uplands. These soils formed in clayey sediment and material over caliche and limestone. They are gently undulating. Slopes range from 1 to 3 percent. The soils of the Valera series are fine, montmorillonitic, thermic Petrocalcic Calciustolls.

Typical pedon of Valera silty clay, 1 to 3 percent slopes; from U.S. Highway 83 in Eden, about 5.4 miles east on U.S. Highway 87, 2.2 miles north on Farm Road 2134, 0.4 mile east and north on a pasture road, and 300 feet east, in a cultivated field:

Ap—0 to 4 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; very hard, very firm, sticky and plastic; few fragments of limestone; calcareous, moderately alkaline; abrupt smooth boundary.

A1—4 to 18 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist;

moderate angular blocky structure; very hard, very firm, sticky and plastic; few fragments of limestone; calcareous, moderately alkaline; gradual wavy boundary.

A2—18 to 36 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate angular blocky structure; very hard, very firm, sticky and plastic; 8 percent limestone fragments; calcareous, moderately alkaline; abrupt wavy boundary.

Bkm—36 to 47 inches; pink (7.5YR 8/4) strongly cemented calcium carbonate; pinkish white (7.5YR 8/2) moist; many fragments of limestone; common fine soft white bodies of calcium carbonate.

R—47 to 50 inches; fractured limestone, reprecipitated calcium carbonate in fractures.

The solum ranges in thickness from 20 to 40 inches and corresponds to the depth to the petrocalcic horizon. Coarse fragments of limestone make up less than 15 percent of the control section. The texture of the control section is silty clay or clay. Clay content ranges from 40 to 55 percent.

The Ap and A1 horizons are very dark grayish brown, dark grayish brown, grayish brown, dark brown, and brown. The A2 horizon has the same colors and in places is dark reddish brown.

Some pedons have a Bw or Bk horizon that is one or two color units higher than the A horizon.

The Bkm horizon ranges from strongly cemented to indurated calcium carbonate that is pink, white, or very pale brown.

The R layer ranges from indurated limestone that contains interbedded marls, to soft limestone that is cemented in the upper part of the layer, to a mixture of limestone fragments, marls, and cemented caliche.

Yahola Series

The Yahola series consists of deep, well drained, moderately rapidly permeable soils on flood plains bordered by deeply cut channels of the Colorado River. These soils formed in loamy, calcareous, alluvial deposits of mixed origin. They are nearly level to gently sloping. Slopes range from 0 to 2 percent. The soils in the Yahola series are coarse-loamy, mixed (calcareous), thermic Typic Ustifluvents.

Typical pedon of Yahola fine sandy loam, rarely flooded; about 650 feet south of the Colorado River on Farm Road 2134 and 40 feet west of highway right-of-way, in idle cropland:

A—0 to 9 inches; brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 3/4) moist; weak fine subangular blocky structure; slightly hard, very friable; many fine roots; common worm casts; few fine siliceous pebbles; calcareous, moderately alkaline; clear smooth boundary.

C1—9 to 36 inches; light reddish brown (5YR 6/4) fine sandy loam, reddish brown (5YR 4/4) moist; massive; soft, very friable; common thin strata of loam; common fine roots; few worm casts; few fine siliceous pebbles; calcareous, moderately alkaline; gradual smooth boundary.

C2—36 to 60 inches; light reddish brown (5YR 6/4) loam, reddish brown (5YR 4/4) moist; massive; slightly hard, very friable; common thin strata of fine sandy loam; few fine siliceous pebbles; calcareous, moderately alkaline.

The A horizon ranges in thickness from 4 to 15 inches. It is brown, light brown, light reddish brown, reddish brown, reddish yellow, and yellowish red.

The C horizon is light reddish brown, reddish brown, reddish yellow, brown, and light brown. It is fine sandy loam or loam, or it has strata (bedding planes) of these textures and loamy fine sand or occasionally of silty clay loam. Clay content ranges from 5 to 18 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 characteristics of the soil at any given point are determined by the physical and mineral composition of the parent material; the climate under which the parent material accumulated and has existed since accumulation; the plant and animal life on and in the soil; the relief, or lay of the land; and the length of time the forces of soil formation have acted on the soil material. All of these factors influence the present characteristics of every soil, but the significance of each factor varies from one place to another. In one area one factor can dominate the formation of a soil, and in another, a different factor can be more important.

The interrelationship among these five factors is complex, and the effects of any one factor cannot be isolated and completely evaluated. Each factor and the probable effects of each factor are described separately.

Parent Material

Parent material is the unconsolidated mass from which the soils form. The kind of parent material determines the limits of the chemical and mineralogical composition of the soil. In Concho County, the soils formed in material from three different geological systems—the Permian, Cretaceous, and Quaternary *(3)*.

Material of the Permian system is mainly interbedded limy shale, marl, and limestone of the Wichita and Clear Fork Groups (fig. 16). Several rock formations of Permian age are in the northern half of Concho County. The oldest formation is on the eastern side of the county, and the youngest is on the western side *(6)*. These formations lie in a north-south direction, and several of them form prominent east-facing escarpments. The Lueders, Talpa, and Speck soils formed in material weathered from limestone and marl. The Throck soils formed in material weathered from limy shale.

An outstanding topographic feature of the county is the Brady Mountains, which are part of the Cretaceous system. The mountains extend from east to west across the central part of the county and are outlined in most areas by steep escarpments that are generally north facing. These hills are capped with limestone of the Fort Terrett Formation and form the northern edge of the Edwards Plateau in Concho County. The lower part of these hills are composed of a narrow band of limy sediment of the Antlers Sand Formation. Real soils formed below the limestone scarps and along foot slopes in the loamy material of the basal Cretaceous (Antlers Sand). The Segovia Formation is in the south and southwest part of the county and also consists of alternating beds of limestone and marl. The Eola, Kavett, Oplin, Tarrant, and Valera soils formed over limestones of the Fort Terrett and Segovia Formations.

Loamy and clayey material of the Quaternary system was deposited in valleys, on high terraces, and on upland plains over extensive areas in Concho County. The Angelo, Cho, Karnes, Lipan, Mereta, Miles, Nuvalde, Rowena, Sagerton, and Tobosa soils formed in this material. The Cho soils formed in the most calcareous and most gravelly outwash, and Tobosa soils formed in the most clayey outwash. The parent material of soils on flood plains of streams consists of recent deposits of alluvium. The Dev, Frio, Gageby, Rioconcho, and Yahola soils formed in these deposits and are moderately alkaline.

Plant and Animal Life

Plants, animals, earthworms, insects, bacteria, and fungi have contributed to the development of soils. The mixed prairie grassland contributes large amounts of organic matter and organic acids that help to weather the parent material and reduce erosion. When the roots of grasses and trees decay, they leave a network of channels and pores that increase the passage of air and water through the soil. Burrowing by earthworms and termites increases porosity by leaving open channels for the movement of water and air into the soil. Earthworms also help distribute organic matter to deeper parts of the soil through their castings. Micro-organisms help to decompose organic matter, release nutrients, and add nitrogen to the soil.

At one time there were millions of prairie dogs throughout this area. They burrowed deep down into the caliche and brought highly calcareous soil material to the surface. Tree roots are now able to grow much deeper through these old filled-in burrows, especially in shallow soils, such as the Cho and Mereta soils.

Climate

The climate of Concho County is dry, subhumid, and fairly uniform. It has had a definite effect on soil formation. Rainfall, evaporation, temperature, and wind

Figure 16.—Permian limestone underlies most of soils in the northern half of Concho County. An upheaval of limestone bedrock in the bed of Kickapoo Creek west of Paint Rock is about 500 feet long, 40 feet wide, and 10 feet high. It follows the course of the stream. The soil along the creek banks is Frio silty clay loam, occasionally flooded.

are factors of climate that influence soils. The limited rainfall has not been heavy enough to cause much leaching of calcium carbonate from the soils; therefore, they are calcareous to the surface. Most of the soils have a layer in which calcium carbonate has accumulated at the normal wetting depth.

Patterns of rainfall distribution cause the soils to be alternately wet and dry. When a clay soil, such as Tobosa clay, dries, it becomes severely cracked. The cracks fill with water during rainfall. As the clay soil becomes wet, it swells and the cracks begin to close. This alternate shrinking and swelling causes the soil to churn and offsets the downward movement of clay into the subsoil.

Relief

Relief, or topography, affects soil formation through its influence on drainage, runoff, erosion, plant cover, and soil temperature. The relief of Concho County ranges from nearly level plains to broad, dissected interstream divides that are sloping to steep. More water enters soils that are nearly level because runoff is slower. These soils are generally deep. Runoff is more rapid on soils that are strongly sloping or steep. Steeper soils are more likely to erode, and thus are less likely to be deep.

Relief also affects the kind and amount of vegetation on a soil. Soils that have north-facing slopes receive less direct sunlight and lose less moisture through evaporation than soils that have south-facing slopes. The north-facing soils generally produce more vegetation and are darker.

Time

The length of time in which climate, living organisms, and topography have acted on parent material affects soil characteristics. Soils that have been weathered for a short period resemble the parent material more than those weathered for a longer period. Soils that formed in recent alluvium on bottom lands and stream terraces are younger than soils that formed on uplands. Except for an accumulation of organic matter and darkening of the surface layer, Dev, Frio, Gageby, and Yahola soils have retained most of the characteristics of their loamy parent material. Miles and Sagerton soils are an example of older soils that have well developed horizons. These soils have developed a distinct surface layer and subsoil that bear little resemblance to the original parent material.

Processes of Horizon Differentiation

The soil-forming factors produce a succession of layers, or horizons, in the soil profile from the surface down to bedrock. The horizons differ in one or more properties; for example, thickness, color, texture, structure consistence, porosity, and reaction.

Most profiles consist of three major horizons, the A, B, and C horizons. In some young soils, a B horizon has not developed. Several processes are involved in the formation of horizons. In Concho County, the main processes are leaching of calcium carbonate and bases, accumulation of organic matter, and formation and translocation of silicate clay minerals. In most soils, more than one of these processes have been active in the development of the horizons.

The A horizon is the surface layer. It is the horizon of maximum accumulation of organic matter. Various dissolved or suspended materials, such as calcium carbonate, iron, or clay, may have been leached out of the A horizon down into the B horizon. If a soil is plowed, the upper part of the A horizon is disturbed. This disturbed layer is called the Ap horizon.

The B horizon lies directly below the A horizon. It is the horizon of maximum accumulation of dissolved or suspended material or an altered horizon that shows distinct structure but little evidence of clay translocation or accumulation.

The Bk horizon is a layer of carbonates, commonly calcium carbonate. Some soils have calcium carbonate concretions that have become cemented or indurated. An indurated, or petrocalcic, horizon is called a Bkm horizon. Karnes soils have a distinct Bk horizon, and Cho and Mereta soils have a distinct Bkm horizon.

The Bt horizon has a significant amount of clay accumulation and generally is firmer than the horizons directly above or below. A Bw horizon has distinct structure and little evidence of accumulation of clay material. Miles and Sagerton soils have a distinct Bt horizon, and Frio and Tobosa soils have a Bw horizon.

The C horizon is relatively unchanged by the soil forming processes; however, it has been somewhat modified by weathering. The Ck horizon has accumulated a significant amount of calcium carbonates. The Cr horizon is unconsolidated underlying material, such as soft shale or soft limestone.

The R layer is consolidated bedrock, such as limestone.

Some soils do not have a B horizon, a C horizon, or an R layer.

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) Sellards, E.H., W.S. Adkins, and F.B. Plummer. 1932. Geology of Texas, stratigraphy, vol. 1. Univ. Tex. Bull. 3232, 1,007 pp., illus.

(4) 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.)

(5) 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.

(6) University of Texas. 1978. Geologic atlas of Texas, Brownwood sheet. Univ. Tex., Bur. Econ. Geol.

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.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

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.

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.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a fragment.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. 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 (in tables). 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.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

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.

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.

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.

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.

Escarpment. A steep slope separating two comparatively level or more gently sloping surfaces.

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 (in tables). Excess carbonates in the soil restrict the growth of some plants.

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.

Fine textured soil. Sandy clay, silty clay, and clay.

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.

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.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an 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.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the 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.

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.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

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.

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.

Mast. Acorns, pecans, and similar seeds of trees that serve as food for deer, turkey, and other animals.

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.

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.

Motte. A clump of trees in a prairie.

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.

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.

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.

Percs slowly (in tables). The slow movement of water through the soil adversely affects the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 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 (in tables). 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.

Playa. The flat-floored bottom of an enclosed basin that becomes at times a shallow lake.

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.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of 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

Relief. The elevations or inequalities of a land surface, considered collectively.

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.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2 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.

Seepage (in tables). The movement of water through the soil adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and 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.

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.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

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.

Substratum. The part of the soil below the solum.

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."

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). Otherwise suitable soil material is too thin for the specified use.

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.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial melt water. In nonglaciated regions, alluvium deposited in stream valleys by heavily loaded streams.

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.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Data recorded in the period 1951-81 at Eden, Texas]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days*	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	61.1	33.1	47.1	84	8	107	1.02	0.10	1.69	2	1.1
February---	65.6	36.8	51.2	87	13	133	1.13	0.32	1.79	3	1.0
March------	73.5	43.5	58.5	93	19	301	1.17	0.21	1.91	3	0.3
April------	81.9	52.9	67.4	98	29	522	2.17	0.74	3.34	4	0.0
May--------	87.0	59.7	73.4	102	40	725	3.49	1.59	5.11	5	0.0
June-------	93.9	66.5	80.2	105	52	906	2.37	0.71	3.72	3	0.0
July-------	96.9	69.1	83.0	107	60	1,023	1.77	0.33	2.89	3	0.0
August-----	96.0	68.0	82.0	106	58	992	2.46	0.74	3.86	4	0.0
September--	89.5	62.9	76.2	103	44	786	3.70	0.96	5.88	4	0.0
October----	81.0	53.3	67.2	97	31	533	2.40	0.45	3.93	4	0.0
November---	69.3	42.3	55.8	86	18	215	1.33	0.33	2.12	3	0.8
December---	63.1	35.3	49.2	83	13	82	0.86	0.10	1.41	2	0.3
Yearly: Average--	79.9	52.0	65.9	---	---	---	---	---	---	---	---
Extreme--	---	---	---	109	6	---	---	---	---	---	---
Total----	---	---	---	---	---	6,325	23.87	17.17	30.03	40	3.5

* 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 Eden, 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 25	April 5	April 15
2 years in 10 later than--	March 17	March 30	April 10
5 years in 10 later than--	March 3	March 17	March 30
First freezing temperature in fall:			
1 year in 10 earlier than--	November 10	October 30	October 23
2 years in 10 earlier than--	November 17	November 5	October 29
5 years in 10 earlier than--	November 30	November 16	November 9

TABLE 3.--GROWING SEASON

[Data recorded in the period 1951-81 at Eden, 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	244	215	200
8 years in 10	253	225	208
5 years in 10	271	243	223
2 years in 10	288	261	239
1 year in 10	297	271	247

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
AnA	Angelo silty clay loam, 0 to 1 percent slopes	29,180	4.6
AnB	Angelo silty clay loam, 1 to 3 percent slopes	9,950	1.6
ChB	Cho loam, 1 to 5 percent slopes	5,630	0.9
COC	Cho gravelly loam, undulating	79,190	12.5
DV	Dev gravelly loam, frequently flooded	1,990	0.3
EKB	Eola-Kavett association, undulating	23,750	3.7
Fo	Frio silty clay loam, occasionally flooded	5,970	0.9
Fr	Frio silty clay loam, frequently flooded	10,690	1.7
Ga	Gageby loam, rarely flooded	3,440	0.5
KaB	Karnes loam, 1 to 5 percent slopes	6,780	1.1
KtB	Kavett silty clay, 0 to 3 percent slopes	24,170	3.8
KXB	Kavett-Cho-Oplin complex, undulating	53,360	8.4
LpA	Lipan clay, ponded	1,420	0.2
LTE	Lueders-Throck association, hilly	8,360	1.3
MeA	Mereta clay loam, 0 to 1 percent slopes	17,780	2.8
MeB	Mereta clay loam, 1 to 3 percent slopes	49,810	7.8
MfB	Miles fine sandy loam, 1 to 3 percent slopes	810	0.1
NuA	Nuvalde silty clay loam, 0 to 1 percent slopes	20,690	3.3
NuB	Nuvalde silty clay loam, 1 to 3 percent slopes	30,690	4.8
ORE	Oplin-Real complex, hilly	11,340	1.8
Rc	Rioconcho silty clay loam, occasionally flooded	1,260	0.2
RoA	Rowena clay loam, 0 to 1 percent slopes	27,410	4.3
RoB	Rowena clay loam, 1 to 3 percent slopes	43,070	6.8
SaB	Sagerton clay loam, 1 to 3 percent slopes	628	0.1
SpB	Speck cobbly clay loam, undulating	1,290	0.2
TAC	Talpa-Lueders-Cho complex, undulating	67,470	10.6
TKC	Tarrant-Oplin-Kavett association, undulating	67,700	10.7
ToA	Tobosa clay, 0 to 1 percent slopes	6,400	1.0
ToB	Tobosa clay, 1 to 3 percent slopes	3,680	0.6
VaB	Valera silty clay, 1 to 3 percent slopes	19,600	3.1
Ya	Yahola fine sandy loam, rarely flooded	700	0.1
YC	Yahola fine sandy loam, channeled	960	0.2
	Total	635,168	100.0

TABLE 5.--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	Wheat	Grain sorghum	Cotton lint	Oats	Pasture
		Bu	Bu	Lbs	Bu	AUM*
AnA----------------------- Angelo	IIIc	20	35	250	40	3.0
AnB----------------------- Angelo	IIIe	20	30	225	40	3.0
ChB----------------------- Cho	IVs	10	---	---	20	1.5
COC----------------------- Cho	VIs	---	---	---	---	---
DV------------------------ Dev	VIw	---	---	---	---	---
EKB:						
Eola----------------------	VIIs	---	---	---	---	---
Kavett--------------------	IIIs	10	---	---	20	1.5
Fo------------------------ Frio	IIw	25	50	375	50	4.0
Fr------------------------ Frio	Vw	---	---	---	---	---
Ga------------------------ Gageby	IIc	25	40	300	45	3.5
KaB----------------------- Karnes	IIIe	15	25	150	30	2.0
KtB----------------------- Kavett	IIIe	15	20	150	---	2.0
KXB----------------------- Kavett-Cho-Oplin	VIs	---	---	---	---	---
LpA----------------------- Lipan	IIIw	15	20	250	---	3.5
LTE----------------------- Lueders-Throck	VIIs	---	---	---	---	---
MeA----------------------- Mereta	IIIs	20	25	200	30	2.0
MeB----------------------- Mereta	IIIe	15	20	150	25	2.0
MfB----------------------- Miles	IIIe	20	30	250	35	3.0
NuA----------------------- Nuvalde	IIc	20	40	300	50	3.0

See footnote at end of table.

TABLE 5.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Map symbol and soil name	Land capability	Wheat	Grain sorghum	Cotton lint	Oats	Pasture
		Bu	Bu	Lbs	Bu	AUM*
NuB----------------------- Nuvalde	IIe	20	35	250	45	3.0
ORE----------------------- Oplin-Real	VIIs	---	---	---	---	---
Rc------------------------ Rioconcho	IIw	25	35	250	45	3.5
RoA----------------------- Rowena	IIc	25	40	300	40	3.0
RoB----------------------- Rowena	IIe	25	35	250	40	3.0
SaB----------------------- Sagerton	IIe	20	25	225	40	3.0
SpB----------------------- Speck	VIs	---	---	---	---	---
TAC----------------------- Talpa-Lueders-Cho	VIIs	---	---	---	---	---
TKC:						
Tarrant-------------------	VIIs	---	---	---	---	---
Oplin---------------------	VIIs	---	---	---	---	---
Kavett--------------------	IVe	10	---	---	20	1.5
ToA----------------------- Tobosa	IIIs	20	35	250	40	3.5
ToB----------------------- Tobosa	IIIe	20	30	200	40	3.0
VaB----------------------- Valera	IIe	20	30	200	45	3.5
Ya------------------------ Yahola	IIe	30	40	300	50	4.0
YC------------------------ Yahola	Vw	---	---	---	---	---

* 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 6.--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	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
AnA, AnB: Angelo	Clay Loam	3,500	2,500	1,500
ChB, COC: Cho	Very Shallow	2,500	2,000	1,000
DV: Dev	Loamy Bottomland	4,000	3,000	2,000
EKB:				
Eola	Very Shallow	2,500	2,000	1,000
Kavett	Shallow	3,000	2,500	1,500
Fo, Fr: Frio	Loamy Bottomland	5,000	3,500	2,500
Ga: Gageby	Loamy Bottomland	4,500	3,000	2,000
KaB: Karnes	Clay Loam	3,500	2,500	1,500
KtB: Kavett	Shallow	3,000	2,500	1,500
KXB:				
Kavett	Shallow	3,000	2,500	1,500
Cho	Very Shallow	2,500	2,000	1,000
Oplin	Low Stony Hills	2,000	1,500	1,000
LpA: Lipan	Clay Flat	3,500	2,000	1,000
LTE:				
Lueders	Very Shallow	2,000	1,500	1,000
Throck	Rocky Hills	3,000	2,000	1,500
MeA, MeB: Mereta	Shallow	3,000	2,500	1,800
MfB: Miles	Sandy Loam	3,500	2,500	2,000
NuA, NuB: Nuvalde	Clay Loam	4,000	3,000	2,000
ORE:				
Oplin	Steep Rocky	2,000	1,500	1,000
Real	Steep Adobe	2,500	2,000	1,000
Rc: Rioconcho	Loamy Bottomland	4,000	3,000	2,000

TABLE 6.--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
RoA, RoB: Rowena	Clay Loam	4,000	3,000	2,000
SaB: Sagerton	Clay Loam	4,000	3,000	2,000
SpB: Speck	Redland	3,000	2,500	1,500
TAC:				
Talpa	Very Shallow	1,500	1,200	500
Lueders	Very Shallow	2,000	1,500	1,000
Cho	Very Shallow	2,500	2,000	1,000
TKC:				
Tarrant	Low Stony Hills	2,500	2,000	1,500
Oplin	Low Stony Hills	2,000	1,500	1,000
Kavett	Shallow	3,000	2,500	1,500
ToA, ToB: Tobosa	Clay Flat	3,500	2,500	1,500
VaB: Valera	Clay Loam	4,000	3,000	2,000
Ya, YC: Yahola	Loamy Bottomland	5,000	4,000	2,500

TABLE 7.--POTENTIAL PLANT COMMUNITY

[The numbers in the column under the range site represent the percentage of total production of the plant species shown in the left hand column, on an air-dry basis. A dash indicates the plant does not occur in that particular range site. A letter T indicates a trace amount of production. The percentages followed by the same letter are grouped together to equal the indicated percentage. Example: In the Clay Flat range site Canada wildrye, reverchon panicum, purple threeawn, and hooded windmillgrass each are identified with a 5a percentage; thus these four plants together equal 5 percent of the total composition of this range site]

Plant species	Range site										
	Clay Flat	Clay Loam	Loamy Bottomland	Low Stony Hills	Redland	Rocky Hills	Sandy Loam	Shallow	Steep Adobe	Steep Rocky	Very Shallow
FORBS:											
blacksamson	---	---	T	---	T	---	T	T	T	T	T
bluebonnet	---	---	---	T	T	---	T	T	---	---	---
bushsunflower	---	T	10c	10e	5d	10c	---	10d	T	5f	5f
bundleflower	---	10c	10c	---	T	10c	T	---	---	5f	---
croton	---	---	---	T	---	---	---	T	T	T	5f
dalea	---	---	10c	---	5d	10c	T	---	5a	5f	---
dayflower	10b	---	T	T	---	---	T	T	---	T	---
Engelmann-daisy	10b	10c	10c	10e	5d	10c	5	10d	---	5f	---
evening primrose	---	---	T	---	T	---	T	T	---	---	---
fern acacia	10b	---	---	---	---	---	---	---	---	---	---
gaura	---	---	T	---	---	---	T	T	---	---	5f
gayfeather	---	---	---	10e	---	10c	T	10d	---	5f	---
heath aster	10b	10c	10c	---	---	---	---	---	---	---	---
halfshrub sundrop	---	---	T	T	T	---	T	T	---	5f	---
Indian mallow	---	T	---	T	---	---	---	---	T	---	---
Indian paintbrush	10b	---	T	T	---	---	T	T	---	---	---
ironweed	---	---	10c	---	---	---	---	---	---	---	---
Maximilian sunflower	---	---	10c	---	---	---	5c	---	---	T	---
Mexican sagewort	10b	10c	10c	10e	5d	10c	T	T	---	---	---
orange zexmenia	---	T	---	10e	T	---	5c	10d	---	---	5f
partridge pea	---	---	10c	---	---	---	5c	---	---	---	---
penstemon	---	---	T	---	---	---	T	10d	---	---	---
phlox	T	---	T	---	---	---	T	---	---	---	---
prairiegentain	10b	---	10c	---	---	---	T	T	---	---	---
scurfpea	---	---	---	T	---	---	---	T	5a	T	---
sensitivebrier	10b	10c	10c	T	T	10c	---	T	---	5f	---
skullcap	---	---	---	---	---	---	T	---	---	---	---
snow-on-the-mountain	10b	---	---	T	---	---	T	---	---	5f	---
spiderwort	10b	---	10c	---	---	---	T	---	---	---	---
trailing ratany	10b	10c	T	---	---	10c	T	---	5a	5f	---
verbena	---	T	T	T	---	---	T	T	---	---	T
vetch	---	---	10c	---	T	---	5c	T	---	5f	---
western indigo	10b	---	10c	10e	---	---	5c	10d	---	5f	---
western ragweed	---	10c	---	---	T	---	T	T	---	---	---
wildbean	T	---	10c	T	T	---	---	T	---	---	---
winecup	T	---	10c	T	T	---	T	T	---	---	---
woollywhite	---	---	---	---	---	---	---	T	---	---	5f
yellow neptunia	---	---	10c	T	---	---	T	T	---	5f	---

TABLE 7.--POTENTIAL PLANT COMMUNITY--Continued

Plant species	Range site										
	Clay Flat	Clay Loam	Loamy Bottomland	Low Stony Hills	Redland	Rocky Hills	Sandy Loam	Shallow	Steep Adobe	Steep Rocky	Very Shallow
GRASSES AND GRASS-LIKES:											
Arizona cottontop	---	---	---	---	---	---	5	T	---	---	---
bluestem, big	---	---	5	T	5	5	---	---	---	5a	---
bluestem, cane	T	10a	5	10a	5b	5	T	5a	---	10b	5a
bluestem, little	---	10a	5	15	20	15	15	T	35	20	5
bluestem, silver	10	10a	T	10a	5b	T	5	5a	T	10b	5a
bristlegrass, plains	---	10	---	---	---	---	---	---	---	---	---
buffalograss	5	10b	T	10b	10a	5a	5	10	---	---	15c
Canada wildrye	5a	5	5	5	5	5	5	5	---	---	---
curlymesquite	10	10b	T	10b	10a	5a	---	10	---	---	15c
dropseed, hairy	---	---	---	T	---	10	---	---	10	---	10
dropseed, meadow	10	T	5	---	---	---	---	---	---	---	---
dropseed, sand	---	---	---	---	---	---	T	5	---	---	T
dropseed, tall	T	---	---	---	5	---	---	---	---	10b	---
eastern gamagrass	---	---	T	---	---	---	---	---	---	---	---
fall witchgrass	---	---	---	T	---	T	T	5	---	5c	T
grama, hairy	---	---	---	T	---	T	---	T	T	T	T
grama, red	---	---	---	T	---	---	---	T	---	---	T
grama, sideoats	15	25	15	15	20	15	15	25	15	20	30
grama, tall hairy	---	---	---	---	---	---	---	---	5	5c	---
grama, Texas	---	---	---	---	---	---	---	T	---	---	T
green sprangletop	---	---	T	5	---	---	---	T	---	5	T
indiangrass	---	---	5	5	5	5	10	---	10	5a	---
lovegrass, plains	---	---	---	T	---	---	5	---	---	5c	---
panicum, Hall	---	---	---	5	---	---	---	---	---	---	---
panicum, reverchon	5a	---	T	---	---	---	T	5	---	5d	---
panicum, low	---	---	5	---	---	---	5a	---	---	---	---
paspalum, fringeleaf	---	---	---	---	---	---	5a	---	---	---	---
paspalum, sand	---	---	---	---	---	---	5a	---	---	---	---
sedges	---	---	T	---	---	T	---	---	T	5d	---
switchgrass	---	---	5	---	---	---	---	---	---	---	---
Texas bluegrass	---	---	10a	---	---	---	---	---	---	---	---
Texas cupgrass	---	T	T	T	5	10	---	---	---	5d	---
Texas wintergrass	10	10	10a	5	10	5	5	5	---	5d	5
threeawn, purple	5a	---	---	5c	---	---	---	5b	T	5d	10d
threeawn, red	---	---	---	5c	---	---	---	5b	---	---	10d
threeawn, Wright	T	---	---	5c	---	T	T	5b	T	5d	10d
tridens, hairy	---	---	---	T	---	---	---	---	---	---	T
tridens, rough	---	---	---	T	---	5	---	5c	5b	5e	10b
tridens, slim	---	---	---	T	---	T	---	5c	5b	5e	10b
tridens, white	10	5	T	---	T	---	---	---	---	---	---
vine-mesquite	15	15	15	T	T	---	5	---	---	---	---
western wheatgrass	---	T	10a	---	---	---	---	---	---	---	---
windmillgrass, hooded	5a	---	---	---	T	---	5	---	---	---	---

TABLE 7.--POTENTIAL PLANT COMMUNITY--Continued

Plant species	Range site										
	Clay Flat	Clay Loam	Loamy Bottomland	Low Stony Hills	Redland	Rocky Hills	Sandy Loam	Shallow	Steep Adobe	Steep Rocky	Very Shallow
WOODY PLANTS:											
agarito	---	---	5b	T	T	T	---	5e	T	T	T
black willow	---	---	5b	---	---	---	---	---	---	---	---
bumelia	---	---	5b	T	5c	---	---	---	T	T	---
catclaw acacia	---	---	---	T	5c	T	---	5e	T	---	T
cottonwood	---	---	5b	---	---	---	---	---	---	---	---
elbowbush	---	---	---	T	---	5b	---	---	T	5g	---
elm	T	T	T	T	5c	5b	---	---	---	T	---
grape	---	---	5b	---	---	---	---	---	---	---	---
greenbrier	---	---	5b	T	---	---	---	---	T	T	---
hackberry	T	T	5b	T	5c	5b	5b	5e	T	5g	---
hawthorn	---	---	5b	T	---	---	---	---	---	T	---
honeysuckle	---	---	5b	T	---	T	---	T	T	T	T
hoptree	---	---	5b	---	---	---	---	---	---	---	---
juniper	---	---	---	T	---	---	---	---	T	T	---
lotebush	T	T	---	T	---	T	---	T	---	---	T
oak, live	---	---	5b	10d	T	---	T	T	5	10h	5e
oak, shin	---	---	---	10d	---	---	---	---	T	10h	---
oak, Texas	---	---	---	T	---	---	---	---	10	10h	---
pecan	---	---	5	---	---	---	---	---	---	---	---
pricklyash	---	---	T	T	5c	T	T	5e	T	T	T
pricklypear	---	---	---	---	T	---	---	T	T	T	T
redbud	---	---	---	T	---	---	---	---	T	5i	---
sacahuista	---	---	---	T	---	---	---	T	T	---	5e
sumac, flameleaf	---	---	---	T	---	---	---	5e	T	5i	---
sumac, littleleaf	---	---	---	---	---	T	5b	T	T	T	T
sumac, skunkbush	---	---	---	---	---	5b	5b	---	T	---	---
Texas persimmon	---	---	---	T	---	T	---	---	---	5i	---
vineephedra	---	---	---	---	T	T	T	T	---	---	5e
walnut	---	---	5b	---	---	---	---	---	---	---	---
wild plum	---	---	5b	---	T	---	---	---	---	---	---
yucca	---	---	---	T	T	T	T	5e	T	---	5e

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
AnA------------------- Angelo	Slight----------	Slight----------	Slight----------	Slight----------	Slight.
AnB------------------- Angelo	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
ChB, COC-------------- Cho	Severe: cemented pan.	Severe: cemented pan.	Severe: small stones, cemented pan.	Slight----------	Severe: cemented pan.
DV-------------------- Dev	Severe: flooding, small stones.	Severe: small stones.	Severe: small stones, flooding.	Moderate: flooding.	Severe: small stones, droughty, flooding.
EKB:					
Eola-----------------	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: small stones.	Severe: small stones.	Severe: small stones, depth to rock.
Kavett---------------	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan.	Moderate: too clayey.	Severe: depth to rock, too clayey.
Fo-------------------- Frio	Severe: flooding.	Moderate: too clayey.	Moderate: too clayey, flooding.	Moderate: too clayey.	Severe: too clayey.
Fr-------------------- Frio	Severe: flooding.	Severe: flooding, too clayey.	Severe: too clayey, flooding.	Moderate: too clayey, flooding.	Severe: flooding, too clayey.
Ga-------------------- Gageby	Severe: flooding.	Slight----------	Slight----------	Slight----------	Slight.
KaB------------------- Karnes	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
KtB------------------- Kavett	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan.	Moderate: too clayey.	Severe: depth to rock, too clayey.
KXB:					
Kavett---------------	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan.	Moderate: too clayey.	Severe: depth to rock, too clayey.
Cho------------------	Severe: cemented pan.	Severe: cemented pan.	Severe: small stones, cemented pan.	Slight----------	Severe: cemented pan.
Oplin----------------	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: small stones.	Severe: large stones, depth to rock.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
LpA: Lipan	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, too clayey.
LTE:					
Lueders	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones, depth to rock.	Moderate: large stones, slope.	Severe: small stones, depth to rock.
Throck	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: large stones, slope.	Severe: slope.
MeA, MeB: Mereta	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Slight	Severe: cemented pan.
MfB: Miles	Slight	Slight	Moderate: slope.	Slight	Slight.
NuA: Nuvalde	Slight	Slight	Slight	Slight	Slight.
NuB: Nuvalde	Slight	Slight	Moderate: slope.	Slight	Slight.
ORE:					
Oplin	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: small stones.	Severe: large stones, slope, depth to rock.
Real	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: small stones.	Severe: depth to rock, slope.
Rc: Rioconcho	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
RoA: Rowena	Slight	Slight	Slight	Slight	Slight.
RoB: Rowena	Slight	Slight	Moderate: slope.	Slight	Slight.
SaB: Sagerton	Slight	Slight	Moderate: slope.	Slight	Slight.
SpB: Speck	Severe: depth to rock.	Severe: depth to rock.	Severe: large stones, depth to rock.	Slight	Severe: depth to rock, too clayey.
TAC:					
Talpa	Severe: depth to rock.	Severe: depth to rock.	Severe: small stones, depth to rock.	Slight	Severe: depth to rock.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
TAC:					
Lueders	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, small stones, depth to rock.	Moderate: large stones.	Severe: small stones, depth to rock.
Cho	Severe: cemented pan.	Severe: cemented pan.	Severe: small stones, cemented pan.	Slight	Severe: cemented pan.
TKC:					
Tarrant	Severe: large stones, depth to rock.	Severe: large stones, depth to rock.	Severe: large stones, small stones.	Severe: large stones.	Severe: large stones, depth to rock.
Oplin	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: small stones.	Severe: large stones, depth to rock.
Kavett	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan.	Moderate: too clayey.	Severe: depth to rock, too clayey.
ToA Tobosa	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: too clayey, percs slowly.	Moderate: too clayey.	Severe: too clayey.
ToB Tobosa	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: slope, too clayey, percs slowly.	Moderate: too clayey.	Severe: too clayey.
VaB Valera	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope, small stones, too clayey.	Moderate: too clayey.	Severe: too clayey.
Ya Yahola	Severe: flooding.	Slight	Slight	Slight	Slight.
YC Yahola	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.

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 herba-ceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
AnA, AnB----------- Angelo	Fair	Fair	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
ChB---------------- Cho	Fair	Poor	Poor	Poor	Poor	Very poor	Poor	Very poor	Poor.
COC---------------- Cho	Poor	Poor	Poor	Poor	Poor	Very poor	Poor	Very poor	Poor.
DV----------------- Dev	Poor	Poor	Fair	Fair	Poor	Very poor	Poor	Very poor	Fair.
EKB:									
Eola--------------	Very poor	Very poor	Poor	Fair	Very poor	Very poor	Poor	Very poor	Poor.
Kavett------------	Fair	Fair	Fair	Poor	Poor	Very poor	Fair	Very poor	Poor.
Fo----------------- Frio	Good	Good	Fair	Good	Poor	Very poor	Good	Very poor	Fair.
Fr----------------- Frio	Very poor	Poor	Fair	Good	Poor	Very poor	Poor	Very poor	Fair.
Ga----------------- Gageby	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
KaB---------------- Karnes	Fair	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Fair.
KtB---------------- Kavett	Fair	Fair	Fair	Poor	Poor	Very poor	Fair	Very poor	Poor.
KXB:									
Kavett------------	Fair	Fair	Fair	Poor	Poor	Very poor	Fair	Very poor	Poor.
Cho---------------	Fair	Poor	Poor	Poor	Poor	Very poor	Poor	Very poor	Poor.
Oplin-------------	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
LpA---------------- Lipan	Fair	Fair	Fair	Very poor	Poor	Fair	Fair	Poor	Poor.
LTE:									
Lueders-----------	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
Throck------------	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
MeA, MeB----------- Mereta	Fair	Fair	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
MfB---------------- Miles	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
NuA, NuB----------- Nuvalde	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	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 herba-ceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
ORE:									
Oplin	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
Real	Very poor	Very poor	Poor	Fair	Very poor	Very poor	Very poor	Very poor	Poor.
Rc Rioconcho	Good	Good	Fair	Good	Poor	Very poor	Good	Very poor	Fair.
RoA, RoB Rowena	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
SaB Sagerton	Good	Good	Fair	Good	Very poor	Very poor	Good	Very poor	Fair.
SpB Speck	Poor	Poor	Fair	Good	Very poor	Very poor	Poor	Very poor	Fair.
TAC:									
Talpa	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
Lueders	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
Cho	Poor	Poor	Poor	Poor	Poor	Very poor	Poor	Very poor	Poor.
TKC:									
Tarrant	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
Oplin	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
Kavett	Fair	Fair	Fair	Poor	Poor	Very poor	Fair	Very poor	Poor.
ToA, ToB Tobosa	Fair	Fair	Poor	Fair	Poor	Very poor	Fair	Very poor	Poor.
VaB Valera	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
Ya Yahola	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
YC Yahola	Poor	Fair	Fair	Good	Poor	Very poor	Fair	Very poor	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	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
AnA, AnB: Angelo	Moderate: too clayey.	Severe: shrink-swell.	Moderate: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
ChB: Cho	Severe: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.	Moderate: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.
COC: Cho	Severe: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.	Moderate: slope, cemented pan.	Moderate: cemented pan.	Severe: cemented pan.
DV: Dev	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: small stones, droughty, flooding.
EKB:						
Eola	Severe: depth to rock, cemented pan.	Moderate: depth to rock, cemented pan.	Severe: depth to rock, cemented pan.	Moderate: depth to rock.	Moderate: depth to rock, cemented pan.	Severe: small stones, depth to rock.
Kavett	Severe: depth to rock, cemented pan.	Severe: depth to rock, shrink-swell, cemented pan.	Severe: depth to rock, shrink-swell, cemented pan.	Severe: depth to rock, shrink-swell, cemented pan.	Severe: depth to rock, cemented pan, shrink-swell.	Severe: depth to rock, too clayey.
Fo: Frio	Moderate: too clayey, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Severe: too clayey.
Fr: Frio	Moderate: too clayey, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Severe: flooding, too clayey.
Ga: Gageby	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.	Slight.
KaB: Karnes	Slight	Slight	Slight	Slight	Slight	Slight.
KtB: Kavett	Severe: depth to rock, cemented pan.	Severe: depth to rock, shrink-swell, cemented pan.	Severe: depth to rock, shrink-swell, cemented pan.	Severe: depth to rock, shrink-swell, cemented pan.	Severe: depth to rock, cemented pan, shrink-swell.	Severe: depth to rock, too clayey.
KXB:						
Kavett	Severe: depth to rock, cemented pan.	Severe: depth to rock, shrink-swell, cemented pan.	Severe: depth to rock, shrink-swell, cemented pan.	Severe: depth to rock, shrink-swell, cemented pan.	Severe: depth to rock, cemented pan, shrink-swell.	Severe: depth to rock, too clayey.
Cho	Severe: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.	Moderate: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
KXB:						
Oplin	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: large stones, depth to rock.
LpA: Lipan	Severe: cutbanks cave, ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, shrink-swell.	Severe: ponding, too clayey.
LTE:						
Lueders	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: small stones, depth to rock.
Throck	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: slope.
MeA, MeB: Mereta	Severe: cemented pan.	Moderate: shrink-swell, cemented pan.	Severe: cemented pan.	Moderate: shrink-swell, cemented pan.	Severe: low strength.	Severe: cemented pan.
MfB: Miles	Slight	Slight	Slight	Slight	Slight	Slight.
NuA, NuB: Nuvalde	Slight	Severe: shrink-swell.	Moderate: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
ORE:						
Oplin	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: large stones, slope, depth to rock.
Real	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: depth to rock, slope.
Rc: Rioconcho	Moderate: too clayey, flooding.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: shrink-swell, low strength, flooding.	Moderate: flooding.
RoA, RoB: Rowena	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
SaB: Sagerton	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
SpB: Speck	Severe: depth to rock.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, low strength, shrink-swell.	Severe: depth to rock, too clayey.
TAC:						
Talpa	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
TAC:						
Lueders----------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: small stones, depth to rock.
Cho--------------	Severe: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.	Moderate: slope, cemented pan.	Moderate: cemented pan.	Severe: cemented pan.
TKC:						
Tarrant----------	Severe: depth to rock, large stones.	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: large stones, depth to rock.
Oplin------------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: large stones, depth to rock.
Kavett-----------	Severe: depth to rock, cemented pan.	Severe: depth to rock, shrink-swell, cemented pan.	Severe: depth to rock, shrink-swell, cemented pan.	Severe: depth to rock, shrink-swell, cemented pan.	Severe: depth to rock, cemented pan, shrink-swell.	Severe: depth to rock, too clayey.
ToA, ToB---------- Tobosa	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
VaB--------------- Valera	Severe: depth to rock, cemented pan.	Severe: shrink-swell.	Severe: depth to rock, cemented pan, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
Ya---------------- Yahola	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Slight.
YC---------------- Yahola	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.

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
AnA: Angelo	Severe: percs slowly.	Moderate: seepage.	Slight	Slight	Good.
AnB: Angelo	Severe: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
ChB, COC: Cho	Severe: cemented pan.	Severe: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.	Poor: cemented pan, small stones.
DV: Dev	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding, seepage.	Poor: small stones.
EKB:					
Eola	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan.	Severe: depth to rock.	Severe: depth to rock, cemented pan.	Poor: depth to rock, small stones.
Kavett	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan, too clayey.	Severe: depth to rock, cemented pan.	Poor: depth to rock, too clayey, hard to pack.
Fo, Fr: Frio	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, too clayey.	Severe: flooding.	Poor: too clayey, hard to pack.
Ga: Gageby	Moderate: flooding.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
KaB: Karnes	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: excess lime.
KtB: Kavett	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan, too clayey.	Severe: depth to rock, cemented pan.	Poor: depth to rock, too clayey, hard to pack.
KXB:					
Kavett	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan, too clayey.	Severe: depth to rock, cemented pan.	Poor: depth to rock, too clayey, hard to pack.
Cho	Severe: cemented pan.	Severe: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.	Poor: cemented pan, small stones.
Oplin	Severe: depth to rock.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: depth to rock.

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
LpA------------------ Lipan	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
LTE:					
Lueders-------------	Severe: depth to rock, slope.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: depth to rock, small stones, slope.
Throck--------------	Severe: percs slowly, slope.	Severe: slope.	Severe: slope, too clayey.	Severe: slope.	Poor: too clayey, slope.
MeA, MeB------------ Mereta	Severe: cemented pan.	Severe: cemented pan.	Moderate: cemented pan, too clayey.	Severe: cemented pan.	Poor: cemented pan, too clayey, hard to pack.
MfB------------------ Miles	Slight------------	Moderate: seepage, slope.	Slight------------	Slight------------	Good.
NuA------------------ Nuvalde	Moderate: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight------------	Fair: too clayey.
NuB------------------ Nuvalde	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight------------	Fair: too clayey.
ORE:					
Oplin---------------	Severe: depth to rock, slope.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope.	Poor: depth to rock, slope.
Real----------------	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: depth to rock, small stones, slope.
Rc------------------- Rioconcho	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, too clayey.	Severe: flooding.	Poor: 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.
SaB------------------ Sagerton	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight------------	Poor: too clayey.
SpB------------------ Speck	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.

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
TAC:					
Talpa	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
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.
Cho	Severe: cemented pan.	Severe: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.	Poor: cemented pan, small stones.
TKC:					
Tarrant	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
Oplin	Severe: depth to rock.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: depth to rock.
Kavett	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan, too clayey.	Severe: depth to rock, cemented pan.	Poor: depth to rock, too clayey, hard to pack.
ToA Tobosa	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
ToB Tobosa	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
VaB Valera	Severe: depth to rock, cemented pan, percs slowly.	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan, too clayey.	Severe: depth to rock, cemented pan.	Poor: depth to rock, too clayey, hard to pack.
Ya Yahola	Moderate: flooding.	Severe: seepage, flooding.	Severe: seepage.	Severe: seepage.	Good.
YC Yahola	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding, seepage.	Good.

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
AnA, AnB: Angelo	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
ChB, COC: Cho	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: cemented pan, small stones, area reclaim.
DV: Dev	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
EKB:				
Eola	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, cemented pan, small stones.
Kavett	Poor: depth to rock, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, cemented pan, too clayey.
Fo, 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.	Good.
KaB: Karnes	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: excess lime.
KtB: Kavett	Poor: depth to rock, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, cemented pan, too clayey.
KXB:				
Kavett	Poor: depth to rock, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, cemented pan, too clayey.
Cho	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: cemented pan, small stones, area reclaim.
Oplin	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, large stones.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
LpA: Lipan	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
LTE:				
Lueders	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones, slope.
Throck	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones, slope.
MeA, MeB: Mereta	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: cemented pan, too clayey.
MfB: Miles	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
NuA, NuB: Nuvalde	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
ORE:				
Oplin	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, large stones, slope.
Real	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones, slope.
Rc: Rioconcho	Poor: low strength, shrink-swell.	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.
SaB: Sagerton	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
SpB: Speck	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, too clayey, small stones.
TAC:				
Talpa	Poor: depth to rock.	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
TAC:				
Lueders	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones.
Cho	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: cemented pan, small stones, area reclaim.
TKC:				
Tarrant	Poor: depth to rock, low strength, large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: depth to rock, too clayey, large stones.
Oplin	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, large stones.
Kavett	Poor: depth to rock, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, cemented pan, too clayey.
ToA, ToB Tobosa	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
VaB Valera	Poor: depth to rock, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones.
Ya, YC Yahola	Good	Improbable: excess fines.	Improbable: excess fines.	Good.

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
AnA, AnB Angelo	Moderate: seepage.	Slight	Favorable	Favorable	Too arid.
ChB, COC Cho	Severe: cemented pan, seepage.	Severe: thin layer.	Cemented pan, slope, droughty.	Cemented pan	Droughty, cemented pan.
DV Dev	Severe: seepage.	Slight	Droughty, flooding.	Favorable	Droughty.
EKB:					
Eola	Severe: depth to rock, cemented pan.	Slight	Droughty, depth to rock.	Depth to rock, cemented pan.	Droughty, depth to rock.
Kavett	Severe: depth to rock, cemented pan, seepage.	Severe: thin layer.	Slow intake, depth to rock, cemented pan.	Depth to rock, cemented pan.	Depth to rock, cemented pan.
Fo, Fr Frio	Slight	Moderate: hard to pack.	Slow intake, flooding.	Favorable	Favorable.
Ga Gageby	Moderate: seepage.	Moderate: piping.	Favorable	Favorable	Favorable.
KaB Karnes	Severe: seepage.	Moderate: piping.	Excess lime, slope.	Favorable	Favorable.
KtB Kavett	Severe: depth to rock, cemented pan, seepage.	Severe: thin layer.	Slow intake, depth to rock, cemented pan.	Depth to rock, cemented pan.	Depth to rock, cemented pan.
KXB:					
Kavett	Severe: depth to rock, cemented pan, seepage.	Severe: thin layer.	Slow intake, depth to rock, cemented pan.	Depth to rock, cemented pan.	Depth to rock, cemented pan.
Cho	Severe: cemented pan, seepage.	Severe: thin layer.	Cemented pan, slope, droughty.	Cemented pan	Droughty, cemented pan.
Oplin	Severe: depth to rock.	Severe: thin layer, large stones.	Slope, large stones, depth to rock.	Large stones, depth to rock.	Large stones, depth to rock.
LpA Lipan	Slight	Severe: hard to pack, ponding.	Ponding, slow intake, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.

TABLE 13.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes and levees	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
LTE:					
Lueders	Severe: depth to rock, slope.	Severe: large stones.	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Throck	Severe: slope.	Slight	Percs slowly, slope.	Slope, percs slowly.	Slope, rooting depth, percs slowly.
MeA, MeB Mereta	Severe: cemented pan, seepage.	Severe: thin layer.	Cemented pan	Cemented pan	Cemented pan.
MfB Miles	Moderate: seepage.	Moderate: piping.	Soil blowing	Soil blowing	Favorable.
NuA, NuB Nuvalde	Moderate: seepage.	Moderate: piping.	Favorable	Favorable	Favorable.
ORE:					
Oplin	Severe: depth to rock, slope.	Severe: thin layer, large stones.	Slope, large stones, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
Real	Severe: depth to rock, slope, seepage.	Severe: thin layer, seepage.	Droughty, depth to rock, excess lime.	Slope, depth to rock.	Slope, droughty, depth to rock.
Rc Rioconcho	Slight	Severe: hard to pack.	Percs slowly, flooding.	Percs slowly	Percs slowly.
RoA, RoB Rowena	Slight	Moderate: hard to pack.	Favorable	Favorable	Favorable.
SaB Sagerton	Slight	Moderate: piping.	Favorable	Favorable	Favorable.
SpB Speck	Severe: depth to rock.	Severe: thin layer.	Percs slowly, depth to rock.	Large stones, depth to rock, percs slowly.	Large stones, depth to rock, percs slowly.
TAC:					
Talpa	Severe: depth to rock.	Severe: thin layer.	Depth to rock, slope.	Depth to rock	Depth to rock.
Lueders	Severe: depth to rock.	Severe: large stones.	Large stones, droughty, depth to rock.	Large stones, depth to rock.	Large stones, droughty.
Cho	Severe: cemented pan, seepage.	Severe: thin layer.	Cemented pan, slope, droughty.	Cemented pan	Droughty, cemented pan.
TKC:					
Tarrant	Severe: depth to rock.	Severe: thin layer, hard to pack, large stones.	Large stones, slow intake, depth to rock.	Large stones, depth to rock.	Large stones, depth to rock.

TABLE 13.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for--		Features affecting--		
	Pond reservoir areas	Embankments, dikes and levees	Irrigation	Terraces and diversions	Grassed waterways
TKC:					
Oplin	Severe: depth to rock.	Severe: thin layer, large stones.	Slope, large stones, depth to rock.	Large stones, depth to rock.	Large stones, depth to rock.
Kavett	Severe: depth to rock, cemented pan, seepage.	Severe: thin layer.	Slow intake, depth to rock, cemented pan.	Depth to rock, cemented pan.	Depth to rock, cemented pan.
ToA, ToB: Tobosa	Slight	Severe: hard to pack.	Slow intake, percs slowly.	Percs slowly	Percs slowly.
VaB: Valera	Moderate: depth to rock, cemented pan.	Moderate: thin layer, hard to pack.	Slow intake, depth to rock, cemented pan.	Depth to rock, cemented pan.	Depth to rock, cemented pan.
Ya: Yahola	Severe: seepage.	Severe: piping.	Favorable	Soil blowing	Favorable.
YC: Yahola	Severe: seepage.	Severe: piping.	Flooding	Soil blowing	Favorable.

TABLE 14.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Map symbol and soil name	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
AnA--------------- Angelo	0-14	Silty clay loam	CL	A-6, A-7-6	0	90-100	90-100	85-100	60-90	37-50	18-30
	14-27	Clay, silty clay loam, silty clay.	CL, CH	A-6, A-7-6	0	90-100	90-100	85-100	70-92	37-60	20-38
	27-62	Clay loam, silty clay loam, clay.	CL	A-6, A-7-6	0	60-100	60-100	60-100	50-90	30-49	15-30
AnB--------------- Angelo	0-13	Silty clay loam	CL	A-6, A-7-6	0	90-100	90-100	85-100	60-90	37-50	18-30
	13-30	Clay, silty clay loam, silty clay.	CL, CH	A-6, A-7-6	0	90-100	90-100	85-100	70-92	37-60	20-38
	30-65	Clay loam, silty clay loam, clay.	CL	A-6, A-7-6	0	60-100	60-100	60-100	50-90	30-49	15-30
ChB--------------- Cho	0-15	Loam, greavelly loam, clay loam.	CL, CH	A-6, A-7-6	0-3	80-100	75-100	65-94	55-84	35-55	15-30
	15-19	Cemented, indurated.	---	---	---	---	---	---	---	---	---
	19-60	Gravelly loam, gravelly clay loam, very gravelly loam.	SC, GC, GM-GC, SM-SC	A-2, A-4, A-6, A-7-6	0-5	50-80	35-65	20-55	15-45	24-47	5-22
COC--------------- Cho	0-8	Gravelly loam, gravelly clay loam.	CL, SC, GC	A-6, A-7-6	0-5	60-85	55-80	50-80	40-70	30-50	11-26
	8-17	Cemented, indurated.	---	---	---	---	---	---	---	---	---
	17-60	Gravelly loam, gravelly clay loam, very gravelly loam.	SC, GC, GM-GC, SM-SC	A-2, A-4, A-6, A-7-6	0-5	50-80	35-65	20-55	15-45	24-47	5-22
DV---------------- Dev	0-10	Gravelly loam----	GC, SC	A-2, A-4, A-6, A-7	0-10	45-80	45-70	35-55	20-50	28-47	9-24
	10-60	Very gravelly loam, very gravelly clay loam, extremely gravelly loam.	GC, GP-GC, SC, SP-SC	A-2-4, A-2-6, A-7, A-6	0-10	10-78	5-65	5-50	5-42	28-47	9-24
EKB: Eola--------------	0-12	Very gravelly clay loam.	SC, GC	A-2	0-10	40-70	30-60	25-50	15-30	25-40	10-25
	12-18	Cemented, indurated.	---	---	---	---	---	---	---	---	---
	18-35	Weathered bedrock	---	---	---	---	---	---	---	---	---
Kavett------------	0-14	Silty clay, cobbly silty clay loam.	CH	A-7-6	0-5	90-100	80-100	75-100	70-98	51-66	25-40
	14-17	Indurated, cemented.	---	---	---	---	---	---	---	---	---
	17-24	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	
Fo------------------ Frio	0-45	Silty clay loam, clay loam, silty clay.	CL, CH	A-6, A-7	0-2	90-100	85-100	85-100	69-96	36-59	17-34
	45-60	Silty clay, silty clay loam, clay loam.	CL, CH	A-6, A-7	0-5	90-100	90-100	85-100	68-96	36-59	17-34
Fr------------------ Frio	0-41	Silty clay loam, clay loam, silty clay.	CL, CH	A-6, A-7	0-2	90-100	85-100	85-100	69-96	36-59	17-34
	41-60	Silty clay, silty clay loam, clay loam.	CL, CH	A-6, A-7	0-5	90-100	90-100	85-100	68-96	36-59	17-34
Ga------------------ Gageby	0-21	Loam-------------	CL, SC	A-6	0	100	96-100	80-100	45-70	23-35	11-20
	21-56	Loam, clay loam	CL, SC	A-6	0	95-100	92-100	90-100	45-85	23-40	11-25
	56-70	Loam, gravelly loam, silt loam, clay loam.	CL, SC, GC	A-6	0	60-100	50-100	45-100	40-85	23-40	11-25
KaB----------------- Karnes	0-43	Loam, clay loam	SC, CL, CL-ML, SM-SC	A-4, A-6, A-2-4, A-2-6	0-5	85-100	75-100	50-100	30-65	20-35	4-15
	43-60	Loam, clay loam	SC, CL, CL-ML, SM-SC	A-4, A-6, A-2-4, A-2-6	0-5	85-100	75-100	45-100	25-65	20-35	4-15
KtB----------------- Kavett	0-15	Silty clay, clay, silty clay loam.	CH	A-7	0-2	90-100	80-100	75-100	70-98	51-66	25-40
	15-20	Indurated, cemented.	---	---	---	---	---	---	---	---	---
	20-30	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
KXB:											
Kavett------------	0-13	Silty clay, cobbly silty clay loam.	CH	A-7	0-5	90-100	80-100	75-100	70-98	51-66	25-40
	13-20	Indurated, cemented.	---	---	---	---	---	---	---	---	---
	20-25	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Cho---------------	0-10	Gravelly clay loam, gravelly loam.	CL, CH	A-6, A-7-6	0-3	80-100	70-100	65-94	55-84	35-55	15-30
	10-18	Cemented----------	---	---	---	---	---	---	---	---	---
	18-48	Gravelly loam, gravelly clay loam, very gravelly loam.	SC, GC, GM-GC, SM-SC	A-2, A-4, A-6, A-7-6	0-5	50-80	35-65	20-50	15-45	24-47	5-22
Oplin-------------	0-14	Cobbly clay loam	GM, ML, CL, GC	A-2, A-4, A-6, A-7	15-45	40-75	35-75	30-65	25-60	30-56	8-25
	14-20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
LpA----------------- Lipan	0-52	Clay-------------	CH	A-7-6	0-5	95-100	95-100	95-100	80-98	55-75	32-49
	52-65	Clay, silty clay	CH	A-7-6	0-5	95-100	95-100	95-100	70-98	51-70	32-45

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	
LTE:											
Lueders	0-5	Very cobbly 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
	5-11	Extremely cobbly loam, extremely cobbly clay loam, extremely gravelly clay loam, extremely cobbly silty clay loam.	CL, GC, SC	A-2, A-4, A-6, A-7	30-50	35-70	30-65	25-60	25-55	25-49	8-25
	11-15	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Throck	0-4	Stony clay loam	CL	A-6, A-7-6	5-30	70-90	70-90	60-90	55-85	30-50	15-30
	4-32	Gravelly clay, gravelly silty clay, clay, silty clay, clay loam.	CL	A-6, A-7-6	0-5	70-99	60-99	60-99	60-90	35-50	18-31
	32-40	Silty clay, shaly clay.	CL	A-6, A-7-6	0	95-100	95-100	90-100	70-98	28-50	12-30
MeA: Mereta	0-8	Clay loam	CL	A-6, A-7-6	0-5	90-100	85-100	80-97	60-85	39-50	19-28
	8-18	Clay loam, clay	CL, CH	A-6, A-7-6	0-5	90-100	85-100	80-97	60-85	39-52	19-30
	18-26	Cemented, indurated.	---	---	---	---	---	---	---	---	---
	26-60	Variable, marl	---	---	---	---	---	---	---	---	---
MeB: Mereta	0-6	Clay loam	CL	A-6, A-7-6	0-5	90-100	85-100	80-97	60-85	39-50	19-28
	6-15	Clay loam, clay	CL, CH	A-6, A-7-6	0-5	90-100	85-100	80-97	60-85	39-52	19-30
	15-18	Cemented, indurated.	---	---	---	---	---	---	---	---	---
	18-60	Variable, marl	---	---	---	---	---	---	---	---	---
MfB: Miles	0-6	Fine sandy loam	SM, SM-SC, CL-ML, ML	A-2-4, A-4	0	98-100	96-100	85-98	25-55	16-22	2-7
	6-61	Sandy clay loam, clay loam.	CL, SC, SM-SC, CL-ML	A-4, A-6, A-2-4, A-2-6	0	98-100	96-100	85-98	30-72	20-40	4-20
	61-80	Sandy clay loam, clay loam.	CL, SC, SM-SC, CL-ML	A-2-4, A-4, A-6	0	90-100	90-100	80-100	30-72	20-36	4-18
NuA: Nuvalde	0-12	Silty clay loam	CH, CL	A-7-6, A-6	0	95-100	95-100	90-100	80-96	38-60	20-38
	12-48	Clay loam, silty clay loam, silty clay.	CH, CL	A-7-6, A-6	0	95-100	95-100	85-100	70-98	38-58	20-36
	48-60	Clay loam, silty clay loam, silty clay.	CL	A-6, A-7-6	0	85-100	85-100	75-98	65-90	30-50	14-30

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
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
	11-33	Clay loam, silty clay loam, silty clay.	CH, CL	A-7-6, A-6	0	95-100	95-100	85-100	70-98	38-58	20-36
	33-60	Clay loam, silty clay loam, silty clay.	CL	A-6, A-7-6	0	85-100	85-100	75-98	65-90	30-50	14-30
ORE: Oplin-----------	0-8	Cobbly clay loam	GM, ML, CL, GC	A-2, A-4, A-6, A-7	15-45	40-75	35-75	30-65	25-60	30-56	8-25
	8-15	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Real------------	0-4	Gravelly clay loam.	SM, GC, GM, ML	A-4, A-6, A-7	1-5	65-90	50-85	45-80	36-70	30-55	8-25
	4-12	Very gravelly loam, very gravelly clay loam.	GM, GC, SM, SC	A-2, A-4, A-6, A-7	1-10	25-75	20-65	20-60	20-50	30-55	8-25
	12-60	Variable, weathered bedrock.	---	---	---	---	---	---	---	---	---
Rc-------------- Rioconcho	0-5	Silty clay loam	CL, CH	A-6, A-7-6	0-5	85-100	83-100	75-100	70-99	35-55	20-35
	5-60	Clay, silty clay, clay loam, silty clay loam.	CL, CH	A-7-6, A-6	0-5	85-100	83-100	75-100	70-99	35-70	20-45
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
	6-29	Clay, clay loam, silty clay.	CH, CL	A-7-6	0	98-100	96-100	90-100	75-98	41-60	25-40
	29-60	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
	6-21	Clay, clay loam, silty clay.	CH, CL	A-7-6	0	98-100	96-100	90-100	75-98	41-60	25-40
	21-60	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
SaB------------- Sagerton	0-7	Clay loam--------	CL	A-6, A-4	0	95-100	95-100	90-100	55-80	25-35	8-18
	7-28	Clay loam, clay	CL	A-6, A-7-6	0	95-100	95-100	90-100	65-95	36-50	18-30
	28-65	Clay loam, clay	CL	A-6, A-4, A-7-6	0	90-100	90-100	80-100	60-85	25-50	8-30
SpB------------- Speck	0-4	Cobbly clay loam	CL	A-6, A-7-6	1-5	80-100	75-100	70-95	65-90	30-50	15-30
	4-14	Clay, clay loam, cobbly clay.	CL, CH	A-7-6	0-25	60-100	60-100	55-95	55-85	45-65	25-40
	14-17	Indurated, 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	
TAC:											
Talpa-----------	0-8	Loam, gravelly loam, silt loam, clay loam, silty clay loam.	CL	A-6, A-7	0-5	70-100	65-100	65-98	55-90	30-45	11-25
	8-15	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Lueders---------	0-7	Very cobbly 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
	7-10	Extremely cobbly loam, extremely cobbly clay loam, extremely gravelly clay loam, cobbly silty clay loam.	CL, GC, SC	A-2, A-4, A-6, A-7	30-50	35-70	30-65	25-60	25-55	25-49	8-25
	10-20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Cho-------------	0-7	Gravelly loam, gravelly clay loam.	CL, SC, GC	A-6, A-7-6	0-5	60-85	55-80	50-80	40-70	30-50	11-26
	7-15	Cemented, indurated.	---	---	---	---	---	---	---	---	---
	15-47	Gravelly loam, gravelly clay loam, very gravelly loam.	SC, GC, GM-GC, SM-SC	A-2, A-4, A-6, A-7-6	0-5	50-80	35-65	20-50	15-45	24-47	5-22
TKC:											
Tarrant---------	0-13	Very cobbly clay, cobbly clay, extremely flaggy clay.	CH, GC, SC	A-7-6, A-7-5	33-77	55-100	51-100	48-99	36-95	51-75	25-44
	13-20	Indurated, unweathered bedrock.	---	---	---	---	---	---	---	---	---
Oplin-----------	0-14	Cobbly clay loam, very flaggy clay loam.	GM, ML, MH, GC	A-2, A-4, A-6, A-7	15-45	30-75	25-75	20-65	20-60	30-56	8-25
	14-20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Kavett----------	0-11	Clay-------------	CH	A-7-6	0-2	90-100	80-100	75-100	70-98	51-66	25-40
	11-17	Indurated, cemented.	---	---	---	---	---	---	---	---	---
	17-20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
ToA-------------- Tobosa	0-30	Clay-------------	CH	A-7-6	0-2	98-100	97-100	90-100	85-98	51-70	30-45
	30-56	Clay, silty clay	CH	A-7-6	0-2	98-100	96-100	90-100	85-98	55-72	35-48
	56-65	Clay, silty clay	CH, CL	A-7-6	0-2	96-100	95-100	90-100	80-95	45-65	30-45
ToB-------------- Tobosa	0-25	Clay-------------	CH	A-7-6	0-2	98-100	97-100	90-100	85-98	51-70	30-45
	25-50	Clay, silty clay	CH	A-7-6	0-2	98-100	96-100	90-100	85-98	55-72	35-48
	50-60	Clay, silty clay	CH, CL	A-7-6	0-2	96-100	95-100	90-100	80-95	45-65	30-45
VaB-------------- Valera	0-36	Silty clay, clay	CL, CH	A-7-6	0-2	85-100	75-100	75-95	75-90	41-62	20-38
	36-47	Cemented, indurated.	---	---	---	---	---	---	---	---	---
	47-50	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	
Ya---------------- Yahola	0-9	Fine sandy loam	SM, ML, CL-ML, SM-SC	A-4	0	100	95-100	90-100	36-60	<26	NP-7
	9-60	Fine sandy loam, loam.	SM, ML, CL, SC	A-4	0	100	95-100	90-100	36-85	<30	NP-10
YC---------------- Yahola	0-6	Fine sandy loam	SM, ML, CL-ML, SM-SC	A-4	0	100	95-100	90-100	36-60	<26	NP-7
	6-60	Fine sandy loam, loam.	SM, ML, CL, SC	A-4	0	100	95-100	90-100	36-85	<30	NP-10

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less 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	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cc	In/hr	In/in	pH					Pct
AnA-------------	0-14	30-40	1.25-1.45	0.6-2.0	0.14-0.20	7.9-8.4	Moderate-----	0.32	4	4	1-4
Angelo	14-27	35-50	1.35-1.55	0.2-0.6	0.14-0.20	7.9-8.4	High---------	0.32			
	27-62	30-45	1.40-1.60	0.6-2.0	0.14-0.20	7.9-8.4	Moderate-----	0.32			
AnB-------------	0-13	30-40	1.25-1.45	0.6-2.0	0.14-0.20	7.9-8.4	Moderate-----	0.32	4	4	1-4
Angelo	13-30	35-50	1.35-1.55	0.2-0.6	0.14-0.20	7.9-8.4	High---------	0.32			
	30-65	30-45	1.40-1.60	0.6-2.0	0.14-0.20	7.9-8.4	Moderate-----	0.32			
ChB-------------	0-15	15-35	1.30-1.50	0.6-2.0	0.10-0.15	7.9-8.4	Low----------	0.28	1	4L	1-2
Cho	15-19	---	---	---	---	---	-------------	----			
	19-60	20-35	1.40-1.60	0.6-2.0	0.05-0.10	7.9-8.4	Low----------	0.15			
COC-------------	0-8	20-35	1.30-1.50	0.6-2.0	0.07-0.12	7.9-8.4	Low----------	0.17	1	8	1-2
Cho	8-17	---	---	---	---	---	-------------	----			
	17-60	20-35	1.40-1.60	0.6-2.0	0.05-0.10	7.9-8.4	Low----------	0.15			
DV--------------	0-10	18-35	1.30-1.50	2.0-6.0	0.06-0.10	7.9-8.4	Low----------	0.15	5	8	1-3
Dev	10-60	18-35	1.30-1.50	2.0-6.0	0.03-0.10	7.9-8.4	Very low-----	0.10			
EKB:											
Eola-----------	0-12	27-35	1.30-1.50	0.6-2.0	0.06-0.12	7.9-8.4	Low----------	0.10	1	8	1-3
	12-18	---	---	---	---	---	-------------	----			
	18-35	---	---	---	---	---	-------------	----			
Kavett---------	0-14	35-50	1.25-1.40	0.2-0.6	0.15-0.20	7.9-8.4	High---------	0.32	1	4	1-3
	14-17	---	---	---	---	---	-------------	----			
	17-24	---	---	---	---	---	-------------	----			
Fo--------------	0-45	30-50	1.30-1.55	0.2-0.6	0.11-0.17	7.9-8.4	Moderate-----	0.32	5	4	1-4
Frio	45-60	35-50	1.40-1.60	0.2-0.6	0.11-0.15	7.9-8.4	Moderate-----	0.32			
Fr--------------	0-41	30-50	1.30-1.55	0.2-0.6	0.11-0.17	7.9-8.4	Moderate-----	0.32	5	4	1-4
Frio	41-60	35-50	1.40-1.60	0.2-0.6	0.11-0.15	7.9-8.4	Moderate-----	0.32			
Ga--------------	0-21	18-27	1.40-1.55	0.6-2.0	0.16-0.20	7.4-8.4	Moderate-----	0.28	5	5	1-3
Gageby	21-56	18-35	1.40-1.55	0.6-2.0	0.16-0.20	7.9-8.4	Moderate-----	0.28			
	56-70	18-35	1.45-1.60	0.6-2.0	0.16-0.20	7.9-8.4	Moderate-----	0.28			
KaB-------------	0-43	18-30	1.25-1.50	2.0-6.0	0.10-0.15	7.9-8.4	Low----------	0.28	5	4L	.5-1
Karnes	43-60	15-30	1.20-1.50	2.0-6.0	0.08-0.15	7.9-8.4	Low----------	0.28			
KtB-------------	0-15	35-50	1.25-1.40	0.2-0.6	0.15-0.20	7.9-8.4	High---------	0.32	1	4	1-3
Kavett	15-20	---	---	---	---	---	-------------	----			
	20-30	---	---	---	---	---	-------------	----			
KXB:											
Kavett---------	0-13	35-50	1.25-1.40	0.2-0.6	0.15-0.20	7.9-8.4	High---------	0.32	1	4	1-3
	13-20	---	---	---	---	---	-------------	----			
	20-25	---	---	---	---	---	-------------	----			
Cho------------	0-10	15-35	1.30-1.50	0.6-2.0	0.10-0.15	7.9-8.4	Low----------	0.28	1	8	1-2
	10-18	---	---	---	---	---	-------------	----			
	18-48	20-35	1.40-1.60	0.6-2.0	0.05-0.10	7.9-8.4	Low----------	0.15			
Oplin----------	0-14	28-35	1.35-1.55	0.6-2.0	0.10-0.15	7.9-8.4	Low----------	0.10	1	8	1-3
	14-20	---	---	---	---	---	-------------	----			

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cc	In/hr	In/in	pH					Pct
LpA------------- Lipan	0-52	40-60	1.20-1.35	<0.06	0.13-0.18	7.4-8.4	Very high----	0.32	5	4	1-3
	52-65	40-60	1.30-1.45	<0.06	0.13-0.18	7.9-8.4	Very high----	0.32			
LTE:											
Lueders---------	0-5	20-35	1.35-1.55	0.6-2.0	0.06-0.12	7.9-8.4	Low----------	0.10	1	8	1-3
	5-11	20-35	1.35-1.55	0.6-2.0	0.05-0.10	7.9-8.4	Low----------	0.10			
	11-15	---	---	---	---	---	-------------	----			
Throck----------	0-4	35-40	1.45-1.60	0.2-0.6	0.10-0.18	7.9-8.4	High---------	0.17	3	8	.5-2
	4-32	35-45	1.55-1.65	0.06-0.2	0.12-0.20	7.9-8.4	High---------	0.32			
	32-40	35-50	1.50-1.80	0.06-0.2	0.10-0.18	7.9-8.4	High---------	0.32			
MeA------------- Mereta	0-8	35-40	1.25-1.45	0.2-0.6	0.15-0.20	7.9-8.4	Moderate-----	0.32	1	4	1-3
	8-18	35-45	1.25-1.45	0.2-0.6	0.15-0.20	7.9-8.4	Moderate-----	0.32			
	18-26	---	---	---	---	---	-------------	----			
	26-60	---	---	---	---	---	-------------	----			
MeB------------- Mereta	0-6	35-40	1.25-1.45	0.2-0.6	0.15-0.20	7.9-8.4	Moderate-----	0.32	1	4	1-3
	6-15	35-45	1.25-1.45	0.2-0.6	0.15-0.20	7.9-8.4	Moderate-----	0.32			
	15-18	---	---	---	---	---	-------------	----			
	18-60	---	---	---	---	---	-------------	----			
MfB------------- Miles	0-6	7-18	1.45-1.60	2.0-6.0	0.10-0.15	6.1-7.8	Low----------	0.24	5	3	.5-1
	6-61	20-35	1.50-1.65	0.6-2.0	0.12-0.18	6.6-8.4	Low----------	0.32			
	61-80	20-35	1.50-1.65	0.6-2.0	0.12-0.16	7.4-8.4	Low----------	0.32			
NuA------------- Nuvalde	0-12	35-50	1.10-1.40	0.6-2.0	0.14-0.20	7.9-8.4	High---------	0.28	5	4L	1-3
	12-48	35-50	1.20-1.45	0.6-2.0	0.12-0.18	7.9-8.4	High---------	0.28			
	48-60	27-45	1.25-1.45	0.6-2.0	0.12-0.18	7.9-8.4	Moderate-----	0.32			
NuB------------- Nuvalde	0-11	35-50	1.10-1.40	0.6-2.0	0.14-0.20	7.9-8.4	High---------	0.28	5	4L	1-3
	11-33	35-50	1.20-1.45	0.6-2.0	0.12-0.18	7.9-8.4	High---------	0.28			
	33-60	27-45	1.25-1.45	0.6-2.0	0.12-0.18	7.9-8.4	Moderate-----	0.32			
ORE:											
Oplin-----------	0-8	28-35	1.35-1.55	0.6-2.0	0.10-0.15	7.9-8.4	Low----------	0.10	1	8	1-3
	8-15	---	---	---	---	---	-------------	----			
Real------------	0-4	22-40	1.25-1.55	0.6-2.0	0.05-0.10	7.9-8.4	Low----------	0.15	1	8	1-4
	4-12	22-40	1.25-1.55	0.6-2.0	0.05-0.10	7.9-8.4	Low----------	0.10			
	12-60	---	---	---	---	---	-------------	----			
Rc-------------- Rioconcho	0-5	35-45	1.30-1.50	0.06-0.2	0.15-0.20	7.4-8.4	High---------	0.32	5	4	1-4
	5-60	35-55	1.30-1.50	0.06-0.2	0.15-0.20	7.4-8.4	High---------	0.32			
RoA------------- Rowena	0-6	35-40	1.35-1.50	0.2-0.6	0.15-0.20	7.9-8.4	Moderate-----	0.32	5	4L	2-4
	6-29	35-50	1.35-1.50	0.2-0.6	0.14-0.18	7.9-8.4	High---------	0.32			
	29-60	35-50	1.35-1.50	0.2-0.6	0.11-0.15	7.9-8.4	High---------	0.32			
RoB------------- Rowena	0-6	35-40	1.35-1.50	0.2-0.6	0.15-0.20	7.9-8.4	Moderate-----	0.32	5	4L	2-4
	6-21	35-50	1.35-1.50	0.2-0.6	0.14-0.18	7.9-8.4	High---------	0.32			
	21-60	35-50	1.35-1.50	0.2-0.6	0.11-0.15	7.9-8.4	High---------	0.32			
SaB------------- Sagerton	0-7	27-35	1.25-1.45	0.6-2.0	0.15-0.20	6.6-7.8	Moderate-----	0.32	5	6	1-3
	7-28	35-45	1.35-1.55	0.2-0.6	0.14-0.19	6.6-8.4	Moderate-----	0.32			
	28-65	35-45	1.35-1.60	0.2-0.6	0.10-0.17	7.9-8.4	Moderate-----	0.32			
SpB------------- Speck	0-4	27-39	1.40-1.60	0.2-0.6	0.10-0.17	6.1-7.8	Moderate-----	0.17	1	8	1-3
	4-14	35-60	1.45-1.70	0.06-0.2	0.10-0.15	6.1-7.8	High---------	0.32			
	14-17	---	---	---	---	---	-------------	----			

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cc	In/hr	In/in	pH					Pct
TAC:											
Talpa-----------	0-8	25-35	1.30-1.45	0.6-2.0	0.12-0.18	7.9-8.4	Low----------	0.32	1	4L	1-3
	8-15	---	---	---	---	---	-------------	----			
Lueders---------	0-7	20-35	1.35-1.55	0.6-2.0	0.06-0.12	7.9-8.4	Low----------	0.10	1	8	1-3
	7-10	20-35	1.35-1.55	0.6-2.0	0.05-0.10	7.9-8.4	Low----------	0.10			
	10-20	---	---	---	---	---	-------------	----			
Cho-------------	0-7	20-35	1.30-1.50	0.6-2.0	0.07-0.12	7.9-8.4	Low----------	0.17	1	8	1-2
	7-15	---	---	---	---	---	-------------	----			
	15-47	20-35	1.40-1.60	0.6-2.0	0.05-0.10	7.9-8.4	Low----------	0.15			
TKC:											
Tarrant---------	0-13	40-60	1.35-1.55	0.2-0.6	0.10-0.17	7.9-8.4	Moderate-----	0.15	1	8	2-7
	13-20	---	---	---	---	---	-------------	----			
Oplin-----------	0-14	28-35	1.35-1.55	0.6-2.0	0.10-0.15	7.9-8.4	Low----------	0.10	1	8	1-3
	14-20	---	---	---	---	---	-------------	----			
Kavett----------	0-11	35-50	1.25-1.40	0.2-0.6	0.15-0.20	7.9-8.4	High---------	0.32	1	4	1-3
	11-17	---	---	---	---	---	-------------	----			
	17-20	---	---	---	---	---	-------------	----			
ToA-------------- Tobosa	0-30	40-60	1.35-1.40	<0.06	0.12-0.18	7.4-8.4	Very high----	0.32	5	4	1-3
	30-56	40-60	1.35-1.40	<0.06	0.12-0.18	7.9-8.4	Very high----	0.32			
	56-65	40-60	1.35-1.40	<0.06	0.10-0.16	7.9-8.4	High---------	0.32			
ToB-------------- Tobosa	0-25	40-60	1.35-1.40	<0.06	0.12-0.18	7.4-8.4	Very high----	0.32	5	4	1-3
	25-50	40-60	1.35-1.40	<0.06	0.12-0.18	7.9-8.4	Very high----	0.32			
	50-60	40-60	1.35-1.40	<0.06	0.10-0.16	7.9-8.4	High---------	0.32			
VaB-------------- Valera	0-36	40-55	1.25-1.40	0.2-0.6	0.15-0.20	7.9-8.4	High---------	0.32	2	4	1-5
	36-47	---	---	---	---	---	-------------	----			
	47-50	---	---	---	---	---	-------------	----			
Ya--------------- Yahola	0-9	10-18	1.30-1.60	2.0-6.0	0.11-0.15	7.4-8.4	Low----------	0.20	5	3	.5-1
	9-60	5-18	1.40-1.70	2.0-6.0	0.11-0.20	7.9-8.4	Low----------	0.32			
YC--------------- Yahola	0-6	10-18	1.30-1.60	2.0-6.0	0.11-0.15	7.4-8.4	Low----------	0.20	5	3	.5-1
	6-60	5-18	1.40-1.70	2.0-6.0	0.11-0.20	7.9-8.4	Low----------	0.32			

TABLE 16.--SOIL AND WATER FEATURES

["Flooding" terms such as "rare" and "brief" are explained in the text. The symbol > 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	Hydrologic group	Flooding			Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Duration	Months	Depth	Hardness	Depth	Thickness	Uncoated steel	Concrete
					In		In			
AnA, AnB: Angelo	C	None	---	---	>60	---	---	---	High	Low.
ChB, COC: Cho	C	None	---	---	>60	---	7-20	Thin	High	Low.
DV: Dev	A	Frequent	Very brief	Apr-Oct	>60	---	---	---	Moderate	Low.
EKB:										
Eola	D	None	---	---	7-20	Soft	4-16	Thin	Moderate	Low.
Kavett	D	None	---	---	11-26	Hard	10-20	Thick	High	Low.
Fo: Frio	B	Occasional	Very brief	Apr-Oct	>60	---	---	---	High	Low.
Fr: Frio	B	Frequent	Very brief	Apr-Oct	>60	---	---	---	High	Low.
Ga: Gageby	B	Rare	---	---	>60	---	---	---	Moderate	Low.
KaB: Karnes	B	None	---	---	>60	---	---	---	Moderate	Low.
KtB: Kavett	D	None	---	---	11-26	Hard	10-20	Thick	High	Low.
KXB:										
Kavett	D	None	---	---	11-26	Hard	10-20	Thick	High	Low.
Cho	C	None	---	---	>60	---	7-20	Thin	High	Low.
Oplin	C	None	---	---	7-20	Hard	---	---	Moderate	Low.
LpA: Lipan	D	Occasional*	Brief to long.	Apr-Jun	>60	---	---	---	High	Low.
LTE:										
Lueders	C	None	---	---	7-20	Hard	---	---	Moderate	Low.
Throck	C	None	---	---	>60	---	---	---	High	Low.
MeA, MeB: Mereta	C	None	---	---	>60	---	14-20	Thin	High	Low.
MfB: Miles	B	None	---	---	>60	---	---	---	Moderate	Low.
NuA, NuB: Nuvalde	B	None	---	---	>60	---	---	---	High	Low.
ORE:										
Oplin	C	None	---	---	7-20	Hard	---	---	Moderate	Low.

See footnote at end of table.

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			
ORE:										
Real-------------	D	None--------	---	---	8-20	Soft	---	---	High-----	Low.
Rc---------------- Rioconcho	C	Occasional	Very brief	Apr-Oct	>60	---	---	---	High-----	Low.
RoA, RoB---------- Rowena	C	None--------	---	---	>60	---	---	---	High-----	Low.
SaB--------------- Sagerton	C	None--------	---	---	>60	---	---	---	Moderate	Low.
SpB--------------- Speck	D	None--------	---	---	14-20	Hard	---	---	High-----	Low.
TAC:										
Talpa------------	D	None--------	---	---	5-14	Hard	---	---	High-----	Low.
Lueders----------	C	None--------	---	---	7-20	Hard	---	---	Moderate	Low.
Cho--------------	C	None--------	---	---	>60	---	7-20	Thin	High-----	Low.
TKC:										
Tarrant----------	D	None--------	---	---	6-20	Hard	---	---	High-----	Low.
Oplin------------	C	None--------	---	---	7-20	Hard	---	---	Moderate	Low.
Kavett-----------	D	None--------	---	---	11-26	Hard	10-20	Thick	High-----	Low.
ToA, ToB---------- Tobosa	D	None--------	---	---	>60	---	---	---	High-----	Low.
VaB--------------- Valera	C	None--------	---	---	21-52	Hard	20-40	Thick	High-----	Low.
Ya---------------- Yahola	B	Rare--------	---	---	>60	---	---	---	Low------	Low.
YC---------------- Yahola	B	Frequent----	Very brief	Apr-Oct	>60	---	---	---	Low------	Low.

* This is actually ponding of water following heavy rainfall rather than flooding.

TABLE 17.--ENGINEERING INDEX TEST DATA

Soil name, sample number, horizon, and depth (in inches)	Classification: AASHTO	Classification: Unified	Grain-size distribution: Percentage passing sieve--: 5/8 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	Percentage smaller than--: .05 mm	.005 mm	.002 mm	Liquid limit	Plasticity index	Particle density	Shrinkage: Limit	Linear	Ratio
												Pct		G/cm^3	Pct	Pct	Pct
Cho: 1/ 2/ (82TX-095-001)																	
A ----- 0-8	A-7-6(8)	CL	70	66	63	60	57	51	40	20	11	48	22	2.64	20.0	11.9	0.70
Ck ----- 15-60	A-6(2)	SC	93	90	79	65	51	42	40	25	11	36	13	2.70	38.0	5.5	0.60
Gageby: 3/ 4/ (81TX-095-001)																	
A1 ----- 0-12	A-6(14)	CL	100	100	100	100	99	83	68	38	27	36	18	2.61	17.0	9.1	1.80
A2 ----- 12-30	A-6(13)	CL	100	100	100	100	100	82	67	28	20	34	17	2.63	17.0	8.5	1.81
Bk ----- 30-57	A-6(16)	CL	100	100	100	100	97	79	71	39	30	40	22	2.64	18.0	10.5	1.82
Kavett: 5/ (81TX-095-002)																	
A1 ----- 0-7	A-7-5(35)	CH	100	100	100	100	100	97	90	51	42	60	30	2.64	20.0	16.0	1.73
A2 ----- 7-15	A-7-6(42)	CH	100	100	100	100	99	97	91	53	44	64	37	2.61	15.0	20.1	1.95
Lueders: 5/ 6/ (82TX-095-002)																	
A ----- 0-7	A-7-5(4)	GC	74	65	55	50	45	41	33	12	8	49	19	2.60	24.0	11.0	1.60
Oplin: 5/ 7/ (82TX-095-003)																	
A ----- 0-7	A-7-5(9)	MH	70	64	60	57	54	51	42	17	12	55	23	2.59	23.0	13.0	1.63
Ak ----- 7-14	A-2-7(0)	GC	46	37	30	25	22	20	17	7	5	54	23	2.62	26.0	18.4	1.57
Real: 5/ (81TX-095-003)																	
A ----- 0-4	A-7-6(3)	GC	87	79	66	57	46	39	34	14	8	48	20	2.57	24.0	10.2	1.59
Ak ----- 4-12	A-7-5(4)	GC	85	77	66	58	50	42	34	17	9	51	20	2.61	23.0	11.1	1.59
Talpa: 5/ (82TX-095-004)																	
A ----- 0-4	A-7-6(15)	CL	100	99	98	96	90	82	31	28	18	41	18	2.66	20.0	10.0	1.73
Ak ----- 4-8	A-7-6(9)	CL	77	74	71	69	65	58	47	21	15	43	19	2.66	21.0	10.1	1.71

1/ Cho series: From U.S. Highway 83 in Eden, 0.6 mile east on U.S. Highway 87, 2.6 miles south and east on Barnett Street and county road, 100 feet south, in rangeland.

2/ 2 percent of 0- to 8-inch layer was rock fragments larger than 3 inches in diameter and was discarded before testing.

3/ Gageby series: From Farm Road 380 in Eola, 1.6 miles north on Farm Road 381, 1.8 miles east on a private road, 0.9 mile north on a ranch road, 15 feet southwest of road, in rangeland.

4/ 0- to 12-inch layer has a higher percentage passing the 200 sieve and slightly higher liquid limit than typical for the series.

5/ Location of pedon sample is the same as the pedon given as typical for series in "Soil Series and Their Morphology."

6/ 10 percent of sample was rock fragments larger than 3 inches in diameter and was discarded before testing.

7/ 20 percent of each sample was rock fragments larger than 3 inches in diameter and was discarded before testing.

TABLE 18.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Angelo	Fine-silty, mixed, thermic Aridic Calciustolls
Cho	Loamy, carbonatic, thermic, shallow Petrocalcic Calciustolls
Dev	Loamy-skeletal, carbonatic, thermic Cumulic Haplustolls
Eola	Loamy-skeletal, carbonatic, thermic, shallow Petrocalcic Calciustolls
Frio	Fine, montmorillonitic, thermic Cumulic Haplustolls
Gageby	Fine-loamy, mixed, thermic Cumulic Haplustolls
Karnes	Coarse-loamy, carbonatic, thermic Typic Ustochrepts
Kavett	Clayey, montmorillonitic, thermic, shallow Petrocalcic Calciustolls
Lipan	Fine, montmorillonitic, thermic Entic Pellusterts
Lueders	Loamy-skeletal, carbonatic, thermic Lithic Calciustolls
Mereta	Clayey, mixed, thermic, shallow Petrocalcic Calciustolls
Miles	Fine-loamy, mixed, thermic Udic Paleustalfs
Nuvalde	Fine-silty, mixed, thermic Typic Calciustolls
Oplin	Loamy-skeletal, carbonatic, thermic Lithic Calciustolls
Real	Loamy-skeletal, carbonatic, thermic, shallow Typic Calciustolls
Rioconcho	Fine, mixed, thermic Vertic Haplustolls
Rowena	Fine, mixed, thermic Vertic Calciustolls
Sagerton	Fine, mixed, thermic Typic Paleustolls
Speck	Clayey, mixed, thermic Lithic Argiustolls
Talpa	Loamy, mixed, thermic Lithic Calciustolls
Tarrant	Clayey-skeletal, montmorillonitic, thermic Lithic Calciustolls
Throck	Fine, mixed, thermic Typic Ustochrepts
Tobosa	Fine, montmorillonitic, thermic Typic Chromusterts
Valera	Fine, montmorillonitic, thermic Petrocalcic Calciustolls
Yahola	Coarse-loamy, mixed [calcareous], thermic Typic Ustifluvents

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