United States
Department of
Agriculture

Natural
Resources
Conservation
Service

In cooperation with
Texas Agricultural
Experiment Station

Soil Survey of Llano County, Texas

How to Use This Soil Survey

General Soil Map

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

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

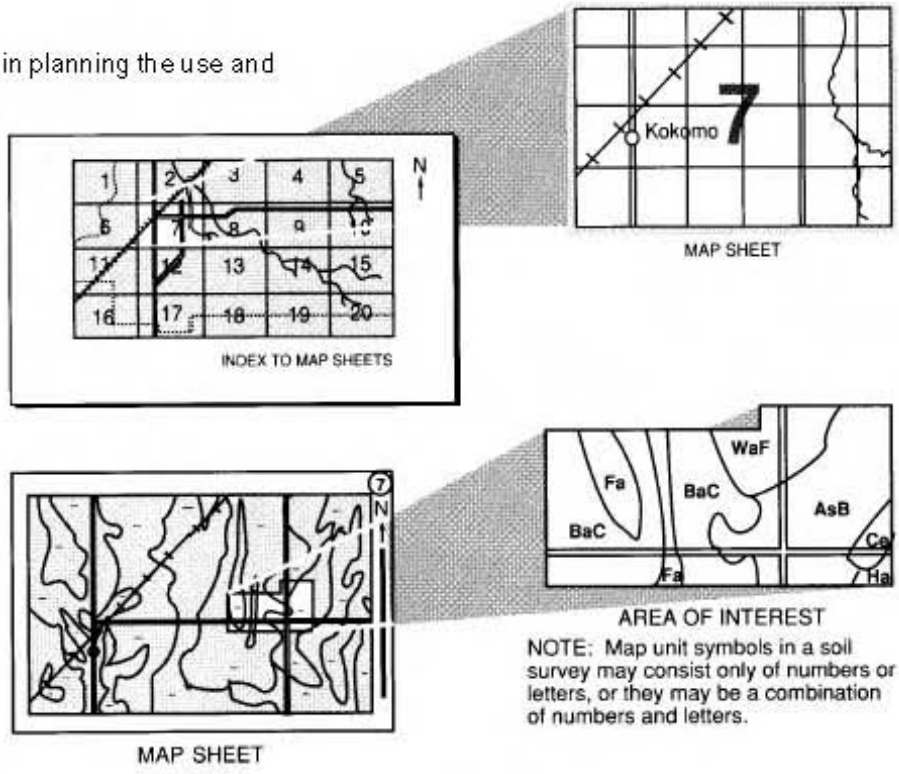
Detailed Soil Maps

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

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

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

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



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

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 Natural Resources Conservation Service (formerly the Soil Conservation Service) has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1988. Soil names and descriptions were approved in 1990. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1988. This survey was made cooperatively by the Natural Resources Conservation Service and the Texas Agricultural Experiment Station. The survey is part of the technical assistance furnished to the Llano County 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 : Enchanted Rock is a 640-acre granite outcrop rising 325 feet above the ground. It is in southern Llano County and is in the Rock outcrop, granite, map unit.

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Issued October 1998

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Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Llano 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 ensure 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.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. The information in this report is intended to identify soil properties that are used in making various land use or land treatment decisions. Statements made in this report are intended to help the land users identify and reduce the effects of soil limitations that affect various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

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 Natural Resources Conservation Service or the Cooperative Extension Service.

John P. Burt
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Soil Survey of
Llano County, Texas

By Auline R. Goerdel, Natural Resources Conservation Service

Fieldwork by Winfred C. Coburn, Paul R. Finnell, and Auline R. Goerdel, soil scientists,
Natural Resources Conservation Service

United States Department of Agriculture, Natural Resources Conservation Service,
in cooperation with
the Texas Agricultural Experiment Station

Llano County is in central Texas (fig. 1). It borders San Saba County on the north; Mason County on the west; Gillespie and Blanco Counties on the south; and Burnet County, the Highland Lakes, and the Colorado River on the east. The county is about 29 miles north to south and 34 miles east to west. It has an area of about 966 square miles, or 618,413 acres. Of this area, 17,093 acres is areas of water larger than 40 acres.

Llano County is in the Central Basin Land Resource Area. The topography is nearly level to steep. The elevation ranges from 825 feet above sea level at Kingsland to 1,904 feet in the northwest corner of the county. Most of the soils formed under a post oak, blackjack oak, and live oak savannah with mid and tall grasses. Many isolated hills and mountains are scattered throughout the county. Enchanted Rock, a large granite outcrop, and Packsaddle Mountain, a sandstone mountain, are two distinctive landmarks within the county. The Llano River flows through the county, entering near Castell on the west and flowing east into Lake LBJ at Kingsland. Other major streams are Bullhead Creek, Hickory Creek, Johnson Creek, Little Llano River, Pecan Creek, Sandy Creek, and San Fernando Creek.

The major land use in Llano County is cattle ranching. In 1992, about 87 percent of the county was used as rangeland, 2 percent as improved pastureland, and 1 percent as cropland. The other 10 percent includes water areas, built-up land, and miscellaneous areas.

This soil survey updates the "Reconnaissance Soil Survey of South-Central Texas" published in 1915 *(4)*. It provides additional information and has larger maps, which show the soils in greater detail.

General Nature of the County

This section gives general information concerning Llano County. It discusses settlement and population, agriculture, natural resources, and climate.

Settlement and Population

Llano County was created from the Bexar District, Gillespie County, in 1856. Llano, is Spanish for "plains." Llano, the county seat, is located on the Llano River near the center of the county. In 1990, according to the Bureau of Census, the population of the county was 11,631. Llano had a population of 2,962. About 60 percent of the population lives in the cities of Buchanan Dam, Kingsland, and Sunrise Beach. Other communities are Bluffton, Castell, Horseshoe Bay, Lone Grove, Sandy Harbor, Valley Spring, and Tow. There are also residential developments along Lake Buchanan and Lake Lyndon B. Johnson.

Agriculture

The major agricultural enterprise is the beef cattle industry. Hogs and goats are also produced. In cultivated areas, crops such as peanuts, oats, and hay are grown. Other more specialized farming operations include vineyards and pecan orchards.

Natural Resources

The soil is the most important resource in Llano County. The geology of the county is unique and complex, and the

Figure 1.—Location of Llano County, in Texas.

soils vary widely in parent material. There are five primary types of bedrock within the county. They are granite, gneiss, schist, limestone, and sandstone. The age of the bedrock ranges from Precambrian (1.3 billion years old) to Ordovician (425 million years old). Llano County has several granite quarries (fig. 2). Vermiculite and marble are also mined.

Climate

Llano County has hot summers and mild winters. An occasional surge of cold air in winter causes a sharp drop in temperatures. Rainfall is usually heaviest in late spring or early fall. In the fall, rainfall is often associated with a dissipating tropical storm. Total annual precipitation is generally adequate for range vegetation, but without supplemental irrigation, it is often not adequate for cotton, small grains, and sorghum.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Llano in the period 1961 to 1990. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on the length of the growing season.

In winter, the average temperature is 47.3 degrees F and the average daily minimum temperature is 33.3 degrees. The lowest temperature on record, which occurred on December 22, 1929, is -7 degrees. In summer, the average temperature is 82.6 degrees, and the average daily maximum temperature is 94.7 degrees. The highest temperature on record, which occurred at Llano on July 15, 1933, is 115 degrees.

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

The total annual precipitation is about 26.44 inches. Of this, about 18.88 inches, or 71 percent, generally falls in April through October. The growing season for most crops

falls within this period. The heaviest 1-day rainfall on record is 12.53 inches at Llano on September 11, 1952. Thunderstorms occur on about 41 days each year, and most occur in May.

Tornadoes and severe thunderstorms occur occasionally. These storms are local and of short duration, and the pattern of damage is variable and spotty.

The average seasonal snowfall is 1.2 inches. The greatest snow depth at any one time on record is 8 inches on January 31, 1949. The heaviest 1-day snowfall on record is 10 inches on February 23, 1966.

The average relative humidity in midafternoon is about 56 percent. Humidity is higher at night, and the average at dawn is about 83 percent. The sun shines 73 percent of the time possible in summer and 50 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 10.8 miles per hour, in March.

How This Survey Was Made

This survey was made to provide information about the soils and miscellaneous areas in the survey area. The information includes a description of the soils and miscellaneous areas and their location and a discussion of their suitability, limitations, and management for specified uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; 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 in 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 and miscellaneous areas in the survey area are in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept or model of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually

Figure 2.—Granite quarry in an area of Rock outcrop, granite.

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-vegetation-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 color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, 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. Soil taxonomy, 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 generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are 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 are 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 predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict 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.

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, it consists of one or more major soils or miscellaneous areas and some minor soils or miscellaneous areas. It is named for the major soils or miscellaneous areas. The components of one map unit can occur in another but in a different pattern.

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

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

Soils formed in material weathered from granite and gneiss; on uplands

This group of general soil map units makes up about 61 percent of the land area in Llano County. The major soils are Castell, Click, Keese, Lou, and Voca. Rock outcrop is also part of this group. These units are dominantly on foot slopes, convex ridgetops, side slopes, and hills. They have a loamy surface layer and a loamy or clayey subsoil. They are underlain by granite grus, granite, or gneiss bedrock.

The native vegetation is a mid and tall grass savannah that has scattered live oak, post oak, or blackjack oak. Much of the area is used for rangeland, and a few small areas are used for pasture.

1. Castell-Keese

Gently sloping to steep, moderately deep or shallow, loamy soils underlain by gneiss or granite bedrock.

The Castell soils in this map unit are on foot slopes, and the Keese soils are on ridgetops, small knobs, and side slopes. Slopes range from 1 to 30 percent, but are mostly 1 to 8 percent. The underlying material is Precambrian gneiss and granite (fig. 3).

This map unit makes up about 29 percent of the county. It is about 37 percent Castell soils, 32 percent Keese soils, and 31 percent other soils and Rock outcrop.

The Castell soils are gently sloping and are moderately deep. Typically, the surface layer is brown sandy loam. The subsoil is yellowish brown sandy clay in the upper part and strong brown sandy clay in the lower part. The underlying material is weathered gneiss bedrock.

The Keese soils are gently sloping to steep and are shallow. Stones are on the soil surface. Typically, the surface layer is dark brown coarse sandy loam in the upper part and strong brown gravelly coarse sandy loam in the lower part. The underlying material is granite grus or weathered gneiss bedrock.

Of minor extent in this map unit are the Bauman, Click, Fieldcreek, Katemcy, Ligon, Lou, and Voca soils. Areas of Riverwash and Rock outcrop are also included. The deep, loamy Bauman soils are in nearly level drainageways. The deep, loamy Click soils are on gently sloping ridgetops and side slopes. The very deep, loamy Fieldcreek soils are on flood plains of small streams and creeks. The moderately deep, loamy Katemcy soils are in gently sloping valleys and are underlain by schist. The moderately deep, loamy Ligon soils are on gently sloping to strongly sloping ridges and side slopes and are underlain by schist. The moderately deep, loamy Lou soils are on gently sloping ridgetops. The deep, loamy Voca soils are on broad, nearly level foot slopes. The sandy Riverwash is the stream bed of larger creeks. The Rock outcrop is barren or nearly barren gneiss or granite bedrock.

The soils in this unit are used mainly as rangeland. The native plant community is mainly a live oak and post oak savannah with an understory of mid and tall grasses. Mesquite has invaded most areas. The very low and low available water capacity and the shallow and moderately deep root zone limit forage production of native grasses.

Production of cultivated crops and pasture grasses is limited in the Castell soils by the low available water capacity and the moderately deep root zone. The Keese soils are not suited for use as cropland or pasture because of depth to rock and stones on the surface. The hazard of water erosion is moderate.

The soils in this unit are well suited to wildlife habitat. Deer, turkey, dove, quail, and squirrel are the most common game species. In most of these areas, ranchers manage deer and turkey for hunting.

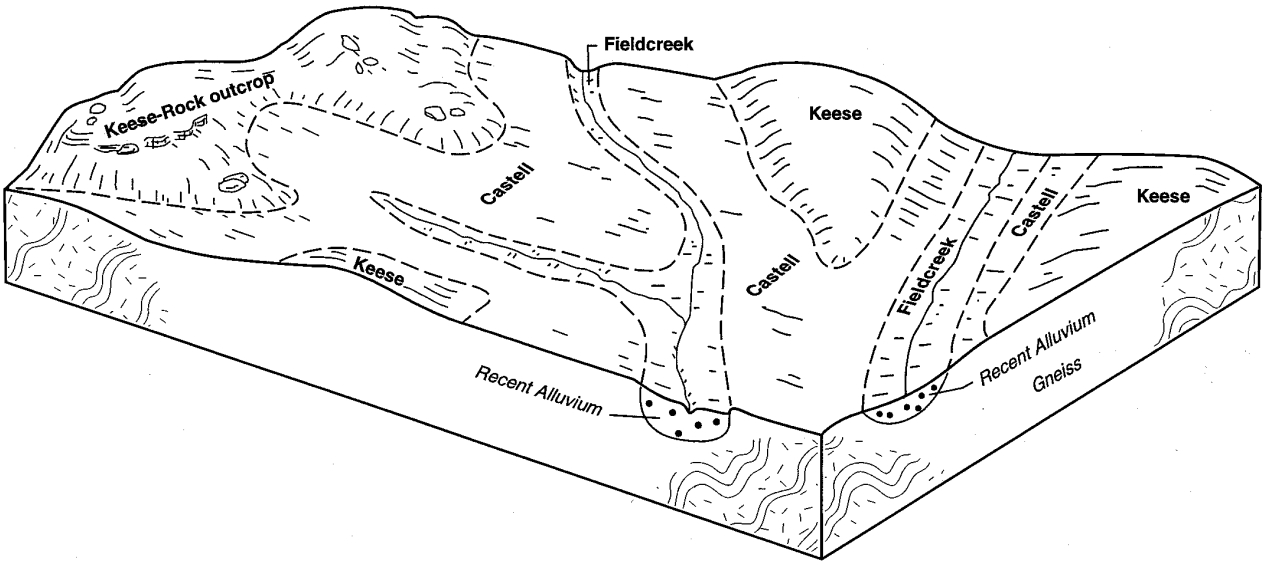

Figure 3.—Typical pattern of soils and parent material in the Castell-Keese general soil map unit.

The depth to rock, low strength, and slope are limitations on sites for buildings and septic tank absorption fields.

2. Voca-Lou-Click

Nearly level to moderately sloping, moderately deep or deep, loamy soils underlain by granite grus.

The Voca soils in this map unit are on foot slopes, the Lou soils are on foot slopes and ridgetops, and the Click soils are on foot slopes, ridgetops, and side slopes. Slopes range from 0 to 8 percent, but are mostly 0 to 3 percent. The underlying material is granite grus that has weathered from Precambrian granite.

This map unit makes up about 16 percent of the county. It is about 33 percent Voca soils, 32 percent Lou soils, 14 percent Click soils, and 21 percent other soils.

The Voca soils are nearly level to very gently sloping and are deep. Typically, the surface layer is brown gravelly sandy loam. The subsoil is reddish brown gravelly sandy clay in the upper part and mottled reddish brown and brown gravelly sandy clay loam in the lower part. The underlying material is granite grus (fig. 4).

The Lou soils are gently sloping and are moderately deep. Typically, the surface layer is brown coarse sandy loam. The subsoil is reddish brown gravelly coarse sandy loam in the upper part and yellowish red gravelly sandy clay loam in the lower part. The underlying material is granite grus.

The Click soils are gently sloping to moderately sloping and are deep. Typically, the surface layer is brown very gravelly coarse sandy loam. The subsoil is yellowish red very gravelly coarse sandy loam and red very gravelly sandy clay loam in the upper part. It is light red very gravelly coarse sandy loam in the lower part. The underlying material is granite grus.

Of minor extent in this map unit are the Bauman, Castell, Fieldcreek, Honeycreek, Katemcy, Keese, and Ligon soils. Areas of Riverwash and Rock outcrop are also included. The deep, loamy Bauman soils are in nearly level drainageways. The moderately deep, loamy Castell soils are on gently sloping foot slopes and are underlain by gneiss. The very deep, loamy Fieldcreek soils are on flood plains of small streams and creeks. The deep, loamy Honeycreek soils are on gently sloping foot slopes and are underlain by schist. The moderately deep, loamy Katemcy soils are on gently sloping foot slopes and are underlain by schist. The shallow, loamy Keese soils are on gently sloping to steep ridgetops and hills and are underlain by granite or gneiss. The moderately deep, loamy Ligon soils are on gently sloping to strongly sloping ridgetops and side slopes and are underlain by schist. The sandy, gravelly, and cobbly Riverwash is the stream bed of larger creeks. The Rock outcrop is barren or nearly barren gneiss or granite bedrock.

The soils in this unit are mainly used as rangeland. The native plant community is an open savannah of post oak, blackjack oak, and live oak with an understory of mid and tall grasses. Most areas have been invaded by mesquite trees. The very low and low available water capacity limits forage production of native rangeland grasses.

Production of cultivated crops and pasture grasses is

severely limited by the very low and low available water capacity.

The soils in this unit are well suited to wildlife habitat. Deer, turkey, dove, quail, and squirrel are the most common game species. In most of these areas, ranchers manage deer and turkey for hunting.

The soils in this unit have moderate limitations on sites for buildings. They have severe limitations on sites for septic tank absorption fields because of the depth to rock and slow permeability.

3. Keese-Rock outcrop

Gently sloping to steep, shallow, loamy soils underlain by gneiss and granite bedrock, and rock outcrop.

The Keese soils in this map unit are on foot slopes and side slopes. Slopes range from 1 to 30 percent, but are mostly 8 to 30 percent. The underlying material is Precambrian gneiss and granite.

This map unit makes up about 16 percent of the county. It is about 51 percent Keese soils, 22 percent Rock outcrop and 27 percent other soils.

The Keese soils are gently sloping to steep and are shallow. Stones are on the soil surface. Typically, the surface layer is dark brown coarse sandy loam in the upper part and strong brown gravelly coarse sandy loam in the lower part. The underlying material is granite or gneiss bedrock.

The Rock outcrop is barren or nearly barren granite or gneiss bedrock.

Of minor extent in this map unit are the Bauman, Castell, Click, Katemcy, Ligon, Lou, and Voca soils. The deep, loamy Bauman soils are in nearly level drainageways. The moderately deep, loamy Castell soils are on gently sloping foot slopes. The deep, loamy Click soils are on gently sloping to moderately sloping foot slopes and are underlain by granite grus. The moderately deep, loamy Katemcy soils are on gently sloping foot slopes and are underlain by schist. The moderately deep, loamy Ligon soils are on gently sloping to strongly sloping ridgetops and are underlain by schist. The moderately deep, loamy Lou soils are on gently sloping foot slopes and are underlain by granite grus. The deep, loamy Voca soils are on broad, nearly level to very gently sloping foot slopes and are underlain by granite grus.

These soils are used mainly as rangeland. The native plant community is a savannah of scattered live oak and blackjack oak with an understory of mid and tall grasses. The very low available water capacity limits forage production of rangeland grasses.

This unit is not suited for use as cropland or pasture because of the surface stones, very low available water capacity, shallow root zone, and slope.

The soils in this unit are well suited to wildlife habitat. Deer, turkey, dove, quail, and squirrel are the most

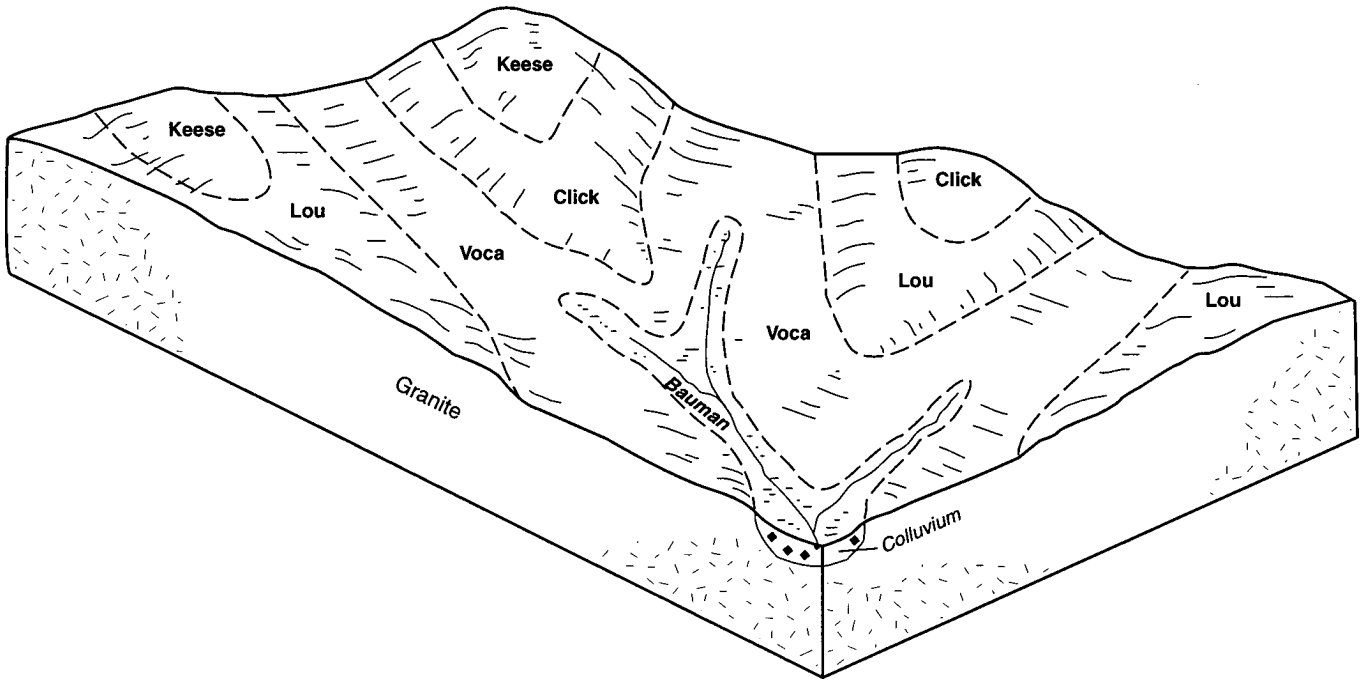

Figure 4.—Typical pattern of soils and parent material in the Voca-Lou-Click general soil map unit.

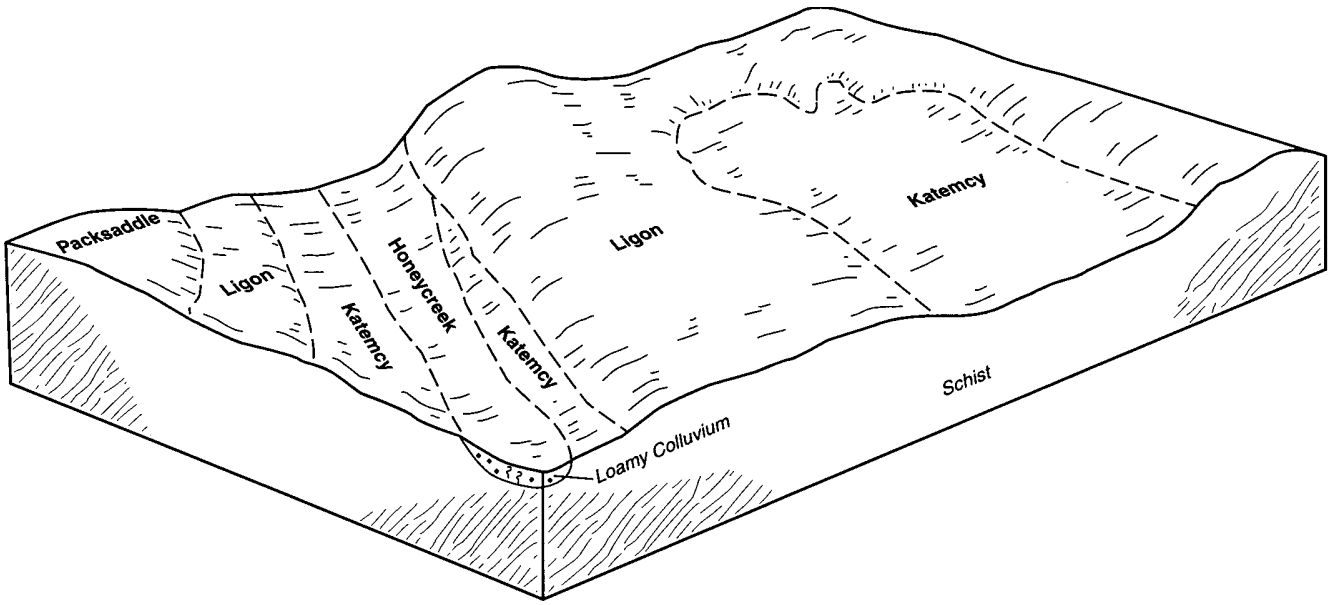

Figure 5.—Typical pattern of soils and parent material in the Ligon-Katemcy general soil map unit.

common game species. In most of these areas, ranchers manage deer and turkey for hunting.

The surface stones, depth to rock, and slope are severe limitations on sites for buildings and septic tank absorption fields.

Soils formed in material weathered from schist, sandstone, and limestone; on uplands

This group of general soil map units makes up about 25 percent of the land area in Llano County. The major soils are Campair, Katemcy, Ligon, Loneoak, Nebgen, and Yates. Rock outcrop is also part of this group. These units are dominantly on foot slopes, convex ridgetops, side slopes, and hills. They have a sandy or loamy surface layer and a loamy or clayey subsoil. They are underlain by schist, sandstone, or limestone bedrock.

The native plant community consists of scattered post oak, blackjack oak, or live oak with an understory of mid and tall grasses. Much of the area is used as rangeland. Some areas of the Campair and Loneoak soils are used as cropland and pasture.

4. Ligon-Katemcy

Gently sloping to strongly sloping, moderately deep, loamy soils underlain by schist bedrock.

The Ligon soils in this map unit are on ridgetops and side slopes, and the Katemcy soils are on foot slopes and side slopes. Slopes range from 1 to 12 percent, but are mostly 1 to 5 percent. The underlying material is Precambrian schist.

This map unit makes up about 14 percent of the county. It is about 62 percent Ligon soils, 22 percent Katemcy soils, and 16 percent other soils.

The Ligon soils are on gently sloping to strongly sloping ridges. Typically, the surface layer is reddish brown fine sandy loam. The subsoil is reddish brown clay in the upper part and red clay and sandy clay loam in the lower part. The underlying material is tilted, weathered schist (fig. 5).

The Katemcy soils are on gently sloping side slopes and foot slopes. Typically, the surface layer is reddish brown sandy loam. The subsoil is reddish brown sandy clay loam and red clay in the upper part, and it is reddish brown gravelly sandy clay grading to channery sandy clay loam in the lower part. The underlying material is tilted, weathered schist.

Of minor extent in this map unit are the Bauman, Castell, Cho, Click, Fieldcreek, Honeycreek, Keese, Lou, Luckenbach, Nuvalde, Packsaddle, and Voca soils. Areas of Riverwash and Rock outcrop are also included. The deep, loamy Bauman soils are in nearly level drainageways. The moderately deep, loamy Castell soils are on gently sloping foot slopes and are underlain by gneiss. The very shallow and shallow, loamy Cho soils have a thin, hard caliche layer and are on gently sloping ridges. The deep, loamy Click soils are on gently sloping ridges and are underlain by granite grus. The very deep, loamy Fieldcreek soils are on flood plains of small streams and creeks. The deep, loamy Honeycreek soils are on

gently sloping foot slopes and are underlain by schist. The shallow, loamy Keese soils are on gently sloping to steep ridgetops and hills and are underlain by granite or gneiss. The moderately deep, loamy Lou soils are on gently sloping ridges and are underlain by granite grus. The very deep, loamy Luckenbach and Nuvalde soils are on broad, gently sloping foot slopes and are underlain by loamy material. The moderately deep, loamy Packsaddle soils are on gently sloping to moderately sloping ridges and are underlain by graphitic schist. The deep, loamy Voca soils are on broad, nearly level to very gently sloping foot slopes and are underlain by granite grus. The sandy, gravelly, and cobbly Riverwash is the stream bed of larger creeks. The Rock outcrop is barren or nearly barren gneiss or granite bedrock.

The soils in this unit are mainly used as rangeland. The native plant community is a grassland with occasional post oak and blackjack oak throughout the landscape. Mesquite trees and whitebrush have invaded these soils. The low available water capacity limits forage production of rangeland grasses.

The low available water capacity and moderately deep root zone limit production of cultivated crops and pasture grasses.

The soils in this unit are well suited to wildlife habitat. Deer, turkey, dove, and quail are the most abundant game species. In most of these areas, ranchers manage deer and turkey for hunting.

Depth to bedrock and slow percolation are severe limitations on sites for septic tank absorption fields and buildings.

5. Nebgen-Yates-Rock outcrop

Gently sloping to steep, very shallow or shallow, loamy soils underlain by sandstone or limestone bedrock.

The Nebgen and Yates soils in this map unit are on ridgetops, foot slopes, and escarpments. Stones are on the soil surface. Slopes range from 1 to 40 percent, but are mostly 8 to 40 percent. The underlying material is Cambrian sandstone or limestone.

This map unit makes up about 8 percent of the county. It is about 27 percent Nebgen soils, 22 percent Yates soils, 11 percent Rock outcrop, and 40 percent other soils.

Typically, the Nebgen soils are stongly sloping to steep. They have a surface layer that is dark brown sandy loam. The underlying material is sandstone bedrock.

Typically, the Yates soils are gently sloping to steep. They have a surface layer that is reddish brown very stony loam. The underlying material is limestone bedrock.

Rock outcrop occurs throughout this unit as a complex with other soils. It is barren or nearly barren sandstone or limestone bedrock.

Of minor extent in this unit are the Eckrant, Hye, Oben, Oplin, Pontotoc, Roughcreek, and Rumple soils. The very shallow and shallow, clayey Eckrant soils are on broad, gently sloping ridgetops and steep escarpments and are underlain by limestone. The moderately deep, loamy Hye soils are on gently sloping ridges near the base of escarpments and are underlain by sandstone. The shallow, loamy Oben soils are on broad, gently sloping hilltops and are underlain by sandstone. The very shallow and shallow, loamy Oplin soils are on broad, gently sloping hilltops and steep escarpments and are underlain by limestone. The very deep, loamy Pontotoc soils are on foot slopes near the base of escarpments and are underlain by sandstone. The shallow, loamy Roughcreek soils are on broad, gently sloping to moderately sloping hilltops and steep escarpments and are underlain by limestone. The moderately deep, loamy Rumple soils are on broad, gently sloping ridgetops and are underlain by limestone.

This unit is mainly used as rangeland. The native plant community on the Yates soils is a mid grass prairie. The native plant community on the Nebgen soils is a savannah of mid and tall grasses with an overstory of post oak and blackjack oak. The very low available water capacity limits forage production of rangeland grasses.

This unit is not suited to cropland or pasture because of the surface stones, very low available water capacity, very shallow or shallow root zone, and slope. Minor soils, such as the Hye and Pontotoc soils, are suitable for cropland and pasture.

The soils in this unit are moderately suited to wildlife habitat. Deer, turkey, dove, and quail are the most abundant game species. In most of these areas, ranchers manage deer and turkey for hunting.

The surface stones, depth to bedrock, and slope are severe limitations on sites for buildings and septic tank absorption fields.

6. Campair-Loneoak

Nearly level to gently sloping, moderately deep or deep, sandy soils underlain by sandstone bedrock.

The Campair soils in this map unit are on side slopes and the Loneoak soils are on foot slopes. Slopes range from 0 to 5 percent, but are mostly 1 to 5 percent. This unit is in broad valleys between sandstone hills. The underlying material is Cambrian sandstone.

This map unit makes up about 3 percent of the county. It is 43 percent Campair soils, 37 percent Loneoak soils, and 20 percent other soils.

The Campair soils are gently sloping and are moderately deep. Typically, the surface layer is pale brown and very pale brown sand. The subsoil is reddish brown and reddish yellow sandy clay loam in the upper part and light gray sandy clay loam in the lower part. The underlying material is cemented sandstone bedrock (fig. 6).

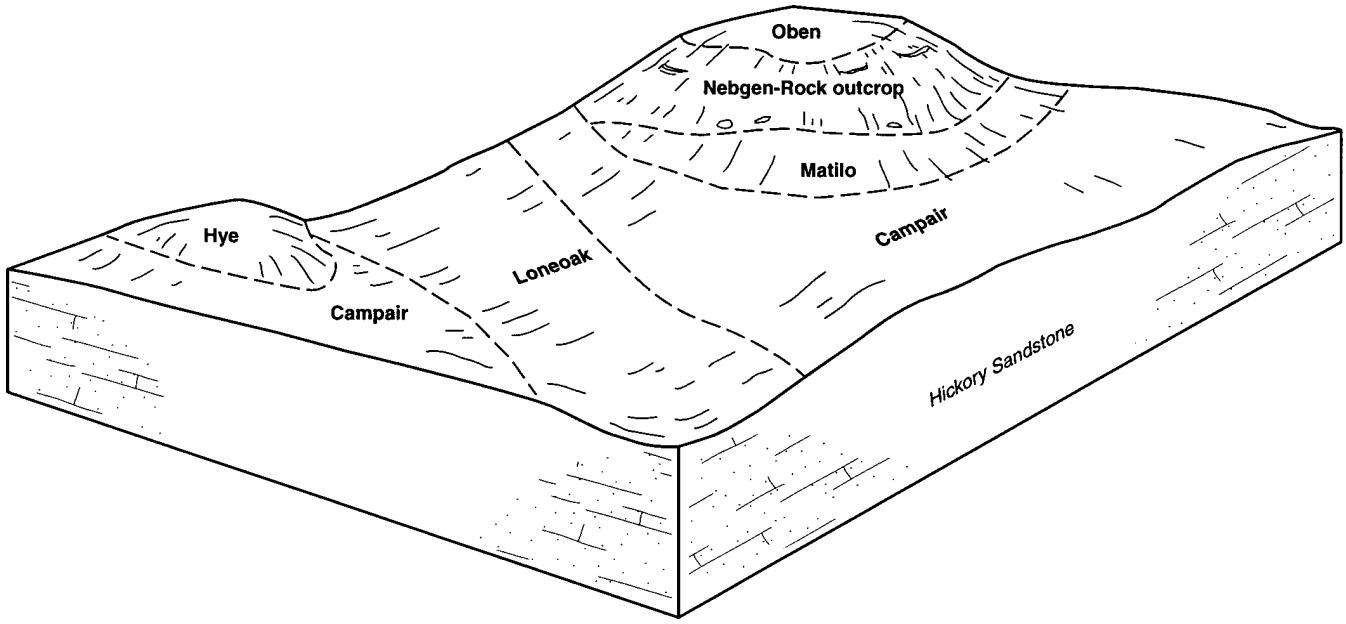

Figure 6.—Typical pattern of soils and parent material in the Campair-Loneoak general soil map unit.

The Loneoak soils are nearly level and are deep. Typically, the surface layer is yellowish brown sand in the upper part and very pale brown loamy sand in the lower part. The subsoil is light yellowish brown to brownish yellow sandy clay and sandy clay loam. The underlying material is weakly cemented sandstone bedrock.

Of minor extent in this map unit are the Hye, Matilo, Nebgen, Oben, and Pontotoc soils. The moderately deep, loamy Hye soils are on gently sloping ridges. The very deep, sandy Matilo soils are on gently sloping foot slopes. The very shallow and shallow, loamy Nebgen soils are on moderately sloping ridges and steep hills. The shallow, loamy Oben soils are on broad, gently sloping ridgetops. The very deep, loamy Pontotoc soils are on gently sloping foot slopes.

The soils in this unit are used as cropland, rangeland, and pasture. Grain and forage sorghums, peanuts, and small grains are the main crops. The peanuts are irrigated using water from wells.

The native plant community is a post oak and blackjack oak savannah with an understory of mid and tall grasses.

The soils in this unit are well suited to wildlife habitat. Deer, turkey, quail, dove, and squirrel are the most common game species. On some of the rangeland areas, ranchers manage deer and turkey for hunting.

The depth to bedrock, slow percolation, and a seasonal perched water table are limitations on sites for septic tank absorption fields. The depth to rock and shrink-swell potential are limitations on sites for buildings.

Soils formed in material weathered from limestone; on uplands

This group of general soil map units makes up about 9 percent of the land area in Llano County. The major soils are Eckrant, Hensley, and Roughcreek. Rock outcrop is also part of this group. These units are dominantly on ridgetops, hills, and escarpments. They have a loamy or clayey surface layer and a clayey subsoil. They are underlain by limestone bedrock.

The native vegetation consists of a tall grass savannah with scattered oak. These areas are used as rangeland.

7. Roughcreek-Eckrant-Rock outcrop

Gently sloping to steep, very shallow or shallow, loamy and clayey soils underlain by limestone bedrock.

The Roughcreek soils in this map unit are on ridgetops and escarpments, and the Eckrant soils are on ridgetops, side slopes, and escarpments. Stones are on the soil surface. Slopes range from 1 to 40 percent, but are mostly 1 to 8 percent. The underlying material is Ordovician limestone.

This map unit makes up about 8 percent of the county. It is about 26 percent Roughcreek soils, 23 percent Eckrant soils, 13 percent Rock outcrop, and 38 percent other soils.

The loamy Roughcreek soils are strongly sloping to steep and are shallow. Typically, the surface layer is dark

brown very stony clay loam. The subsoil is reddish brown very cobbly clay. The underlying material is limestone bedrock.

The clayey Eckrant soils are gently sloping to steep and are very shallow or shallow. Typically, the surface layer is very dark grayish brown very cobbly clay. The underlying material is limestone bedrock.

Rock outcrop occurs throughout this unit as a complex with other soils. It is barren or nearly barren limestone bedrock.

Of minor extent in this map unit are the Harper, Hensley, Luckenbach, Nuvalde, Oplin, Real, and Rumple soils. The shallow, stony, clayey Harper soils are on gently sloping ridges. The shallow, loamy Hensley soils are on gently sloping ridges and side slopes. The very deep, loamy Luckenbach and Nuvalde soils are on broad, gently sloping foot slopes near the base of the escarpments. The very shallow and shallow, stony and loamy Oplin soils are on broad, gently sloping to moderately sloping hilltops and on steep escarpments. The very shallow and shallow, loamy Real soils are on gently sloping to moderately sloping hilltops and steep escarpments and are underlain by soft limestone. The moderately deep, loamy Rumple soils are on broad, gently sloping ridges.

The soils in this map unit are used mainly as rangeland. The native plant community is a savannah of tall grasses with live oak, Texas oak, and shin oak.

The major soils are not suited to cropland or pasture because of the slope, surface stones, and very shallow or shallow root zone. Some areas of the Luckenbach and Nuvalde soils are used as cropland or pasture.

This unit is well suited to wildlife habitat. Deer, turkey, dove, quail, and squirrel are the most common game species. In most areas, ranchers manage deer and turkey for hunting.

The depth to rock, large stones, slope, and corrosivity to uncoated steel are severe limitations on sites for buildings, roads, and septic tank absorption fields.

8. Hensley

Gently sloping, shallow, loamy soils underlain by limestone bedrock.

The Hensley soils in this map unit are on ridgetops and side slopes. Stones are on the soil surface. Slopes range from 1 to 5 percent. The underlying material is Ordovician limestone.

This map unit makes up about 1 percent of the county. It is about 72 percent Hensley soils and 28 percent other soils and Rock outcrop.

Typically, the Hensley soils have a surface layer that is dark brown loam. The subsoil is red clay. The underlying material is limestone bedrock.

Of minor extent in this map unit are the Eckrant and Roughcreek soils. Areas of Rock outcrop are also included. The very shallow and shallow, clayey Eckrant soils and the shallow, very stony, and loamy Roughcreek soils are on broad, gently sloping to moderately sloping hilltops and on steep escarpments. The Rock outcrop occurs as a complex with the Eckrant and Roughcreek soils. It is barren or nearly barren limestone bedrock.

This unit is mainly used as rangeland. The native plant community is a savannah of tall grasses with scattered post oak, blackjack oak, and live oak. The very low available water capacity limits forage production of rangeland grasses.

The surface stones and shallow root zone severely limit use of this soil as cropland or pasture.

The soils in this unit are moderately suited to wildlife habitat. Deer, turkey, quail, dove, and squirrel are the most common game species. On some of the areas, ranchers manage deer and turkey for hunting.

The surface stones and depth to bedrock are severe limitations on sites for buildings and septic tank absorption fields.

Soils formed dominantly in alluvium; on flood plains and terraces

This group of general soil map units makes up about 3 percent of the land area in Llano County. The major soils are Bastrop, Boerne, Luckenbach, and Nuvalde. These soils are on foot slopes and terraces below the base of escarpments and are on flood plains and terraces of the Colorado River. They have a sandy or loamy surface layer and a loamy or clayey subsoil. They are underlain by loamy alluvium.

The native vegetation consists of a savannah of mid and tall grasses with an overstory of mixed hardwoods. Most of the areas are used as cropland, pasture, or rangeland.

9. Riverwash-Boerne-Bastrop

Riverwash, and nearly level to gently sloping, very deep, loamy and sandy soils underlain by loamy alluvium.

This map unit includes the Llano River and the narrow, nearly level to gently sloping stream terraces. The Bastrop soils are on stream terraces, and the Boerne soils are on flood plains along the Colorado River. Slopes range from 0 to 5 percent, but are mostly 0 to 3 percent. The underlying material is loamy alluvium of Holocene age.

This map unit makes up about 2 percent of the county. It is about 28 percent riverbed of the Llano River, 16 percent Boerne soils, 15 percent Bastrop soils, and 41 percent other soils and Rock outcrop.

The Llano River riverbed consists of Riverwash, Rock outcrop, and the flowing stream. Riverwash is sandy, gravelly, and cobbly alluvium. Rock outcrop is barren or nearly barren gneiss or granite bedrock.

The loamy Boerne soils are nearly level. Typically, the surface layer is dark yellowish brown fine sandy loam. The subsoil is strong brown and pink fine sandy loam. The underlying material is reddish yellow loam.

The sandy Bastrop soils are gently sloping. Typically, the surface layer is dark yellowish brown and dark brown loamy fine sand. The subsoil is yellowish red and reddish yellow sandy clay loam.

Of minor extent in this map unit are the Castell, Click, Katemcy, Keese, Ligon, Lou, Venus, Voca, and Weswood soils. The moderately deep, loamy Castell soils are on gently sloping foot slopes and are underlain by gneiss. The deep, loamy Click soils are on gently sloping foot slopes and are underlain by granite grus. The moderately deep, loamy Katemcy soils are on gently sloping foot slopes and are underlain by schist. The shallow, loamy Keese soils are on gently sloping to steep ridges and are underlain by gneiss or granite. The moderately deep, loamy Ligon soils are on gently sloping to moderately sloping upland ridges and are underlain by schist. The moderately deep, loamy Lou soils are on gently sloping ridges and are underlain by granite grus. The very deep, loamy Venus soils are on gently sloping low stream terraces. The deep, loamy Voca soils are on broad, nearly level to very gently sloping foot slopes and are underlain by granite grus. The very deep, loamy Weswood soils are on nearly level flood plains.

The riverbed of the Llano River has very limited use as rangeland for grazing. The narrow strip of stream terrace soils are used as cropland, pasture, and rangeland.

Most of these areas are too narrow and too small to be used as cropland or pasture. Where an area is wide enough to be used as cropland, it needs protection from runoff from adjacent upland areas. The native plant community is semi-wooded with tall and mid grasses.

The soils in this unit are well suited to wildlife habitat. Deer, turkey, quail, dove, and squirrel are the most common game species. On some of the rangeland areas, ranchers manage deer and turkey for hunting.

The soils of the low stream terraces and flood plain have a severe limitation on sites for buildings because of the flooding hazard.

10. Nuvalde-Luckenbach

Nearly level to very gently sloping, very deep, loamy soils underlain by loamy material.

The Nuvalde and Luckenbach soils in this map unit are on nearly level and very gently sloping toe slopes at the base of escarpments and on terraces. Slopes range from 0 to 3 percent. The underlying material is alluvium of Pleistocene age.

This map unit makes up about 1 percent of the county. About 48 percent is Nuvalde soils, 36 percent Luckenbach soils, and 16 percent other soils.

Typically, the Nuvalde soils have a surface layer that is dark brown clay loam. The subsoil is dark brown, brown, and yellowish brown clay loam. The underlying material is dark brown clay loam.

Typically, the Luckenbach soils have a surface layer that is very dark grayish brown clay loam. The subsoil is brown and yellowish brown clay. The underlying material is strong brown clay loam.

Of minor extent in this map unit are the Cho, Hye, Krum, Pedernales, and Venus series. The very shallow and shallow, loamy Cho soils are on gently sloping ridges and have a thin, hard caliche layer. The moderately deep, loamy Hye soils are on gently sloping ridges and are underlain by sandstone. The very deep, clayey Krum soils are on broad, gently sloping valley floors. The very deep, loamy Pedernales soils are on gently sloping ridges. The very deep, loamy Venus soils are in broad, nearly level valleys.

These soils are mainly used as cropland and pasture. Some areas are used as rangeland.

The native plant community is a tall grass prairie that has few woody species.

The soils in this unit are moderately suited to wildlife habitat. Deer, turkey, quail, dove, and squirrel are the most common game species. On some of the rangeland areas, ranchers manage deer and turkey for hunting.

The shrink-swell potential is a severe limitation on sites for buildings. The slow percolation rate is a severe limitation on sites for septic tank absorption fields.

Detailed Soil Map Units

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

A map unit delineation on a map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils or miscellaneous areas. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils and miscellaneous areas are natural phenomena, and they have the characteristic variability of all natural phenomena. 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 other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some “included” areas that belong to other taxonomic classes.

Most included soils have properties 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, or similar, inclusions. They may or may not be mentioned in the map unit description. Other included soils and miscellaneous areas, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, inclusions. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. The included areas of contrasting soils or miscellaneous areas are mentioned in the map unit descriptions. A few included areas may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

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

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit 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, 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, slope, stoniness, salinity, 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, Ligon fine sandy loam, 1 to 5 percent slopes, is a phase of the Ligon series.

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

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Keese-Rock outcrop complex, 1 to 8 percent slopes, very stony, is an example.

This survey includes some map units that are *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Riverwash, frequently flooded, is an example. There are some kinds of miscellaneous areas for which there is not a detailed description. In this survey these are dams and water areas more than 40 acres in size.

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 or miscellaneous areas.

BaC—Bastrop loamy fine sand, 1 to 5 percent slopes. This very deep, gently sloping soil is on terraces along the Llano and Colorado Rivers. The slopes are convex. Areas are elongated and range from 10 to 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 5 inches; dark yellowish brown loamy fine sand

Subsurface layer:

5 to 13 inches; dark brown loamy fine sand

Subsoil:
13 to 48 inches; yellowish red sandy clay loam
48 to 80 inches; reddish yellow sandy clay loam

Important soil properties—

Available water capacity: moderate
Permeability: moderate
Drainage: well drained
Runoff: 1 to 3 percent slopes—very low; 3 to 5 percent slopes—low
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: neutral in surface layer; slightly acid and neutral in subsoil
Shrink-swell potential: low
Water erosion hazard: moderate
Wind erosion hazard: moderate

Included with this soil in mapping are small areas of Boerne, Fieldcreek, Venus, and Weswood soils. These soils do not have a sandy clay loam subsoil and are on flood plains and lower terraces. The included soils make up less than 15 percent of any mapped area.

The Bastrop soil is used as cropland, pasture, or rangeland.

This soil is well suited to use as cropland. The moderate water and wind erosion hazards limit production of cultivated crops.

This soil is well suited to use as pasture. Soil blowing is a limitation when establishing pasture grasses.

This Bastrop soil is well suited to rangeland.

This soil is suited to most urban uses. Seepage and slope are limitations on sites for some sanitary facilities, and low strength is a limitation on sites for roads and streets.

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

BmA—Bauman loam, 0 to 2 percent slopes. This deep, nearly level soil is along drainageways. The slopes are linear to concave. Areas are elongated and range from 5 to 40 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 4 inches; light brownish gray loam

Subsurface layer:
4 to 6 inches; light gray loam

Subsoil:
6 to 11 inches; dark gray clay loam that has common granite pebbles
11 to 20 inches; dark brown clay loam that has common granite pebbles
20 to 26 inches; brown clay loam that has common granite pebbles
26 to 42 inches; light brownish gray gravelly sandy clay loam that has films and threads of gypsum, common masses of calcium carbonate, and 30 percent granite pebbles

Substratum:
42 to 72 inches; finely fragmented granite grus that has fragments coated with red clay

Important soil properties—

Available water capacity: low
Permeability: slow
Drainage: moderately well drained
Runoff: low
Water table: none within a depth of 6 feet. A seasonal perched water table occurs during heavy rainfall periods in the spring months
Root zone: deep; however, the high sodium content in the subsoil is more resistant to root penetration
Soil reaction: slightly acid in the surface layer and slightly alkaline to moderately alkaline in the subsoil
Shrink-swell potential: low in the surface layer and high in the subsoil
Water erosion hazard: slight
Wind erosion hazard: slight

Included with this soil in mapping are small areas of Castell, Click, Lou, and Voca soils. The Castell soils are 20 to 40 inches deep, are in the higher positions, and are underlain by gneiss bedrock. The Click, Lou, and Voca soils are in the slightly higher positions. The Click and Lou soils have loamy subsoils. The Voca soils are underlain by granite bedrock. These soils do not have the

high sodium content in the subsoil like the Bauman soils. The included soils make up about 10 percent of any mapped area.

The Bauman soil is used as pasture or rangeland.

This soil is poorly suited to use as cropland. The high sodium content limits the kinds of crops that can be grown. The low available water capacity is a limitation. The water uptake by plant roots is restricted, and root growth into the sodium-affected layers is reduced.

This soil is poorly suited to use as pasture. The high sodium content in the soil limits the kinds of pasture grasses grown and the amount of forage produced. The low available water capacity is a limitation.

This Bauman soil is suited to rangeland. The high sodium content in the soil limits the kinds of plants grown and the amount of forage produced. The low available water capacity is a limitation.

This soil is poorly suited to urban uses. The slow permeability and depth to rock are severe limitations on sites for most sanitary facilities. The high shrink-swell potential is a limitation on sites for buildings.

This soil is in capability subclass IVs and the Tightland range site.

Br—Boerne fine sandy loam, rarely flooded. This very deep, nearly level soil is on the second-level flood plain of the Llano River. The slopes are convex. Areas are oblong and range from 10 to 50 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 10 inches; dark yellowish brown fine sandy loam

Subsoil:
10 to 21 inches; strong brown fine sandy loam
21 to 50 inches; pink fine sandy loam
50 to 62 inches; reddish yellow loam that has few masses and many films and threads of calcium carbonate

Important soil properties—

Available water capacity: moderate
Permeability: moderately rapid
Drainage: well drained
Runoff: negligible
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: moderately alkaline
Shrink-swell potential: low
Water erosion hazard: slight
Wind erosion hazard: moderate

Included with this soil in mapping are small areas of Bastrop, Castell, Keese, and Venus soils. The Bastrop soils have a sandy clay loam subsoil. The Castell soils are 20 to 40 inches deep, have a clayey subsoil, and are underlain by gneiss bedrock. The Keese soils are less than 20 inches deep and are underlain by granite or gneiss bedrock. The Venus soils are more clayey in the subsoil. The included soils make up less than 15 percent of any mapped area.

The Boerne soil is used mainly as pasture. A few small areas are used as rangeland or cropland.

This soil is suited to cropland. The moderate wind erosion hazard limits its use as cropland. The high lime content can limit growth of some cultivated crops.

This soil is well suited to pasture and rangeland.

This Boerne soil is not suited to urban uses because of the hazard of flooding. Seepage is a severe limitation on sites for most sanitary facilities.

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

CaB—Campair sand, 1 to 5 percent slopes. This moderately deep, gently sloping soil is on gently sloping uplands. The slopes are convex. Areas are rounded to irregular in shape and range from 10 to 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 11 inches; pale brown sand

Subsurface layer:
11 to 14 inches; very pale brown sand

Subsoil:
14 to 18 inches; reddish brown sandy clay loam
18 to 31 inches; reddish yellow sandy clay loam that has red mottles
31 to 38 inches; light gray sandy clay loam that has red and yellowish brown mottles

Substratum:
38 to 42 inches; coarse-grained, strongly cemented sandstone

Important soil properties—

Available water capacity: low
Permeability: moderate
Drainage: well drained
Runoff: 1 to 3 percent slopes—very low; 3 to 5 percent slopes—low
Water table: none within a depth of 6 feet
Root zone: moderately deep
Soil reaction: slightly acid in the surface layer and moderately acid in the subsoil
Shrink-swell potential: low
Water erosion hazard: moderate
Wind erosion hazard: severe

Included with this soil in mapping are small areas of Castell and Loneoak soils. The Castell soils have a clayey subsoil and are underlain by gneiss bedrock. The Loneoak soils are 40 to 60 inches deep, have a thick sandy surface layer, and are on foot slopes. The included soils make up about 10 percent of any mapped area.

The Campair soil is used mainly as cropland, pasture, or rangeland.

This soil is suited to cropland. The moderate water erosion hazard and severe wind erosion hazard limit its use as cropland. The low available water capacity and moderately deep root zone are limitations.

This soil is suited to pasture and rangeland. The low available water capacity and moderately deep root zone are limitations.

This Campair soil is poorly suited to most urban uses. The depth to bedrock is a severe limitation on sites for sanitary facilities and buildings.

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

CeC—Castell sandy loam, 1 to 5 percent slopes. This moderately deep, gently sloping soil is on foot slopes. The slopes are concave to convex. Areas are oblong to irregular in shape and range from 15 to 1,000 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 8 inches; brown sandy loam

Subsoil:
8 to 17 inches; yellowish brown sandy clay
17 to 30 inches; strong brown sandy clay that has reddish yellow and yellowish brown mottles

Substratum:
30 to 42 inches; weathered pinkish gneiss that increases in hardness with depth

Important soil properties—

Available water capacity: low
Permeability: slow
Drainage: well drained
Runoff: medium
Water table: none within a depth of 6 feet
Root zone: moderately deep
Soil reaction: slightly acid in the surface layer and slightly acid to moderately acid in the subsoil
Shrink-swell potential: low in the surface layer and moderate in the subsoil
Water erosion hazard: moderate
Wind erosion hazard: moderate

Included with this soil in mapping are small areas of Bauman, Keese, Ligon, and Voca soils. The Bauman soils have a high sodium content in the subsoil and are along drainageways. The Keese soils are less than 20 inches deep and are underlain by granite or gneiss bedrock. The Ligon soils are underlain by schist. The Keese and Ligon soils are on more sloping ridges. The Voca soils are 40 to 60 inches deep and are in the lower positions. The included soils make up less than 20 percent of any mapped area.

The Castell soil is used as pasture, rangeland, or cropland.

This soil is poorly suited to cropland. The moderate water and wind erosion hazards limit its use as cropland. The low available water capacity and moderately deep root zone are limitations.

Some areas that were once cultivated have been allowed to revert to native grasses and are used as rangeland, or they have been planted to improved grasses and are used as pasture. On most of these rangeland areas, the native grasses provide low quality forage. The low available water capacity and moderately deep root zone are limitations for both pasture and range.

This soil is poorly suited to urban uses. The depth to bedrock is a severe limitation on sites for sanitary facilities. The depth to bedrock, moderate shrink-swell potential, and low strength are limitations on sites for buildings and roads.

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

ChB—Cho loam, 1 to 3 percent slopes. This very shallow and shallow, very gently sloping soil is on uplands below limestone hills. The slopes are linear to convex. Areas are oblong to irregular in shape and range from 80 to 400 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 14 inches; dark brown loam

Substratum:
14 to 16 inches; reddish yellow indurated caliche
16 to 45 inches; pink gravelly loam that has many concretions of calcium carbonate

Important soil properties—

Available water capacity: very low
Permeability: moderate
Drainage: well drained

Runoff: 1 to 3 percent slopes—low; 3 to 5 percent slopes—medium
Water table: none within a depth of 6 feet
Root zone: very shallow to shallow
Soil reaction: moderately alkaline
Shrink-swell potential: low
Water erosion hazard: moderate
Wind erosion hazard: moderate

Included with this soil in mapping are small areas of similar soils that are deeper than 20 inches to the indurated layer and soils without an indurated layer. The included soils make up about 10 percent of any mapped area.

The Cho soil is used mainly as rangeland.

This soil is poorly suited to cropland. The moderate water erosion hazard limits its use as cropland. The very shallow and shallow root zone and the very low available water capacity are limitations.

This soil is poorly suited to pasture. The very shallow and shallow root zone and the very low available water capacity are severe limitations.

This Cho soil is suited to rangeland. The very low available water capacity is a limitation.

This soil is not suited to most urban uses. The shallow depth to a cemented layer is a severe limitation on sites for most sanitary facilities and buildings.

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

CkC—Click very gravelly coarse sandy loam, 1 to 8 percent slopes. This deep, gently sloping to moderately sloping soil is on convex ridgetops and side slopes. The slopes are concave to convex. Areas are oblong to irregular in shape and range from 15 to 1,000 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 11 inches; brown very gravelly coarse sandy loam

Subsoil:
11 to 18 inches; yellowish red very gravelly coarse sandy loam
18 to 29 inches; red very gravelly sandy clay loam
29 to 46 inches; light red very gravelly coarse sandy loam

Substratum:
46 to 53 inches; red finely fragmented granite grus that has red clay coatings on fragments
53 to 56 inches; pink indurated and fractured granite.

Important soil properties—

Available water capacity: very low
Permeability: rapid
Drainage: somewhat excessively drained
Runoff: 1 to 3 percent slopes—negligible; 3 to 5 percent slopes—very low; 5 to 8 percent slopes—low
Water table: none within a depth of 6 feet
Root zone: deep
Soil reaction: slightly acid in the surface layer and neutral in the subsoil
Shrink-swell potential: low
Water erosion hazard: moderate
Wind erosion hazard: slight

Included with this soil in mapping are small areas of Bauman, Keese, Lou, and Voca soils. The Bauman soils have a clay loam subsoil and are along narrow drainageways. The Keese soils are less than 20 inches deep and are underlain by granite or gneiss bedrock. The Lou soils are 20 to 40 inches deep and are in positions similar to those of the Click soils. The Voca soils have a clayey subsoil and are on nearly level to gently sloping smooth areas. The included soils make up less than 15 percent of any mapped area.

The Click soil is used mainly as rangeland or pasture.

This soil is not suited to cropland because of the gravelly surface layer, very low available water capacity, and moderate water erosion hazard.

Some areas that were once cultivated have been allowed to revert to native grasses and are used as rangeland, or they have been planted to improved grasses and are used as pasture. The very low available water capacity is a limitation for both pasture and rangeland.

This soil is poorly suited to most urban uses. The rapid permeability is a limitation on sites for septic tank absorption fields. Seepage is a severe limitation on sites for sanitary facilities. Slope is a limitation on sites for most buildings.

This soil is in capability subclass VIs and the Granite Gravel range site.

EcC—Eckrant-Rock outcrop complex, 1 to 8 percent slopes, extremely stony. This complex consists of very shallow and shallow, gently sloping to moderately sloping Eckrant soils and Rock outcrop. A typical area is 80 percent Eckrant soils, 12 percent rock outcrop, and 8 percent other soils. The Eckrant soil has stones and cobbles covering 26 percent of the soil surface. Rock outcrop is barren or nearly barren limestone bedrock. The slopes are concave to convex. Areas are oblong to irregular in shape and range from 40 to 1,000 acres in size.

The typical sequence, depth, and composition of the layers of the Eckrant soil are—

Surface layer:
0 to 4 inches; very dark grayish brown very cobbly clay

Subsurface layer:
4 to 11 inches; very dark gray very cobbly clay

Substratum:
11 to 13 inches; light gray indurated limestone bedrock

Important soil properties—

Available water capacity: very low
Permeability: moderately slow
Drainage: well drained
Runoff: 1 to 3 percent slopes—very low; 3 to 5 percent slopes—low; 5 to 8 percent slopes—medium
Water table: none within a depth of 6 feet
Root zone: very shallow to shallow
Soil reaction: slightly alkaline
Shrink-swell potential: moderate
Water erosion hazard: moderate
Wind erosion hazard: slight

Included with this complex in mapping are small areas of Oplin and Yates soils. The Oplin soils are loamy and calcareous. The Yates soils are reddish brown and loamy. Both of these soils are in positions similar to those of the Eckrant soils. The included soils make up less than 20 percent of any mapped area.

The Eckrant-Rock outcrop complex is used as rangeland.

This complex is not suited to cropland or pasture because of the very shallow to shallow root zone, large stones on the surface, and rock outcrop.

This complex is suited to rangeland. The very shallow and shallow root zone, very low available water capacity, and rock outcrop are limitations.

This map unit is poorly suited to most urban uses. The depth to bedrock and large stones are severe limitations on sites for sanitary facilities and buildings.

The Eckrant soils are in capability subclass VIIs and the Low Stony Hill range site. Rock outcrop is in capability class VIIIs and is not assigned a range site.

EcF—Eckrant-Rock outcrop complex, 10 to 40 percent slopes, extremely stony. This complex consists of very shallow and shallow, strongly sloping to steep Eckrant soils and Rock outcrop. A typical area is 70 percent Eckrant soils, 20 percent Rock outcrop, and 10 percent other soils. The Eckrant soil has stones and cobbles covering about 25 percent of the soil surface. Rock outcrop is barren or nearly barren limestone bedrock. The slopes are concave to convex. Areas are oblong to irregular in shape and range from 40 to 1,000 acres in size.

The typical sequence, depth, and composition of the layers of the Eckrant soil are—

Surface layer:
0 to 4 inches; very dark grayish brown very cobbly clay
Subsurface layer:
4 to 13 inches; very dark grayish brown very cobbly clay
Substratum:
13 to 14 inches; light gray coarsely fractured and indurated limestone bedrock

Important soil properties—

Available water capacity: very low
Permeability: mode rately slow
Drainage: well drained
Runoff: 10 to 20 percent slopes—medium; 20 to 40 percent slopes—high
Water table: none within a depth of 6 feet
Root zone: very shallow to shallow
Soil reaction: slightly alkaline
Shrink-swell potential: moderate
Water erosion hazard: severe
Wind erosion hazard: slight

Included with this complex in mapping are small areas of Oplin and Yates soils. The Oplin soils are loamy and calcareous. The Yates soils are reddish brown and loamy. Both of these soils are in positions similar to those of the Eckrant soils. The included soils make up less than 20 percent of any mapped area.

The Eckrant-Rock outcrop complex is used as rangeland.

This complex is not suited to cropland or pasture because of the steep slopes, very shallow and shallow root zone, severe water erosion hazard, rock outcrop, and stones on the surface.

The very shallow and shallow root zone, very low available water capacity, steep slopes, and rock outcrop limit forage production on rangeland.

This complex is not suited to urban uses. The depth to bedrock and steep slopes are severe limitations on sites for sanitary facilities and buildings.

The Eckrant soil is in capability subclass VIIs and the Steep Rocky range site. Rock outcrop is in capability class VIIIs and is not assigned a range site.

Fe—Fieldcreek fine sandy loam, occasionally flooded. This very deep, nearly level soil is on low terraces and on flood plains along streams and creeks. The slopes are linear. Areas are long and narrow and range from 10 to

500 acres in size. This soil is flooded about once in 15 years.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 8 inches; dark brown fine sandy loam

Subsurface layer:
8 to 25 inches; dark grayish brown loam

Subsoil:
25 to 48 inches; dark brown loam
48 to 80 inches; brown fine sandy loam

Important soil properties—

Available water capacity: moderate
Permeability: moderately rapid
Drainage: well drained
Runoff: negligible
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: neutral in the surface layer and slightly alkaline to moderately alkaline in the subsoil
Shrink-swell potential: low
Water erosion hazard: slight
Wind erosion hazard: moderate

Included with this soil in mapping are small areas of gneiss and granite rock outcrop adjacent to the stream channels. The included areas make up less than 15 percent of any mapped area.

The Fieldcreek soil is used mainly as pasture or rangeland. Some areas are used as cropland.

This soil is suited to cropland. The moderate wind erosion hazard limits its use as cropland. The moderate available water capacity is a limitation. Occasional flooding can cause crop damage.

This soil is suited to pasture and rangeland. The moderate available water capacity is a limitation.

This Fieldcreek soil is not suited to most urban uses because of the flooding hazard.

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

HaB—Harper clay, 0 to 3 percent slopes, stony. This shallow, nearly level to very gently sloping soil is on limestone hills. This soil has stones covering about 3 percent of the soil surface. The slopes are linear. Areas are oblong and range from 80 to 150 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 11 inches; very dark gray clay that has limestone fragments on the surface and in the soil

Substratum:
11 to 15 inches; light gray indurated, fractured dolomitic limestone bedrock

Important soil properties—

Available water capacity: very low
Permeability: moderately slow
Drainage: well drained
Runoff: very low
Water table: none within a depth of 6 feet
Root zone: shallow
Soil reaction: slightly alkaline
Shrink-swell potential: high
Water erosion hazard: moderate
Wind erosion hazard: slight

Included with this soil in mapping are small areas of Eckrant, Hensley, Roughcreek, and Rumple soils. The Eckrant soils have more than 35 percent by volume coarse fragments in the soil. The Hensley soils have a loamy surface layer and a red clayey subsoil. The Roughcreek soils have a reddish brown clayey subsoil. The Rumple soils have less than 1 percent stones on the surface, are more than 20 inches deep, and have a red clayey subsoil. The included soils make up about 15 percent of any mapped area.

The Harper soil is used as rangeland.

This soil is not suited to cropland or pasture because of the shallow root zone, very low available water capacity, and stones on the surface.

This soil is suited to rangeland. The shallow root zone, very low available water capacity, depth to rock, and rock outcrop are limitations.

This Harper soil is not suited to urban uses. The depth to rock, stones on the surface, clayey surface layer, and high shrink-swell potential are severe limitations on sites for sanitary facilities and buildings.

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

HaC—Harper-Rock outcrop complex, 1 to 5 percent slopes, very stony. This complex consists of shallow, gently sloping Harper soils and Rock outcrop. A typical area is 70 percent Harper soils, 23 percent Rock outcrop, and 7 percent other soils. The Harper soil has stones and

cobbles covering about 10 percent of the soil surface. Rock outcrop is barren or nearly barren limestone bedrock. The slopes are concave to convex. Areas are oblong to irregular in shape and range from 80 to 400 acres in size.

The typical sequence, depth, and composition of the layers of the Harper soil are—

Surface layer:
0 to 10 inches; very dark gray clay that has limestone pebbles and cobbles

Substratum:

10 to 13 inches; light gray indurated, fractured dolomitic limestone bedrock

Important soil properties—

Available water capacity: very low
Permeability: moderately slow
Drainage: well drained
Runoff: 1 to 5 percent slopes—very low; 3 to 5 percent slopes—low
Water table: none within a depth of 6 feet
Root zone: shallow
Soil reaction: slightly alkaline
Shrink-swell potential: high
Water erosion hazard: moderate
Wind erosion hazard: slight

Included with this complex in mapping are small areas of Eckrant, Hensley, Roughcreek, and Rumple soils. The Eckrant soils have more than 35 percent by volume coarse fragments in the soil. The Hensley soils have a loamy surface layer and a red clayey subsoil. The Roughcreek soils have a reddish brown clayey subsoil. The Rumple soils have less than 1 percent stones on the surface, are more than 20 inches deep, and have a red clayey subsoil. The included soils make up less than 15 percent of any mapped area.

The Harper-Rock outcrop complex is used as rangeland.

This complex is not suited to cropland or pasture because of the very stony surface, very low available water capacity, shallow root zone, and rock outcrop.

This map unit is suited to rangeland. The shallow root zone, depth to rock, very low available water capacity, and rock outcrop are limitations.

This complex is not suited to urban uses. The depth to bedrock and stones on the surface are severe limitations on sites for sanitary facilities. The depth to bedrock and high shrink-swell potential are severe limitations on sites for buildings.

The Harper soil is in capability subclass VIs and the Low Stony Hill range site. Rock outcrop is in capability class VIIIs and is not assigned a range site.

HeB—Hensley loam, 1 to 5 percent slopes, stony. This shallow, gently sloping soil is on ridges and side slopes. This soil has stones and cobbles covering about 1 percent of the soil surface. The slopes are linear to convex. Areas are wide and irregular in shape and range from 40 to 400 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 5 inches; dark brown loam that has about 5 percent limestone pebbles and cobbles

Subsoil:
5 to 18 inches; red clay

Substratum:
18 to 20 inches; light gray fractured, dolomitic limestone bedrock

Important soil properties—

Available water capacity: low
Permeability: slow
Drainage: well drained
Runoff: medium
Water table: none within a depth of 6 feet
Root zone: shallow
Soil reaction: neutral in the surface layer and slightly alkaline in the subsoil
Shrink-swell potential: low in the surface layer and moderate in the subsoil
Water erosion hazard: moderate
Wind erosion hazard: slight

Included with this soil in mapping are small areas of Eckrant, Harper, Roughcreek, and Rumple soils and Rock outcrop. The Eckrant, Roughcreek, and Rumple soils have more than 35 percent by volume coarse fragments in the soil. In addition, the Rumple soils are more than 20 inches deep. The Harper soils are clayey throughout. Rock outcrop consists of barren or nearly barren limestone bedrock. The included soils make up less than 20 percent of any mapped area.

The Hensley soil is used as rangeland and pasture.

This soil is not suited to cropland because of the stones on the surface, low available water capacity, and shallow root zone.

This Hensley soil is poorly suited to rangeland and pasture. The depth to rock, shallow root zone, and low available water capacity are limitations.

This soil is not suited to urban uses. The depth to bedrock is a severe limitation on sites for sanitary facilities and buildings.

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

HoB—Honeycreek fine sandy loam, 1 to 3 percent slopes. This deep, very gently sloping soil is on foot slopes and terraces along drainageways and small creeks. The slopes are concave to linear. Areas are long and narrow and range from 10 to 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 9 inches; strong brown fine sandy loam

Subsurface layer:
9 to 17 inches; reddish brown fine sandy loam

Subsoil:
17 to 25 inches; reddish brown fine sandy loam
25 to 37 inches; reddish brown sandy clay loam
37 to 50 inches; strong brown gravelly sandy clay loam
50 to 56 inches; reddish yellow gravelly fine sandy loam

Substratum:
56 to 66 inches; weathered schist bedrock

Important soil properties—

Available water capacity: moderate
Permeability: moderate
Drainage: well drained
Runoff: very low
Water table: none within a depth of 6 feet
Root zone: deep
Soil reaction: slightly acid in the surface layer and neutral in the subsoil
Shrink-swell potential: low
Water erosion hazard: moderate
Wind erosion hazard: slight

Included with this soil in mapping are small areas of Castell, Fieldcreek, and Katemcy soils. The Castell soils have a clayey subsoil and are underlain by gneiss bedrock. The Fieldcreek soils are less clayey in the subsoil and are on flood plains and on low terraces along streams and creeks. The Katemcy soils have a clayey subsoil and are in the higher positions. The included soils make up less than 15 percent of any mapped area.

The Honeycreek soil is used as cropland, pasture, or rangeland.

This soil is suited to cropland. The moderate water erosion hazard limits its use as cropland. The moderate available water capacity is a limitation.

This soil is well suited to pasture and rangeland.

This Honeycreek soil is suited to most urban uses. Seepage is a limitation on sites for some sanitary facilities.

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

HyC—Hye fine sandy loam, 1 to 5 percent slopes. This moderately deep, gently sloping soil is on knolls. The slopes are convex. Areas are round and range from 20 to 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 10 inches; brown fine sandy loam

Subsoil:
10 to 24 inches; reddish brown sandy clay loam
24 to 31 inches; yellowish red gravelly sandy clay loam that has common fragments of ironstone and sandstone

Substratum:
31 to 38 inches; sandstone bedrock

Important soil properties—

Available water capacity: low
Permeability: moderate
Drainage: well drained
Runoff: 1 to 3 percent slopes—very low; 3 to 5 percent slopes—low
Water table: none within a depth of 6 feet
Root zone: moderately deep
Soil reaction: neutral
Shrink-swell potential: low
Water erosion hazard: moderate
Wind erosion hazard: severe

Included with this soil in mapping are small areas of Nebgen, Oben, and Pontotoc soils. The Nebgen and Oben soils are less than 20 inches deep and are on small ridges. The Pontotoc soils are red, are generally more than 60 inches deep, and are on foot slopes. The included soils make up less than 15 percent of any mapped area.

The Hye soil is used as cropland, pasture, or rangeland.

This soil is suited to cropland. The moderate water erosion hazard and severe wind erosion hazard limit its use as cropland. The low available water capacity and moderately deep root zone are limitations.

This soil is suited to pasture and rangeland. The low available water capacity and moderately deep root zone are limitations.

This Hye soil is poorly suited to urban uses. The depth to bedrock is a severe limitation on sites for sanitary facilities. It is also a limitation on sites for buildings.

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

KaC—Katemcy sandy loam, 1 to 5 percent slopes. This moderately deep, gently sloping soil is on foot slopes. The slopes are concave to linear. Areas are oblong to irregular in shape and range from 15 to 200 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 9 inches; reddish brown sandy loam

Subsoil:
9 to 11 inches; reddish brown sandy clay loam
11 to 20 inches; red sandy clay
20 to 27 inches; reddish brown gravelly sandy clay
27 to 38 inches; reddish brown channery sandy clay loam that has common channers

Substratum:
38 to 79 inches; weathered schist bedrock

Important soil properties—

Available water capacity: low
Permeability: moderately slow
Drainage: well drained
Runoff: 1 to 3 percent slopes—very low; 3 to 5 percent slopes—low
Water table: none within a depth of 6 feet
Root zone: moderately deep
Soil reaction: neutral
Shrink-swell potential: low in the surface layer and moderate in the subsoil
Water erosion hazard: moderate
Wind erosion hazard: moderate

Included with this soil in mapping are small areas of Castell, Honeycreek, Ligon, and Packsaddle soils. The Castell soils are in positions similar to those of the Katemcy soils and are underlain by gneiss bedrock. The Honeycreek soils have a sandy clay loam subsoil and are also in similar positions. The Ligon soils have an abrupt texture change between the surface layer and the subsoil and are on ridges and side slopes. The Packsaddle soils are on ridges and side slopes, have more than 35 percent by volume coarse fragments in the subsoil, and are underlain by graphitic schist. The included soils make up less than 20 percent of any mapped area.

The Katemcy soil is used as cropland, pasture, or rangeland.

This soil is suited to cropland. The moderate water and wind erosion hazard limit its use as cropland. The low available water capacity and moderately deep root zone are limitations.

Most areas that were once cultivated have been allowed to revert to native grasses and are used as rangeland, or they have been planted to improved grasses and are used as pasture. Most of the native grasses in these areas produce poor quality forage. The low available water capacity and moderately deep root zone are limitations for both pasture and rangeland.

This soil is poorly suited to urban uses. The depth to bedrock and clayey subsoil are severe limitations on sites for sanitary facilities and buildings.

This soil is in capability subclass IIIe and the Red Savannah range site.

KeC—Keese coarse sandy loam, 1 to 8 percent slopes, stony. This shallow, gently sloping to moderately sloping soil is on convex ridgetops and side slopes. This soil has granite or gneiss stones covering about 2 percent of the soil surface. The slopes are concave to convex. Areas are oblong to irregular in shape and range from 15 to 1,000 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 6 inches; dark brown coarse sandy loam that has common granite pebbles

Subsoil:
6 to 12 inches; dark brown coarse sandy loam that has common granite pebbles
12 to 16 inches; strong brown gravelly coarse sandy loam

Substratum:
16 to 20 inches; weathered granite grus

Important soil properties—

Available water capacity: very low
Permeability: moderately rapid
Drainage: well drained
Runoff: 1 to 3 percent slopes—negligible; 3 to 5 percent slopes—very low; 5 to 8 percent slopes—low
Water table: none within a depth of 6 feet
Root zone: shallow
Soil reaction: slightly acid
Shrink-swell potential: low
Water erosion hazard: moderate to severe
Wind erosion hazard: slight

Included with this soil in mapping are small areas of Bauman, Castell, Click, Lou, and Voca soils. Also included are areas of Rock outcrop. The Bauman soils are 40 to 60 inches deep, have a clay loam subsoil, and are along drainageways. The Castell soils are 20 to 40 inches deep, have a clayey subsoil, and are underlain by gneiss bedrock. The Click soils are 40 to 60 inches deep. The

Lou soils are 20 to 40 inches deep. The Click and Lou soils are on foot slopes. The Voca soils are 40 to 60 inches deep, have a clayey subsoil, and are underlain by granite. Rock outcrop is barren or nearly barren granite or gneiss bedrock. Areas of Rock outcrop are less than 5 acres. The included soils make up about 15 percent of any mapped area.

The Keese soil is used as rangeland.

This soil is not suited to cropland or pasture because of the depth to rock, shallow root zone, very low available water capacity, moderate to severe water erosion hazard, and stones on the surface.

This Keese soil is suited to rangeland. The very low available water capacity, depth to rock, shallow root zone, and stones on the soil surface are limitations.

This soil is not suited to urban uses. The depth to rock is a severe limitation on sites for sanitary facilities and buildings.

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

KoC—Keese-Rock outcrop complex, 1 to 8 percent slopes, very stony. This complex consists of shallow, gently sloping to moderately sloping Keese soils and Rock outcrop (fig. 7). A typical area is about 60 percent Keese soils, 34 percent Rock outcrop, and 6 percent other soils. The Keese soil has stones and cobbles covering about 13 percent of the soil surface. Granite boulders are in some areas. Rock outcrop is barren or nearly barren granite or gneiss bedrock. The slopes are concave to convex. Areas are oblong to rounded and range from 50 to 1,000 acres in size.

The typical sequence, depth, and composition of the layers of the Keese soil are—

Surface layer:
0 to 5 inches; dark brown coarse sandy loam

Subsoil:
5 to 10 inches; dark brown coarse sandy loam
10 to 14 inches; strong brown gravelly coarse sandy loam

Substratum:

14 to 16 inches; reddish brown weathered granite grus

Important soil properties—

Available water capacity: very low
Permeability: moderately rapid
Drainage: well drained
Runoff: 1 to 3 percent slopes—very low; 3 to 5 percent slopes—medium; 5 to 8 percent slopes—medium
Water table: none within a depth of 6 feet
Root zone: shallow
Soil reaction: slightly acid
Shrink-swell potential: low
Water erosion hazard: moderate
Wind erosion hazard: slight

Included with this complex in mapping are small areas of Bauman, Click, Lou, and Voca soils. The Bauman soils are 40 to 60 inches deep, have a clay loam subsoil, and are along drainageways. The Click soils are 40 to 60 inches deep. The Lou soils are 20 to 40 inches deep. The Click and Lou soils are on foot slopes. The Voca soils are 40 to 60 inches deep, have a clayey subsoil, and are in the lower positions. The included soils make up about 6 percent of any mapped area.

The Keese-Rock outcrop complex is used as rangeland.

This complex is not suited to cropland or pasture because of the depth to rock, very low available water capacity, shallow root zone, stones on the surface, and rock outcrop.

This complex is suited to rangeland. The very low available water capacity, depth to rock, shallow root zone, and rock outcrop are limitations.

This map unit is not suited to urban uses. The depth to rock and large stones are severe limitations on sites for sanitary facilities and buildings.

The Keese soil is in capability subclass VIIs and the Shallow Granite range site. Rock outcrop is in capability class VIIIs and is not assigned a range site

KoF—Keese-Rock outcrop complex, 12 to 30 percent slopes, very stony. This complex consists of shallow, moderately steep to steep Keese soils and Rock outcrop. A typical area is about 60 percent Keese soils, 30 percent Rock outcrop and large boulders, and 10 percent other soils. The Keese soil has stones covering about 14 percent of the soil surface. Rock outcrop is barren or nearly barren granite or gneiss bedrock. The slopes are linear. Areas are oblong to rounded and range from 50 to 1,000 acres in size.

The typical sequence, depth, and composition of the layers of the Keese soil are—

Surface layer:
0 to 5 inches; brown coarse sandy loam

Subsoil:
5 to 14 inches; strong brown coarse sandy loam

Substratum:
14 to 20 inches; reddish brown weathered granite grus

Important soil properties—

Available water capacity: very low
Permeability: moderately rapid
Drainage: well drained
Runoff: 12 to 20 percent slopes—medium; 20 to 30 percent slopes—high

Figure 7.- An area of Keese-Rock outcrop complex, 1 to 8 percent slopes, very stony. It is in the Shallow Granite range site.

Water table: none within a depth of 6 feet
Root zone: shallow
Soil reaction: slightly acid
Shrink-swell potential: low
Water erosion hazard: severe
Wind erosion hazard: slight

Included with this complex in mapping are small areas of Click and Lou soils. The Click soils are 40 to 60 inches deep. The Lou soils are 20 to 40 inches deep. The Click and Lou soils are on foot slopes. The included soils make up about 10 percent of any mapped areas.

The Keese-Rock outcrop complex is used as rangeland.

This complex is not suited to cropland or pasture because of the steep slopes, depth to rock, very low available water capacity, shallow root zone, severe water erosion hazard, stones on the surface, and rock outcrop.

This map unit is suited to rangeland. The very low available water capacity, steep slopes, depth to rock, shallow root zone, and rock outcrop are limitations.

This complex is not suited to urban uses. The depth to bedrock, large stones, and steep slopes are severe limitations on sites for sanitary facilities and buildings.

The Keese soil is in capability subclass VIIs and the Granite Hill range site. Rock outcrop is in capability class VIIIs and is not assigned a range site.

KrB—Krum silty clay, 1 to 3 percent slopes. This very deep, very gently sloping soil is on broad foot slopes below limestone hills. The slopes are concave to linear. Areas are oblong and range from 25 to 80 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 28 inches; very dark gray silty clay

Subsoil:
28 to 40 inches; grayish brown silty clay
40 to 48 inches; pale brown silty clay that has 5 percent masses and concretions of calcium carbonate
48 to 55 inches; pale brown silty clay loam that has 1 percent masses and concretions of calcium carbonate
55 to 80 inches; light yellowish brown clay loam

Important soil properties—

Available water capacity: high
Permeability: moderately slow
Drainage: well drained
Runoff: very low
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: moderately alkaline
Shrink-swell potential: high
Water erosion hazard: slight
Wind erosion hazard: slight

Included with this soil in mapping are small areas of Luckenbach and Nuvalde soils. The Luckenbach and Nuvalde soils have a brown clay loam surface layer and are in the slightly higher positions. The included soils make up about 15 percent of any mapped area.

The Krum soil is used as cropland, pasture, or rangeland.

This soil is well suited to cropland, pasture, or rangeland.

This soil is poorly suited to most urban uses. The moderately slow permeability and the clayey surface layer are severe limitations on sites for sanitary facilities. The clayey surface layer is a limitation for shallow excavations. The high shrink-swell potential and low strength are severe limitations on sites for buildings and roads.

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

LgC—Ligon fine sandy loam, 1 to 5 percent slopes. This moderately deep, gently sloping soil is on ridges and side slopes. The slopes are convex to linear. Areas are oblong to rounded and range from 15 to 200 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 4 inches; reddish brown fine sandy loam that has common quartz pebbles

Subsoil:
4 to 7 inches; reddish brown clay that has common quartz cobbles
7 to 18 inches; red clay
18 to 23 inches; red sandy clay loam that has common fragments of weathered schist

Substratum:
23 to 32 inches; reddish brown weathered schist
32 to 51 inches; tilted, weakly cemented schist bedrock

Important soil properties—

Available water capacity: low
Permeability: moderately slow
Drainage: well drained
Runoff: 1 to 3 percent slopes—very low; 3 to 5 percent slopes—low
Water table: none within a depth of 6 feet
Root zone: moderately deep
Soil reaction: slightly acid in the surface layer and slightly acid to neutral in the subsoil
Shrink-swell potential: low in the surface layer and moderate in the subsoil
Water erosion hazard: moderate
Wind erosion hazard: slight

Included with this soil in mapping are small areas of Honeycreek, Katemcy, and Packsaddle soils. The Honeycreek soils are 40 to 60 inches deep, have a sandy clay loam subsoil, and are on foot slopes. The Katemcy soils do not have an abrupt texture change between the surface layer and the subsoil, and they are on foot slopes. The Packsaddle soils are on ridges and side slopes, and they are underlain by graphitic schist bedrock. Also included are small areas of Ligon cobbly fine sandy loam. The included soils make up less than 10 percent of any mapped area.

The Ligon soil is used as cropland, pasture, or rangeland.

This soil is poorly suited to cropland. The moderate water erosion hazard limits its use as cropland. The depth to rock, low available water capacity, and moderately deep root zone are limitations.

This soil is suited to pasture and rangeland. The depth to rock, low available water capacity, and moderately deep root zone are limitations.

This Ligon soil is poorly suited to urban uses. The depth

to rock is a severe limitation on sites for sanitary facilities. The depth to rock and moderate shrink-swell potential are severe limitations on sites for buildings and roads.

This soil is in capability subclass IVs and the Red Savannah range site.

LgD—Ligon cobbly fine sandy loam, 5 to 12 percent slopes. This moderately deep, moderately sloping to strongly sloping soil is on convex ridges and side slopes. The slopes are concave to convex. Areas are oblong to rounded and range from 15 to 200 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 3 inches; strong brown cobbly fine sandy loam

Subsoil:
3 to 16 inches; reddish brown clay that has 10 percent quartz cobbles
16 to 26 inches; reddish brown sandy clay loam that has 10 percent quartz cobbles

Substratum:
26 to 30 inches; weathered, weakly consolidated schist
30 to 60 inches; tilted schist bedrock

Important soil properties—

Available water capacity: low
Permeability: moderately slow
Drainage: well drained
Runoff: medium
Water table: none within a depth of 6 feet
Root zone: moderately deep
Soil reaction: slightly acid in the surface layer and slightly acid to neutral in the subsoil
Shrink-swell potential: low in the surface layer and moderate in the subsoil
Water erosion hazard: moderate
Wind erosion hazard: moderate

Included with this soil in mapping are small areas of Honeycreek, Katemcy, and Packsaddle soils. The Honeycreek soils are 40 to 60 inches deep, have a sandy clay loam subsoil, and are on foot slopes. The Katemcy soils are on foot slopes. The Packsaddle soils are on ridges and side slopes, and they are underlain by graphitic schist bedrock. Also included are small areas of Ligon fine sandy loam. These included soils make up less than 15 percent of any mapped area.

The Ligon soil is used as rangeland.

This soil is not suited to cropland or pasture because of the slope, low available water capacity, and quartz cobbles on the surface.

This soil is suited to rangeland. The low available water capacity, slope, and moderately deep root zone are limitations.

This Ligon soil is poorly suited to most urban uses. The depth to rock and slope are severe limitations on sites for sanitary facilities. The moderate shrink-swell potential, depth to rock, low strength, and slope are limitations on sites for buildings and roads.

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

LkB—Loneoak sand, 0 to 3 percent slopes. This deep, nearly level to very gently sloping soil is on foot slopes. The slopes are concave to linear. Areas are oblong to rounded and range from 15 to 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 5 inches; yellowish brown sand

Subsurface layer:
5 to 15 inches; light yellowish brown loamy sand
15 to 21 inches; brown loamy sand
21 to 28 inches; very pale brown loamy sand

Subsoil:
28 to 41 inches; light yellowish brown sandy clay that has yellowish brown and grayish brown mottles
41 to 50 inches; yellowish brown sandy clay loam that has yellowish brown, grayish brown, and light gray mottles
50 to 57 inches; brownish yellow sandy clay loam that has light brownish gray and light gray mottles

Substratum:
57 to 64 inches; weakly cemented sandstone bedrock

Important soil properties—

Available water capacity: moderate
Permeability: slow
Drainage: moderately well drained
Runoff: 0 to 1 percent slopes—low; 1 to 3 percent slopes—medium
Water table: none within a depth of 6 feet; however, a temporary perched water table may occur for short periods following heavy rainfall
Root zone: deep
Soil reaction: slightly acid or neutral in the surface layer and slightly alkaline in the subsoil
Shrink-swell potential: low in the surface layer and moderate in the subsoil
Water erosion hazard: moderate
Wind erosion hazard: severe

Included with this soil in mapping are small areas of Castell, Campair, and Matilo soils. Also included are areas of soils that are similar to Loneoak but are

underlain by gneiss bedrock. The Castell soils are 20 to 40 inches deep, have a sandy loam surface layer, and are underlain by gneiss bedrock. The Campair soils are 20 to 40 inches deep, have a sandy surface layer 10 to 20 inches thick, and are in the higher positions. The Matilo soils have a surface layer more than 40 inches thick. The included soils make up less than 15 percent of any mapped area.

The Loneoak soil is used as cropland, pasture, or rangeland.

This soil is suited to cropland. The severe wind erosion hazard and moderate water erosion hazard limit its use as cropland. The moderate available water capacity is a limitation.

This soil is suited to pasture. The moderate available water capacity is a limitation. The severe wind erosion hazard is a concern during establishment of improved grasses.

This Loneoak soil is suited to rangeland. The moderate available water capacity is a limitation.

This soil is poorly suited to urban uses. The slow permeability and the seasonally perched water table are severe limitations on sites for sanitary facilities. The depth to rock, moderate shrink-swell potential, and low strength are limitations on sites for buildings and roads. Shallow excavations need to be shored to prevent cave-ins.

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

LoB—Lou coarse sandy loam, 1 to 5 percent slopes. This moderately deep, gently sloping soil is on ridges and side slopes. The slopes are concave to convex. Areas are irregular in shape and range from 20 to 500 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 7 inches; brown coarse sandy loam

Subsurface layer:
7 to 12 inches; brown gravelly coarse sandy loam

Subsoil:
12 to 20 inches; reddish brown gravelly coarse sandy loam
20 to 38 inches; yellowish red gravelly sandy clay loam

Substratum:
38 to 75 inches; finely fragmented granite grus that has fragments coated with red clay

Important soil properties—

Available water capacity: low
Permeability: moderate
Drainage: well drained
Runoff: 1 to 3 percent slopes—very low; 3 to 5 percent slopes—low
Water table: none within a depth of 6 feet
Root zone: moderately deep
Soil reaction: neutral
Shrink-swell potential: low
Water erosion hazard: moderate
Wind erosion hazard: moderate

Included with this soil in mapping are small areas of Click, Keese, and Voca soils. The Click soils contain more gravel in the subsoil and are in positions similar to those of the Lou soils. The Keese soils are loamy, less than 20 inches deep, and are on slightly higher convex ridges. The Voca soils have a clayey subsoil and are on nearly level to gently sloping areas that have plane surfaces. The included soils make up less than 15 percent of any mapped area.

The Lou soil is used as cropland, pasture, or rangeland.

This soil is suited to cropland. The moderate water erosion hazard and moderate wind erosion hazard limit its use as cropland. The low available water capacity and moderately deep root zone are limitations.

This soil is suited to pasture and rangeland. The low available water capacity and moderately deep root zone are limitations (fig. 8).

This Lou soil is poorly suited to most urban uses. The depth to rock is a severe limitation on sites for sanitary facilities. The depth to rock and slope are limitations on sites for buildings.

This soil is in capability subclass IIIe and the Granite Gravel range site.

LuB—Luckenbach clay loam, 0 to 3 percent slopes. This very deep, nearly level to very gently sloping soil is on broad foot slopes below limestone hills and on terraces. The slopes are linear to convex. Areas are irregular in shape and range from 15 to 300 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 9 inches; very dark grayish brown clay loam

Subsoil:
9 to 25 inches; brown clay
25 to 39 inches; yellowish brown clay that has many concretions of calcium carbonate
39 to 64 inches; strong brown clay loam

Important soil properties—

Available water capacity: high
Permeability: moderately slow

Figure 8.- Rangeland in an area of Lou coarse sandy loam, 1 to 5 percent slopes. It is in the Granite Gravel range site.

Drainage: well drained
Runoff: 0 to 1 percent slopes—negligible; 1 to 3 percent slopes—very low
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: neutral in the surface layer and slightly alkaline and moderately alkaline in the subsoil
Shrink-swell potential: low in the surface and moderate in the subsoil
Water erosion hazard: slight to moderate
Wind erosion hazard: slight

Included with this soil in mapping are small areas of Krum and Nuvalde soils. The Krum soils have a very dark gray silty clay surface layer, and they are on foot slopes. The Nuvalde soils are clay loam throughout and are in similar positions. The Krum and Nuvalde soils are moderately alkaline throughout. The included soils make up less than 15 percent of any mapped area.

The Luckenbach soil is used as cropland, pasture, or rangeland.

This soil is well suited to cropland (fig. 9). The slight to moderate water erosion hazard can limit its use as cropland.

This soil is well suited to pasture and rangeland.

This Luckenbach soil is suited to most urban uses. The moderately slow permeability and clayey subsoil are severe limitations on sites for sanitary facilities. The moderate shrink-swell potential and clayey subsoil are limitations on sites for buildings. Low strength is a severe limitation on sites for local roads and streets.

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

MaC—Matilo sand, 1 to 5 percent slopes. This very deep, gently sloping soil is on foot slopes of sandstone hills and ridges. The slopes are linear to convex. Areas are oblong and range from 40 to 200 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 18 inches; pale brown sand

Subsurface layer:
18 to 40 inches; very pale brown sand
40 to 45 inches; white sand

Subsoil:
45 to 56 inches; light gray sandy clay loam that has yellowish red, yellowish brown, and yellow mottles
56 to 71 inches; mottled light gray, yellowish brown, and yellowish red sandy clay loam

Substratum:
71 to 73 inches; weakly cemented sandstone bedrock

Important soil properties—

Available water capacity: low
Permeability: moderate
Drainage: well drained
Runoff: 1 to 3 percent slopes—very low; 3 to 5 percent slopes—low
Water table: a perched water table may occur for brief periods at a depth of 4 to 6 feet following heavy rains during winter and spring months
Root zone: very deep

Figure 9.- A vineyard in an area of Luckenbach clay loam, 0 to 3 percent slopes.

Soil reaction: slightly acid in the surface layer and moderately acid in the subsoil
Shrink-swell potential: low
Water erosion hazard: slight
Wind erosion hazard: severe

Included with this soil in mapping are small areas of Campair and Loneoak soils. The Campair soils are 20 to 40 inches deep to bedrock and are in similar positions. The Loneoak soils are 40 to 60 inches deep to bedrock. The included soils make up less than 15 percent of any mapped area.

The Matilo soil is used for cropland, pasture, and rangeland.

This soil is suited to cropland. The severe wind erosion hazard limits its use as cropland. The low available water capacity is a limitation.

This soil is suited to pasture and rangeland. The low available water capacity is a limitation. The severe wind erosion hazard is a concern during establishment of improved grasses.

This Matilo soil is poorly suited to urban uses. Seepage is a severe limitation on sites for sanitary facilities. The seasonal wetness is a limitation on sites for buildings. Shallow excavations need to be shored to prevent cave-ins.

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

NeF—Nebgen-Rock outcrop complex, 5 to 30 percent slopes, extremely stony. This complex consists of very shallow or shallow Nebgen soils and Rock outcrop. A typical area is 76 percent Nebgen soils, 14 percent Rock outcrop, and 10 percent other soils. The Nebgen soil has stones covering about 20 percent of the soil surface. Rock outcrop is barren or nearly barren sandstone bedrock. The slopes are concave to convex. Areas are round and range from 10 to 600 acres in size.

The typical sequence, depth, and composition of the layers of the Nebgen soil are—

Surface layer:
0 to 11 inches; dark brown sandy loam

Substratum:
11 to 15 inches; reddish brown indurated sandstone bedrock

Important soil properties—

Available water capacity: very low
Permeability: moderately rapid
Drainage: well drained
Runoff: 5 to 20 percent slopes—medium; 20 to 30 percent slopes—high
Water table: none within a depth of 6 feet
Root zone: very shallow to shallow
Soil reaction: slightly acid
Shrink-swell potential: low
Water erosion hazard: severe
Wind erosion hazard: slight

Included with this complex in mapping are small areas of Oben and Yates soils. The Oben soils have a sandy clay loam subsoil and are in positions similar to those of the Nebgen soils. The Yates soils are underlain by limestone bedrock. The included soils make up 10 percent of any mapped area.

The Nebgen-Rock outcrop complex is used as rangeland.

This complex is not suited to cropland or pasture because of the slope, depth to rock, very low available water capacity, very shallow to shallow root zone, severe water erosion hazard, surface stones, and rock outcrop.

This map unit is suited to rangeland. The slope, depth to rock, shallow root zone, very low available water capacity, and rock outcrop are limitations.

This complex is not suited to urban uses. The slope, depth to rock, seepage, and large stones are severe limitations on sites for sanitary facilities. The depth to rock, large stones, and slope are severe limitations on sites for buildings.

The Nebgen soil is in capability subclass VIIs and the Sandstone Hill range site. Rock outcrop is in capability class VIIIs and is not assigned a range site.

NuB—Nuvalde clay loam, 0 to 3 percent slopes. This very deep, nearly level to very gently sloping soil is on broad toe slopes below limestone hills and on terraces. The slopes are linear. Areas are long and narrow and range from 10 to 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 14 inches; dark brown clay loam

Subsoil:
14 to 21 inches; dark brown clay loam
21 to 34 inches; brown clay loam that has common concretions of calcium carbonate
34 to 39 inches; yellowish brown clay loam that has common concretions of calcium carbonate
39 to 65 inches; dark brown clay loam that has many masses and concretions of calcium carbonate

Important soil properties—

Available water capacity: high
Permeability: moderate

Drainage: well drained
Runoff: 0 to 1 percent slopes—negligible; 1 to 3 percent slopes—very low
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: moderately alkaline
Shrink-swell potential: high in the surface layer and moderate to high in the subsoil
Water erosion hazard: moderate
Wind erosion hazard: slight

Included with this soil in mapping are small areas of Cho, Krum, Luckenbach, and Venus soils. The Cho soils are shallow to an indurated caliche layer. The Krum soils have a very dark gray silty clay surface layer and are on gently sloping foot slopes. The Luckenbach soils have a clayey subsoil and are in positions similar to those of the Nuvalde soils. The Venus soils have less clay, less calcium carbonate, and are also in similar positions. The included soils make up about 10 percent of any mapped area.

The Nuvalde soil is used as cropland, pasture, and rangeland.

This soil is well suited to cropland. The moderate water erosion hazard limits its use as cropland.

This soil is well suited to pasture or rangeland.

This Nuvalde soil is well suited to most urban uses. The slow percolation rate and seepage are limitations on sites for most sanitary facilities. The shrink-swell potential is a severe limitation on sites for most buildings.

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

ObC—Oben sandy loam, 1 to 5 percent slopes, stony. This shallow, gently sloping soil is on broad ridgetops. This soil has stones covering about 2 percent of the soil surface. The slopes are convex and mostly range from 3 to 5 percent. Areas are round and range from 20 to 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 7 inches; reddish brown sandy loam

Subsoil:
7 to 18 inches; reddish brown sandy clay loam

Substratum:
18 to 24 inches; reddish brown weakly cemented sandstone bedrock

Important soil properties—

Available water capacity: very low
Permeability: moderate
Drainage: well drained
Runoff: 1 to 3 percent slopes—very low; 3 to 5 percent slopes—low
Water table: none within a depth of 6 feet
Root zone: shallow
Soil reaction: neutral
Shrink-swell potential: low
Water erosion hazard: moderate
Wind erosion hazard: moderate

Included with this soil in mapping are small areas of Hye, Nebgen, and Pontotoc soils. The Hye soils are 20 to 40 inches deep. The Nebgen soils do not have a sandy clay loam subsoil. The Pontotoc soils are deeper than 60 inches. The included soils make up about 15 percent of the unit.

The Oben soil is used as rangeland.

This soil is not suited to cropland or pasture because of the depth to rock, very low available water capacity, moderate water and wind erosion hazards, and stones on the surface.

This Oben soil is suited to rangeland. The very low available water capacity, shallow root zone, depth to rock, and stones on the surface are limitations.

This soil is not suited to urban uses. The depth to rock is a severe limitation on sites for sanitary facilities and buildings.

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

OpC—Oplin-Rock outcrop complex, 1 to 8 percent slopes, stony. This complex consists of very shallow and shallow Oplin soils and Rock outcrop. A typical area is about 75 percent Oplin soils, 17 percent Rock outcrop and large boulders, and 8 percent other soils. The Oplin soil has stones and cobbles covering about 2 percent of the soil surface. Rock outcrop is barren or nearly barren limestone bedrock. The slopes are concave to convex. Areas are round and range from 25 to 200 acres in size.

The typical sequence, depth, and composition of the layers of the Oplin soil are—

Surface layer:
0 to 5 inches; brown very cobbly clay loam

Subsurface layer:
5 to 10 inches; dark brown very cobbly clay loam

Substratum:
10 to 12 inches; coarsely fractured and indurated limestone

Important soil properties—

Available water capacity: very low
Permeability: moderate
Drainage: well drained
Runoff: Oplin, 1 to 3 percent slopes—very low; 3 to 5

percent slopes—low; 5 to 8 percent slopes—medium; Rock outcrop, very high
Water table: none within a depth of 6 feet
Root zone: very shallow and shallow
Soil reaction: moderately alkaline
Shrink-swell potential: low
Water erosion hazard: severe
Wind erosion hazard: slight

Included with this complex in mapping are small areas of Real and Yates soils. The Real soils are underlain by soft limestone. The Yates soils are redder and are in the slightly lower parts of the landscape. The included soils make up about 8 percent of any mapped area.

The Oplin-Rock outcrop complex is used as rangeland.

This complex is not suited to cropland or pasture because of the depth to rock, very low available water capacity, very shallow and shallow root zone, stones on the surface, severe water erosion hazard, and rock outcrop.

This complex is suited to rangeland. The very low available water capacity, depth to rock, very shallow and shallow root zone, and rock outcrop are limitations.

This map unit is not suited to urban uses. The depth to rock and large stones are severe limitations on sites for sanitary facilities. The depth to rock is a severe limitation on sites for buildings.

The Oplin soil is in capability subclass VIIs and the Low Stony Hill range site. Rock outcrop is in capability class VIIIs and is not assigned a range site.

OpF—Oplin-Rock outcrop complex, 8 to 40 percent slopes, stony. This complex consists of very shallow and shallow Oplin soils and Rock outcrop. A typical area is about 66 percent Oplin soils, 24 percent Rock outcrop and large boulders, and 10 percent other soils. The Oplin soil has stones and cobbles covering about 3 percent of the soil surface. Rock outcrop is barren or nearly barren limestone bedrock. The slopes are concave to convex. Areas are long and narrow and range from 25 to 200 acres in size.

The typical sequence, depth, and composition of the layers of the Oplin soil are—

Surface layer:
0 to 10 inches; very dark grayish brown very cobbly clay loam

Substratum:
10 to 20 inches; fractured and indurated limestone bedrock

Important soil properties—

Available water capacity: very low
Permeability: moderate
Drainage: well drained
Runoff: Oplin, 8 to 20 percent slopes—medium; 20 to 40 percent slopes—high; Rock outcrop, very high
Water table: none within a depth of 6 feet
Root zone: very shallow and shallow
Soil reaction: moderately alkaline
Shrink-swell potential: low
Water erosion hazard: severe
Wind erosion hazard: slight

Included with this complex in mapping are small areas of Real and Yates soils. The Real soils are underlain by soft limestone. The Yates soils are redder and are in the slightly lower parts of the landscape. The included soils make up about 10 percent of any mapped area.

The Oplin-Rock outcrop complex is used as rangeland.

This unit is not suited to cropland or pasture because of the slope, depth to rock, very low available water capacity, very shallow and shallow root zone, stones on the surface, severe water erosion hazard, and rock outcrop.

This complex is suited to rangeland. The very low available water capacity, slope, very shallow and shallow root zone, and rock outcrop are limitations.

This complex is not suited to urban uses. The depth to rock, stones, and slope are severe limitations on sites for sanitary facilities. The depth to rock and slope are severe limitations on sites for buildings.

The Oplin soil is in capability subclass VIIs and the Steep Rocky range site. Rock outcrop is in capability class VIIIs and is not assigned a range site.

PaC—Packsaddle channery loam, 3 to 8 percent slopes. This moderately deep, gently sloping to moderately sloping soil is on convex ridges and side slopes. The slopes are convex to linear. Areas are oblong to rounded and range from 15 to 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 6 inches; very dark gray channery loam

Subsoil:
6 to 28 inches; very dark gray very channery clay loam

Substratum:
28 to 36 inches; black, tilted graphitic schist bedrock

Important soil properties—

Available water capacity: very low
Permeability: moderately slow
Drainage: well drained
Runoff: 3 to 5 percent slopes—low; 5 to 8 percent slopes—medium
Water table: none within a depth of 6 feet
Root zone: moderately deep
Soil reaction: neutral
Shrink-swell potential: low
Water erosion hazard: severe
Wind erosion hazard: slight

Included with this soil in mapping are small areas of Katemcy and Ligon soils. The Katemcy soils have a clayey subsoil and are on foot slopes. The Ligon soils have a red clayey subsoil and are in positions similar to those of the Packsaddle soils. Also, the Katemcy and Ligon soils have less than 35 percent by volume coarse fragments in the subsoil. The included soils make up less than 20 percent of any mapped area.

The Packsaddle soil is used as pasture and rangeland.

This soil is not suited to cropland because of the severe water erosion hazard, slope, and channers on the surface.

This soil is suited to pasture and rangeland. The very low available water capacity and moderately deep root zone are limitations.

This Packsaddle soil is poorly suited to most urban uses. The depth to rock and slope are severe limitations on sites for sanitary facilities. The depth to rock and slope are limitations on sites for buildings.

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

PeB—Pedernales fine sandy loam, 1 to 3 percent slopes. This very deep, very gently sloping soil is on uplands. The slopes are linear. Areas are round and range from 25 to 80 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 7 inches; dark brown fine sandy loam

Subsoil:
7 to 18 inches; reddish brown sandy clay
18 to 38 inches; yellowish red sandy clay
38 to 55 inches; yellowish red sandy clay that has common concretions of calcium carbonate
55 to 65 inches; reddish brown sandy clay that has common masses and concretions of calcium carbonate

Substratum:
65 to 80 inches; reddish brown weakly cemented sandstone with sandy clay loam texture

Important soil properties—

Available water capacity: high
Permeability: moderately slow
Drainage: well drained
Runoff: very low
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: neutral in the surface layer and slightly alkaline to moderately alkaline in the subsoil
Shrink-swell potential: low in the surface layer and moderate in the subsoil
Water erosion hazard: moderate
Wind erosion hazard: moderate

Included with this soil in mapping are small areas of Krum, Luckenbach, and Nuvalde soils. These soils have a clay loam or silty clay surface layer and are on foot slopes. The included soils make up less than 15 percent of any mapped area.

The Pedernales soil is used as cropland, pasture, or rangeland.

This soil is suited to cropland. The moderate water and wind erosion hazards limit its use as cropland.

This Pedernales soil is well suited to pasture or rangeland.

This soil is suited to urban uses. The moderately slow permeability rate and clayey subsoil are severe limitations on sites for some sanitary facilities. The moderate shrink-swell potential is a limitation on sites for buildings.

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

PoC—Pontotoc fine sandy loam, 1 to 5 percent slopes. This very deep, gently sloping soil is on foot slopes. The slopes are linear to convex. Areas are rounded to oblong and range from 20 to 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 19 inches; reddish brown fine sandy loam

Subsoil:
19 to 32 inches; dark reddish brown fine sandy loam
32 to 43 inches; dark red sandy clay loam
43 to 65 inches; red sandy clay loam

Substratum:
65 to 72 inches; red weakly cemented sandstone bedrock

Important soil properties—

Available water capacity: high
Permeability: moderate
Drainage: well drained
Runoff: 1 to 3 percent slopes—very low; 3 to 5 percent slopes—low
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: slightly acid
Shrink-swell potential: low
Water erosion hazard: moderate
Wind erosion hazard: moderate

Included with this soil in mapping are small areas of Hye, Nebgen, and Oben soils. The Hye soils are 20 to 40 inches deep and are in positions similar to those of the Pontotoc soils. The Nebgen and Oben soils are less than 20 inches deep and are on small ridges. The included soils make up less than 15 percent of any mapped area.

The Pontotoc soil is used as cropland, pasture, or rangeland.

This soil is well suited to cropland. It has moderate water and wind erosion hazards that limit its use as cropland.

This soil is well suited to pasture or rangeland.

This Pontotoc soil is well suited to urban uses. Excess seepage because of the moderate permeability is a limitation on sites for some sanitary facilities.

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

ReC—Real gravelly loam, 1 to 8 percent slopes. This very shallow and shallow, gently sloping to moderately sloping soil is on hilltops. The slopes are concave to convex. Areas are round and range from 25 to 200 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 8 inches; dark grayish brown gravelly loam

Subsurface layer:
8 to 15 inches; grayish brown extremely gravelly loam

Substratum:
15 to 17 inches; white strongly cemented caliche, indurated with 0.5-inch laminar cap
17 to 22 inches; soft white limestone bedrock

Important soil properties—

Available water capacity: very low
Permeability: moderate
Drainage: well drained
Runoff: 1 to 3 percent slopes—very low; 3 to 5 percent slopes—low; 5 to 8 percent slopes—medium
Water table: none within a depth of 6 feet
Root zone: very shallow and shallow
Soil reaction: moderately alkaline
Shrink-swell potential: low
Water erosion hazard: severe
Wind erosion hazard: slight

Included with this soil in mapping are small areas of Oplin and Yates soils. The Oplin soils are underlain by hard limestone and are in the slightly lower positions. The Yates soils are redder, underlain by hard limestone, and are in positions similar to those of the Real soils. The included soils make up about 10 percent of any mapped area.

The Real soil is used as rangeland.

This soil is not suited to cropland or pasture because of the depth to rock, very low available water capacity, very shallow and shallow root zone, and severe water erosion hazard.

This soil is suited to rangeland. The very low available water capacity, depth to rock, and very shallow and shallow root zone are limitations.

This Real soil is not suited to urban uses. The depth to rock is a severe limitation on sites for sanitary facilities and buildings.

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

ReG—Real gravelly loam, 20 to 40 percent slopes. This very shallow and shallow, steep soil is on escarpments. The slopes are linear. Areas are long and narrow and range from 25 to 200 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 4 inches; dark grayish brown gravelly loam

Subsurface layer:
4 to 12 inches; grayish brown extremely gravelly loam

Substratum:
12 to 14 inches; white, strongly cemented caliche with laminar cap thinner than 0.25 inch
14 to 20 inches; white and pale yellow weathered soft limestone

Important soil properties—

Available water capacity: very low
Permeability: moderate
Drainage: well drained
Runoff: very high

Water table: none within a depth of 6 feet
Root zone: very shallow and shallow
Soil reaction: moderately alkaline
Shrink-swell potential: low
Water erosion hazard: severe
Wind erosion hazard: slight

Included with this soil in mapping are small areas of Oplin and Yates soils. The Oplin soils are underlain by hard limestone and are in the slightly lower positions. The Yates soils are reddish brown and are underlain by hard limestone. The included soils make up about 15 percent of any mapped area.

The Real soil is used as rangeland.

This soil is not suited to cropland or pasture because of the slope, depth to rock, very low available water capacity, very shallow and shallow root zone, and severe water erosion hazard.

This soil is suited to rangeland. The very low available water capacity, slope, depth to rock, and very shallow and shallow root zone are limitations.

This Real soil is not suited to urban uses. The slope and depth to rock are severe limitations on sites for sanitary facilities and buildings.

This soil is in capability subclass VIIs and the Steep Adobe range site.

Rh—Riverwash, frequently flooded. This unit consists of nearly level streambeds and channels of the larger streams within Llano County (fig. 10). Areas are barren and are sandy, gravelly, and cobbly alluvium. The alluvial deposits are unstable and, because of frequent flooding, they are constantly being reworked. These areas have little or no agricultural value because of the frequent flooding.

This miscellaneous unit is in capability subclass Vw and is not assigned a range site.

Rk—Riverwash-Rock outcrop complex, frequently flooded. This unit consists of the nearly level streambed and channel of the Llano River. Areas are barren and are sandy, gravelly, and cobbly lag alluvium intermixed with granite gneiss and schist rock outcrops. The alluvial deposits are unstable and, because of frequent flooding, are constantly being reworked. A typical area is 86 percent Riverwash and 14 percent Rock outcrop. Water flows almost continuously over about 15 percent of this unit.

These areas have little or no agricultural value because of frequent flooding.

The Riverwash unit is in capability subclass Vw, and the Rock outcrop is in capability class VIIIs. Neither of these miscellaneous units is assigned a range site.

Ro—Rock outcrop, granite. This unit consists of extrusions or hills of exposed granite or gneiss bedrock (fig. 11). Areas are rounded to oblong, and they are gently sloping to steep. These areas are 10 to 400 feet higher than the surrounding countryside and are almost barren of vegetation. Various lichens and mosses are the most plentiful plants. Less than 5 percent of this unit supports vegetation which is in small depressions and cracks in the rock. Typically, the rock is pink or gray granite or pink or brown gneiss bedrock. A few of these areas contain pits or quarries used for mining granite. Enchanted Rock, south of Llano on Farm Road 965, is an example of a granite outcrop.

This miscellaneous unit is in capability class VIIIs and is not assigned a range site.

RrC—Roughcreek-Rock outcrop complex, 1 to 8 percent slopes, very stony. This complex consists of shallow, gently sloping to moderately sloping Roughcreek soils and Rock outcrop. A typical area is about 76 percent Roughcreek soils, 10 percent Rock outcrop and large boulders, and 14 percent other soils. The Roughcreek soil has stones and cobbles covering about 15 percent of the soil surface. Rock outcrop is barren or nearly barren limestone bedrock. The slopes are convex. Areas are irregular in shape and range from 20 to 200 acres in size.

The typical sequence, depth, and composition of the layers of the Roughcreek soil are—

Surface layer:
0 to 5 inches; dark brown very stony clay loam

Subsoil:
5 to 16 inches; reddish brown very cobbly clay

Substratum:
16 to 20 inches; fractured dolomitic limestone

Important soil properties—

Available water capacity: very low
Permeability: slow
Drainage: well drained
Runoff: Roughcreek, 1 to 3 percent slopes—medium; 3 to 5 percent slopes—high; 5 to 8 percent slopes—very high; Rock outcrop, very high
Water table: none within a depth of 6 feet
Root zone: shallow
Soil reaction: neutral
Shrink-swell potential: high
Water erosion hazard: severe
Wind erosion hazard: slight

Included with this complex in mapping are small areas of Eckrant and Rumple soils. The Eckrant soils are in positions similar to those of the Roughcreek soils, but they do not have a reddish brown, clayey subsoil. The Rumple soils are 20 to 40 inches deep and are in the flatter landscape positions. The

Figure 10- An area of Riverwash, frequently flooded, along the Llano River.

included soils make up about 15 percent of any mapped area.

The Roughcreek-Rock outcrop complex is used as rangeland.

This complex is not suited to cropland or pasture because of the depth to rock, very low available water capacity, shallow root zone, stones on the surface, and severe water erosion hazard.

This complex is suited to rangeland. The depth to rock, shallow root zone, very low available water capacity, and stones are limitations.

This map unit is not suited to most urban uses. The depth to rock is a severe limitation on sites for sanitary facilities. The depth to rock and high shrink-swell potential are severe limitations on sites for buildings.

The Roughcreek soil is in capability subclass VIs and the Redland range site. Rock outcrop is in capability class VIIIs and is not assigned a range site.

RrF—Roughcreek-Rock outcrop complex, 8 to 40 percent slopes, very stony. This complex consists of shallow, strongly sloping to steep Roughcreek soils and Rock outcrop on shoulder slopes. A typical area is about 75 percent Roughcreek, 15 percent Rock outcrop and large boulders, and 10 percent other soils. The Roughcreek soil has stones and cobbles

covering about 12 percent of the soil surface. Rock outcrop is barren or nearly barren limestone bedrock. The slopes are convex to linear. Areas are long and narrow and range from 20 to 200 acres in size.

The typical sequence, depth, and composition of the layers of the Roughcreek soil are—

Surface layer:
0 to 6 inches; dark brown very stony clay loam

Subsoil:
6 to 15 inches; reddish brown very cobbly clay

Substratum:
15 to 20 inches; fractured dolomitic limestone

Important soil properties—

Available water capacity: very low
Permeability: slow
Drainage: well drained
Runoff: very high
Water table: none within a depth of 6 feet
Root zone: shallow
Soil reaction: neutral
Shrink-swell potential: high
Water erosion hazard: severe
Wind erosion hazard: slight

Included with this complex in mapping are small areas of Eckrant soils. The Eckrant soils are in positions similar to those of the Roughcreek soils, but they do not have a reddish brown, clayey subsoil. The included soils make up about 15 percent of any mapped area.

The Roughcreek-Rock outcrop complex is used as rangeland.

This complex is not suited to cropland or pasture because of the slope, depth to rock, severe water erosion hazard, very low available water capacity, shallow root zone, stones on the surface, and rock outcrop.

This complex is suited to rangeland. The slope, stones on the surface, rock outcrop, depth to rock, very low

Figure 11.—An area of Rock outcrop, granite, that is a dominate feature of the landscape.

available water capacity, and shallow root zone are limitations.

This map unit is not suited to most urban uses. The depth to rock, slope, and stones are severe limitations on sites for sanitary facilities. The depth to rock, slope, stones, and high shrink-swell potential are severe limitations on sites for buildings.

The Roughcreek soil is in capability subclass VIs and the Steep Redland range site. Rock outcrop is in capability class VIIIs and is not assigned a range site.

RuC—Rumple gravelly clay loam, 1 to 5 percent slopes. This moderately deep, gently sloping soil is on plateaus. The slopes are concave to convex. Areas are oblong and range from 100 to 600 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 8 inches; reddish brown gravelly clay loam

Subsoil:
8 to 16 inches; red very gravelly clay
16 to 24 inches; reddish brown very gravelly clay

Substratum:
24 to 27 inches; white and gray fractured and indurated limestone bedrock

Important soil properties—

Available water capacity: very low
Permeability: moderately slow
Drainage: well drained
Runoff: 1 to 3 percent slopes—low; 3 to 5 percent slopes—medium
Water table: none within a depth of 6 feet
Root zone: moderately deep
Soil reaction: neutral
Shrink-swell potential: moderate
Water erosion hazard: moderate
Wind erosion hazard: slight

Included with this soil in mapping are small areas of Eckrant and Roughcreek soils. The Eckrant soils are less than 20 inches deep, and they are in the low positions on the landscape. The Roughcreek soils are less than 20 inches deep, and they are on ridge shoulders and escarpments. The included soils make up about 10 percent of any mapped area.

The Rumple soil is used as pasture and rangeland.

This soil is not suited to cropland because of the small stones on the surface, very low available water capacity, and moderate water erosion hazard.

This soil is suited to pasture and rangeland. The small stones on the surface, moderately deep root zone, and very low available water capacity are limitations.

This Rumple soil is not suited to urban uses. The depth to rock and moderately slow permeability are severe limitations on sites for sanitary facilities. The depth to rock and moderate shrink-swell potential are severe limitations on sites for buildings.

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

VeA—Venus loam, 0 to 2 percent slopes. This very deep, nearly level soil is on terraces along the Llano River and in valley fill positions. The slopes are linear to concave. Areas are long and narrow and range from 10 to 50 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 15 inches; dark grayish brown loam

Subsoil:
15 to 28 inches; brown clay loam that has common films and threads of calcium carbonate
28 to 54 inches; pale brown loam
54 to 62 inches; very pale brown loam

Important soil properties—

Available water capacity: high
Permeability: moderate
Drainage: well drained
Runoff: very low
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: moderately alkaline
Shrink-swell potential: low
Water erosion hazard: slight
Wind erosion hazard: slight

Included with this soil in mapping are small areas of Boerne soils. The Boerne soils are fine sandy loam throughout and are in similar positions. The included soils make up less than 15 percent of any mapped area.

The Venus soil is used as cropland, pasture, or rangeland.

This soil is well suited to cropland, pasture, or rangeland.

This soil is suited to most urban uses. The moderate permeability and seepage are limitations on sites for sanitary facilities.

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

Vn—Venus loam, occasionally flooded. This very deep, nearly level soil is on flood plains of streams below limestone hills. The slopes are linear. Areas are long and narrow and range from 10 to 50 acres in size. Areas are flooded about once in 15 years.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 18 inches; dark grayish brown loam

Subsoil:
18 to 46 inches; brown clay loam that has common films and threads of calcium carbonate
46 to 62 inches; reddish yellow loam

Important soil properties—

Available water capacity: high
Permeability: moderate
Drainage: well drained
Runoff: very low
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: moderately alkaline
Shrink-swell potential: low
Water erosion hazard: slight
Wind erosion hazard: slight

Included with this soil in mapping are small areas of Fieldcreek soils. The Fieldcreek soils have less than 18 percent clay throughout. The included soils make up less than 15 percent of any mapped area.

The Venus soil is used as cropland, pasture, or rangeland.

This soil is well suited to cropland. Occasional flooding may damage cultivated crops in some years.

This soil is well suited to rangeland or pasture.

This Venus soil is not suited to urban uses. The flooding hazard is a severe limitation on sites for sanitary facilities and buildings.

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

VoB—Voca gravelly sandy loam, 0 to 3 percent slopes. This deep, nearly level to very gently sloping soil is on uplands. The slopes are linear. Areas are irregular in shape and range from 20 to 500 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 5 inches; brown gravelly sandy loam

Subsurface layer:
5 to 14 inches; dark brown gravelly sandy loam

Subsoil:
14 to 34 inches; reddish brown gravelly sandy clay
34 to 48 inches; reddish brown very gravelly sandy clay loam

Substratum:
48 to 80 inches; weathered granite grus that has clay coatings on fragments

Important soil properties—

Available water capacity: moderate
Permeability: slow
Drainage: well drained
Runoff: 0 to 1 percent slopes—slow; 1 to 3 percent slopes—medium
Water table: none within a depth of 6 feet
Root zone: deep
Soil reaction: neutral in the upper 25 inches and slightly alkaline below.
Shrink-swell potential: high
Water erosion hazard: moderate
Wind erosion hazard: slight

Included with this soil in mapping are small areas of Bauman, Click, and Lou soils. The Bauman soils have a grayish subsoil and are along drainageways. The Click and Lou soils have a loamy subsoil and are on slightly higher ridges. The included soils make up about 15 percent of any mapped area.

The Voca soil is used as cropland, pasture, or rangeland.

This soil is suited to cropland. The moderate water erosion hazard limits its use as cropland. The moderate available water capacity and the gravelly surface are limitations.

This soil is suited to pasture and rangeland. The moderate available water capacity is a limitation.

This Voca soil is suited to urban uses. The slow permeability and depth to rock are limitations on sites for sanitary facilities. The high shrink-swell potential and low strength are limitations on sites for buildings and roads.

This soil is in capability subclass IVs and the Gravelly Sandy Loam range site.

We—Weswood silt loam, rarely flooded. This very deep, nearly level soil is on flood plains along the Colorado River. The slopes are linear. Areas are long and narrow and range from 10 to 50 acres in size.

The typical sequence, depth, and composition of the layers of this soil are—

Surface layer:
0 to 17 inches; brown silt loam

Subsoil:
17 to 28 inches; light brown very fine sandy loam

28 to 38 inches; light brown very fine sandy loam
38 to 52 inches; light reddish brown silt loam
52 to 60 inches; reddish brown silt loam

Substratum:
60 to 80 inches; stratified light reddish brown very fine sandy loam and reddish brown silt loam

Important soil properties—

Available water capacity: high
Permeability: moderate
Drainage: well drained
Runoff: negligible
Water table: none within a depth of 6 feet
Root zone: very deep
Soil reaction: moderately alkaline
Shrink-swell potential: low
Water erosion hazard: slight
Wind erosion hazard: slight

Included with this soil in mapping are small areas of Bastrop, Boerne, and Venus soils. The Bastrop soils have a loamy fine sand surface layer. The Boerne soils are fine sandy loam throughout. The Venus soils have a clay loam subsoil. All of these soils are on terrace positions. The included soils make up less than 15 percent of any mapped area.

The Weswood soil is used as cropland, pasture, or rangeland.

This soil is well suited to cropland. The high calcium carbonate content can limit production for some cultivated crops.

This soil is well suited to rangeland and pasture.

This Weswood soil is not suited to urban uses. The flooding hazard and seepage are the main concerns on sites for sanitary facilities, and the flooding hazard is the main concern on sites for buildings.

This soil is in capability class I and the Loamy Bottomland range site.

YeC—Yates-Rock outcrop complex, 1 to 8 percent slopes, very stony. This complex consists of very shallow and shallow, gently sloping to moderately sloping Yates soils and Rock outcrop. A typical area is about 70 percent Yates, 20 percent Rock outcrop and large boulders, and 10 percent other soils. The Yates soil has stones and cobbles covering about 10 percent of the soil surface. The Rock outcrop is barren or nearly barren limestone bedrock. The slopes are concave to convex. Areas are round and range from 50 to 300 acres in size.

The typical sequence, depth, and composition of the layers of the Yates soil are—

Surface layer:
0 to 12 inches; reddish brown very stony loam

Substratum:
12 to 18 inches; fractured limestone that has soil material in fractures

Important soil properties—

Available water capacity: very low
Permeability: moderate
Drainage: well drained
Runoff: Yates, 1 to 3 percent slopes—low; 3 to 5 percent slopes—medium; 5 to 8 percent slopes—high; Rock outcrop, very high
Water table: none within a depth of 6 feet
Root zone: very shallow to shallow
Soil reaction: slightly alkaline
Shrink-swell potential: low
Water erosion hazard: severe
Wind erosion hazard: slight

Included with this complex in mapping are small areas of Nebgen and Oplin soils. Also included are areas of soils that are similar to Yates soils that are underlain by marble. The Nebgen soils are underlain by sandstone and are in similar positions. The Oplin soils have a clay loam surface layer and are in the slightly higher positions on the landscape. The included soils make up less than 20 percent of any mapped area.

The Yates-Rock outcrop complex is used as rangeland.

This unit is not suited to cropland or pasture because of the depth to rock, stones on the surface, very low available water capacity, very shallow and shallow root zone, severe water erosion hazard, and rock outcrop.

This complex is suited to rangeland. The very low available water capacity, depth to rock, very shallow and shallow root zone, and rock outcrop are limitations.

This complex is not suited to urban uses. The depth to rock and stones are severe limitations on sites for sanitary facilities and buildings.

The Yates soil is in capability subclass VIIs and the Very Shallow range site. Rock outcrop is in capability class VIIIs and is not assigned a range site.

YeG—Yates-Rock outcrop complex, 12 to 40 percent slopes, very stony. This complex consists of very shallow and shallow, moderately steep to steep Yates soils and Rock outcrop. A typical area is about 70 percent Yates, 20 percent Rock outcrop and large boulders, and 10 percent other soils. The Yates soil has stones and cobbles covering about 10 percent of the soil surface. Rock outcrop is barren or nearly barren limestone bedrock. The slopes are concave to convex. Areas are long and narrow and range from 50 to 300 acres in size.

The typical sequence, depth, and composition of the layers of the Yates soil are—

Surface layer:
0 to 10 inches; reddish brown very stony loam

Substratum:
10 to 15 inches; fractured, indurated limestone that has soil material in fractures

Important soil properties—

Available water capacity: very low
Permeability: moderate
Drainage: well drained
Runoff: very high
Water table: none within a depth of 6 feet
Root zone: very shallow to shallow
Soil reaction: slightly alkaline
Shrink-swell potential: low
Water erosion hazard: severe
Wind erosion hazard: slight

Included with this complex in mapping are small areas of Nebgen and Oplin soils. Also included are areas of soils that are similar to Yates soils that are underlain by marble. The Nebgen soils are underlain by sandstone and are in positions similar to those of the Yates soils. The Oplin soils have a clay loam surface layer and are in the slightly higher positions. The included soils make up about 15 percent of any mapped area.

The Yates-Rock outcrop complex is used as rangeland.

This complex is not suited to cropland or pasture because of the depth to rock, slope, very low available water capacity, very shallow and shallow root zone, stones on the surface, severe water erosion hazard, and rock outcrop.

This complex is suited to rangeland. The very low available water capacity, depth to rock, slope, very shallow and shallow root zone, and rock outcrop are limitations.

This map unit is not suited to urban uses. The depth to rock, slope, and stones on the surface are severe limitations on sites for sanitary facilities and buildings.

The Yates soil is in capability subclass VIIs and the Very Shallow range site. Rock outcrop is in capability class VIIIs and is not assigned a range site.

Prime Farmland

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. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses. It could be cultivated land, pastureland, forest land, or other land, but it is not urban or built-up land or water areas. The soil qualities, growing season, and moisture supply are those needed for the soil to economically produce sustained high yields of crops when proper management, including water management, and acceptable farming methods are applied. In general, prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, an acceptable salt and sodium content, and few or no rocks. It is permeable to water and air. It is not excessively erodible or saturated with water for long periods, and it either is not frequently flooded during the growing season or is protected from flooding. The slope ranges mainly from 0 to 5 percent. More detailed information about the criteria for prime farmland is available at the local office of the Natural Resources Conservation Service.

Only about 4 percent of the soils in Llano County are prime farmland. Another 8 percent qualify for prime farmland when irrigated. Areas of these soils are scattered throughout the county.

A recent trend in land use in some parts of the survey area has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed at the end of this section. This list does not constitute a recommendation for a particular land use. Soils that have an inadequate supply of moisture may qualify as prime farmland if this limitation is overcome by irrigation. If applicable, the need for irrigation is indicated in parentheses after the map unit name in the following list. Onsite evaluation is needed to determine if the limitation has been overcome by corrective measures.

The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

BaC	Bastrop loamy fine sand, 1 to 5 percent slopes
Br	Boerne fine sandy loam, rarely flooded
Fe	Fieldcreek fine sandy loam, occasionally flooded (where irrigated)
HoB	Honeycreek fine sandy loam, 1 to 3 percent slopes
HyC	Hye fine sandy loam, 1 to 5 percent slopes
KaC	Katemcy sandy loam, 1 to 5 percent slopes (where irrigated)
KrB	Krum silty clay, 1 to 3 percent slopes
LuB	Luckenbach clay loam, 0 to 3 percent slopes
NuB	Nuvalde clay loam, 0 to 3 percent slopes
PeB	Pedernales fine sandy loam, 1 to 3 percent slopes
PoC	Pontotoc fine sandy loam, 1 to 5 percent slopes
VeA	Venus loam, 0 to 2 percent slopes
Vn	Venus loam, occasionally flooded
We	Weswood silt loam, rarely flooded

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 to prevent 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 behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreational facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with 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 system of land capability classification used by the Natural Resources Conservation Service is explained. The estimated yields of the main crops and hay and pasture plants are listed for each soil in table 5.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under the heading “Detailed Soil Map Units.” Specific information can be obtained from the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

According to records of the local office of the Natural Resources Conservation Service, about 1 percent of the county is used as cropland, and about 2 percent is used as improved pastureland. Peanuts, oats, and forage sorghum are the main crops. Some acreage that was formerly cropped has been returned to open land.

The acreage used for crops has been gradually decreasing as more land is used for urban development, especially near Lake Buchanan and Lake LBJ, and converted to pasture.

Soil erosion is the major concern on the cropland in Llano County. If the slope is more than 1 percent, there is an erosion hazard. The Castell, Honeycreek, Hye, Katemcy, and Krum soils, for example, have slopes of more than 1 percent.

If the soil has a sandy surface layer, wind erosion is a hazard. The Bastrop, Campair, Loneoak, and Matilo soils, for example, have a sandy surface layer and are susceptible to soil blowing.

Loss of the soil surface layer through water erosion or soil blowing is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the lower layer is incorporated into the plow layer. Loss of the surface layer is especially damaging on soils with a clayey subsoil, such as the Castell, Katemcy, Pedernales, and Voca soils. In addition, loss of the surface layer is damaging to soils that have a restricted rooting depth because of the shallow depth to bedrock. The Cho and Ligon soils, for example, are underlain by caliche and schist at a shallow depth. Second, soil erosion results in the sedimentation of streams, ponds, and reservoirs. This adversely affects domestic water supplies, as well as fish and wildlife resources.

Effective erosion control practices increase the rate of water infiltration, reduce the amount of runoff, and hold soil losses to amounts that can be tolerated without reducing productive capacity. A cropping system that keeps a plant cover on the surface for extended periods helps protect the soil from erosion. Minimum tillage and crop residue

returned to the soil help increase infiltration and reduce the hazard of erosion. These practices can be used on most soils in the survey area.

On livestock farms that require pasture and hay, forage crops of legumes and grasses in the cropping system reduce erosion, provide nitrogen, and improve soil tilth.

Soil blowing is a hazard on the sandy Campair, Loneoak, and Matilo soils. Strong winds can damage these soils in a few hours if they are dry and do not have a plant cover, dead-litter mulch, or surface mulch. Maintaining plant cover, surface mulch, or a rough surface by proper tillage at timely intervals minimizes soil blowing. Crop residue and stripcropping provide protection for emerging seedlings.

Information on erosion control practices for each kind of soil can be obtained at the local office of the Natural Resources Conservation Service.

Soil fertility is naturally low in most of the light-colored sandy or loamy soils on uplands. These soils are mainly slightly acid and neutral, and crops respond readily to fertilizer. Some soils that have a sandy or loamy surface layer need more than a single application of a complete fertilizer during the planting and growing season to keep fertility in balance and reduce loss of nutrients by leaching. In some crop and pasture areas, mainly in older fields, the soil reaction has become too acid, and thus adversely affects plant growth. Liming is recommended in these situations. Some of these light-colored soils are the Campair, Castell, Hye, Loneoak, and Lou soils.

Fertility is naturally high in most soils on flood plains, such as the Fieldcreek and Venus soils. The dark, more clayey alkaline soils on uplands, such as the Krum and Nuvalde soils, are also high in natural fertility. In places, these alkaline soils, especially the Boerne and Venus soils, hold the nutrients in forms unavailable for plant use. On all soils, the amount and type of fertilizer or lime to apply should be based on the results of soil tests, the need of the crops, the expected level of yields, the previous land use or cropping sequence, and the amount of available soil moisture. Local offices of the Cooperative Extension Service can help in determining the kinds and amounts of fertilizer to apply.

Field crops suited to the soils and climate of the survey area include many that are not now commonly grown. Peanuts, forage sorghums, and oats are the common crops. Specialty crops are grown commercially on a small scale. Some of these are grapes, pecans, peaches, cantaloupes, and watermelons.

Improved pasture grasses suited to the soils in the survey area include several varieties of bermudagrass, kleingrass, and Wilman lovegrass. Major management practices for pasture include fertilizing, controlling weeds, and controlling grazing. The amount and type of fertilizer to apply should be based on plant needs, the level of production desired, and the results of soil tests. Weeds are less likely to be a problem on properly grazed, well-managed pasture. On overgrazed, poorly managed pastures, the desirable plant population is reduced.

Hay is commonly harvested from bermudagrass and often from other improved grasses. Some producers earn income by selling seed from kleingrass or Wilman lovegrass or by selling sprigs of bermudagrass.

Temporary pasture is used in many places to supplement permanent pasture or to produce hay. Sudangrass, sorghum-sudangrass crosses, and johnsongrass make good supplemental forage. During the winter, small grain is grown for this purpose and also to attract wildlife, especially deer.

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 land capability classification of each map unit also is shown in the table.

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 ensures 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 Natural Resources 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 most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The 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.

Capability classes, the broadest groups, are designated by 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 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 hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c,* used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-4 and IIIe-6.

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

Rangeland

William C. Reeder, district conservationist, Natural Resources Conservation Service, helped to prepare this section.

In areas of rangeland the native vegetation consists of a wide variety of grasses, grasslike plants, forbs, shrubs, and trees. The vegetation is generally suitable for grazing and browsing by livestock and wildlife. The composition and production of the plant community is strongly influenced by the soils, climate, topography, overstory canopy, and grazing management. Rangeland is not regularly treated with intensive cultural practices such as fertilization or tillage.

According to the field office records of the Natural Resources Conservation Service, about 538,000 acres, or about 87 percent of the land in Llano County, is in rangeland. The native plant community was once an open, tall and mid grass prairie with trees along the streams. Live oak and post oak occurred across the landscape in scattered motts. The rangeland is now used primarily for producing domestic livestock and also supports a great number of white-tailed deer and other wildlife.

The plant community of Llano County rangeland has changed drastically over the last 100 years. Continuous grazing by domestic livestock has removed much of the higher-quality vegetation. Now, in its place is a mixture of mid and short grasses, poor-quality forbs, oaks, mesquite, whitebrush, and other woody plants. The control of prairie fires has led to woody plant encroachment. Remnants of the original plant species still remain in protected areas and on well-managed ranches. In most cases, the higher-quality plants can reestablish themselves on the rangeland when the best range management practices are applied by the rancher.

Rangeland is the major renewable resource in Llano County, and it is mainly used for raising livestock, mostly cow-calf operations, and leasing hunting rights for deer and wild turkey. In 1987, there were 51,000 cattle, 2,000 sheep, and 5,000 angora goats in the county. The white-tailed deer population was estimated at 106,424 in 1989.

Range Sites and Range Condition

Soils vary in their capability to produce grasses and other plants suitable for grazing. Soils that produce about the same kinds and amounts of forage are grouped into a range site.

A range site is a distinctive kind of rangeland that produces a characteristic natural plant community. This community differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. This natural plant community is also referred to as the climax plant community or climax vegetation because it is the product of all the environmental factors responsible for its development.

Generally, the climax vegetation consists of the plants that were present when the area was first settled. If a site contains at least 75 percent of the plants that characterize the climax vegetation, the plant community is relatively stable. It will reproduce itself so that plant composition will not change significantly as long as the environment remains unchanged. If the area is undisturbed and improved plants are not introduced, the most productive combination of forage plants on a range site is the climax vegetation.

Range sites are subject to many influences that modify or even temporarily destroy vegetation. Examples are drought, overgrazing, wild fires, and short-term tillage. If these conditions are not too severe, the plant community will recover and return to climax. However, severe deterioration of the range site may permanently alter the potential of the site.

Grazing can change the quality and quantity of forage on a range site by changing the composition of the plant community.

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

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

Invaders are plants that are normally not included in the climax plant community because they cannot compete with the climax vegetation for moisture, nutrients, and light. They invade the site and grow along with increasers only after the climax vegetation has been reduced by continual heavy grazing. Most invader species have little grazing value.

Range management requires a knowledge of the kinds of soil and of the climax or potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the climax plant community on a particular range site. The more closely the existing community resembles the climax community, the better the range condition. Range condition is an ecological rating only. It does not have a specific meaning about the present plant community in a given use.

Four range condition classes are used to show the degree of departure from the potential, or climax, vegetation brought about by grazing or other uses. A range site is in excellent condition if 76 to 100 percent of the present plant community is the same as the climax vegetation; in good condition if the percentage is 51 to 75; in fair condition if the percentage is 26 to 50; and in poor condition if the percentage is 25 or less.

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

Following years of prolonged overuse of range, seed sources of desirable vegetation will be eliminated. Under these conditions, the vegetation must be reestablished before management can be effective. The condition of the range can be improved by brush control, range seeding, fencing, water development, or other mechanical treatments to revitalize stands of native plants.

The objective in range management is to control grazing so the plants growing on a site remain or improve to 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; water conservation; and erosion control. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Good production of livestock and forage on rangeland is obtained primarily by managing the time of grazing and limiting the amount of forage removed. The green parts of plants manufacture food for growth and store part of it for use in regrowth and seed production. Management practices that permit this process to take place are discussed below.

Proper Grazing Use. The objective of this practice is to graze at an intensity that will maintain enough cover to protect the soil and maintain or improve the quantity of desirable vegetation.

Deferred Grazing. This is the deferment or restriction of

grazing until the better forage plants have completed most of their seasonal growth or have made seed. It helps keep the desirable plants healthy and vigorous and permits plants that have been depleted to recover. Deferred grazing helps to improve plant cover and reduce soil erosion.

Fencing. This practice excludes livestock from areas that should be protected from grazing, confines livestock to an area, subdivides grazing land to permit use of planned grazing systems, and protects new seedlings or plantings from grazing.

Prescribed Burning. Livestock operators and wildlife managers use this practice to periodically remove or reduce a dense cover of mature vegetation. When done properly and at the right time, this practice will stimulate new, succulent growth; help to restore climax plant species; and reduce infestations of noxious weeds and brush. However, desirable plants can be severely damaged or killed if the soil surface is too dry, allowing the fire to reach the plant crowns and roots. Burning is not recommended more often than once every three years, since doing so may harm perennial grass vegetation. Prescribed burning is an effective management tool that can be substituted for chemical or mechanical treatments in many plant communities.

Planned Grazing Systems. The objective of this practice is to rotate the grazing of livestock through two or more pastures in a planned sequence for a specified period of time. A planned grazing system may be relatively simple in design using two pastures, or may be more complex and management intensive, using one or two herds and many pastures. To be successful, it must be tailored to conditions existing in each ranch unit and meet the needs of the plants and animals as well as the rancher.

Table 6 shows, for each soil that supports rangeland vegetation suitable for grazing, the range site and the potential annual production of vegetation in favorable, average, and unfavorable years. An explanation of the column headings in table 6 follows.

A *range site* is indicated for each soil map unit listed in table 6. 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 potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, average, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

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.

In Llano County, twenty-four range sites have been identified. They are Adobe, Clay Loam, Deep Sand, Granite Gravel, Granite Hill, Gravelly Redland, Gravelly Sandy Loam, Loamy Bottomland, Low Stony Hill, Redland, Red Sandy Loam, Red Savannah, Sandstone Hill, Sandy, Sandy Loam, Shallow, Shallow Granite, Shallow Ridge, Steep Adobe, Steep Redland, Steep Rocky, Tightland, Tight Sandy Loam, and Very Shallow.

Adobe range site. The Real soil in map unit ReC is in this range site. The climax plant community is a tall grass and mid grass, oak savannah with a species composition by weight of 85 percent grasses, 5 percent forbs, and 10 percent woody vegetation.

The dominant grasses are little bluestem, sideoats grama, indiangrass, pinhole bluestem, cane bluestem, tall dropseed, hairy grama, and perennial threeawns. The dominant forbs include Engelmann daisy, bushsunflower, and sensitive briar. The woody plants include live oak, Texas oak, flameleaf sumac, evergreen sumac, agarito, and greenbriar.

Little bluestem, indiangrass, Engelmann daisy, and Texas oak are eliminated from the plant community if domestic livestock continuously graze them. These plants are then replaced by sideoats grama, seep muhly and live oak. If continuous heavy grazing continues for many years, ashe juniper will invade and form a dense stand with an understory of plants, such as Texas grama, red grama, puffsheath dropseed, Lindheimer muhly, and Texas persimmon.

Clay Loam range site. The Krum, Luckenbach, Nuvalde, and Venus soils in map units KrB, LuB, NuB, and VeA are in this range site. The climax plant community is a tall grass prairie with a species composition by weight of 85 percent grasses, 15 percent forbs, and a trace of woody species.

The dominant plants are indiangrass, little bluestem, big bluestem, sideoats grama, cane bluestem, vine-mesquite, Texas cupgrass, tall dropseed, and plains lovegrass. The dominant forbs include maximilian sunflower, Engelmann daisy, and bushsunflower. The woody plants include elm, live oak, hackberry, bumelia, and elbowbush.

Little bluestem, indiangrass, and big bluestem are grazed out of the plant community if livestock continuously graze them. These plants are replaced by sideoats grama, Texas wintergrass, cane bluestem, and buffalograss. Continued heavy use causes further deterioration, and plants, such as tumblegrass, hairy tridens, Texas grama, red threeawn, western ragweed, broomweed, prairie coneflower, and ashe juniper, will dominate the site.

Deep Sand range site. The Matilo soil in map unit MaC is in this range site. The climax plant community is post oak and blackjack oak. The woody cover shades about 50 percent of the ground. A few tall grasses are in the scattered open areas. Forbs, legumes, woody vines, and shrubs add to the variety of the vegetation.

The dominant plants are post oak, blackjack oak, greenbriar, skunkbush, sumac, bumelia, sand lovegrass, purpletop tridens, indiangrass, lespedeza, trailing wildbean, and erect dayflower.

Sand lovegrass, indiangrass, and the better-quality forbs are grazed out of the plant community if livestock continuously graze them. These plants are replaced by sand dropseed, fringeleaf paspalum, pricklyash, and annual forbs. Continued heavy use causes further deterioration, and plants, such as gummy lovegrass, sandbur, threeawn, basin sneezeweed, camphorweed, and signalgrass, invade the range site. Bluebonnet, Indian paintbrush, and phlox are just a few of the wildflowers that also grow on this site.

Granite Gravel range site. The Click and Lou soils in map units CkC and LoB are in this range site. The potential plant community is an open savannah of post oak, blackjack oak, and live oak with mid and tall grasses in thin stands. The species composition by weight is 82 percent grasses, 8 percent forbs, and 10 percent woody plants.

The dominant grasses are little bluestem, sideoats grama, indiangrass, sandhill lovegrass, Arizona cottontop, and purpletop tridens. The dominant forbs include orange zexmenia, sagewort, snoutbean, and heath aster. The woody plants include post oak, blackjack oak, and live oak.

Little bluestem, sideoats grama, and the better-quality forbs are grazed by livestock. These plants are replaced by an increase in oaks, threeawn, hairy grama, yucca, mesquite, and persimmon. Continued heavy use causes further deterioration and plants, such as mesquite, whitebrush, yucca, ashe juniper, gummy lovegrass, Texas grama, prairie coneflower, and basin sneezeweed, invade the range site.

Granite Hill range site. The Keese soil in map unit KoF is in this range site (fig.12). The climax plant community is a savannah with scattered motts of live oak and post oak which has an understory of mid and tall grasses. It has a species composition of 85 percent grasses, 5 percent forbs, and 10 percent woody plants.

The dominant grasses are indiangrass, little bluestem, sideoats grama, purpletop, and tanglehead. The dominant forbs are orange zexmenia, bushsunflower, and sensitive briar. The dominant woody plants include live oak, post oak, hickory, and elm.

Little bluestem, indiangrass, and the better-quality forbs are grazed out of the plant community if livestock continuously graze them. These plants are replaced by sideoats grama, sand dropseed, sand lovegrass, silver bluestem, and annual forbs. Continued heavy use causes further deterioration and plants, such as signalgrass, basin sneezeweed, prickly pear, juniper, tasajillo, whitebrush, mesquite, and annual forbs, will dominate the range site.

Gravelly Redland range site. The Rumple soil in map unit RuC is in this range site. The climax plant community is an open savannah of tall and mid grasses with post oak, blackjack oak, and live oak throughout the landscape. The species composition is 85 percent grasses, 10 percent woody plants, and 5 percent forbs.

The dominant grass is little bluestem with lesser amounts of big bluestem, indiangrass, sideoats grama, wildrye, plains lovegrass, Texas wintergrass, vine-mesquite, pinhole bluestem, tall dropseed, and buffalograss. Woody plants include live oak, post oak, blackjack oak, redbud, greenbriar, and hackberry. Forbs, such as velvet bundleflower, Engelmann daisy, orange zexmenia, and Mexican sagewort, are present.

Continuous grazing with heavy stocking rates will slowly eliminate big bluestem, indiangrass, and little bluestem from the plant community. These plants are then replaced by sideoats grama, plains lovegrass, buffalograss, dropseeds, and the woody plants. If this destructive grazing practice continues, the site will deteriorate to a plant population of blueberry juniper, Texas persimmon, prickly pear, live oak, Texas grama, hairy tridens, red grama, prairie coneflower, and broomweeds.

Gravelly Sandy Loam range site. The Voca soil in map unit VoB is in this range site. The climax plant community is a tall and mid grass savannah with occasional post oak and blackjack oak throughout the landscape. The species composition is 90 percent grasses, 5 percent forbs, and 5 percent woody plants.

The dominant grass is little bluestem. Other grasses include indiangrass, sideoats grama, purpletop tridens, wildrye, plains lovegrass, sand lovegrass, hooded windmillgrass, fringeleaf paspalum, and pinhole bluestem. Woody plants include post oak, blackjack oak, live oak, and greenbriar. Forbs, such as maximilian sunflower, Engelmann daisy, sensitive briar, and prairie clovers, are present.

Continuous grazing will slowly eliminate little bluestem

Figure 12.—An area of Keese-Rock outcrop complex, 12 to 30 percent slopes, very stony. It is in the Granite Hill range site.

and indiangrass from the plant community. These plants are then replaced by sideoats grama, purpletop tridens, pinhole bluestem, hairy grama, sand lovegrass, Texas wintergrass, and the woody plants.

Continued heavy use causes further deterioration and plants, such as whitebrush, mesquite, prickly pear, greenbriar, live oak, Texas grama, camphorweed, red grama, curlycup gumweed, sneezeweed, and ragweeds, will dominate the site.

Loamy Bottomland range site. The Boerne, Fieldcreek, Venus, and Weswood soils in map units Br, Fe, Vn, and We are in this range site. The climax plant community is a semi-wooded flood plain that has trees shading as much as 30 percent of the area along the water courses. Away from the water courses, there are tall and mid grasses with occasional trees.

The dominant grasses are indiangrass, eastern gamagrass, big bluestem, little bluestem, switchgrass, southwestern bristlegrass, Virginia wildrye, purple tridens, broadleaf uniola, scribners panicum, plains lovegrass, Texas wintergrass, sideoats grama, cane bluestem, vine-mesquite, and buffalograss. Woody plants include pecan, walnut, oaks, elms, mulberry, sycamore, wild grape, hackberry, greenbriar, honeysuckle, peppervine, and poison ivy or poison oak. Forbs include maximilian sunflower, bushsunflower, Engelmann daisy, blood ragweed, and yellow neptunia.

Continuous grazing with heavy stocking rates will slowly eliminate grasses, such as indiangrass, eastern gama, big

bluestem, little bluestem, and switchgrass, from the plant community. These plants are then replaced by meadow dropseed, vine-mesquite, silver bluestem, sideoats grama, buffalograss, and mesquite. If this destructive grazing practice is continued, the site will deteriorate to an understory plant community of prickly pear, buffalograss, threeawn, Texas wintergrass, red grama, and annual weeds and grasses with a dense overstory of oak, elm, mesquite, and hackberry. Extensive shading by trees and thicket-forming plants is a major management problem on this site.

Low Stony Hill range site. The Eckrant, Harper, and Oplin soils in map units EcC, HaB, HaC, and OpC are in this range site. The climax plant community is a tall grass savannah with motts of live oak throughout the landscape. The species composition is approximately 80 percent grasses, 15 percent woody plants, and 5 percent forbs.

The dominant grass is little bluestem. Other grasses include indiangrass, sideoats grama, wildrye, green sprangletop, tall dropseed, cane and pinhole bluestem, Texas wintergrass, and buffalograss. Woody plants include live oak, shin oak, evergreen sumac, hackberry, elbowbush, redbud, and white honeysuckle. Forbs, such as orange zexmenia, Engelmann daisy, bundleflower, snout bean, and bushsunflower, are present.

Continuous grazing with heavy stocking rates will slowly eliminate little bluestem, indiangrass, and climax forbs from the plant community. These plants are then replaced by sideoats grama, buffalograss, hairy grama, dropseeds, and the woody plants. If this destructive grazing practice continues, the site will deteriorate to a plant population of blueberry juniper, Texas persimmon, live oak, Texas grama, hairy tridens, curly mesquite, threeawns, prairie coneflower, and broomweeds.

Redland range site. The Hensley and Roughcreek soils in map units HeB and RrC are in this range site. The climax plant community is a tall grass savannah with post oak, blackjack oak, and live oak throughout the landscape. The species composition is approximately 85 percent grasses, 10 percent woody plants, and 5 percent forbs.

The dominant grass is little bluestem, which generally makes up 50 percent of the total vegetation. Other grasses include big bluestem, indiangrass, sideoats grama, wildrye, plains lovegrass, Texas wintergrass, vine-mesquite, pinhole bluestem, tall dropseed, and buffalograss. Woody plants include live oak, post oak, blackjack oak, redbud, greenbriar, and hackberry. Forbs, such as velvet bundleflower, Engelmann daisy, orange zexmenia, and Mexican sagewort, are present.

Continuous grazing with heavy stocking rates will slowly eliminate big bluestem, indiangrass, and little bluestem from the plant community. These plants are then replaced by sideoats grama, plains lovegrass, buffalograss, dropseeds, and the woody plants. If this destructive grazing practice continues, the site will deteriorate to a plant population of blueberry juniper, Texas persimmon, prickly pear, mesquite, live oak, Texas grama, hairy tridens, red grama, prairie coneflower, and broomweeds.

Red Sandy Loam range site. The Hye, Oben, and Pontotoc soils in map units HyC, ObC, and PoC are in this range site. The climax plant community consists of live oak and post oak savannah. The trees get rather large on this site. Live oak is more abundant than post oak. The plant composition usually consist of 75 percent grasses, 10 percent woody plants, and 15 percent forbs.

The dominant grasses include little bluestem and sandhill lovegrass. Other grasses include indiangrass, green sprangletop, purpletop tridens, sideoats grama, Arizona cottontop, scribners panicum, plains lovegrass, and silver bluestem. Woody plants include live oak, post oak, greenbriar, wild grape, catclaw, and Texas oak. Forbs, such as maximilian sunflower, Mexican sagewort, orange zexmenia, sensitive briar, bushsunflower, trailing wildbean, evening primrose, and many annual species, are present.

Continuous grazing with heavy stocking rates will slowly eliminate little bluestem, indiangrass, sandhill lovegrass, and big bluestem from the plant community. These plants are then replaced by silver bluestem, hooded windmillgrass, dropseeds, and the woody plants. If this destructive grazing practice continues, the site will deteriorate to a plant population of mesquite, prickly pear, pricklyash, whitebrush, tasajillo, gummy lovegrass, grassbur, red lovegrass, signalgrass, windmillgrass, and weedy forbs.

Red Savannah range site. The Katemcy and Ligon soils in map units KaC and LgC are in this range site. The climax plant community is a grassland with occasional post oak and blackjack oak throughout the landscape. Mid and short grasses along with forbs and a few small shrubs are present. The plant composition consists of 90 percent grasses, 5 percent woody plants, and 5 percent forbs.

The dominant grass is sideoats grama. Other grasses include Arizona cottontop, little bluestem, cane bluestem, pinhole bluestem, wildrye, Texas wintergrass, and hooded windmillgrass. Woody plants include post oak, live oak, and hackberry. Forbs, such as sensitive briar, Engelmann daisy, orange zexmenia, and bundleflower, are present.

Continuous grazing with heavy stocking rates will slowly eliminate sideoats grama and wildrye from the plant community. These plants are then replaced by hooded windmillgrass, curly mesquite, buffalograss, Texas wintergrass, threeawns, hairy grama, and the woody plants. If this destructive grazing practice continues, the site will deteriorate to a plant population of Texas colubrina, whitebrush, mesquite, prickly pear, tasajillo,

Texas persimmon, Texas grama, hairy tridens, red grama, prairie coneflower, broomweeds, and ragweeds.

Sandstone Hill range site. The Nebgen soil in map unit NeF is in this range site. The climax plant community is a tall and mid grass savannah with post oak and blackjack oak throughout the landscape. The species composition is 85 percent grasses, 10 percent woody plants, and 5 percent forbs.

The dominant plant is little bluestem. Other plants include indiangrass, sideoats grama, sand lovegrass, purpletop tridens, green sprangletop, tall dropseed, and wildrye. Forbs include sensitive briar, Engelmann daisy, Mexican sagewort, and prairie clovers. Woody plants are post oak and blackjack oak.

Continuous grazing with heavy stocking rates will slowly eliminate little bluestem, indiangrass, plains lovegrass, and sideoats grama from the plant community. These plants are then replaced by Texas wintergrass, silver bluestem, Arizona cottontop, hooded windmillgrass, dropseeds, and the woody plants. If this destructive grazing practice continues, the site will deteriorate to a plant population of whitebrush, Texas persimmon, prickly pear, tasajillo, catclaw, red lovegrass, tumble windmillgrass, sand dropseed, and prairie coneflower.

Sandy range site. The Loneoak soil in map unit LkB is in this range site. The climax plant community is a tall and mid grass savannah with stands of post oak and blackjack oak throughout the landscape. The trees get rather large on this site. The species composition is generally 80 percent grasses, 15 percent woody plants, and 5 percent forbs.

The dominant plants include little bluestem, indiangrass, plains lovegrass, sand lovegrass, purpletop tridens, and scribners panicum. Woody plants include post oak, blackjack oak, greenbriar, skunkbush sumac, and Texas oak. Forbs, such as Louisiana sagewort, leavenworth vetch, sensitive briar, bushsunflower, trailing wildbean, and western indigo, are present.

Continuous grazing with heavy stocking rates will slowly eliminate little bluestem and indiangrass from the plant community. These plants are then replaced by plains lovegrass, sand lovegrass, hooded windmillgrass, dropseeds, and the woody plants. If this destructive grazing practice continues, the site will deteriorate to a plant population of pricklyash, whitebrush, mesquite, prickly pear, catclaw, skunkbush sumac, greenbriar, tumble lovegrass, red lovegrass, windmillgrass, and weedy forbs.

Sandy Loam range site. The Bastrop, Campair, Castell, and Honeycreek soils in map units BaC, CaB, CeC, and HoB are in this range site. The climax plant community is a tall and mid grass savannah with occasional post oak and live oak throughout the landscape. The species composition is 85 percent grasses, 5 percent woody plants, and 10 percent forbs.

The dominant grass is little bluestem. Other grasses include indiangrass, sideoats grama, purpletop tridens, wildrye, plains lovegrass, sand lovegrass, hooded windmillgrass, fringeleaf paspalum, and pinhole bluestem. Woody plants include post oak, blackjack oak, live oak, and greenbriar. Forbs, such as maximilian sunflower, Engelmann daisy, sensitive briar, and prairie clovers, are present.

Continuous grazing with heavy stocking rates will slowly eliminate little bluestem, indiangrass, and the better-quality forbs from the plant community. These plants are then replaced by sideoats grama, purpletop tridens, pinhole bluestem, hairy grama, sand lovegrass, Texas wintergrass, and the woody plants. If this destructive grazing practice continues, the site will deteriorate to a plant population of whitebrush, mesquite, prickly pear, greenbriar, Texas persimmon, Texas grama, camphorweed, red grama, signalgrass, curlycup gumweed, sneezeweed, and ragweeds.

Shallow range site. The Cho soil in map unit ChB is in this range site. The climax plant community is a mid grass prairie with a species composition of 90 percent grasses, 5 percent woody plants, and 5 percent forbs.

The dominant grass is sideoats grama. Other grasses include Texas wintergrass, silver bluestem, Arizona cottontop, dropseeds, white tridens, buffalograss, and curly mesquite. The woody plant is live oak. Forbs include bushsunflower, orange zexmenia, and gayfeather.

Continuous grazing with heavy stocking rates will slowly eliminate sideoats grama and the climax forbs from the plant community. These plants are then replaced by buffalograss, curly mesquite, threeawns, agarito, and lotebush. If this destructive grazing practice continues, the site will deteriorate to a plant population of lotebush, prickly pear, Texas persimmon, tasajillo, agarito, threeawns, red grama, Texas grama, hairy tridens, prairie coneflower, and broomweeds.

Shallow Granite range site. The Keese soil in map units KeC and KoC is in this range site (fig. 13). The climax plant community is a post oak and live oak savannah. The understory is dominated by tall and mid grasses. The oak overstory shades about 20 percent of the ground. This site supports an abundance of forbs with some woody shrubs and vines. The species composition is 85 percent grasses, 10 percent woody plants, and 5 percent forbs.

The dominant grass is little bluestem, which generally makes up 50 percent of the total vegetation. Other grasses include tanglehead, indiangrass, sideoats grama, big bluestem, green sprangletop, plains lovegrass, Texas wintergrass, and tall grama. Woody plants include live oak, post oak, elm, and hackberry. Forbs, such as Mexican

Figure 13.—Rangeland in an area of Keese coarse sandy loam, 1 to 8 percent slopes, stony. It is in the Shallow Granite range site.

sagewort, Engelmann daisy, bushsunflower, and bundleflower, are present.

Continuous grazing with heavy stocking rates will slowly eliminate little bluestem, tanglehead, and indiangrass from the plant community. These plants are then replaced by sideoats grama, sand dropseed, Arizona cottontop, hooded windmill, sand lovegrass, plains bristlegrass, hairy grama, and the woody plants. If this destructive grazing practice continues, the site will deteriorate to a plant population of whitebrush, juniper, elm, Texas persimmon, prickly pear, mesquite, yucca, signalgrass, tumble windmillgrass, threeawns, hairy grama, red grama, basin sneezeweed, ragweed, and other annual weeds.

Shallow Ridge range site. The Ligon and Packsaddle soils in map units LgD and PaC are in this range site. The climax plant community is a grassland with occasional post oak and blackjack oak throughout the landscape. Mid and short grasses along with forbs and a few small shrubs are present. The plant composition consists of 90 percent grasses, 5 percent woody plants, and 5 percent forbs.

The dominant grass is sideoats grama. Other grasses include Arizona cottontop, little bluestem, cane bluestem, pinhole bluestem, wildrye, Texas wintergrass, and hooded windmillgrass. Woody plants include post oak, live oak, and hackberry. Forbs, such as sensitive briar, Engelmann daisy, orange zexmenia, and bundleflower, are present.

Continuous grazing with heavy stocking rates will slowly eliminate sideoats grama and wildrye from the plant community. These plants are then replaced by hooded windmillgrass, curly mesquite, buffalograss, Texas wintergrass, threeawns, hairy grama, and the

woody plants. If this destructive grazing practice continues, the site will deteriorate to a plant population of Texas colubrina, whitebrush, mesquite, prickly pear, tasajillo, Texas persimmon, Texas grama, hairy tridens, red grama, prairie coneflower, broomweeds, and ragweeds.

Steep Adobe range site. The Real soil in map unit ReG is in this range site. The climax plant community is a tall grass savannah with motts of live oak and Texas oak scattered throughout the landscape. The species composition is 80 percent grasses, 15 percent woody plants, and 5 percent forbs.

The dominant grass is little bluestem, which generally makes up 40 percent of the total vegetation. Other grasses include indiangrass, sideoats grama, tall grama, seep muhly, slim tridens, tall dropseed, and perennial threeawns. Woody plants include live oak, Texas oak, and shin oak. Forbs, such as bundleflower, sensitive briar, maximilian sunflower, Engelmann daisy, and gayfeather, are found throughout the site.

Continuous grazing with heavy stocking rates will slowly eliminate little bluestem, indiangrass, and sideoats grama from the plant community. These plants are then replaced by seep muhly, threeawns, hairy grama, dropseeds, and the woody plants. If this destructive grazing practice continues, the site will deteriorate to a plant population of blueberry juniper, Texas persimmon, agarito, live oak, threeawns, Texas grama, hairy tridens, red grama, prairie coneflower, broomweeds, and ragweeds.

Steep Redland range site. The Roughcreek soil in map unit RrF is in this range site. The climax plant community is a tall grass savannah with post oak, blackjack oak, and live oak throughout the landscape. The species composition is approximately 85 percent grasses, 10 percent woody plants, and 5 percent forbs.

The dominant grass is little bluestem, which generally makes up 50 percent of the total vegetation. Other grasses include big bluestem, indiangrass, sideoats grama, wildrye, plains lovegrass, Texas wintergrass, vine-mesquite, pinhole bluestem, tall dropseed, and buffalograss. Woody plants include live oak, post oak, blackjack oak, redbud, greenbriar, and hackberry. Forbs, such as velvet bundleflower, Engelmann daisy, orange zexmenia, and Mexican sagewort, are present.

Continuous grazing with heavy stocking rates will slowly eliminate little bluestem, indiangrass, and sideoats grama from the plant community. These plants are then replaced by buffalograss, threeawns, hairy grama, dropseeds, and the woody plants. If this destructive grazing practice continues, the site will deteriorate to a plant population of blueberry juniper, Texas persimmon, prickly pear, agarito, live oak, threeawns, Texas grama, hairy grama, red grama, prairie coneflower, broomweed, and ragweed.

Steep Rocky range site. The Eckrant and Oplin soils in map units EcF and OpF are in this range site. The climax plant community is a tall and mid grass savannah with motts of live oak, Texas oak, and shin oak throughout the landscape. The species composition is 75 percent grasses, 15 percent woody plants, and 10 percent forbs.

The dominant grass is little bluestem, which generally makes up 35 percent of the total vegetation. Other grasses include indiangrass, big bluestem, sideoats grama, tall grama, cane bluestem, tall dropseed, slim tridens, green sprangletop, and perennial threeawns. Woody plants include live oak, Texas oak, shin oak, kidneywood, and sumac. Forbs, such as bundleflower, sensitive briar, orange zexmenia, Engelmann daisy, and bushsunflower, are present.

Continuous grazing with heavy stocking rates will slowly eliminate little bluestem, indiangrass, and sideoats grama from the plant community. These plants are then replaced by seep muhly, Texas wintergrass, threeawns, hairy grama, dropseeds, and the woody plants. If this destructive grazing practice continues, the site will deteriorate to a plant population of blueberry juniper, Texas persimmon, agarito, live oak, threeawns, Texas grama, hairy tridens, red grama, prairie coneflower, broomweeds, and ragweeds.

Tightland range site. The Bauman soil in map unit BmA is in this range site. The climax plant community is a mid grass savannah with scattered live oak and whitebrush throughout the landscape with a species composition of 90 percent grasses, 5 percent woody plants, and 5 percent forbs.

The dominant grass is sideoats grama, which generally makes up 25 percent of the total vegetation. Other grasses include cane bluestem, Arizona cottontop, buffalograss, green sprangletop, curly mesquite, vine-mesquite, Texas wintergrass, and perennial threeawns. Woody plants include live oak, hackberry, elm, and whitebrush. Forbs, such as Mexican sagewort, sensitive briar, gayfeather, and prairie clovers, are present.

Continuous grazing with heavy stocking rates will slowly eliminate sideoats grama, cane bluestem, and Texas wintergrass from the plant community. These plants are then replaced by curly mesquite, buffalograss, threeawns, hairy grama, and the woody plants. If this destructive grazing practice continues, the site will deteriorate to a plant population of mesquite, condalia, tasajillo, whitebrush, agarito, prickly pear, threeawns, Texas grama, hairy tridens, red grama, broomweeds, ragweeds, and annual weeds.

Tight Sandy Loam range site. The Pedernales soil in map unit PeB is in this range site.

The climax plant community is a mid grass savannah with occasional post oak and live oak throughout the

landscape. The species composition is 85 percent grasses, 10 percent woody plants, and 5 percent forbs.

The dominant grass is sideoats grama, which generally makes up 25 percent of the total vegetation. Other grasses include little bluestem, cane bluestem, pinhole bluestem, vine-mesquite, wildrye, Arizona cottontop, Texas wintergrass, and hooded windmillgrass. Woody plants include post oak, blackjack oak, live oak, and greenbriar. Forbs include maximilian sunflower, Engelmann daisy, orange zexmenia, and bushsunflower.

Continuous grazing with heavy stocking rates will slowly eliminate little bluestem, sideoats grama, and wildrye from the plant community. These plants are then replaced by hooded windmillgrass, vine-mesquite, Texas wintergrass, threeawns, hairy grama, buffalograss, and the woody plants. If this destructive grazing practice continues, the site will deteriorate to a plant population of blueberry juniper, mesquite, whitebrush, tasajillo, prickly pear, Texas persimmon, Texas grama, hairy tridens, red grama, prairie coneflower, broomweeds, and ragweeds.

Very Shallow range site. The Yates soil in map units YeC and YeG is in this range site. The climax plant community is a mid grass prairie with a species composition of 85 percent grasses, 10 percent woody plants, and 5 percent forbs.

The dominant grass is sideoats grama, which generally makes up 40 percent of the total vegetation. Other grasses include Texas wintergrass, silver bluestem, Arizona cottontop, dropseeds, white tridens, buffalograss, and curly mesquite. The woody plant is live oak. Forbs include bushsunflower, orange zexmenia, and gayfeather.

Continuous grazing with heavy stocking rates will slowly eliminate sideoats grama and the climax forbs from the plant community. These plants are then replaced by buffalograss, curly mesquite, threeawns, agarito, and lotebush. If this destructive grazing practice continues, the site will deteriorate to a plant population of lotebush, prickly pear, Texas persimmon, tasajillo, agarito, threeawns, red grama, Texas grama, hairy tridens, prairie coneflower, and broomweeds.

Recreation

Hunting and fishing opportunities are available in many areas in the county. Leasing land for hunting rights is an important source of income for many landowners. White-tailed deer, wild turkey, exotic animals, dove, and quail are the major game species. Lake Buchanan, Inks Lake, Lake LBJ, the Colorado River, the Llano River, and the many farm ponds provide recreational opportunities for residents and visitors alike.

Rock hunters and geologists come to Llano County in search of unique rocks, gems, and minerals. Several historical sites in the county draw visitors as well.

The soils of the survey area are rated in table 7 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. 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 uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 7, 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 a combination of these measures.

The information in table 7 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 10 and interpretations for dwellings without basements and for local roads and streets in table 9.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas (fig. 14).

Playgrounds require soils that can withstand intensive

Figure. 14.—A picnic area at Enchanted Rock State Natural Area on Fieldcreek fine sandy loam, occasionally flooded.

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

Steve Nelle, wildlife biologist, Natural Resources Conservation Service, helped prepare this section.

Wildlife is an important natural resource in Llano County. The area is renowned for its white-tailed deer population, which has earned Llano County the title “Deer Capital of the World.” However, the kinds and numbers of wildlife have changed considerably since the settlement by European man. Livestock numbers increased and fencing of the range led to yearlong, continuous grazing. The taller grasses and most desirable forbs were weakened and grazed out. Natural wildfires caused by lightning ceased to burn the area regularly because of inadequate grass for fuel. Woody plants which were kept suppressed by the thick grass and periodic fires began to increase and invade.

With the change from a grass-dominated to a brush-dominated landscape, combined with the previously

unregulated hunting, the major kinds of wildlife changed. Animals which were once present but which no longer exist in the survey area include bison, pronghorn, gray wolf, red wolf, black bear, jaguar, lesser prairie chicken, passenger pigeon, and Carolina parakeet.

Even with the changes that have occurred, Llano County still supports a wide variety of wildlife. The basic habitat needs for any wildlife population are food, cover, and water. The kind and abundance of wildlife depend largely on the amount and distribution of these needs. The 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. In order for a given kind of wildlife to inhabit an area, the land must either naturally provide the habitat needs, or it must be managed so that the specific habitat needs are met. 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. The past and present management of the land have a major influence on wildlife in the county.

In Llano County, the land management practices that affect wildlife habitat include grazing management, brush and weed control, range seeding and pasture planting, livestock water development, subdivision development, hunting practices, and large reservoir projects. The soils in the survey area are grouped into range sites according to the kinds, proportions, and amounts of vegetation that the soils and climate can support. These range sites have individual characteristics and vary in their ability to meet the habitat needs of various wildlife. Each site can be managed to either harm or benefit wildlife habitat. Therefore, a good understanding of range sites and their response to management is essential to proper wildlife habitat management. For detailed information on range sites, refer to the “Rangeland” section of this soil survey.

Only one species of native hoofed mammal still exists in Llano County. The white-tailed deer is by far the most common of the large mammals, having a definite impact on the rangeland resource as well as the ranching industry and the local economy.

Deer are distributed across the entire county, and populations are generally in excess of the carrying capacity of the habitat. The eradication of the parasitic screw worm fly, predator control, the dramatic increase in brush, and the switch away from sheep and goat production have all been responsible for high deer numbers. In recent years, the deer population has fluctuated between about 50,000 and 110,000. Average deer densities range from about 7 to 12 acres per deer, however peak densities of 1 to 2 acres per deer have been documented in certain areas.

Deer feed primarily on broadleaf forbs and on browse. Perennial forbs provide not only high-quality feed but also a reliable, yearlong food supply, being deep-rooted and not affected by the frequent short-term dry periods. Because of past grazing management and excessive deer numbers, the more preferred, perennial forbs have disappeared from most rangeland. Annual forbs also provide high nutritional quality but are only present during periods of adequate soil moisture. As the soil dries, the shallow-rooted annuals die, providing no food for deer.

Between these periods of plentiful annual forbs, deer must rely on browse for subsistence. Browse is a reliable deer food since it is deep-rooted and produces food even in the dry periods. However, the best, most desirable browse plants are no longer abundant in Llano County. They have been so severely browsed that they have been eliminated or severely suppressed in most areas. The presence of pronounced browse lines and severe hedging, an evidence of overbrowsing, is common on the better browse plants. These good browse plants are not reproducing well because of the vulnerability of seedlings to browsing. The lower-quality browse plants, such as persimmon, whitebrush, mesquite, and juniper, are slowly replacing the desirable species.

Deer habitat management and deer herd management have become an important part of many ranching operations. Deer habitat is managed by retaining adequate, well-distributed, brushy cover and by maintaining or improving the food supply. Cover is retained by selectively controlling brush in patterns. Blocks or strips of thick brush are left interspersed between small clearings; thus providing escape cover and shade near the more open feeding areas. Deer-food supplies are managed by retaining the better browse plants during brush-control projects and by practicing grazing management that minimizes competition for the good deer-food plants. Heavy and continuous grazing by livestock, especially sheep and goats, is detrimental to deer-food production. Moderate stocking with cattle and the use of grazing rotations are the best ways to ensure a reliable food supply. Keeping deer numbers at or near carrying capacity through hunting is also needed to keep the food supply productive.

Deer herd management involves a specified and selective harvest of deer based on age and sex to achieve a balanced and more desirable population. This usually involves a heavy harvest of does to improve the sex ratio and a selective harvest of bucks to improve antler size. As deer numbers are reduced, diet quality increases, leading to better body size and larger antlers.

An estimated 90 percent of Llano County is leased to hunters primarily in the pursuit of white-tailed deer. An average of 16,000 hunters harvest an average of 18,000 deer each year. Turkey, quail, feral hogs, and exotic game animals are also hunted. Hunters pay an estimated 2.5 million dollars annually to Llano County landowners for the

right to hunt. The local economy is also enriched by the expenditures of sportsmen on food, lodging, travel, and supplies.

Even though the high deer numbers have been an economic asset to Llano County, their overpopulation is slowly deteriorating the quality and diversity of the habitat. As the habitat deteriorates, only the lesser-quality food plants can thrive and reproduce. This decrease in the stable carrying capacity of the habitat has caused decreased diet quality for deer, which has led to decreased body weight, antler development, and reproduction. Even with a seemingly high harvest, there are still too many deer for the stable, yearlong food supply.

In addition to the high native deer population, there are over 2,000 head of exotic deer, sheep, and antelope in Llano County. These exotic herbivores are generally highly competitive with white-tailed deer for the preferred food plants. If their numbers are not managed, they pose a potential threat to native wildlife in Llano County. The escape of the domestic pig has created a large and growing population of feral hogs. The introduction of the European wild boar and their interbreeding with feral hogs has made the animals larger, wilder, and smarter. These wild hogs damage fences, feeders, and fields and compete with livestock and other wildlife for food. They are hunted for sport, for meat, and to control the damage they cause.

Besides the abundant white-tailed deer, Llano County provides habitat for about 40 other species of native mammals. Twelve species of native carnivores exist, and many of these will also eat insects and vegetation. These include the raccoon, ringtail, skunk, badger, fox, coyote, bobcat, and cougar. The larger predators are commonly trapped or shot, since they sometimes prey upon sheep and goats. However, it should be remembered that predators play an essential role in helping keep the rodent, rabbit, and deer populations in balance.

There are many species of native rodents, including ground squirrel, fox squirrel, pocket gopher, pocket mouse, harvest mouse, cotton rat, wood rat, beaver, and porcupine. The introduced rodents are the species that most often cause the problems that people associate with rodents. These include the house mouse, Norway rat, roof rat, and nutria. Other mammals include six species of bats, cottontail rabbit, jackrabbit, opossum, Eastern mole, and armadillo.

The bird life of Llano County is also quite diverse. About 230 species are common enough to be seen each year. About 80 to 100 species are expected to nest in the county. A large number of birds are associated with the waters of Llano County. Nearly all of these are migratory. They include loons, grebes, cormorants, herons, egrets, geese, seven species of dabbling ducks, five species of diving ducks, mergansers, bald eagle, osprey, coot, killdeer and several other species of plover, sandpipers, yellowlegs, snipe, dowitchers, avocets, stilts, gulls, terns, and kingfisher.

Raptorial birds associated with land are common and include Mississippi kite, Coopers hawk, and red-tailed hawk. The golden eagle, marsh hawk, kestrel, and six species of owls also are present. These birds are much-maligned because of their predatory nature; however, they play an important part in the natural balance. The turkey vulture and black vulture are also present in the county.

A large group of birds in the survey area are almost exclusively insect eaters. The more common ones include nighthawks, poor-wills, woodpeckers, cuckoos, kingbirds, flycatchers, phoebes, swallows, wrens, gnatcatchers, kinglets, vireos, and warblers. The loggerhead shrike and roadrunner not only eat insects but also reptiles, mice, and small birds.

Another group of birds are primarily seed eaters. These include cardinals, grosbeaks, buntings, finches, towhees, sparrows, and doves. Birds which readily eat insects, fruits, or seeds include blue jay, crow, chickadee, titmouse, mockingbird, catbird, thrashers, robins, bluebirds, waxwings, meadowlarks, blackbirds, and the ubiquitous house sparrow.

Upland game birds are also common in the survey area. They are the bobwhite quail, turkey, and mourning dove. These birds are hunted throughout the county. Landowners sometimes perform specific management practices intended to increase the numbers of these birds.

Bobwhite quail spend their entire life in a rather small area, and therefore, they must have all of their habitat needs close together. Nesting cover consists of large clumps of grass left from the previous year. Heavy grazing can greatly limit nesting success. Quail feed primarily on the hard seeds of forbs, grasses, and some brush species. In many cases, it is the “weedy” kinds of plants which produce the best quail food. These plants normally grow best on soil that is periodically disturbed or has significant bare areas. Quail require some low-growing brush to hide under and protect themselves from hot summer sun, cold winter winds, rain, and predators. Therefore, the best quail habitat consists of areas with scattered, low-growing, thick bushes interspersed with bunchgrasses, bare ground, and forbs. The presence of surface water is not considered essential to quail. However, in dry years water sources are utilized and increase quail survival.

Turkey range over a much wider area than do quail and will travel 10 to 30 miles to find suitable habitat. Turkey also require large clumps of grass or weeds to nest in and are, therefore, affected by heavy grazing. Turkey eat fruits and seeds of forbs, brush, and cactus, as well as grass seed. Young, succulent grasses and forbs are also grazed, and insects are essential for young poults. Turkey need

considerable brush for escape and concealment as well as food. Turkey roost in tall trees and, therefore, are attracted to bottomlands and draws. Turkey must drink water daily and have benefited greatly from the extensive development of livestock water in the area.

Mourning dove, being migratory, can fly long distances to find suitable food, cover, and water. Dove eat seeds almost exclusively and are especially fond of the seeds of agricultural crops and the associated weeds. Dove nest equally well on the ground or in trees. They prefer to feed in areas of bare ground or in areas of sparse cover where seeds can be easily seen. Dove require water daily and will fly some distance from feeding grounds to water. Livestock water troughs do not provide ideal water for quail, turkey, or dove. Water troughs can be modified to provide ground-level water with an overflow pipe leading to a small, nearby depression.

Amphibians are common throughout the survey area near creeks, rivers, ponds, lakes, and where windmills overflow. Seven species of toads, five species of frogs, and two kinds of salamanders are in the county.

Numerous reptiles also inhabit Llano County. Eight species of turtles are associated with water, while the ornate box turtle is in upland areas.

There are at least 16 species of lizards, skinks, and geckos; including the common six-lined racerunner, earless lizard, spiny lizard, collared lizard, and horned lizard.

Over 30 species of snakes are found in Llano County, most of them being nonpoisonous and very beneficial to the natural balance. The more commonly seen snakes include garter snakes, ribbon snakes, rat snakes, hognose snakes, bullsnakes, kingsnakes, coachwhips, racers, and water snakes. The poisonous snakes include the coral snake, copperhead, cottonmouth, and diamondback rattlesnake.

Fish are an important resource of the waters of Llano County. Three distinct kinds of fish habitat exist in the county: the Llano River; the numerous small farm ponds; and the large reservoirs.

Many kinds of native fish exist in the Llano River. Small fish which feed on microscopic plants and animals and which provide forage for larger fish include killifish, mosquito fish, silversides, shiners, darters, and minnows. At least five species of sunfish occur as well as five species of catfish. Largemouth and smallmouth bass and white crappie live in the Llano River along with buffalo, freshwater drum, and three species of gar. The most prolific introduced fish is the carp. Their abundance is considered detrimental to native fish populations.

Throughout the county, about 1,100 farm ponds have been constructed primarily for livestock water and erosion control. Because of the porous nature of the soils, only about half of these ponds are considered permanent enough for fish production. Most ponds are less than 1 acre in size. These are often stocked with such fish as fathead minnows, channel catfish, bluegill sunfish, and largemouth bass for recreational fishing. Less desirable species, such as bullheads, carp, crappie, and green sunfish, sometimes find their way into these ponds during periods of spillway flow from downstream. Unbalanced fish populations often develop. Pond management practices include aquatic weed control, fertilization, pond renovation, and proper harvest.

The dams on the Colorado River represent both the destruction of vast areas of valuable bottomland and river habitat, as well as the development of large lakes that provide good fish and waterfowl habitat. Lake Buchanan, Inks Lake, and Lake Lyndon B. Johnson cover about 17,095 acres of Llano County. All of the fish species listed above are also present in the lakes. The most common game fish, providing recreation for thousands of fishermen, include white crappie, largemouth bass, channel catfish, flathead catfish, blue catfish, white bass, striped bass, and hybrid striped bass. The most abundant forage fish are the gizzard shad and sunfish.

Although more emphasis has traditionally been placed upon the management and conservation of the relatively few game species in the county, the numerous nongame species are, nevertheless, just as important. Nongame species are often benefited by the management intended to benefit livestock and game species. Land treatment that promotes maximum plant diversity and water quality will also favor the greatest diversity of wildlife.

In table 8, 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 flooding. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flooding, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, lovegrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, and 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 sumac, greenbriar, agarito, bumelia, and elbowbush.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, saltgrass, cordgrass, 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 waterfowl feeding areas and ponds.

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. Wildlife attracted to these areas include bobwhite quail, meadowlark, field sparrow, cottontail, and red fox.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include deer, quail, and meadowlark.

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. Ratings are given for 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 should 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 or 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 kinds 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 9 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 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, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 10 shows the degree and 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 10 also shows the suitability of the soils for use as daily cover for landfill. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are

moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to 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 10 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in 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 should be considered.

The ratings in table 10 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench 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 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 wind erosion.

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 the 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 11 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 to 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, a 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 a 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 have a water table at a depth of 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. They are used in many kinds of construction. Specifications for each use vary widely. In table 11, 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 high 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 12 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 and 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 for each soil the restrictive features that affect 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. The underlying material is not rated and should be evaluated during an onsite investigation. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, and sulfur. Availability of drainage outlets is not considered in the ratings.

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 control 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 erosion 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 and sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 20.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, 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 13 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 the heading "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 about 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, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 20.

Rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters,

respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 14 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, 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 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 and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6

percent; *high*, more than 6 percent; and *very high*, greater than 9 percent.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.02 to 0.64. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. The groups are as follows:

1. Coarse sands, sands, fine sands, and very fine sands.
2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, ash material, and sapric soil material.
3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay.
5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material.
6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay.
7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material.
8. Soils that are not subject to wind erosion because of coarse fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 14, 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 in 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 15 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, 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 and very 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 to very deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

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

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, and water standing in swamps and marshes is considered ponding rather than flooding.

Table 15 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs, on the average, once or less in 2 years (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it

occurs, on the average, more than once in 2 years (the chance of flooding is more than 50 percent in any year). *Common* is used when the occasional and frequent classes are grouped for certain purposes. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 days to 1 month, and *very long* if more than 1 month. Probable dates are expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

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.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The estimates are based mainly on observations of the water table at selected sites and on the evidence of a saturated zone, namely grayish colors or mottles (redoximorphic features) in the soil. Indicated in table 15 are the depth to the seasonal high water table; the kind of water table, that is, perched, apparent, or artesian; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 15.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone. An *artesian* water table is under hydrostatic head, generally below an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

Two numbers in the column showing depth to the water table indicate the normal range in depth to a saturated zone. Depth is given to the nearest half foot. The first numeral in the range indicates the highest water level. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. “More than 6.0” indicates that the water table is below a depth of 6 feet or that it is within a depth of 6 feet for less than a month.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is 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.

A *cemented pan* is a cemented or indurated subsurface layer within a depth of 5 feet. Such a pan causes 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 results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low, moderate,* or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Physical and Chemical Analyses of Selected Soils

The results of physical analysis of several typical pedons in the survey area are given in table 16 and the results of chemical analysis in table 17. The data are for soils sampled at carefully selected sites. Unless otherwise indicated, the pedons are typical of the series. They are described in the section “Soil Series and Their Morphology.” Soil samples were analyzed by the National Soil Survey Laboratory, Natural Resources Conservation Service, Lincoln, Nebraska.

Most determinations, except those for grain-size analysis and bulk density, were made on soil material smaller than 2 millimeters in diameter. Measurements

reported as percent or quantity of unit weight were calculated on an ovendry basis. The methods used in obtaining the data are indicated in the list that follows. The codes in parentheses refer to published methods *(8)*.

Sand—(0.05-2.0 mm fraction) weight percentages of material less than 2 mm (3A1).

Silt—(0.002-0.05 mm fraction) pipette extraction, weight percentages of all material less than 2 mm (3A1).

Clay—(fraction less than 0.002 mm) pipette extraction, weight percentages of material less than 2 mm (3A1).

Water retained—pressure extraction, percentage of ovendry weight of less than 2 mm material; $^1/_3$ or $^1/_{10}$ bar (4B1), 15 bars (4B2).

Linear extensibility—change in clod dimension based on whole soil (4D).

Organic carbon—wet combustion. Walkley-Black modified acid-dichromate, ferric sulfate titration (6A1c).

Extractable cations—ammonium acetate pH 7.0, atomic absorption; calcium (6N2e), magnesium (6O2d), sodium (6P2b), potassium (6Q2b).

Cation-exchange capacity—sum of cations (5A3a).

Base saturation—sum of cations, TEA, pH 8.2 (5C3).

Reaction (pH)—1:1 water dilution (8C1f).

Sodium adsorption ratio (5E).

Engineering Index Test Data

Table 20 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are representative of the series described in the section “Soil Series and Their Morphology.” The soil samples were tested by the Texas State Department of Highways and Public Transportation.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 422 (ASTM), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 4318 (ASTM); Plasticity index—T 90 (AASHTO), D 4318 (ASTM); Specific gravity—T 100 (AASHTO), D 854 (ASTM); and 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 *(7, 9)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 21 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven 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 Alfisol.

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 Ustalf (*Ust*, meaning burnt or dry, plus *alf*, from Alfisol).

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; type of saturation; 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 Paleustalfs (*Pale*, meaning old, plus *ustalf*, the suborder of the Alfisols that has an ustic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic subgroup 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 taxonomic class. 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 Paleustalfs.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle size, mineral content, soil temperature regime, soil depth, and reaction. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine, mixed, thermic Typic Paleustalfs.

SERIES. The series consists of soils within a family that have horizons similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. Characteristics of the soil and the material in which it formed are identified for each 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 “National Soil Survey Handbook” *(6)*. Many of the technical terms used in the descriptions are defined in “Soil Taxonomy” *(7)* and in “Keys to Soil Taxonomy” *(9)*. Unless otherwise indicated, 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.”

Bastrop Series

The Bastrop series consists of very deep, well drained, moderately permeable soils on terraces. These soils formed in loamy alluvial materials. Slopes range from 1 to 5 percent. The soils are fine-loamy, mixed, thermic Udic Paleustalfs.

Typical pedon of Bastrop loamy fine sand, 1 to 5 percent slopes; in Kingsland, from the intersection of Ranch Road 1431 and Ranch Road 3404, 1.0 mile west on Ranch Road 3404, 1.75 miles south on county road, and 68 feet west in rangeland.

A1—0 to 5 inches; dark yellowish brown (10YR 4/4) loamy fine sand, dark yellowish brown (10YR 3/4) moist; weak fine subangular blocky structure; slightly hard, very friable; common fine roots; neutral; clear smooth boundary.

A2—5 to 13 inches; dark brown (7.5YR 4/4) loamy fine sand, dark brown (7.5YR 3/4) moist; weak medium subangular blocky structure; slightly hard, very friable; common fine roots; few wormcasts; neutral; clear smooth boundary.

Bt1—13 to 20 inches; yellowish red (5YR 4/6) sandy clay loam, yellowish red (5YR 4/6) moist; moderate medium subangular blocky structure; hard, firm; few fine roots; few fine and very fine pores; few discontinuous clay films on surfaces of peds and in pores; slightly acid; gradual smooth boundary.

Bt22—20 to 48 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; moderate medium subangular blocky structure; hard, firm; few fine roots; few fine pores; few discontinuous clay films on surfaces of peds and in pores; neutral; gradual smooth boundary.

Bt3—48 to 80 inches; reddish yellow (5YR 6/6) sandy clay loam, yellowish red (5YR 5/6) moist; moderate medium subangular blocky structure; hard, firm; few fine roots; few fine pores; few discontinuous clay films on surfaces of peds; neutral.

Solum thickness ranges from 60 to more than 80 inches. Small siliceous pebbles range from none to about 3 percent by volume. The clay content of the control section ranges from 20 to 30 percent.

The A horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 4. The A horizon ranges from 6 to 20 inches in thickness. Reaction is moderately acid to neutral.

The Bt horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 4 to 6. Texture is loam, sandy clay loam, or clay loam. Reaction is moderately acid to neutral in the upper part and moderately acid to moderately alkaline in the lower part. Some pedons have calcium carbonate in the form of films, threads, and concretions below a depth of 60 inches.

The C horizon, where present, has hue of 5YR to 7.5YR, value of 5 to 7, and chroma of 4 to 6. Texture is loam, sandy clay loam, or clay loam with or without strata of fine sandy loam.

These soils are drier than typical for the series and therefore are less productive. They are taxadjuncts in this respect.

Bauman Series

The Bauman series consists of deep, moderately well drained, slowly permeable soils on uplands. These soils formed in colluvium and residuum weathered from granite grus (fig. 15). Slopes range from 0 to 2 percent. The soils are fine-loamy, mixed, thermic Typic Natrustalfs.

Typical pedon of Bauman loam, 0 to 2 percent slopes; in Llano, from the intersection of Texas Highway 16 and Texas Highway 29, about 11.5 miles east on Texas Highway 29 to the Granite Hills Hereford Ranch, 2.5 miles north on private ranch road, and 100 feet west in rangeland.

A—0 to 4 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, friable; common fine roots; few fine granite pebbles; slightly acid; abrupt smooth boundary.

E—4 to 6 inches; light gray (10YR 7/2) loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, friable; common fine roots; few fine granite pebbles; slightly acid; abrupt smooth boundary.

Btn1—6 to 11 inches; dark gray (10YR 4/1) clay loam, very dark gray (10YR 3/1) moist; moderate medium columnar structure parting to weak angular and subangular blocky; extremely hard, very firm; common fine roots on surfaces of peds; tops of columns coated with about 0.5 inch grayish cap; common fine angular weathered granite pebbles; neutral; gradual wavy boundary.

Btn2—11 to 20 inches; dark brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate medium angular and subangular blocky; extremely hard, very firm; few fine roots; discontinuous clay films on surfaces of peds; common fine angular weathered granite pebbles; neutral; clear wavy boundary.

Btkn—20 to 26 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; moderate fine angular and subangular blocky structure; hard, firm; few fine roots; discontinuous clay films on surfaces of peds; few fine masses and concretions of calcium carbonate; common fine granite pebbles; slightly alkaline; clear wavy boundary.

Btkng—26 to 42 inches; light brownish gray (2.5Y 6/2) gravelly sandy clay loam, grayish brown (2.5Y 5/2) moist; few very dark gray vertical streaks; weak medium prismatic structure parting to moderate very fine subangular blocky; hard, firm; few fine roots; discontinuous clay films on surfaces of peds; vertical surfaces of prisms having discontinuous coatings of films and threads of whitish fine crystalline material assumed to be gypsum; about 30 percent by volume angular granite pebbles; common masses and concretions of calcium carbonate; few fine concretions and stains of iron-manganese; slightly alkaline; clear wavy boundary.

2Crt—42 to 72 inches; finely fragmented granite grus with horizontal and vertical surfaces of fragments coated with red clay; few fine roots; few fine seams of clay in fractures; slightly alkaline.

Solum thickness and depth to weathered granite grus range from 40 to 60 inches. The weighted average clay content of the control section ranges from 30 to 35 percent. Coarse fragments consist of quartz and feldspar. Exchangeable sodium in the natric horizon ranges from 15 to 30 percent within 16 inches of the upper boundary of the Bt horizon. The EC ranges from 8 to 16 mmhos/cm below 26 inches. Some pedons contain one or more lithologic discontinuities based on the coarse sand to fine sand ratios. Redoximorphic features, where present, are considered relict.

The A horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 4. Very coarse and coarse sand content ranges from 5 to 15 percent. Coarse fragments range from few to 10 percent by volume. Reaction is slightly acid or neutral. The A horizon ranges from 3 to 10 inches in thickness.

The E horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 1 to 4. Coarse fragments range from few to 10 percent by volume. Reaction is slightly acid or neutral.

The Btn horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 1 to 3. Redoximorphic features in shades of brown, olive, or gray range from none to common. Texture is sandy clay loam or clay loam or their gravelly counterparts. Coarse fragments range from 2 to 15 percent by volume in the upper part and 10 to 20 percent in the lower part. Reaction is neutral or slightly alkaline.

The Btkn horizon, where present, has hue of 10YR to 5Y, value of 5 to 7, chroma of 2 to 4. Calcium carbonate content in the form of masses and concretions ranges from 2 to 5 percent. The content of gypsum and other salts ranges from a few crystals to about 5 percent. Coarse fragments range from 10 to 35 percent by volume. Reaction ranges from neutral to moderately alkaline.

The 2Cr horizon consists of weathered, finely fractured granite grus. Colors are variable. The materials have granite structure with nearly all natural surfaces having clay coatings. The grus becomes more compact and less weathered with depth. Reaction ranges from neutral to moderately alkaline.

Boerne Series

The Boerne series consists of very deep, well drained, moderately rapidly permeable soils on flood plains. These soils formed in loamy alluvial sediments. Slopes range from 0 to 2 percent. The soils are coarse-loamy, carbonatic, thermic Fluventic Ustochrepts.

Typical pedon of Boerne fine sandy loam, rarely flooded; in Castell, from the intersection of Ranch Road 152 and Ranch Road 2768, 0.2 mile north on Ranch Road 2768 across the Llano River to a county road, 1.6 miles east on county road, and 20 feet north in cropland.

Ap—0 to 10 inches; dark yellowish brown (10YR 4/4) fine sandy loam, dark yellowish brown (10YR 3/4) moist; moderate fine granular structure; slightly hard, friable; common fine roots; common very fine and fine pores; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk1—10 to 21 inches; strong brown (7.5YR 5/6) fine sandy loam, strong brown (7.5YR 4/6) moist; moderate medium subangular blocky structure; hard, firm; few fine roots; common fine pores; many films and threads of calcium carbonate; few masses of calcium carbonate; violently effervescent; moderately alkaline; clear smooth boundary.

Bk2—21 to 50 inches; pink (7.5YR 7/4) fine sandy loam, light brown (7.5YR 6/4) moist; moderate medium subangular blocky structure; hard, firm; few fine roots; about 12 percent by volume limestone coated with secondary carbonates; violently effervescent; moderately alkaline; clear smooth boundary.

BCk—50 to 62 inches; reddish yellow (7.5YR 6/6) loam, strong brown (7.5YR 5/6) moist; massive; hard, friable; few fine roots; few masses, many films and threads of calcium carbonate; strongly effervescent; moderately alkaline.

Solum thickness ranges from 40 to 80 inches. The calcium carbonate equivalent ranges from 40 to 75 percent. The texture of the control section is fine sandy loam or loam with 9 to 18 percent silicate clay content and up to 5 percent carbonate clay. Reaction is moderately alkaline throughout.

The A horizon has hue of 10YR, value of 4 to 6, and chroma of 2 to 4.

The Bk horizon has hue of 7.5YR or 10YR, value of 4 to 7, and chroma of 2 to 6.

The BCk horizon is similar in color to the Bk horizon. Texture is fine sandy loam or loam.

Campair Series

The Campair series consists of moderately deep, well drained, moderately permeable soils on uplands. These soils formed in material weathered from sandstone bedrock. Slopes range from 1 to 5 percent. The soils are fine-loamy, siliceous, thermic Typic Haplustalfs.

Typical pedon of Campair sand, 1 to 5 percent slopes; in Llano, from the northern intersection of Texas Highway 16 and Texas Highway 71, 12.0 miles west and northwest on Texas Highway 71, 0.5 mile east on county road (road in southern Valley Springs), 0.4 mile north to end of private road, and 300 feet north in rangeland.

A—0 to 11 inches; pale brown (10YR 6/3) sand, dark brown (10YR 4/3) moist; weak fine granular structure;

soft, very friable; common fine roots; few fine siliceous pebbles; slightly acid; clear smooth boundary.
E—11 to 14 inches; very pale brown (10YR 7/4) sand, dark yellowish brown (10YR 4/4) moist; weak very fine granular and subangular blocky structure; slightly hard, very friable; common fine roots; few fine siliceous pebbles; slightly acid; abrupt wavy boundary.
Bt1—14 to 18 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 5/4) moist; moderate medium angular blocky structure; hard, firm; few fine roots; few thin discontinuous clay films on surfaces of peds; common sandstone pebbles and cobbles somewhat aligned along the E—Bt contact; few fine siliceous pebbles; moderately acid; clear wavy boundary.
Bt2—18 to 31 inches; reddish yellow (7.5YR 6/6) sandy clay loam, strong brown (7.5YR 5/6) moist; moderate medium angular blocky structure; extremely hard, very firm; few fine roots; many medium prominent red (2.5YR 4/6) masses of iron accumulation with sharp boundaries; few thin clay films on surfaces of peds; few fine siliceous pebbles; moderately acid; gradual wavy boundary.
Bt3—31 to 38 inches; light gray (10YR 7/2) sandy clay loam, light brownish gray (10YR 6/2) moist; moderate coarse angular blocky structure; extremely hard, very firm; few fine roots; many coarse prominent red (2.5YR 4/8) and many coarse distinct yellowish brown (10YR 5/8) masses of iron accumulation with sharp boundaries; few thin clay films on surfaces of peds; moderately acid; abrupt smooth boundary.
R—38 to 42 inches; coarse-grained, strongly cemented sandstone that contains about 10 percent by volume imbedded fine siliceous pebbles; cementation strongest and reddish staining most expressed in upper 1 to 2 centimeters.

Solum thickness and depth to sandstone bedrock range from 20 to 40 inches. The combined thickness of the A and E horizons ranges from 10 to 20 inches. Redoximorphic features, where present, are considered relict.

The A horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 3 or 4. Reaction is slightly acid or neutral. The A horizon ranges from 6 to 18 inches in thickness.

The E horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 4. Reaction is slightly acid or neutral.

The Bt horizon has hue of 5YR or 7.5YR, value of 4 to 7, and chroma of 2 to 6. Redoximorphic features in shades of red, yellow, brown, or gray range from few to many in the lower part. In places, the matrix is light gray. Texture is sandy clay loam or clay loam. Reaction is moderately acid to neutral.

The R layer is reddish or brownish sandstone. Because of similar weathering patterns, some layers are metamorphic gneiss bedrock.

Castell Series

The Castell series consists of moderately deep, well drained, slowly permeable soils on uplands. These soils formed in materials weathered from gneiss bedrock (fig. 16). Slopes range from 1 to 5 percent. The soils are fine, mixed, thermic Typic Paleustalfs.

Typical pedon of Castell sandy loam, 1 to 5 percent slopes; in Llano, from the intersection of Texas Highway 16 and Texas Highway 29, 9.7 miles west on Texas Highway 29, and 120 feet south of highway in rangeland.

A—0 to 8 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; massive when dry; very hard, friable; common fine roots; common fine pores; few fine fragments of angular quartz; slightly acid; clear smooth boundary.
Bt1—8 to 17 inches; yellowish brown (10YR 5/4) sandy clay, dark yellowish brown (10YR 4/4) moist; moderate medium subangular blocky structure; very hard, firm; common fine roots; common fine pores; thin discontinuous clay films on surfaces of peds; few fine and medium fragments of quartz and gneiss; slightly acid; clear smooth boundary.
Bt2—17 to 30 inches; strong brown (7.5YR 4/6) sandy clay, strong brown (7.5YR 4/6) moist; moderate medium subangular blocky structure; very hard, firm; few fine roots; few fine pores; common fine distinct reddish yellow and yellowish brown masses of iron accumulation; thin discontinuous clay films on surfaces of peds; few fine and medium fragments of gneiss and quartz; moderately acid; abrupt smooth boundary.
Cr—30 to 42 inches; weathered pinkish gneiss that becomes harder with depth.

Solum thickness ranges from 20 to 40 inches. The solum is underlain by weathered gneiss bedrock. Coarse fragments consisting mostly of feldspar, gneiss, and quartz are throughout the solum and range from 5 to 30 percent by volume. Base saturation ranges from 75 to 100 percent.

The A horizon has hue of 5YR to 10YR, value of 4 or 5, and chroma of 2 to 4. The boundary between the A and Bt horizon is abrupt or clear. Reaction is moderately acid to neutral. The A horizon ranges from 6 to 18 inches in thickness.

The Bt horizon dominantly has hue of 7.5YR or 10YR (but can include 5YR), value of 4 to 6, and chroma of 3 to 6. Redoximorphic features with hue of 2.5YR to 10YR, value of 4 to 6, and chroma of 3 to 6 range from none to

common. Texture is sandy clay, clay loam, clay, or their gravelly counterparts. The clay content of the fine earth fraction ranges from 35 to 50 percent. Reaction is moderately acid to slightly alkaline.

The Cr horizon consists of weathered gneiss (saprolite) or relatively unweathered and finely fractured gneiss.

Cho Series

The Cho series consists of well drained and moderately permeable soils on uplands. These soils are very shallow and shallow over a petrocalcic layer. They formed in loamy and gravelly sediments. Slopes range from 1 to 3 percent. The soils are loamy, carbonatic, thermic, shallow Petrocalcic Calciustolls.

Typical pedon of Cho loam, 1 to 3 percent slopes; in Kingsland, from intersection of Ranch Road 1431 and Ranch Road 3404, 0.6 mile north on Ranch Road 1431, 2.6 miles east and northeast on county road, and 100 feet west in rangeland.

A1—0 to 5 inches; dark brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; moderate fine subangular blocky structure; slightly hard, friable; many very fine and common fine roots; about 5 percent by volume fragments of indurated caliche; strongly effervescent; moderately alkaline; clear smooth boundary.

A2—5 to 14 inches; dark brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, firm; common very fine and few fine roots; about 5 percent by volume pebbles of indurated caliche; common very fine, irregular soft filaments of calcium carbonate; violently effervescent; moderately alkaline; abrupt wavy boundary.

Bkm—14 to 16 inches; reddish yellow (7.5YR 8/6) indurated caliche, reddish yellow (7.5YR 6/6) moist; broken into plates 6 to 12 inches across and 1 to 2 inches thick; laminar in upper part; about 5 percent by volume brown (7.5YR 5/4) loam between plates and in solution channels; few fine roots; violently effervescent; moderately alkaline; clear wavy boundary.

BCk—16 to 45 inches; pink (7.5YR 7/4) gravelly loam, light brown (7.5YR 6/4) moist; weak fine subangular blocky structure; soft, very friable; few fine roots; about 30 percent by volume fine concretions of calcium carbonate; violently effervescent; moderately alkaline.

Solum thickness, depth to the petrocalcic horizon, and thickness of the mollic epipedon range from 8 to 20 inches. The clay content of the control section is from 15 to 25 percent. Calcium carbonate equivalent ranges from 40 to 65 percent. Reaction is moderately alkaline throughout.

The A horizon has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 2 or 3. Pebbles and fragments of indurated caliche make up 5 to 14 percent by volume.

The Bkm horizon is platy or massive, typically with a laminar cap from 0.5 to about 2.5 inches thick.

The BCk horizon has hue of 5YR or 7.5YR, value of 7 or 8, and chroma of 2 to 4. Texture of the fine earth fraction is loam or clay loam.

Click Series

The Click series consists of deep, somewhat excessively drained, rapidly permeable soils on uplands. These soils formed in material weathered from granite grus (fig. 17). Slopes range from 1 to 8 percent. The soils are loamy-skeletal, mixed, thermic Typic Haplustalfs.

Typical pedon of Click very gravelly coarse sandy loam, 1 to 8 percent slopes; in Llano, from the intersection of Texas Highway 16 and Ranch Road 2323, 23.7 miles southwest on Ranch Road 2323 past the Prairie Mountain Community Center, 0.3 mile west on county road, 3.9 miles northwest on county road, and 100 feet south in rangeland.

A—0 to 11 inches; brown (7.5YR 5/4) very gravelly coarse sandy loam, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, very friable; many fine, common medium, and few coarse roots; many fine and few coarse discontinuous tubular pores; about 40 percent by volume fragments of angular quartz and feldspar 2 to 5 millimeters across; slightly acid; clear wavy boundary.

Bt1—11 to 18 inches; yellowish red (5YR 5/6) very gravelly coarse sandy loam, yellowish red (5YR 4/6) moist; weak medium subangular blocky structure; slightly hard, very friable; common fine and medium roots; common fine and few coarse discontinuous tubular pores; about 45 percent by volume fragments of angular quartz and feldspar 2 to 5 millimeters across; slightly acid; clear smooth boundary.

Bt2—18 to 29 inches; red (2.5YR 5/6) very gravelly sandy clay loam, red (2.5YR 4/6) moist; weak coarse subangular blocky structure parting to weak medium subangular blocky; slightly hard, very friable; few fine and medium roots; few fine and coarse discontinuous tubular pores; discontinuous clay films on surfaces of peds and clay bridging of sand grains; about 55 percent by volume fragments of angular quartz and feldspar, 2 to 10 millimeters across; neutral; clear wavy boundary.

Bt3—29 to 46 inches; light red (2.5YR 6/8) very gravelly coarse sandy loam, red (2.5YR 5/8) moist; weak very

coarse prismatic structure parting to weak coarse subangular blocky; hard, firm; few fine and medium roots; few fine and medium discontinuous tubular pores; distinct clay films on surfaces of prisms, in root channels, and on fragments; dark brown (10YR 4/3) coatings on surfaces of prisms; about 60 percent by volume fragments of angular quartz and feldspar, 2 to 10 millimeters across; common mica flakes; neutral; abrupt smooth boundary.

Cr—46 to 53 inches; red (2.5YR 5/8) finely fragmented granite grus; structure controlled by angular rock fragments; few fine roots about 2 to 3 feet apart; fragments coated with thin red clay in horizontal and vertical fractures; neutral; abrupt smooth boundary.

R—53 to 56 inches; pink indurated and fractured granite.

Solum thickness to fractured granite grus containing less than 5 percent fine earth ranges from 40 to 60 inches. Reaction is slightly acid or neutral throughout.

The A horizon has hue of 7.5YR or 10YR, value of 4 to 7, and chroma of 3 or 4. Very coarse and coarse sand make up 40 to 60 percent of the sand fraction. Fragments of feldspar and angular quartz 2 to 15 millimeters across make up 35 to 45 percent by volume.

The Bt horizon has hue of 2.5YR to 7.5YR, value of 4 to 6, and chroma of 4 to 8. Texture is very gravelly sandy loam or very gravelly sandy clay loam with a clay content of 12 to 21 percent in the fine earth fraction. Fragments of feldspar and angular quartz 2 to 20 millimeters across range from 35 to 60 percent by volume.

The Cr horizon is fractured, weathered granite grus. Coarse fragments in the upper few inches have clay coatings.

The R layer is crystalline granite that is fractured. It contains up to 5 percent by volume streaks and masses of clayey earth.

Eckrant Series

The Eckrant series consists of very shallow and shallow, well drained, moderately slowly permeable soils on uplands. These soils formed in clayey residuum weathered from limestone bedrock (fig. 18). Slopes range from 1 to 40 percent. The soils are clayey-skeletal, montmorillonitic, thermic Lithic Haplustolls.

Typical pedon of Eckrant very cobbly clay, in an area of Eckrant-Rock outcrop complex, 10 to 40 percent slopes, extremely stony; in Llano, from the southern intersection of Texas Highway 16 and Texas Highway 71, 12.1 miles southeast on Texas Highway 71, 1.8 miles south on a county road, and 586 feet west in rangeland.

A1—0 to 4 inches; very dark grayish brown (10YR 3/2) very cobbly clay, very dark brown (10YR 2/2) moist; strong fine granular and subangular blocky structure; very hard, firm; many fine and few medium roots; few fine pores; few wormcasts; about 25 percent of the soil surface covered by fragments of limestone more than 10 inches across; 35 percent by volume of limestone cobbles and pebbles; slightly alkaline; clear irregular boundary.

A2—4 to 13 inches; very dark grayish brown (10YR 3/2) very cobbly clay, very dark brown (10YR 2/2) moist; strong fine granular and subangular blocky structure; very hard, firm; many fine and medium roots; few fine pores; 40 percent by volume limestone cobbles and stones; slightly alkaline; abrupt wavy boundary.

R—13 to 14 inches; light gray, coarsely fractured indurated limestone bedrock.

Solum thickness and depth to limestone bedrock range from 5 to 14 inches. Fragments of limestone more than 10 inches across range from 15 to 40 percent by volume. Limestone cobbles and pebbles range from 20 to 55 percent. Reaction is neutral to moderately alkaline.

The A horizon has hue of 7.5YR or 10YR, value of 2 to 4, and chroma of 1 to 3. Clay content ranges from 35 to 60 percent.

The R layer is hard, fractured limestone bedrock with a hardness of more than 3 on Mohs scale.

Fieldcreek Series

The Fieldcreek series consists of very deep, well drained, moderately rapidly permeable soils on flood plains. These soils formed in loamy alluvial sediments weathered from sedimentary and metamorphic rock. Slopes range from 0 to 2 percent. The soils are coarse-loamy, mixed, thermic Cumulic Haplustolls.

Typical pedon of Fieldcreek fine sandy loam, occasionally flooded; in Llano, from southern intersection of Texas Highway 16 and Texas Highway 71, 8.5 miles southeast on Texas Highway 71, 3.8 miles east on Ranch Road 3404, and 190 feet north in native pecan orchard.

A1—0 to 8 inches; dark brown (10YR 4/3) fine sandy loam, dark brown (10YR 3/3) moist; weak fine granular structure; slightly hard, very friable; many fine roots; common fine pores; few pebbles of feldspar and quartz less than 1 inch across; neutral; clear smooth boundary.

A2—8 to 25 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky and granular structure; slightly hard, friable; common fine roots; many fine and few medium pores; few wormcasts; few mica flakes; neutral; gradual smooth boundary.

Bw1—25 to 48 inches; dark brown (7.5YR 4/4) loam, dark brown (7.5YR 3/4) moist; weak fine subangular blocky; slightly hard, friable; few fine roots; few dark stains; common mica flakes; slightly alkaline; gradual smooth boundary.

Bw2—48 to 80 inches; brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) moist; weak fine subangular blocky; slightly hard, very friable; few fine roots; many mica flakes; about 10 percent by volume feldspar and quartz pebbles mainly less than 2 inches across; very slightly effervescent; moderately alkaline.

Solum thickness is greater than 80 inches to bedrock. The weighted average clay content of the control section ranges from 10 to 18 percent. Coarse fragments range from none to 10 percent by volume in the control section. Some pedons have thin gravelly strata below a depth of 40 inches.

The A horizon has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 2 or 3. Reaction is slightly acid to moderately alkaline. The thickness of the A horizon ranges from 20 to 40 inches.

The Bw horizon has hue of 7.5YR or 10YR, value of 4 to 6, chroma of 4 to 6. Texture is sandy loam, fine sandy loam, loam, or their gravelly counterparts. Siliceous and feldspar pebbles range from 1 to 20 percent by volume. Some pedons have buried A horizons with fine sandy loam or sandy clay loam textures. Reaction is neutral to moderately alkaline.

Harper Series

The Harper series consists of shallow, well drained, moderately slowly permeable soils on uplands. These soils formed in residuum weathered from limestone bedrock. Slopes range from 0 to 5 percent. The soils are clayey, montmorillonitic, thermic Lithic Haplustolls.

Typical pedon of Harper clay, 0 to 3 percent slopes, stony; in Llano, from the southern intersection of Texas Highway 16 and Texas Highway 71, 24.5 miles southeast on Texas Highway 71 to intersection with Ranch Road 2147, continue 3 miles southeast on Highway 71 to gas pipeline, about 40 feet south of the highway and 500 feet east of the gas pipeline.

A1—0 to 5 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate medium granular structure; slightly hard, firm; common fine and medium roots; about 3 percent of surface is covered by fragments of limestone more than 10 inches across; 10 percent by volume limestone pebbles and cobbles; noncalcareous; slightly alkaline; clear smooth boundary.

A2—5 to 11 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate medium granular structure; slightly hard, firm; common fine roots; about 10 percent by volume limestone pebbles and cobbles; noncalcareous; slightly alkaline; abrupt smooth boundary.

R—11 to 15 inches; light gray indurated, fractured dolomitic limestone bedrock.

Solum thickness and depth to limestone bedrock range from 11 to 18 inches. Fragments of limestone on the soil surface range from 2 to 10 percent. Limestone pebbles and cobbles in the soil range from 5 to 10 percent by volume.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. Reaction is slightly alkaline or moderately alkaline, and the horizon is noncalcareous.

The R layer is indurated dolomitic limestone or dolomite. The limestone bedrock is harder than 3 on Mohs scale.

Hensley Series

The Hensley series consists of shallow, well drained, slowly permeable soils on uplands. These soils formed in residuum weathered from dolomitic limestone bedrock. Slopes range from 1 to 5 percent. The soils are clayey, mixed, thermic Lithic Rhodustalfs.

Typical pedon of Hensley loam, 1 to 5 percent slopes, stony; in Llano, from the southern intersection of Texas Highway 16 and Texas Highway 71, 24.5 miles southeast on Texas Highway 71 to the intersection of Ranch Road 2147, continue 2.1 miles southeast on Highway 71, 0.15 mile south on private ranch road, and 50 feet east in rangeland.

A—0 to 5 inches; dark brown (7.5YR 4/2) loam, dark brown (10YR 3/2) moist; moderate medium granular structure; hard, firm; common fine and medium roots; about 1 percent of the soil surface covered by fragments of limestone more than 10 inches across; about 5 percent by volume limestone pebbles and cobbles; neutral; clear smooth boundary.

Bt—5 to 18 inches; red (2.5YR 4/6) clay, dark red (2.5 YR 3/6) moist; weak coarse prismatic structure parting to moderate medium subangular blocky structure; hard, firm; common very fine and fine roots; slightly alkaline; abrupt smooth boundary.

R—18 to 20 inches; hard, light gray, fractured dolomitic limestone bedrock.

Solum thickness and depth to limestone bedrock range

from 10 to 20 inches. Fragments of limestone more than 10 inches across cover 1 to 3 percent of the soil surface. Limestone pebbles and cobbles range from 2 to 10 percent by volume.

The A horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4. Reaction is slightly acid to slightly alkaline. The A horizon ranges from 5 to 8 inches in thickness.

The Bt horizon has hue of 2.5YR, value of 3 or 4, and chroma of 4 to 6. Texture is clay loam or clay with clay content of 35 to 55 percent. Reaction is neutral to moderately alkaline.

The R layer is fractured dolomitic limestone with a hardness of greater than 3 on Mohs scale.

Honeycreek Series

The Honeycreek series consists of deep, well drained, moderately permeable soils on uplands. These soils formed over schist bedrock. Slopes range from 1 to 3 percent. The soils are fine-loamy, mixed, thermic Typic Haplustalfs.

Typical pedon of Honeycreek fine sandy loam, 1 to 3 percent slopes; in Llano, from the southern intersection of Texas Highway 16 and Texas Highway 71, 12.0 miles southeast on Texas Highway 71 to Click county road, 5.8 miles west and south on county road to the intersection of Oxford county road, and 150 feet southwest in rangeland.

A1—0 to 9 inches; strong brown (7.5YR 4/6) fine sandy loam, dark brown (7.5YR 3/4) moist; weak medium subangular blocky structure; hard, friable; common fine and few medium roots; many very fine and fine pores; slightly acid; clear smooth boundary.

A2—9 to 17 inches; reddish brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; weak medium subangular blocky structure; hard, friable; few fine and medium roots; common very fine and fine and few coarse pores; slightly acid; gradual smooth boundary.

Bt1—17 to 25 inches; reddish brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; moderate coarse subangular blocky structure; very hard, firm; few fine roots; few fine and medium pores; few thin clay films in pores and clay bridging of sand grains; neutral; clear smooth boundary.

Bt2—25 to 37 inches; reddish brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; moderate medium subangular blocky structure; very hard, firm; common very fine and fine roots; thin, discontinuous clay films on surfaces of peds; few siliceous pebbles less than 2 inches across; neutral; gradual smooth boundary.

Bt3—37 to 50 inches; strong brown (7.5YR 5/6) gravelly sandy clay loam, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; hard, firm; few very fine roots; common very fine and fine pores; thin discontinuous clay films on surfaces of peds; about 20 percent by volume siliceous pebbles less than 2 inches across; neutral; clear smooth boundary.

BCt—50 to 56 inches; reddish yellow (7.5YR 6/6) gravelly fine sandy loam, strong brown (7.5YR 4/6); weak fine subangular blocky structure; hard, firm; few fine roots; few very fine and fine pores; thin, discontinuous clay films on surfaces of peds; about 20 percent by volume siliceous pebbles less than 2 inches across; neutral; clear smooth boundary.

Cr—56 to 66 inches; weathered schist bedrock; weak coarse platy structure that is tilted 30 degrees from horizontal; few fine roots.

Solum thickness and depth to bedrock range from 40 to 60 inches. The average clay content of the control section ranges from 18 to 25 percent. The reaction is slightly acid or neutral throughout.

The A horizon has hue of 5YR to 10YR, value of 4 to 6, and chroma of 3 or 4. The A horizon ranges from 6 to 19 inches in thickness.

The Bt horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 4 or 6. Some pedons have redoximorphic features in shades of red, yellow, or brown that range from few to common. Texture is sandy loam, fine sandy loam, or sandy clay loam. Coarse fragments consisting of quartz gravel range from 0 to 35 percent by volume. Coarse fragments are mainly in the lower part of the argillic horizon, but some pedons have few pebbles throughout.

The BCt horizon is similar to the Bt horizon in color and texture, but the structure is weaker.

The Cr horizon is schist, schistose-gneiss, or gneiss bedrock. It is commonly tilted 10 to 45 degrees from horizontal. The bedrock has colors mainly in shades of yellow or brown.

Hye Series

The Hye series consists of moderately deep, well drained, moderately permeable soils on uplands. These soils formed in residuum weathered from sandstone bedrock. Slopes range from 1 to 5 percent. The soils are fine-loamy, mixed, thermic Typic Haplustalfs.

Typical pedon of Hye fine sandy loam, 1 to 5 percent slopes; in Llano, from the southern intersection of Texas Highway 16 and Texas Highway 71, 1.2 miles south on Texas Highway 16, 7.0 miles east and southeast on county road, and 50 feet west in rangeland.

A—0 to 10 inches; brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) moist; weak fine subangular blocky and weak fine granular structure; hard, very friable; many fine roots; neutral; gradual smooth boundary.

Bt1—10 to 18 inches; reddish brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; moderate fine subangular blocky structure; very hard, friable; common fine and medium roots; common fine pores; few discontinuous clay films on surfaces of peds; common fine fragments of ironstone and sandstone; few wormcasts; neutral; gradual smooth boundary.

Bt2—18 to 24 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; moderate fine subangular blocky structure; very hard, friable; few fine and medium roots; few fine pores; few discontinuous clay films on surfaces of peds; few fine fragments of ironstone and sandstone; neutral; gradual smooth boundary.

Bt3—24 to 31 inches; yellowish red (5YR 5/6) gravelly sandy clay loam, yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; hard, friable; few fine roots; few fine pores; few discontinuous clay films on surfaces of peds; 20 percent by volume fine fragments of ironstone and sandstone; neutral; abrupt smooth boundary.

Cr—31 to 38 inches; weathered sandstone bedrock, moderately cemented in upper 4 inches.

Solum thickness and depth to sandstone bedrock range from 20 to 40 inches. Clay content of the control section ranges from 18 to 32 percent. Reaction is slightly acid or neutral throughout. Redoximorphic features, where present, are considered relict.

The A horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. The A horizon ranges from 8 to 14 inches in thickness.

The Bt horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 4 to 6. Some pedons have redoximorphic features with sharp boundaries in shades of yellow, brown, or gray below a depth of 30 inches. Texture is fine sandy loam or sandy clay loam. Fragments of ironstone and sandstone range from 5 to 30 percent by volume.

The Cr layer is weathered sandstone with fractures at intervals of 2 to 12 feet.

Katemcy Series

The Katemcy series consists of moderately deep, well drained, moderately slowly permeable soils on uplands. These soils formed over schist bedrock (fig. 19). Slopes range from 1 to 5 percent. The soils are fine, mixed, thermic Typic Haplustalfs.

Typical pedon of Katemcy sandy loam, 1 to 5 percent slopes; in Llano, from the intersection of Texas Highway 16 and Ranch Road 2323, 12.3 miles southwest on Ranch Road 2323, 0.5 mile north and 1.8 miles west on county road, 0.5 mile west on private road to ranch headquarters, 500 feet northeast to pasture gate, 1.6 miles north on field road, and 100 feet east in rangeland.

A1—0 to 3 inches; reddish brown (5YR 5/3) sandy loam, dark reddish brown (5YR 3/3) moist; weak coarse platy structure; very hard and massive when dry, very friable; many fine and few coarse roots; common fine and medium discontinuous tubular pores; 2 percent by volume angular quartz pebbles 2 to 8 centimeters across; neutral; clear smooth boundary.

A2—3 to 9 inches; reddish brown (5YR 5/3) sandy loam, dark reddish brown (5YR 3/3) moist; weak coarse subangular blocky structure; very hard and massive when dry, very friable; many fine and few coarse roots; common fine and medium discontinuous tubular pores; 2 percent by volume angular quartz pebbles 2 to 8 centimeters across; neutral; abrupt smooth boundary.

Bt1—9 to 11 inches; reddish brown (5YR 5/3) sandy clay loam, dark reddish brown (5YR 3/3) moist; weak coarse subangular blocky structure; very hard, firm; common fine and few coarse roots; common fine and medium tubular pores; common thin, discontinuous clay films on surfaces of peds and pore linings; 5 percent by volume angular quartz pebbles 2 to 8 centimeters across; neutral; clear smooth boundary.

Bt2—11 to 20 inches; red (2.5YR 4/6) sandy clay, dark red (2.5YR 3/6) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, firm; common fine and few coarse roots; continuous, distinct clay films on vertical and horizontal surfaces of peds; 10 percent by volume quartz and schist pebbles 2 to 8 centimeters across; 2 percent schist cobbles 8 to 20 centimeters across; neutral; gradual smooth boundary.

Bt3—20 to 27 inches; reddish brown (2.5YR 5/4) gravelly sandy clay, reddish brown (2.5YR 4/4) moist; moderate medium and coarse prismatic structure parting to weak medium subangular blocky; very hard, very firm; few fine and coarse roots; few fine and medium tubular pores; continuous, distinct clay films on vertical and horizontal surfaces of peds; 15 percent by volume quartz and schist pebbles 2 to 8 centimeters across; 2 percent schist cobbles 8 to 20 centimeters across; neutral; abrupt irregular boundary.

BCt—27 to 38 inches; reddish brown (2.5YR 5/4) channery sandy clay loam, reddish brown (2.5YR 4/4) moist; weak medium subangular blocky structure; very hard, firm; few fine and coarse roots; few fine and

medium tubular pores; discontinuous, distinct clay films on vertical and horizontal surfaces of peds; about 20 percent by volume schist channers 3 to 4 inches across; neutral; abrupt irregular boundary.

Cr—38 to 79 inches, weathered schist that is tilted and jointed; few fine roots along fractures; clay coatings along some fractures.

Solum thickness and depth to weathered schist bedrock range from 20 to 40 inches. Coarse fragments on the soil surface consist of quartz, schist, or schistose-gneiss and are mainly less than 3 inches across. Reaction is slightly acid to slightly alkaline throughout.

The A horizon has hue of 5YR to 10YR, value of 3 to 5, and chroma of 2 to 4. Coarse fragments range from few to 10 percent by volume.

The Bt horizon has hue of 2.5YR to 7.5YR, value of 3 to 6, and chroma of 3 to 6. Texture of the Bt1 and Bt2 horizons is sandy clay loam, sandy clay, or clay with clay content ranging from 27 to 40 percent but averaging more than 35 percent in the control section. Coarse fragments range from few to 15 percent by volume.

Texture of the Bt3 and BCt horizons, where present, is sandy clay loam, sandy clay, or their gravelly counterparts. Coarse fragments consisting of gravel and channers range from 15 to 30 percent by volume.

The Cr horizon is saprolite, and it is weakly cemented to indurated schist and schistose-gneiss that is finely fractured. These materials are in shades of red, yellow, brown, gray, olive, or green and are tilted from 10 to 60 degrees from horizontal. Reddish clay coatings are along fractures.

Keese Series

The Keese series consists of shallow, well drained, moderately rapidly permeable soils on uplands. These soils formed in residuum weathered from granite or gneiss bedrock. Slopes range from 1 to 30 percent. The soils are loamy, mixed, thermic, shallow, Typic Ustochrepts.

Typical pedon of Keese coarse sandy loam, in an area of Keese-Rock outcrop complex, 1 to 8 percent slopes, very stony; in Llano, from the intersection of Texas Highway 16 and Ranch Road 152, 18.2 miles west on Ranch Road 152, 3.5 miles south on county road, 2.0 miles east and north on private ranch road, and 20 feet east in rangeland.

A—0 to 5 inches, dark brown (7.5YR 4/4) coarse sandy loam, dark brown (7.5YR 3/4) moist; weak medium granular structure; slightly hard, very friable; common fine roots; about 8 percent by volume granite pebbles; few fragments of granite 8 to 15 inches across; slightly acid; clear smooth boundary.

Bw1—5 to 10 inches; dark brown (7.5YR 4/4) coarse sandy loam, dark brown (7.5YR 3/4) moist; weak medium subangular blocky structure; slightly hard, friable; common fine roots; about 10 percent by volume granite pebbles; few fragments of granite 8 to 15 inches across; slightly acid; clear smooth boundary.

Bw2—10 to 14 inches; strong brown (7.5YR 4/6) gravelly coarse sandy loam, strong brown (7.5YR 4/6) moist; weak medium subangular blocky structure; slightly hard, very friable; common fine roots; about 20 percent by volume granite pebbles; few fragments of granite 8 to 15 inches across; slightly acid; abrupt smooth boundary.

Cr—14 to 16 inches; reddish brown weathered granite grus with fragments up to 4 inches across; few fine roots.

Solum thickness and depth to weathered granite or gneiss range from 10 to 20 inches. Fragments of feldspar and quartz 1 to 15 millimeters across make up 5 to 30 percent by volume. Coarse fragments of granite or gneiss from 8 to 20 inches across cover 2 to 15 percent of the soil surface. Reaction is moderately acid or slightly acid throughout.

The A horizon has hue of 5YR to 10YR, value of 5 or 6, and chroma of 4 to 6. Texture is coarse sandy loam, sandy loam, or their gravelly counterparts. The A horizon ranges from 4 to 10 inches in thickness.

The B horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 4 to 6. Texture is coarse sandy loam, sandy loam, or their gravelly counterparts.

Some pedons have a C horizon of partially weathered granite grus.

The Cr layer is weathered granite grus in shades of red, brown, or gray or weathered gneiss in shades of red or brown. These materials are weakly to strongly cemented when dry but can be chipped or dug with a spade when moist. This material becomes harder with depth.

Krum Series

The Krum series consists of very deep, well drained, moderately slowly permeable soils on uplands. These soils formed in clayey alluvium. Slopes range from 1 to 3 percent. The soils are fine, montmorillonitic, thermic Udertic Haplustolls.

Typical pedon of Krum silty clay, 1 to 3 percent slopes; in Llano, from the southern intersection of Texas Highway 16 and Texas Highway 71, 12 miles southeast on Texas Highway 71, 2.25 miles west on county road to the Honey Creek Ranch, 0.8 mile south on private ranch road, and 600 feet southeast in rangeland.

A1—0 to 12 inches; very dark gray (10YR 3/1) silty clay, black (10YR 2/1) moist; strong medium subangular blocky structure; hard, friable; many fine roots; few fine pores; slightly effervescent; moderately alkaline; gradual smooth boundary.
A2—12 to 28 inches; very dark gray (10YR 3/1) silty clay, black (10YR 2/1) moist; strong medium subangular blocky structure; hard, friable; common fine roots; common fine pores; strongly effervescent; moderately alkaline; gradual smooth boundary.
Bw—28 to 40 inches; grayish brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; hard, firm; few fine roots; common fine pores; few fine concretions of calcium carbonate; few films and threads of calcium carbonate; strongly effervescent; moderately alkaline; gradual smooth boundary.
Bk1—40 to 48 inches; pale brown (10YR 6/3) silty clay, brown (10YR 5/3) moist; moderate medium subangular blocky structure; hard, firm; few fine roots; few fine pores; about 5 percent by volume masses and concretions of calcium carbonate; violently effervescent; moderately alkaline; clear smooth boundary.
Bk2—48 to 55 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 5/3) moist; weak subangular blocky structure; hard, friable; few fine roots; few fine pores; about 10 percent by volume masses and concretions of calcium carbonate; violently effervescent; moderately alkaline; diffuse smooth boundary.
BCk—55 to 80 inches, light yellowish brown (10YR 6/4) silty clay loam, yellowish brown (10YR 5/4) moist; massive; hard, friable; few fine roots; 4 percent by volume masses and concretions of calcium carbonate; strongly effervescent; moderately alkaline.

Solum thickness ranges from 60 to more than 80 inches. The soil, when dry, has cracks 0.5 to 1.5 inches wide that extend to a depth of 20 inches.

The A horizon has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 1 to 3. Reaction is slightly alkaline or moderately alkaline. The A horizon ranges from 12 to 30 inches in thickness.

The Bw horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 2 to 4. Texture is silty clay or clay. Reaction is slightly alkaline or moderately alkaline.

The Bk horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 3 to 6. Texture is silty clay or clay. Calcium carbonate in the form of concretions and masses ranges up to 10 percent by volume. Reaction is moderately alkaline.

The BCk horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 4 to 6. Texture is silty clay loam, silty clay, or clay. Calcium carbonate in the form of concretions and soft powdery lime ranges from 1 to 10 percent by volume. Reaction is moderately alkaline.

These soils are drier than typical for the series and therefore are less productive. They are taxadjuncts in this respect.

Ligon Series

The Ligon series consists of moderately deep, well drained, moderately slowly permeable soils on uplands. These soils formed in residuum weathered from schist and schistose-gneiss bedrock. Slopes range from 1 to 12 percent. The soils are fine, mixed, thermic, Typic Rhodustalfs.

Typical pedon of Ligon fine sandy loam, 1 to 5 percent slopes; in Llano, from the intersection of Texas Highway 16 and Ranch Road 2323, 11.6 miles southwest on Ranch Road 2323, 3.0 miles north on county road, 1.3 miles north on private road, and 60 feet west in rangeland.

A—0 to 4 inches; reddish brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; weak fine subangular blocky structure parting to moderate very fine granular; hard, friable; many very fine and fine roots; many very fine and fine discontinuous tubular pores; 10 percent by volume quartz pebbles; slightly acid; abrupt smooth boundary.
Bt1—4 to 7 inches; reddish brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) moist; moderate fine subangular blocky structure; very hard, firm; common fine and few medium roots; discontinuous dark reddish brown (2.5YR 3/4) clay films on surfaces of peds and on coarse fragments; 15 percent by volume quartz cobbles; slightly acid; clear smooth boundary.
Bt2—7 to 18 inches; red (2.5YR 4/6) clay, dark red (2.5YR 3/6) moist; weak medium prismatic structure parting to moderate medium subangular blocky; very hard, firm; few very fine and fine roots; discontinuous dark red (2.5YR 3/6) clay films on surfaces of peds; neutral; gradual smooth boundary.
Bt/C—18 to 23 inches; red (2.5YR 4/6) sandy clay loam, dark red (2.5YR 3/6) moist; weak medium prismatic structure parting to weak medium subangular blocky; hard, firm; few fine and medium roots; discontinuous clay films on surfaces of peds; 3 percent by volume siliceous pebbles; weakly consolidated reddish brown (5YR 4/4) fragments of schist (C) make up 20 percent by volume; neutral; gradual smooth boundary.
C—23 to 32 inches; reddish brown (5YR 4/4) weathered schist; few very fine and fine roots penetrating cleavage planes; neutral; gradual wavy boundary.
Cr—32 to 51 inches; tilted, weakly cemented schist bedrock; few fine roots between plates and seams.

Solum thickness and depth to schist or schistose-gneiss bedrock range from 20 to 40 inches. Coarse fragments of quartz and angular schist range from few to 20 percent by volume. Reaction is moderately acid to slightly alkaline throughout.

The A horizon has hue of 2.5YR to 7.5YR, value of 3 to 5, and chroma of 4 to 6. Texture is fine sandy loam or cobbly fine sandy loam.

The Bt horizon has hue of 2.5YR, value of 2 to 4, and chroma of 4 to 6. Texture is sandy clay loam, clay loam, clay, or their gravelly counterparts. Average clay content of the control section is 35 to 45 percent.

The C horizon is weathered schist or schistose-gneiss.

The Cr horizon is weakly consolidated to cemented, weathered tilted schist or schistose-gneiss bedrock that can be dug with a spade when moist. In most pedons there are clay coatings on the rock fragments.

Loneoak Series

The Loneoak series consists of deep, moderately well drained, slowly permeable soils on uplands. These soils formed in material weathered from sandstone (fig. 20). Slopes range from 0 to 3 percent. The soils are loamy, siliceous, thermic Arenic Paleustalfs.

Typical pedon of Loneoak sand, 0 to 3 percent slopes; in Llano, from the intersection of Texas Highway 16 and Texas Highway 29, 2.8 miles west on Texas Highway 29, 8.7 miles northwest on Texas Highway 71, 1.0 mile east on county road, 1.2 miles north on county road, and 235 feet west in cultivated field.

Ap—0 to 5 inches; yellowish brown (10YR 5/4) sand, dark yellowish brown (10YR 3/4) moist; weak fine granular structure; slightly hard, very friable; many fine roots; slightly acid; clear smooth boundary.

A1—5 to 15 inches; light yellowish brown (10YR 6/4) loamy sand, dark yellowish brown (10YR 4/4) moist; weak fine granular structure; slightly hard, very friable; common fine roots; few fine siliceous pebbles; neutral; abrupt smooth boundary.

A2—15 to 21 inches; brown (10YR 5/3) loamy sand, dark brown (10YR 4/3) moist; single grained; slightly hard, very friable; few fine roots; few very fine pores; few fine siliceous pebbles; neutral; abrupt smooth boundary.

E—21 to 28 inches; very pale brown (10YR 7/3) loamy sand, brown (10YR 5/3) moist; single grained; slightly hard, very friable; few very fine roots; common reddish and yellowish stains slightly more clayey in texture; neutral; clear smooth boundary.

Bt1—28 to 41 inches; light yellowish brown (10YR 6/4) sandy clay, dark yellowish brown (10YR 4/4) moist; weak medium angular blocky structure; very hard, very firm; few very fine and fine roots; few fine pores; many medium faint yellowish brown (10YR 5/6) masses of iron accumulation with sharp boundaries, and many medium prominent grayish brown (10YR 5/2) iron depletions with sharp boundaries; few fine black concretions of iron-manganese; few fine siliceous pebbles; slightly alkaline; gradual smooth boundary.

Bt2—41 to 50 inches; yellowish brown (10YR 5/4) sandy clay loam, dark yellowish brown (10YR 4/6) moist; weak medium angular blocky structure; very hard, very firm; few very fine roots; many coarse faint yellowish brown (10YR 5/6) masses of iron accumulation with sharp boundaries, and many coarse distinct grayish brown (10YR 5/2) and few medium faint light gray (10YR 7/2) iron depletions with sharp boundaries; common fine black concretions of iron-manganese; slightly alkaline; gradual smooth boundary.

Bt3—50 to 57 inches; brownish yellow (10YR 6/6) sandy clay loam, yellowish brown (10YR 5/6) moist; weak medium angular blocky structure; extremely hard, very firm; few very fine roots; many coarse distinct light brownish gray (10YR 6/2) and few medium faint light gray (10YR 7/2) iron depletions with sharp boundaries; few black concretions of iron-manganese; slightly alkaline; abrupt smooth boundary.

Cr—57 to 64 inches; weakly cemented sandstone bedrock; few fine roots.

Solum thickness and depth to sandstone bedrock range from 40 to 60 inches. Clay content of the control section ranges from 30 to 35 percent. Redoximorphic features are considered to be mainly relict. However, in 1 to 3 years out of 10 the soil is saturated for periods long enough to have reducing conditions. The thickness of the A and E horizons is 20 to 30 inches.

The Ap and A horizons have hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 3 or 4. Reaction is moderately acid to neutral.

The E horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 3 or 4. Texture is sand or loamy sand . Reaction is moderately acid to neutral.

The Bt horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 4 to 6. Redoximorphic features are in shades of red, yellow, brown, and gray. Texture is sandy clay loam, sandy clay, or clay. Reaction is slightly acid to slightly alkaline.

The Cr horizon is in shades of red, yellow, brown, or gray. It is weakly to strongly cemented sandstone.

Lou Series

The Lou series consists of moderately deep, well drained, moderately permeable soils on uplands. These soils formed in loamy and gravelly residuum weathered

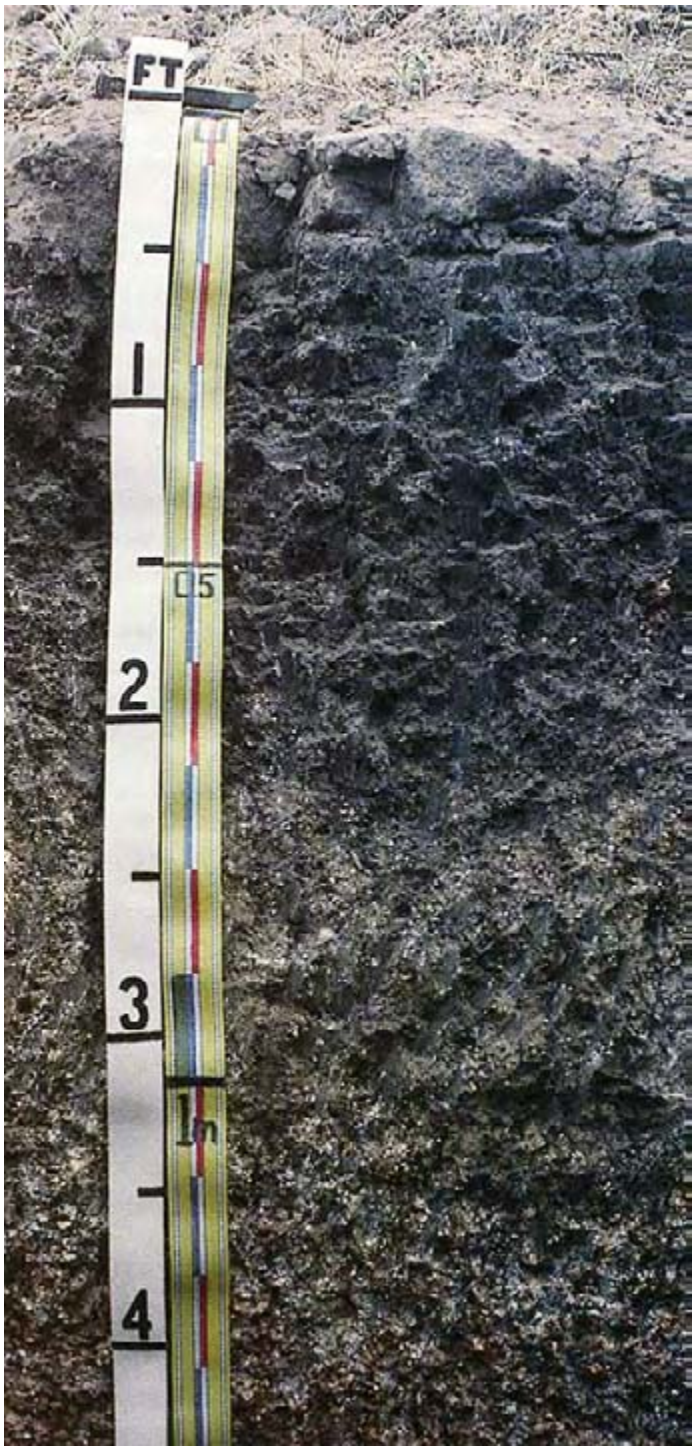

Figure 15.—Profile of Bauman loam. Weathered granite (grus) is at a depth of 42 inches. (Scale is in feet and meters.)

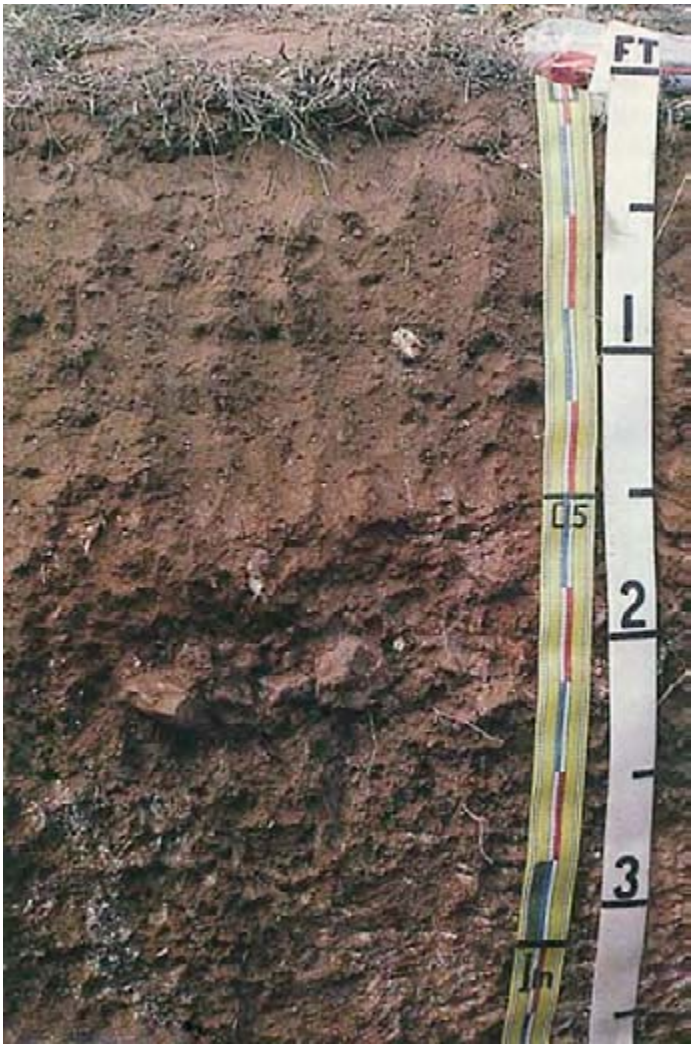

Figure 16.—Profile of Castell sandy loam. The sandy clay subsoil begins at a depth of 16 inches. (Scale is in feet and meters.)

Figure 17.—Profile of Click very gravelly coarse sandy loam. The subsoil has many angular fragments of quartz and feldspar that are coated with clay films. (Scale is in feet and centimeters.)

Figure 18.—Profile of Eckrant very cobbly clay. The limestone bedrock is at a depth of 16 inches. (Scale is in inches.)

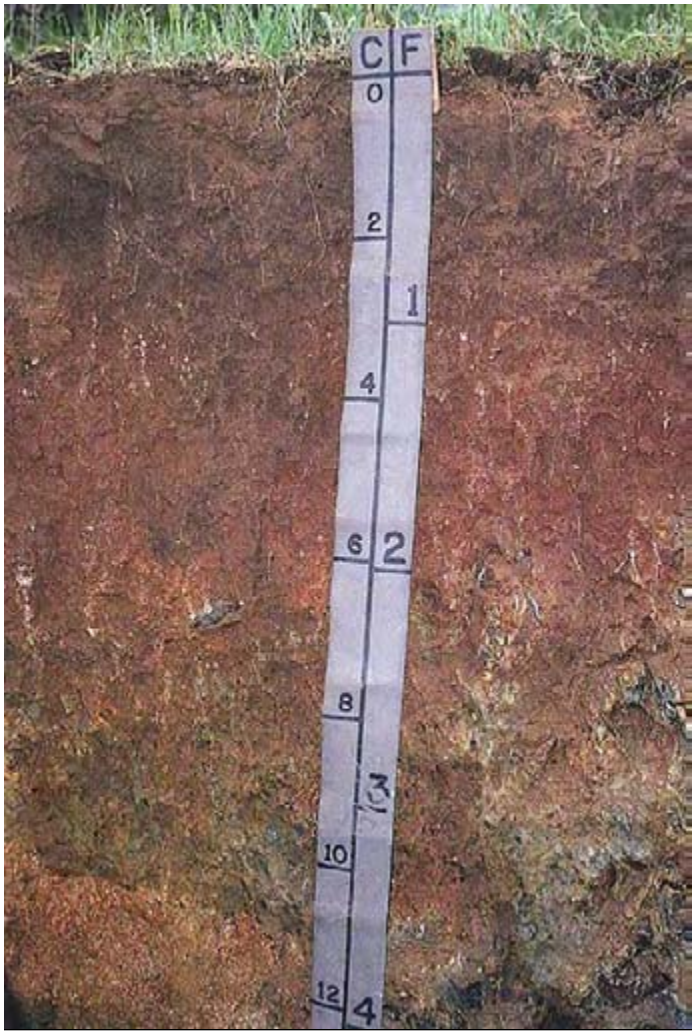

Figure 19.—Profile of Katemcy sandy loam. At a depth of 38 inches, this soil is underlain by tilted beds of weathered schist. (Scale is in feet and centimeters.)

Figure 20.—Profile of Loneoak sand. The sandy surface layer is about 26 inches thick and is the reason this soil is best suited to growing drought-tolerant crops. (Scale is in feet and centimeters.)

Figure 21.—Profile of Oben sandy loam. The sandstone parent material begins at a depth of 18 inches. (Scale is in inches.)

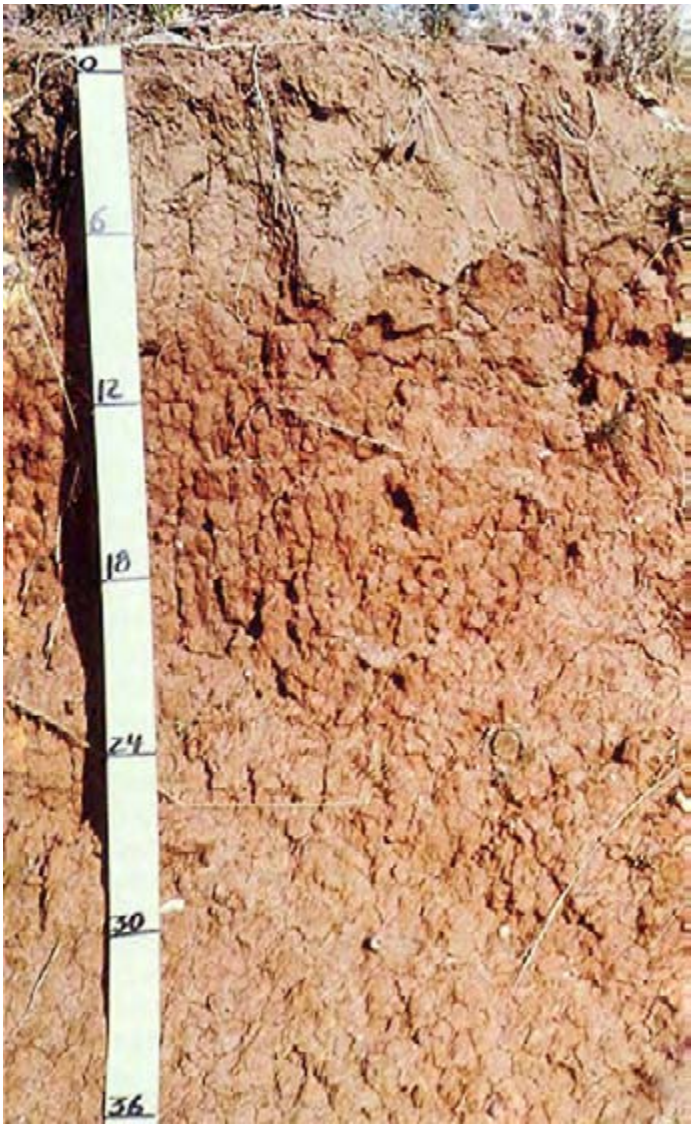

Figure 22.—Profile of Pedernales fine sandy loam. The sandy clay subsoil begins at a depth of about 8 inches. (Scale is in inches.)

from granite grus. Slopes range from 1 to 5 percent. The soils are fine-loamy, mixed, thermic Typic Haplustalfs.

Typical pedon of Lou coarse sandy loam, 1 to 5 percent slopes; in Llano, from the intersection of Texas Highway 29 and Texas Highway 16, 15 miles east on Texas Highway 29 to junction with Farm Road 1431, 1.6 miles northeast on Farm Road 1431, 0.6 mile north on county road and private ranch road, and 100 feet east in rangeland.

A1—0 to 7 inches, brown (7.5YR 5/3) coarse sandy loam, dark brown (7.5YR 3/3) moist; weak fine granular structure; very hard, friable; common fine roots; 13 percent by volume granite pebbles; neutral; clear smooth boundary.

A2—7 to 12 inches; brown (7.5YR 5/4) gravelly coarse sandy loam, dark brown (7.5YR 4/4) moist; weak very fine and fine subangular blocky structure; hard, friable; common fine roots; 20 percent by volume granite pebbles; neutral; clear smooth boundary.

Bt1—12 to 20 inches; reddish brown (5YR 5/4) gravelly coarse sandy loam, reddish brown (5YR 4/4) moist; moderate fine subangular blocky structure; hard, firm; common fine roots; 27 percent by volume granite pebbles; neutral; clear smooth boundary.

Bt2—20 to 30 inches; yellowish red (5YR 5/6) gravelly sandy clay loam, yellowish red (5YR 4/6) moist; moderate fine subangular blocky structure; hard, firm; few fine roots; discontinuous clay films on surfaces of peds, fragments, and in pores; 27 percent by volume granite pebbles; neutral; gradual wavy boundary.

Bt3—30 to 38 inches; yellowish red (5YR 5/6) gravelly sandy clay loam, yellowish red (5YR 4/6) moist; moderate fine subangular blocky structure; very hard, firm; few fine roots; few fine faint red and reddish brown masses of iron accumulation; discontinuous clay films on surfaces of peds and fragments; 30 percent by volume granite pebbles; slightly acid; clear wavy boundary.

Cr—38 to 75 inches; finely fragmented granite grus (saprolite); horizontal and vertical fracture planes contain red clay coatings, but comprise less than 10 percent of the matrix; structure controlled by angular rock fragments; few fine roots in fractures.

Solum thickness and depth to granite grus (paralithic contact) range from 20 to 40 inches. Approximately 80 percent of the coarse fragments are between 2 and 4 millimeters across; the remaining 20 percent are more than 4 millimeters across. Reaction is slightly acid or neutral throughout.

The A horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 or 4. The clay content ranges from 6 to 12 percent. Gravel content ranges from 2 to 20 percent. The A horizon ranges from 4 to 14 inches in thickness.

An E horizon is present in some pedons.

The Bt horizon has hue of 2.5YR to 7.5YR, value of 4 to 6, and chroma of 4 to 6. Texture is gravelly coarse sandy loam, gravelly sandy loam, or gravelly sandy clay loam. Coarse fragments consisting of quartz and feldspar crystals range from 15 to 35 percent by volume. Clay content ranges from 18 to 35 percent. The Bt horizon is 13 to 30 inches thick.

The Cr horizon is dominated by granite grus. Gravel content ranges from 35 to 80 percent by volume. Clay films are evident on surfaces of coarse fragments, possibly due to the weathering of mica flakes.

Luckenbach Series

The Luckenbach series consists of very deep, well drained, moderately slowly permeable soils on uplands. These soils formed in loamy and clayey alluvial sediments. Slopes range from 0 to 3 percent. The soils are fine, mixed, thermic Typic Argiustolls.

Typical pedon of Luckenbach clay loam, 0 to 3 percent slopes; in Llano, from the intersection of Texas Highway 16 and Ranch Road 2323, 25.2 miles southwest on Ranch Road 2323 to county line, 900 feet west along county line, and 240 feet north in rangeland.

A—0 to 9 inches; very dark grayish brown (10YR 3/2) clay loam, very dark brown (10YR 2/2) moist; moderate fine subangular blocky structure; slightly hard, firm; common fine and medium roots; few wormcasts; neutral; clear smooth boundary.

Bt—9 to 20 inches; brown (7.5YR 5/4) clay, dark brown (7.5YR 4/4) moist; moderate medium angular blocky structure; very hard, very firm; few fine roots; continuous clay films on surfaces of peds; slightly alkaline; gradual smooth boundary.

Btk1—20 to 25 inches; brown (7.5YR 5/4) clay, dark brown (7.5YR 3/4) moist; moderate medium angular blocky structure; very hard, very firm; few fine roots; few fine pores; few slickensides; discontinuous clay films on surfaces of peds; common fine concretions of calcium carbonate; few thin dark stains along surfaces of peds; few fine siliceous pebbles; slightly effervescent; moderately alkaline; gradual smooth boundary.

Btk2—25 to 39 inches; yellowish brown (10YR 5/4) clay, dark yellowish brown (10YR 4/4) moist; weak medium angular blocky structure; very hard, very firm; few fine roots; few fine pores; few discontinuous clay films on surfaces of peds; many fine concretions of calcium carbonate; few thin dark stains along surfaces of

peds; few fine siliceous pebbles; strongly effervescent; moderately alkaline; clear smooth boundary.
Bk—39 to 64 inches; strong brown (7.5YR 5/6) clay loam, strong brown (7.5YR 4/6) moist; weak coarse subangular blocky structure; hard, firm; few fine roots; few fine concretions of calcium carbonate; strongly effervescent; moderately alkaline.

Solum thickness is greater than 60 inches. The mollic epipedon ranges from 8 to 20 inches thick. Secondary carbonates are within a depth of 18 to 28 inches.

The A horizon has hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 2 or 3. Reaction is slightly acid to slightly alkaline. The A horizon ranges from 8 to 16 inches in thickness.

The Bt and Btk horizons have hue of 5YR to 10YR, value of 4 or 5, and chroma of 2 to 4. Texture is clay loam or clay. Visible carbonates in the form of concretions, films, threads, and soft powdery lime range from none to 10 percent by volume. Reaction is slightly alkaline or moderately alkaline.

The Bk horizon has hue of 5YR or 7.5YR, value of 4 to 7, and chroma of 4 to 6. Texture is clay loam or clay. Concretions and masses of calcium carbonate range from few to common.

Matilo Series

The Matilo series consists of very deep, well drained, moderately slowly permeable soils on uplands. These soils formed in sandy material weathered from sandstone bedrock. Slopes range from 1 to 5 percent. The soils are loamy, siliceous, thermic Grossarenic Paleustalfs.

Typical pedon of Matilo sand, 1 to 5 percent slopes; in Llano, from the intersection of Texas Highway 16 and Texas Highway 29, 2.8 miles west on Texas Highway 29, 8.7 miles northwest on Texas Highway 71, 1.0 mile east on county road, 1.2 miles north on county road, and 900 feet east in rangeland.

A—0 to 18 inches; pale brown (10YR 6/3) sand, brown (10YR 5/3) moist; weak fine granular structure; loose; few fine roots; slightly acid; clear smooth boundary.
E1—18 to 40 inches; very pale brown (10YR 7/3) sand, yellowish brown (10YR 5/4) moist; single grained; loose; few fine roots; slightly acid; gradual smooth boundary.
E2—40 to 45 inches; white (10YR 8/2) sand, pale brown (10YR 6/3) moist; single grained; loose; few fine roots; few fine fragments of ironstone; slightly acid; clear smooth boundary.
Bt1—45 to 52 inches; light gray (10YR 7/2) sandy clay loam, light brownish gray (10YR 6/2) moist; moderate medium subangular blocky structure; hard, friable; few very fine roots; many medium prominent yellowish red (5YR 5/8) and many medium and coarse distinct yellowish brown (10YR 5/8) and yellow (10YR 7/6) masses of iron accumulation with sharp boundaries; few discontinuous clay films on surfaces of peds; few fine siliceous pebbles; few very fine fragments of ironstone; moderately acid; clear irregular boundary.
Bt2—52 to 56 inches; light gray (10YR 7/2) sandy clay loam, light brownish gray (10YR 6/2) moist; weak medium subangular blocky structure; hard, friable; few fine roots; few fine prominent yellow (10YR 7/6) masses of iron accumulation with sharp boundaries; discontinuous clay films on surfaces of peds; few fine siliceous pebbles; few fine fragments of ironstone; moderately acid; clear smooth boundary.
Bt3—56 to 71 inches; light gray (10YR 7/2), yellowish brown (10YR 5/8), and yellowish red (5YR 5/8) sandy clay loam; weak medium subangular blocky structure; hard, friable; few discontinuous clay films on surfaces of peds; moderately acid; abrupt irregular boundary.
Cr—71 to 73 inches; weakly cemented sandstone bedrock; few fine roots.

Solum thickness and depth to sandstone bedrock range from 60 to 80 inches. The combined thickness of the A and E horizons ranges from 40 to 72 inches. Redoximorphic features, where present, are considered relict.

The A horizon has hue of 7.5YR or 10YR, value of 4 to 7, and chroma of 2 to 4. Reaction is moderately acid or slightly acid. In some pedons, an Ab horizon is present, and the color is one unit in value darker.

The E horizon has hue of 7.5YR or 10YR, value of 6 to 8, and chroma of 2 to 4. Texture is sand or loamy sand. Reaction is moderately acid or slightly acid. The E horizon ranges from 15 to 40 inches in thickness.

The Bt horizon has hue of 5YR to 10YR, value of 5 to 7, and chroma of 2 to 6. Redoximorphic features in shades of red, yellow, brown, and gray range from few to many. Some pedons have a matrix that is a mixture of these colors. Texture is sandy loam or sandy clay loam. Reaction is moderately acid or slightly acid.

The Cr horizon is weakly cemented to moderately cemented sandstone that has colors and redoximorphic features in shades of red, yellow, brown, or gray. Reaction is moderately acid to neutral.

Nebgen Series

The Nebgen series consists of very shallow or shallow, well drained, moderately rapidly permeable soils on uplands. These soils formed in residuum weathered from sandstone bedrock. Slopes range from 5 to 30 percent. The soils are loamy, mixed, nonacid, thermic Lithic Ustorthents.

Typical pedon of Nebgen sandy loam in an area of

Nebgen-Rock outcrop complex, 5 to 30 percent slopes, extremely stony; in Llano, from the intersection of Texas Highway 16 and Ranch Road 2323, 19 miles southwest on Ranch Road 2323, 0.6 mile east on private ranch road, and 50 feet east in rangeland.

A1—0 to 5 inches; dark brown (7.5YR 4/4) sandy loam, dark brown (7.5YR 3/4) moist; moderate medium granular structure; slightly hard, friable; common fine roots; surface has 20 percent cover of sandstone fragments more than 6 inches across; 5 percent by volume sandstone pebbles; slightly acid; clear smooth boundary.

A2—5 to 11 inches; dark brown (7.5YR 4/4) sandy loam, dark brown (7.5YR 3/4) moist; moderate medium granular structure; slightly hard, friable; common fine roots; 10 percent by volume sandstone pebbles; slightly acid; abrupt smooth boundary.

R—11 to 15 inches; reddish brown, indurated sandstone bedrock.

Solum thickness and depth to sandstone bedrock range from 4 to 14 inches. Fragments of sandstone more than 10 inches across cover 15 to 30 percent of the soil surface. Sandstone pebbles range from 0 to 20 percent by volume. Reaction is slightly acid or neutral throughout.

The A horizon has hue of 5YR to 10YR, value of 3 to 6, and chroma of 3 to 6. Base saturation is more than 75 percent.

A Cr/A horizon may be present in some pedons.

The R layer is reddish or brownish sandstone that can be cut with a spade when moist, but it is very hard or indurated when dry. The sandstone or individual strata within the sandstone is calcareous in some places.

Nuvalde Series

The Nuvalde series consists of very deep, well drained, moderately permeable soils on uplands. These soils formed in loamy alluvial sediments. Slopes range from 0 to 3 percent. The soils are fine-silty, mixed, thermic Typic Calciustolls.

Typical pedon of Nuvalde clay loam, 0 to 3 percent slopes; in Llano, from the intersection of Texas Highway 16 and Texas Highway 29, 1.5 miles east on Texas Highway 29 to intersection with Ranch Road 2241, 6 miles northeast on Ranch Road 2241, 2 miles north on county road, 2.7 miles northeast on county road, and 240 feet southwest in pasture.

Ap—0 to 5 inches; dark brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure parting to weak fine granular; hard, firm; many fine roots; slightly effervescent; moderately alkaline; abrupt smooth boundary.

A—5 to 14 inches; dark brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure; hard, firm; common fine roots; common fine and few medium pores; few fine concretions of calcium carbonate; slightly effervescent; moderately alkaline; gradual smooth boundary.

Bw—14 to 21 inches; dark brown (7.5YR 4/4) clay loam, dark brown (7.5YR 3/4) moist; moderate fine subangular blocky structure; hard, firm; common fine roots; many fine and few medium pores; few fine concretions of calcium carbonate; strongly effervescent; moderately alkaline; gradual smooth boundary.

Bk1—21 to 34 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; moderate fine subangular blocky structure; hard, firm; few fine roots; few fine pores; common fine concretions of calcium carbonate; few black stains in old root channels; violently effervescent; moderately alkaline; gradual wavy boundary.

Bk2—34 to 39 inches; yellowish brown (10YR 5/4) clay loam, dark yellowish brown (10YR 4/4) moist; weak fine subangular blocky structure; hard, firm; few fine roots; few fine pores; common fine concretions of calcium carbonate; few black stains; violently effervescent; moderately alkaline; gradual wavy boundary.

BCk—39 to 65 inches; dark brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; weak coarse subangular blocky structure; slightly hard, friable; few fine roots; about 55 percent masses and concretions of calcium carbonate; violently effervescent; moderately alkaline.

Solum thickness ranges from 60 to more than 80 inches. The mollic epipedon ranges from 10 to 20 inches in thickness. Depth to the calcic horizon ranges from 20 to 40 inches. Reaction is slightly alkaline or moderately alkaline throughout.

The A horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 or 3.

The B horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 4. Texture is clay loam, silty clay loam, silty clay, or clay. Coarse fragments consisting of limestone pebbles and concretions of calcium carbonate range from 1 to 15 percent by volume.

The BCk horizon ranges from brownish to white. Texture is loam, clay loam, or silty clay loam.

Oben Series

The Oben series consists of shallow, well drained, moderately permeable soils on uplands. These soils formed in loamy material weathered from sandstone

bedrock (fig. 21). Slopes range from 1 to 5 percent. The soils are loamy, mixed, thermic, shallow Typic Haplustalfs.

Typical pedon of Oben sandy loam, 1 to 5 percent slopes, stony; in Llano, from the southern intersection of Texas Highway 16 and Texas Highway 71, 3.4 miles east on Texas Highway 71, 1.1 miles south and 0.3 mile west on county road to cattle guard, and 2,000 feet southeast in rangeland.

A—0 to 7 inches; reddish brown (5YR 4/4) sandy loam, dark reddish brown (5YR 3/4) moist; weak fine subangular blocky structure; slightly hard, very friable; many fine roots; common fine pores; surface has 2 percent cover of sandstone fragments more than 6 inches across; few fine sandstone pebbles; neutral; clear smooth boundary.

Bt1—7 to 14 inches; reddish brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; moderate fine and medium subangular blocky structure; very hard, friable; many fine roots; common fine pores; few discontinuous clay films on surfaces of peds; few fine sandstone pebbles; neutral; clear smooth boundary.

Bt2—14 to 18 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; moderate fine and medium subangular blocky structure; common fine roots; common fine pores; few discontinuous clay films on surfaces of peds; 15 percent by volume sandstone pebbles and cobbles; neutral; abrupt wavy boundary.

Cr—18 to 24 inches; reddish brown (5YR 5/4) weakly cemented sandstone, dark reddish brown (5YR 3/4) moist; weakly cemented; hard and fractured; few fine roots.

Solum thickness and depth to sandstone range from 12 to 20 inches. Fragments of sandstone more than 10 inches across cover from 1 to 3 percent of the soil surface. Sandstone pebbles and cobbles range from 5 to 15 percent by volume throughout the solum. Reaction is slightly acid or neutral throughout.

The A horizon has hue of 5YR or 7.5YR, value or 4 to 6, and chroma of 4.

The Bt horizon has hue of 2.5YR to 7.5YR, value of 4 to 6, and chroma of 3 to 6. Texture is sandy loam or sandy clay loam. The lower part of some pedons is mottled in shades of red, yellow, or brown.

The Cr horizon is reddish or yellowish, weakly to strongly cemented, fractured sandstone with a hardness of less than 3 on Mohs scale.

Oplin Series

The Oplin series consists of very shallow and shallow, well drained, moderately permeable soils on uplands. These soils formed in loamy residuum weathered from limestone bedrock. Slopes range from 1 to 40 percent. The soils are loamy-skeletal, carbonatic, thermic Lithic Calciustolls.

Typical pedon of Oplin very cobbly clay loam, in an area of Oplin-Rock outcrop complex, 8 to 40 percent slopes, stony; in Llano, from the southern intersection of Texas Highway 16 and Texas Highway 71, 1.2 miles south on Texas Highway 16, 11.7 miles east and south on county road to cattle guard, 1,000 feet north along fence, and 50 feet west in rangeland.

A—0 to 4 inches; very dark grayish brown (10YR 3/2) very cobbly clay loam, very dark brown (10YR 2/2) moist; strong fine subangular blocky structure; slightly hard, friable; many very fine and fine and few medium roots; surface has 3 percent cover of limestone fragments more than 10 inches across; about 40 percent by volume of limestone pebbles and cobbles; slightly effervescent; moderately alkaline; clear smooth boundary.

Bk—4 to 10 inches; very dark grayish brown (10YR 3/2) very cobbly clay loam, very dark brown (10YR 2/2) moist; weak fine subangular blocky structure; slightly hard, friable; many fine roots; few films and threads of secondary carbonates; pendants of calcium carbonate on undersides of limestone fragments; 40 percent by volume limestone cobbles; strongly effervescent; moderately alkaline; clear smooth boundary.

R—10 to 20 inches; fractured and indurated limestone bedrock.

Solum thickness and depth to limestone bedrock range from 8 to 18 inches. Fragments of limestone more than 10 inches across cover 1 to 3 percent of the soil surface. Cobbles range from 35 to 55 percent by volume. Reaction is moderately alkaline throughout.

The A and Bk horizons have hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 2 or 3.

The R layer is indurated limestone bedrock. It is fractured, with fractures being 8 to 20 inches apart. The upper part of the bedrock is plugged with carbonates, and some pedons have a discontinuous petrocalcic horizon.

Packsaddle series

The Packsaddle series consists of moderately deep, well drained, moderately slowly permeable soils on uplands. These soils formed in loamy material weathered from graphitic schist bedrock. Slopes range from 3 to 8 percent. The soils are loamy-skeletal, mixed, thermic Typic Argiustolls.

Typical pedon of Packsaddle channery loam, 3 to 8 percent slopes; in Llano, from the southern intersection of Texas Highway 16 and Texas Highway 71, 14.5 miles

southeast on Texas Highway 71, 1.3 miles east on county road, and 750 feet south in rangeland.

A—0 to 6 inches; very dark gray (10YR 3/1) channery loam, black (10YR 2/1) moist; moderate fine granular structure; slightly hard, friable; many very fine and fine and few medium roots; about 30 percent by volume graphitic schist channers mainly less than 3 inches across; neutral; gradual smooth boundary.

Bt—6 to 13 inches; very dark gray (10YR 3/1) very channery clay loam, black (10YR 2/1) moist; moderate medium subangular blocky structure; hard, firm; common fine and few medium roots; few discontinuous clay films on surfaces of peds; about 40 percent by volume graphitic schist channers mainly less than 3 inches across; neutral; gradual smooth boundary.

BCt—13 to 28 inches; very dark gray (5Y 3/1) very channery clay loam, black (5Y 2.5/1) moist; weak fine and medium subangular blocky structure; hard, firm; few very fine and fine roots; few discontinuous clay films on surfaces of peds; about 50 percent graphitic schist bedrock (C) tilted 20 to 30 degrees from horizontal in bedding planes, easily parting to channers mainly less than 3 inches across; most of the channers can be broken and some can be crushed by hand; volume and hardness of channers increase with depth; neutral; gradual smooth boundary.

Cr—28 to 36 inches; black, tilted weathered graphitic schist bedrock.

Solum thickness and depth to schist bedrock range from 20 to 40 inches. The surface has a thin pavement of graphitic schist channers that range from less than an inch to about 6 inches long. Fragments of schist range from 35 to 50 percent by volume in the control section.

The A horizon has hue of 10YR to 5Y, value of 2 or 3, and chroma of 1 or 2. Clay content ranges from 12 to 20 percent. Channers range from 15 to 40 percent. Reaction is slightly acid or neutral. The A horizon ranges from 4 to 8 inches in thickness.

The Bt horizon has hue of 10YR to 5Y, value of 2 or 3, and chroma of 1 or 2. Texture is very channery sandy clay loam or very channery clay loam. Clay content ranges from 25 to 35 percent. Coarse fragments range from 35 to 50 percent by volume. Reaction ranges from moderately acid to neutral.

The BCt horizon has hue of 10YR to 5Y, value of 2.5 or 3, and chroma of 1. Texture is very channery sandy clay loam or very channery clay loam. Clay content ranges from 25 to 35 percent. The weathered graphitic schist channers range from less than 1 inch up to 6 inches long. They make up from 35 to 65 percent by volume. The reaction is slightly acid or neutral.

The Cr horizon is weathered graphitic schist bedrock that is black or very dark gray. The bedrock is typically tilted 20 to 40 degrees from horizontal. It is commonly underlain by indurated graphitic schist at depths of 4 to 6 feet.

Pedernales Series

The Pedernales series consists of very deep, well drained, moderately slowly permeable soils on uplands. These soils formed in loamy and clayey calcareous sediments (fig. 22). Slopes range from 1 to 3 percent. The soils are fine, mixed, thermic Typic Paleustalfs.

Typical pedon of Pedernales fine sandy loam, 1 to 3 percent slopes; in Llano, from the intersection of Texas Highway 16 and Texas Highway 29, 1.5 miles east on Texas Highway 29 to intersection with Ranch Road 2241, 16 miles northeast on Ranch Road 2241 to Tow, 1 mile north of Tow Post Office on Ranch Road 2241 and county road, 0.5 mile west on private lane to second gate, and 1,000 feet northwest in rangeland.

A—0 to 7 inches; dark brown (7.5YR 4/4) fine sandy loam, dark brown (7.5YR 3/4) moist; weak fine subangular blocky structure; hard, very friable; many fine roots; neutral; abrupt smooth boundary.

Bt1—7 to 18 inches; reddish brown (5YR 4/4) sandy clay, reddish brown (5YR 4/4) moist; moderate fine and medium angular blocky structure; very hard, firm; common fine roots; few fine pores; common discontinuous clay films on surfaces of peds; slightly alkaline; clear smooth boundary.

Bt2—18 to 38 inches; yellowish red (5YR 5/6) sandy clay, yellowish red (5YR 4/6) moist; moderate fine and medium angular blocky structure; very hard, firm; common fine roots; few fine pores; common discontinuous clay films on surfaces of peds; slightly alkaline; clear smooth boundary.

Btk—38 to 55 inches, yellowish red (5YR 5/6) sandy clay, yellowish red (5YR 4/6) moist; weak coarse subangular blocky structure; very hard, firm; few fine roots; few fine pores; few discontinuous clay films on surfaces of peds; 5 percent concretions of calcium carbonate; slightly effervescent; moderately alkaline; gradual smooth boundary.

BCtk—55 to 65 inches; reddish brown (5YR 5/4) sandy clay, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; very hard, firm; few fine roots; few discontinuous clay films on surfaces of peds; 15 percent masses and concretions of calcium carbonate; strongly effervescent; moderately alkaline; clear wavy boundary.

C—65 to 80 inches; reddish brown (5YR 5/4) weakly cemented sandstone with sandy clay loam texture; few fine roots; slightly effervescent; moderately alkaline.

Solum thickness ranges from 60 to more than 80 inches. Secondary carbonates are at depths of 28 to 50 inches. The clay content of the control section ranges from 35 to 55 percent.

The A horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 4 to 6. Reaction is slightly acid to slightly alkaline. The A horizon ranges from 6 to 12 inches in thickness.

The Bt and Btk horizons have hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 4 to 6. The texture is sandy clay loam, clay loam, or sandy clay. Reaction is slightly acid to moderately alkaline.

The BCtk horizon is in shades of red, yellow, or brown. Texture is sandy clay loam, clay loam, or sandy clay. It contains 5 to 30 percent by volume calcium carbonates in the form of concretions and powdery masses. Reaction is slightly alkaline or moderately alkaline.

The C horizon, where present, is in shades of red and brown. It is weakly cemented sandstone.

Pontotoc Series

The Pontotoc series consists of very deep, well drained, moderately permeable soils on uplands. These soils formed in loamy residuum weathered from sandstone bedrock. Slopes range from 1 to 5 percent. The soils are coarse-loamy, mixed, thermic Rhodic Paleustalfs.

Typical pedon of Pontotoc fine sandy loam, 1 to 5 percent slopes; in Llano, from the intersection of Texas Highway 16 and Texas Highway 29, 2.2 miles east on Texas Highway 29 to the intersection with Ranch Road 2241, 6.0 miles northeast on Ranch Road 2241 to Lone Grove, 1.9 miles north on county road, 1.8 miles northeast on county road, and 150 feet south in pasture.

A1—0 to 4 inches; reddish brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; weak very fine subangular blocky and granular structure; slightly hard, very friable; common fine roots; common fine pores; slightly acid; abrupt smooth boundary.

A2—4 to 19 inches; reddish brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; weak medium subangular blocky structure; slightly hard, friable; common fine roots; common fine pores; slightly acid; gradual smooth boundary.

Bt1—19 to 32 inches; dark reddish brown (2.5YR 3/4) fine sandy loam, dark reddish brown (2.5YR 3/4) moist; moderate medium subangular blocky structure; hard, friable; few fine roots; common fine pores; few discontinuous clay films in pores; few iron-manganese concretions; slightly acid; gradual smooth boundary.

Bt2—32 to 43 inches; dark red (2.5YR 3/6) sandy clay loam, dark red (2.5YR 2/6) moist; weak medium subangular blocky structure; hard, friable; few fine roots; common fine pores; few discontinuous clay films in pores and clay bridging of sand grains; few iron-manganese concretions; slightly acid; clear smooth boundary.

Bt3—43 to 65 inches; red (2.5YR 4/6) sandy clay loam, dark red (2.5YR 3/6) moist; weak medium subangular blocky structure; hard, friable; few fine roots; common fine pores; few discontinuous clay films in pores and clay bridging of sand grains; many iron-manganese concretions; slightly acid; clear smooth boundary.

Cr—65 to 72 inches; red weakly cemented sandstone bedrock; few fine roots between fractures.

Solum thickness ranges from 60 to 80 inches over sandstone bedrock. Glauconitic material is present within the sandstone. Reaction is slightly acid or neutral throughout.

The A horizon has hue of 2.5YR or 5YR, value of 3 or 4, and chroma of 3 or 4. Coarse fragments consisting of sandstone and ironstone pebbles range from 0 to 10 percent by volume. The A horizon ranges from 6 to 20 inches in thickness.

The Bt horizon has hue of 10R to 2.5YR, value of 3 or 4, and chroma of 4 to 6. Texture is fine sandy loam or sandy clay loam. Coarse fragments consisting of sandstone or ironstone gravel range from 0 to 10 percent by volume.

The Cr horizon is red sandstone that is weakly to strongly cemented. It has a hardness of 2 to 3 on Mohs scale.

Real Series

The Real series consists of shallow, well drained, moderately permeable soils on uplands. These soils formed in loamy residuum weathered from soft limestone. Slopes range from 1 to 40 percent. The soils are loamy-skeletal, carbonatic, thermic, shallow Petrocalcic Calciustolls.

Typical pedon of Real gravelly loam, 1 to 8 percent slopes; in Llano, from the southern intersection of Texas Highway 16 and Texas Highway 71, 1.2 miles south on Texas Highway 16, 11.7 miles east and southeast on county road, 0.6 mile south on county road to small pit on the west side of the road, and 50 feet west in rangeland.

A—0 to 8 inches; dark grayish brown (10YR 4/2) gravelly loam, very dark brown (10YR 2/2) moist; moderate fine subangular blocky structure; slightly hard, friable; many very fine and fine and few medium roots; about 30 percent by volume soft limestone pebbles; violently effervescent; moderately alkaline; clear smooth boundary.

Bk—8 to 15 inches; grayish brown (10YR 5/2) extremely gravelly loam, dark brown (10YR 3/3) moist; weak fine

subangular blocky structure; slightly hard, friable; many fine roots; many films and threads of secondary carbonates and few small masses of powdery calcium carbonate throughout; about 75 percent by volume soft limestone pebbles; violently effervescent; moderately alkaline; clear wavy boundary.

Bkm—15 to 17 inches; white strongly cemented caliche; indurated laminar cap approximately 0.5 inch thick on the surface of strongly cemented caliche; clear wavy boundary.

Cr—17 to 22 inches; white soft limestone; few fine roots.

Solum thickness ranges from 8 to 20 inches and corresponds to the depth to a petrocalcic horizon above a paralithic contact of soft limestone. Coarse fragments consisting of siltstone and limestone pebbles and cobbles range from 30 to 80 percent by volume. Texture of the fine earth fraction is loam. Reaction is moderately alkaline.

The A and Bk horizons have hue of 10YR, value of 3 to 5, and chroma of 2 or 3. Calcium carbonate in the form of pendants and coatings are on undersides of limestone fragments.

The Bkm horizon is weakly to strongly cemented and may be indurated in the upper part. A laminar cap is present in the upper inch. The cap is white or pink.

The Cr horizon is white, pale yellow, or light yellowish brown, weakly to strongly cemented limestone chalk.

Roughcreek Series

The Roughcreek series consists of very stony, shallow, well drained, slowly permeable soils on uplands. These soils formed in clayey residuum weathered from dolomitic limestone. Slopes range from 1 to 40 percent. The soils are clayey-skeletal, montmorillonitic, thermic Lithic Argiustolls.

Typical pedon of Roughcreek very stony clay loam in an area of Roughcreek-Rock outcrop complex, 1 to 8 percent slopes, very stony; in Llano, from the southern intersection of Texas Highway 16 and Texas Highway 71, 1.2 miles south on Texas Highway 16, 8.3 miles east and southeast on county road, 0.7 mile west on private ranch road to gate, 190 feet south of gate, and 42 feet east of cross fence in rangeland.

A—0 to 5 inches; dark brown (7.5YR 3/2) very stony clay loam, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure parting to weak fine granular; very hard, firm; common fine and medium roots; surface has 15 percent cover of limestone fragments 10 to 26 inches across; about 30 percent cobbles and 3 percent chert pebbles by volume; neutral; clear smooth boundary.

Bt—5 to 16 inches; reddish brown (5YR 4/3) very cobbly clay, dark reddish brown (5YR 3/3) moist; moderate medium angular blocky structure; very hard, very firm; few fine roots; few fine pores; common continuous clay films on surfaces of peds; about 45 percent cobbles and 10 percent chert pebbles by volume; neutral; abrupt wavy boundary.

R—16 to 20 inches; hard, fractured dolomitic limestone; limestone is harder than 3 on Mohs scale.

Solum thickness and depth to the lithic contact range from 10 to 20 inches. The soil has stones covering about 8 to 15 percent of the soil surface. Fragments smaller than 10 inches across range from 35 to 50 percent by volume in the A horizon and 40 to 60 percent in the Bt horizon. Reaction is slightly acid to slightly alkaline.

The A horizon has hue of 5YR to 10YR, value of 3 to 5, and chroma of 2 or 3.

The Bt horizon has hue of 2.5YR to 7.5YR, value of 4 or 5, and chroma of 2 to 6.

The R layer is dolomitic limestone with a hardness of 4 or 5 on Mohs scale.

Rumple Series

The Rumple series consists of moderately deep, well drained, moderately slowly permeable soils on uplands. These soils formed in clayey residuum weathered from limestone. Slopes range from 1 to 5 percent. The soils are clayey-skeletal, mixed, thermic Typic Argiustolls.

Typical pedon of Rumple gravelly clay loam, 1 to 5 percent slopes; in Llano, from the southern intersection of Texas Highway 16 and Texas Highway 71, 1.2 miles south on Texas Highway 16, 8.7 miles east and southeast on county road, and 80 feet west in rangeland.

A—0 to 8 inches, reddish brown (5YR 4/3) gravelly clay loam, dark reddish brown (5YR 3/3) moist; moderate very fine and fine subangular blocky structure; very hard, firm; common fine roots; 20 percent by volume fragments of angular chert; neutral; clear smooth boundary.

Bt1—8 to 16 inches; red (2.5YR 4/6) very gravelly clay, dark red (2.5YR 3/6) moist; moderate fine and medium subangular blocky structure; very hard, firm; few fine roots; few discontinuous clay films on surfaces of peds; 35 percent by volume fine fragments of angular chert; neutral; gradual smooth boundary.

Bt2—16 to 24 inches; reddish brown (5YR 4/4) very gravelly clay, dark reddish brown (5YR 3/4) moist; weak medium subangular blocky structure; few fine roots; few discontinuous clay films on surfaces of peds; 60 percent by volume fine fragments of angular chert; neutral; abrupt wavy boundary.

R—24 to 27 inches; white and gray, fractured, indurated limestone.

Solum thickness and depth to limestone bedrock range from 20 to 40 inches. The thickness of the mollic epipedon, which includes the A horizon and may include the upper part of the Bt horizon, ranges from 8 to 15 inches.

The A horizon has hue of 2.5YR to 7.5YR, value of 3 to 5, and chroma of 2 or 3. Coarse fragments consisting of chert range from 15 to 35 percent by volume. The A horizon ranges from 5 to 9 inches in thickness. Reaction is slightly acid or neutral.

The Bt horizon has hue of 2.5YR or 5YR, value of 3 or 4, and chroma of 3 to 6. Coarse fragments of chert and limestone range from 35 to 85 percent by volume. The thickness of the Bt horizon ranges from 12 to 24 inches. Reaction is slightly acid to slightly alkaline.

The R layer is white and gray indurated limestone or dolomitic limestone. Embedded chert and similar quartz fragments range from few to many.

Venus Series

The Venus series consists of very deep, well drained, moderately permeable soils on terraces. These soils formed in calcareous, loamy alluvial sediments. Slopes range from 0 to 2 percent. The soils are fine-loamy, mixed, thermic Udic Calciustolls.

Typical pedon of Venus loam, 0 to 2 percent slopes; in Llano, from the intersection of Texas Highway 16 and Ranch Road 152, 9 miles west on Ranch Road 152, 0.4 miles north on county road (Scotts Crossing), and 50 feet east in rangeland.

A1—0 to 4 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky and granular structure; hard, friable; common fine and few medium roots; common fine and few medium pores; many wormcasts; few concretions of calcium carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.

A2—4 to 15 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; hard, friable; few fine roots; common fine and few medium pores; many wormcasts; few concretions of calcium carbonate; few siliceous pebbles; strongly effervescent; moderately alkaline; gradual smooth boundary.

Bk1—15 to 28 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; weak fine subangular blocky structure; slightly hard, very friable; few fine roots; common fine pores; common films and threads of calcium carbonate; common wormcasts; few very fine siliceous pebbles; violently effervescent; moderately alkaline; gradual smooth boundary.

Bk2—28 to 54 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; weak very fine granular structure; slightly hard, very friable; few fine roots; few fine pores; few films, threads, and masses of calcium carbonate; few fine siliceous pebbles; violently effervescent; moderately alkaline; gradual smooth boundary.

BCk—54 to 62 inches; very pale brown (10YR 7/4) loam, yellowish brown (10YR 5/4) moist; weak very fine granular structure; slightly hard, very friable; few fine roots; few films, threads, and concretions of calcium carbonate; strongly effervescent; moderately alkaline.

Solum thickness ranges from 60 to 80 inches. The mollic epipedon ranges from 10 to 20 inches in thickness. Clay content of the control section ranges from 18 to 30 percent. Siliceous pebbles range from none to few. Calcium carbonate equivalent ranges from 15 to 40 percent. Reaction is moderately alkaline throughout.

The A horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 or 3. The A horizon ranges from 10 to 20 inches in thickness.

The Bk horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 2 to 4. Texture is loam, sandy clay loam, or clay loam. Calcium carbonate in the form of films, threads, and masses ranges from 5 to 20 percent by volume. The calcium carbonate equivalent in the Bk horizon is 15 to 40 percent.

The BCk horizon is in shades of yellow or brown. It is fine sandy loam, loam, sandy clay loam, or clay loam.

These soils are drier than typical for the series and therefore are less productive. They are taxadjuncts in this respect.

Voca Series

The Voca series consists of deep, well drained, slowly permeable soils on uplands. These soils formed in material weathered from granite grus. Slopes range from 0 to 3 percent. The soils are fine, mixed, thermic Typic Paleustalfs.

Typical pedon of Voca gravelly sandy loam, 0 to 3 percent slopes; in Llano, from the intersection of Texas Highway 16 and Ranch Road 152, 17.0 miles west on Ranch Road 152, 4.7 miles south on county road, 0.7 mile west on county road, and 1,000 feet south of road in rangeland.

A1—0 to 5 inches; brown (10YR 5/3) gravelly sandy loam, dark brown (10YR 3/3) moist; weak fine granular structure; very hard, friable; many fine and few medium roots; few very fine pores; 18 percent by volume granite and quartz pebbles; neutral; clear smooth boundary.

A2—5 to 14 inches; dark brown (10YR 4/3) gravelly sandy loam, dark brown (10YR 3/3) moist; weak fine granular structure; very hard, friable; common fine and few medium roots; many very fine and few coarse pores; 18 percent by volume granite and quartz pebbles; neutral; abrupt smooth boundary.

Bt1—14 to 25 inches; reddish brown (5YR 5/4) gravelly sandy clay, reddish brown (5YR 4/4) moist; moderate medium prismatic structure parting to moderate medium angular blocky; very hard, very firm; few fine and medium roots; common continuous clay films on vertical and horizontal surfaces of peds; few rounded black concretions; 18 percent by volume granite and quartz pebbles; neutral; gradual smooth boundary.

Bt2—25 to 34 inches; reddish brown (5YR 5/3) gravelly sandy clay, reddish brown (5YR 4/3) moist; moderate medium prismatic structure parting to moderate medium angular blocky; very hard, very firm; few very fine and fine roots; common continuous clay films on vertical and horizontal surfaces of peds; few rounded black concretions; 18 percent by volume granite and quartz pebbles; slightly alkaline; clear smooth boundary.

Bt3—34 to 43 inches; reddish brown (5YR 5/4) very gravelly sandy clay loam, reddish brown (5YR 4/4) moist; weak medium prismatic structure parting to moderate medium angular blocky; very hard, very firm; few fine roots; common medium distinct red (2.5YR 4/6) and common medium prominent black (10YR 2/1) masses of iron-manganese accumulation; few discontinuous clay films on vertical surfaces of peds; 37 percent by volume granite and quartz pebbles; slightly alkaline; clear smooth boundary.

BCt—43 to 48 inches; reddish brown (5YR 5/4) very gravelly sandy clay loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; very hard, firm; few fine and medium roots; few fine faint red and black masses of iron-manganese accumulation; few discontinuous clay films on surfaces of peds; 55 percent by volume granite grus material; slightly alkaline; clear smooth boundary.

Cr—48 to 80 inches; weathered granite grus material; individual fragments up to 2 inches across; clay coatings in cracks between fragments; few fine roots.

Solum thickness and depth to weathered granite bedrock range from 40 to 60 inches.

The A horizon has hue of 5YR to 10YR, value of 4 to 6, and chroma of 3 to 6. Pebbles consisting of quartz and feldspar crystals range from 15 to 25 percent by volume. Reaction is slightly acid to neutral. The A horizon ranges from 6 to 20 inches in thickness.

An E horizon is present in some pedons. It has hue of 7.5YR or 10YR, value of 6, and chroma of 2 to 4. Texture is sandy loam or gravelly sandy loam. Reaction is slightly acid.

The Bt1 and Bt2 horizons have hue of 2.5YR or 5YR, value of 3 to 5, and chroma of 4 to 8. Texture is sandy clay, clay, or their gravelly counterparts. Pebbles range from 10 to 35 percent by volume. Clay content ranges from 35 to 55 percent. Reaction is moderately acid to neutral.

The Bt3 and BCt horizons are similar to the upper Bt horizons in color. Texture is very gravelly sandy clay loam or very gravelly sandy clay. Coarse fragments range from 35 to 70 percent by volume. Redoximorphic features in shades of red and brown range from few to common and occur above the Cr horizon.

The Cr horizon is weathered granite grus. Pebbles range from 55 to 80 percent by volume. Clay films are evident on fragment surfaces.

Weswood Series

The Weswood series consists of very deep, well drained, moderately permeable soils on flood plains. These soils formed in calcareous, loamy alluvial sediments. Slopes range from 0 to 2 percent. The soils are fine-silty, mixed, thermic Udifluventic Ustochrepts.

Typical pedon of Weswood silt loam, rarely flooded; in Llano, from the intersection of Texas Highway 16 and Texas Highway 29, 15 miles east on Texas Highway 29 to the intersection with Ranch Road 1431, 3 miles south on Ranch Road 1431, 3.5 miles east on county road, and 100 feet north in coastal bermudagrass pasture.

A1—0 to 5 inches; brown (7.5YR 5/4) silt loam, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable; many very fine and fine roots; strongly effervescent; moderately alkaline; gradual smooth boundary.

A2—5 to 17 inches; brown (7.5YR 5/4) silt loam, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, firm; many very fine and fine roots; strongly effervescent; moderately alkaline; clear smooth boundary.

Bw1—17 to 28 inches; light brown (7.5YR 6/4) very fine sandy loam, brown (7.5YR 5/4) moist; moderate medium subangular blocky structure; slightly hard, friable; common very fine and fine roots; strongly effervescent; moderately alkaline; clear smooth boundary.

Bw2—28 to 38 inches; light brown (7.5YR 6/4) very fine sandy loam, brown (7.5YR 5/4) moist; moderate medium subangular blocky structure; slightly hard, friable; common very fine and fine roots; strongly effervescent; moderately alkaline; clear smooth boundary.

Bw3—38 to 52 inches; light reddish brown (5YR 6/4) silt loam, reddish brown (5YR 5/4) moist; moderate medium subangular blocky structure; slightly hard, friable; few fine roots; strongly effervescent; moderately alkaline; abrupt smooth boundary.
Bw4—52 to 60 inches; reddish brown (5YR 4/4) silt loam, dark reddish brown (5YR 3/4) moist; moderate medium subangular blocky structure; slightly hard, friable; few fine roots; few fine threads of calcium carbonate; strongly effervescent; moderately alkaline; clear smooth boundary.
C—60 to 80 inches; stratified light reddish brown (5YR 6/4) very fine sandy loam and reddish brown (5YR 4/4) silt loam; massive; strongly effervescent; moderately alkaline.

Solum thickness ranges from 40 to 60 inches. Reaction is slightly alkaline or moderately alkaline throughout.

The A horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 4. The A horizon ranges from 6 to 18 inches in thickness.

The Bw horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 4 to 6. Texture is silt loam, very fine sandy loam, or silty clay loam. Clay content of the control section ranges from 20 to 35 percent.

Buried horizons are present in some pedons.

The C horizon has hue of 2.5YR or 5YR, value of 4 to 6, and chroma of 4 to 6. Texture is very fine sandy loam and silt loam and is usually stratified with these textures.

These soils are drier than typical for the series and therefore are less productive. They are taxadjuncts in this respect.

Yates Series

The Yates series consists of very shallow, well drained, moderately permeable soils on uplands. These soils formed in loamy residuum and colluvium weathered from indurated limestone bedrock. Slopes range from 1 to 40 percent. The soils are loamy-skeletal, mixed, nonacid, thermic Lithic Ustorthents.

Typical pedon of Yates very stony loam, in an area of Yates-Rock outcrop complex, 12 to 40 percent slopes, very stony; in Llano, from the southern intersection of Texas Highway 16 and Texas Highway 71, 11.5 miles southeast on Texas Highway 71, 6.0 miles south on county road, 3.0 miles west on county road, and 60 feet north in rangeland.

A1—0 to 4 inches; reddish brown (5YR 4/4) very stony loam, dark reddish brown (5YR 3/4) moist; moderate fine granular structure; slightly hard, friable; common fine roots; surface has 10 percent cover of limestone fragments more than 10 inches across; 40 percent by volume limestone cobbles and pebbles; slightly alkaline; gradual smooth boundary.
A2—4 to 10 inches; reddish brown (5YR 4/4) very stony loam, dark reddish brown (5YR 3/4) moist; moderate fine granular structure; slightly hard, friable; common fine roots; about 30 percent by volume fragments 3 to 20 inches across and 1 to 2 inches thick; about 10 percent by volume limestone cobbles and pebbles; slightly alkaline; clear smooth boundary.
R—10 to 15 inches; fractured, indurated limestone bedrock; soil material in vertical and horizontal fractures in upper 2 inches.

Solum thickness and depth to the lithic contact range from 4 to 14 inches. Fragments of limestone more than 10 inches across cover 10 to 15 percent of the soil surface. Coarse fragments consisting of limestone pebbles, cobbles, and stones range from 35 to 50 percent by volume.

The A horizon has hue of 2.5YR to 7.5YR, value of 3 to 5, and chroma of 4 to 6. Reaction ranges from neutral to moderately alkaline.

The R layer is limestone bedrock that is fractured at intervals of 10 to 24 inches. Soil material can occur in fractures in the upper part of this layer.

Formation of the Soils

In this section the factors of soil formation are described as they relate to soils in Llano County. The geology of the county is also discussed.

Factors of Soil Formation

The five major factors of soil formation are discussed briefly in terms of their effect on the soils of Llano County. These are parent material, climate, living organisms, relief, and time.

Parent Material

Parent material is the unconsolidated mass from which the soils formed. It determines the limits of the chemical and mineralogical composition of the soil. In Llano County the parent material consists of material weathered from gneiss, granite, schist, limestone, sandstone, and alluvium, all discussed in more detail in the “Geology” section.

Climate

The main climatic factors that influence soil formation are temperature, rainfall, and the seasonal distribution of this rainfall. Climate directly affects the soil through its influence on weathering of the parent material, leaching of carbonates, translocation of clay, reduction and transfer of iron, and rate of erosion. It is also directly responsible for the kind and amount of vegetation.

Living Organisms

Plants, micro-organisms, earthworms, rodents, and other forms of life in or on the soil are active in soil formation processes. Plants add organic residue to the surface, micro-organisms help to decompose this material, and earthworms and rodents help to mix this in the upper layer of the soil. This organic matter is what gives soil a darker colored surface.

Relief

Relief, or topography, affects soil formation through its influence on drainage, erosion, plant cover, and runoff. The topography of Llano County ranges from nearly level to steep. The soils on steep areas have a higher rate of runoff, which increases geologic erosion and decreases the water available for plant growth. The soils on these areas are generally not as deep as the soils on nearly level areas.

Time

Time, generally a long time, is required for a soil to develop. This is the length of time that the landscape has been exposed to the action of the other four soil-forming factors. Geologic erosion generally keeps steep areas young, while nearly level areas have had more time for the soil-forming factors to act on the parent material.

Geology

Dr. Virgil E. Barnes, geologist, Austin, Texas, prepared this section.

Llano County is centrally located in the Llano Region of Central Texas, which is also known as the Central Mineral Region and the Llano Uplift. The Llano Region combines a range of geologic section, quality of natural exposures, diversity of mineral commodities, and climate difficult to duplicate in an equivalent area elsewhere in the United States. Llano County comprises slightly less than a quarter of the Llano Region. Technical summaries of the geology of the Llano Region are found in the “Geologic Atlas of Texas, Llano Sheet” *(10)* and the “Bureau of Economic Geology, Guidebook 13” *(3)*. An excellent description of the geological history and landscape in layman’s terms is in “Enchanted Rock State Natural Area: A Guide to the Landforms” *(5)*, which may be purchased at Enchanted Rock State Natural Area.

The Llano Region is an oval topographic basin of about 4,000 square miles. It is rimmed by the Edwards Plateau on the west, south, and east, and by the Osage Plain to the north. Geologically, the Llano Region is a structural dome, or uplift, in which Precambrian and early Paleozoic rocks have been exposed by erosion and removal of formerly overlying upper Paleozoic and Cretaceous rocks. The Llano Uplift is part of a large, relatively positive geological feature that extends to the northwest as the Concho Arch, to the north as the Bend Arch, and to the southeast as the San Marcos Arch. Rock type and multiple erosion surfaces indicate that the Llano region has been near sea level (that is, probably not much higher than it is now, nor lower than a few hundred feet below sea level) for several hundred million years. Most mineral deposits

that have been found occur in Precambrian rocks. Similar old rocks are known to occur, but are buried at increasingly greater depths, on the flanks of the Llano Uplift.

Precambrian sedimentary rocks, mostly shale and sandstone with thin limestone beds, were compressed, heated, and faulted. During and after this process the sedimentary rocks became metamorphic rocks (schist, gneiss, and marble) and were intruded by several types of granite and other igneous rocks. Granite is exposed widely in the county. The west side of Lake Buchanan and the Enchanted Rock vicinities are good examples of granite outcrops. Age dating by analysis of radioactive minerals from the igneous rocks indicates a range of about 1.1 to 1.2 billion years. Younger igneous rocks in the county have not been dated. After this very active Precambrian period of geologic history, the region was covered by mostly limestone sedimentary rocks of Cambrian, Ordovician, Mississippian, and Pennsylvanian age.

Precambrian and Paleozoic rocks were fractured and displaced by a prominent system of faults that currently control the major topographic features in the county, mainly ridges and valleys. The faults strike mostly northeast-southwest. They are steeply dipping to vertical, braided and branching, and have throws of tens of feet to a few thousand feet. Paleozoic strata between the primary faults have gentle dips and are remarkably unbroken by secondary faults. Paradoxically, many downfaulted blocks are now the highest ridges in the county. This is because the Paleozoic sedimentary rocks were removed from the uplifted blocks by erosion that was accelerated due to the higher position. The underlying granite and schist then eroded at an even faster rate. The sedimentary rocks on the downfaulted blocks were eroded at a much slower rate so that eventually their position became higher than the more erodible granite and schist. The few resistant granite knobs, particularly Enchanted Rock, and the sedimentary rock ridges give the county a rugged and mountainous appearance, but relief does not exceed 600 feet in most places.

The basin-like Llano Uplift at one time was completely covered by Cretaceous limestone which has subsequently been removed by erosion. This area is now entirely below the level of the adjacent Edwards Plateau which was not uplifted and contains Cretaceous limestone that is more resistant to erosion than the now exposed rocks of the Llano Uplift.

Quaternary deposits consist of Pleistocene fluvial sediments under a relict terrace in the southeastern portion of the county, and Holocene alluvium along the major drainageways.

The geologic outcrops are discussed from oldest to youngest in the following paragraphs. Only those which are dominant as soil parent materials are mentioned. Weathered limestone, shale, sandstone, granite, schist, and marble are the major parent materials of soils in Llano County. This wide variety of parent materials has resulted in drastically different soils.

Precambrian rocks include Valley Spring Gneiss, Packsaddle Schist, Town Mountain Granite, Oatman Creek Granite, and Sixmile Granite.

The Valley Spring Gneiss, which is exposed in much of Llano County, is mainly pink quartz-feldspar gneiss, but has schist and other kinds of gneiss present. Soils that have formed in materials weathered from Valley Spring Gneiss are common to the Castell-Keese and Keese-Rock outcrop general soil map units.

The Packsaddle Schist, is divided into the Click Formation, Rough Ridge Formation, Sandy Formation, and Honey Formation. All the formations are comprised mostly of alternating hornblende schist, quartz-feldspar-mica schist, and leptite (fig. 23). The Honey Formation is unique because it contains a significant amount of graphite schist which is the parent material of Packsaddle channery loam, a very dark colored mollisol. Soils formed in materials weathered from the Packsaddle Schist are common to the Ligon-Katemcy general soil map unit.

The Town Mountain Granite, as well as younger granitic intrusive rocks such as Oatman Creek Granite and Sixmile Granite, are exposed in many places in the county. They consist mainly of pink feldspathic granite. Typical exposures of these formations are in the area around Enchanted Rock. Soils formed in materials weathered from these rocks are common to the Voca-Lou-Click general soil map unit and part of the Keese-Rock outcrop general soil map unit.

Cambrian rocks include the Riley Formation and Wilberns Formation. The Riley Formation is divided into the Hickory Sandstone and Cap Mountain Limestone members. These sedimentary strata are exposed at each corner of the county and in a severely faulted area southeast of Llano. The sandstone is iron-enriched and the limestone is somewhat glauconitic. Soils formed in weathered sandstone are part of the Campair-Loneoak general soil map unit and include the Nebgen soils of the Nebgen-Yates-Rock outcrop general soil map unit. Soils formed in material weathered from limestone include the Yates soils of the Nebgen-Yates-Rock outcrop general soil map unit. The Wilberns Formation is mainly limestone with interbedded sandstone. Outcrops are in the northern, central, and southern parts of the county. Soils developed in these areas are part of the Roughcreek-Eckrant-Rock outcrop general soil map unit.

Figure 23.—A roadcut in an area of Ligon fine sandy loam, 1 to 5 percent slopes, exposes the underlying tilted schist bedrock.

Ordovician rocks include the Ellenburger Group, which are mainly limestone and dolomite. Most Ellenburger Group outcrops are in the northeastern and southeastern parts of the county. Soils formed in these areas are included in the Hensley general soil map unit and are part of the Roughcreek-Eckrant-Rock outcrop general soil map unit.

Quaternary rocks include Pleistocene sediments under relict terraces and Holocene deposits on stream flood plains. Pleistocene-age deposits are parent materials of soils in the Nuvalde-Luckenbach and Riverwash-Boerne-Bastrop general soil map units. Holocene-age deposits are parent materials of flood plain soils that are restricted in area and not shown on the general soil map. Included are the Fieldcreek soils along local streams and the Weswood soils along the Colorado River.

References

(1) American Association of State Highway and Transportation Officials. 1986. Standard specifications for highway materials and methods of sampling and testing. Ed. 14, 2 vols.

(2) American Society for Testing and Materials. 1993. Standard classification of soils for engineering purposes. ASTM Stand. D 2487.

(3) Barnes, V.E., W.C. Bell, S.E. Clabaugh, P.E. Cloud, Jr., R.V. McGhehee, P.V. Rodda, and K. Young. 1972. Geology of the Llano Region and Austin area, field excursion. Univ. Tex., Bur. Econ. Geol., Guidebook 13.

(4) Kocher, A. E., and party. 1915. Reconnaissance Soil Survey of South-Central Texas. U.S. Dept. Agric., Bur. Soils.

(5) Peterson, J.F. 1988. Enchanted Rock State Natural Area: A guide to the landforms. 2d ed.

(6) United States Department of Agriculture, Soil Conservation Service. National soil survey handbook. Soil Surv. Staff. (Available in the State Office of the Natural Resources Conservation Service at Temple, Texas)

(7) United States Department of Agriculture, Soil Conservation Service. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. U.S. Dep. Agric. Handb. 436.

(8) United States Department of Agriculture, Soil Conservation Service. 1991. Soil survey laboratory methods manual. Soil Surv. Invest. Rep. 42.

(9) United States Department of Agriculture, Soil Conservation Service. 1992. Keys to soil taxonomy. 5th ed. Soil Surv. Staff, Soil Manage. Support Serv. Tech. Monogr. 19.

(10) University of Texas, Bureau of Economic Geology. 1981. Geologic atlas of Texas, Llano sheet.

Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep, rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Animal unit month (AUM). The amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for 1 month.

Aquic conditions. Current soil wetness characterized by saturation, reduction, and redoximorphic features.

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.

Argillic horizon. A subsoil horizon characterized by an accumulation of illuvial clay.

Aspect. The direction in which a slope faces.

Association, soil. A group of soils or miscellaneous areas 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:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Back slope. The geomorphic component that forms the steepest inclined surface and principal element of many hillsides. Back slopes in profile are commonly steep, are linear, and may or may not include cliff segments.

Badland. Steep or very steep, commonly nonstony, barren land dissected by many intermittent drainage channels. Badland is most common in semiarid and arid regions where streams are entrenched in soft geologic material. Local relief generally ranges from 25 to 500 feet. Runoff potential is very high, and geologic erosion is active.

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

Bedding planes. Fine strata, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediment.

Bedding system. A drainage system made by plowing, grading, or otherwise shaping the surface of a flat field. It consists of a series of low ridges separated by shallow, parallel dead furrows.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bedrock-controlled topography. A landscape where the configuration and relief of the landforms are determined or strongly influenced by the underlying bedrock.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to

make the soil suitable for tillage and to prevent accelerated erosion.

Bisequum. Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

Bottomland. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Breaks. The steep and very steep broken land at the border of an upland summit that is dissected by ravines.

Brush management. Use of mechanical, chemical, or biological methods to make conditions favorable for reseeding or to reduce or eliminate competition from woody vegetation and thus allow understory grasses and forbs to recover. Brush management increases forage production and thus reduces the hazard of erosion. It can improve the habitat for some species of wildlife.

Butte. An isolated small mountain or hill with steep or precipitous sides and a top variously flat, rounded, or pointed that may be a residual mass isolated by erosion or an exposed volcanic neck.

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 directly beneath the solum, or it is exposed at the surface by erosion.

Canopy. The leafy crown of trees or shrubs. (See Crown.)

Canyon. A long, deep, narrow, very steep sided valley with high, precipitous walls in an area of high local relief.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Cement rock. Shaly limestone used in the manufacture of cement.

Channery soil material. Soil material that is, by volume, 15 to 35 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches (15 centimeters) along the longest axis. A single piece is called a channer.

Chemical treatment. Control of unwanted vegetation through the use of chemicals.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay depletions. Low-chroma zones having a low content of iron, manganese, and clay because of the chemical reduction of iron and manganese and the removal of iron, manganese, and clay. A type of redoximorphic depletion.

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.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax plant community. 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 textured soil. Sand or loamy sand.

Cobble (or cobblestone). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Cobbly soil material. Material that is 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. Very cobbly soil material has 35 to 60 percent of these rock fragments, and extremely cobbly soil material has more than 60 percent.

Colluvium. Soil material or 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 establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil or miscellaneous areas 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 or miscellaneous areas are somewhat similar in all areas.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Concretions. Cemented bodies with crude internal symmetry organized around a point, a line, or a plane.

They typically take the form of concentric layers visible to the naked eye. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up concretions. If formed in place, concretions of iron oxide or manganese oxide are generally considered a type of redoximorphic concentration.

Conglomerate. A coarse grained, clastic rock composed of rounded or subangular rock fragments more than 2 millimeters in diameter. It commonly has a matrix of sand and finer textured material. Conglomerate is the consolidated equivalent of gravel.

Conservation cropping system. Growing crops in combination with needed cultural and management practices. In a good conservation cropping system, the soil-improving crops and practices more than offset the effects of the soil-depleting crops and practices. Cropping systems are needed on all tilled soils. Soil-improving practices in a conservation cropping system include the use of rotations that contain grasses and legumes and the return of crop residue to the soil. Other practices include the use of green manure crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.

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. Refers to the degree of cohesion and adhesion of soil material and its resistance to deformation when ruptured. Consistence includes resistance of soil material to rupture and to penetration; plasticity, toughness, and stickiness of puddled soil material; and the manner in which the soil material behaves when subject to compression. Terms describing consistence are defined in the "Soil Survey Manual."

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.

Corrosion. Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cropping system. Growing crops according to a planned system of rotation and management practices.

Crop residue management. Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

Crown. The upper part of a tree or shrub, including the living branches and their foliage.

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 grazing land for a prescribed period.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth, soil. Generally, the thickness of the soil over bedrock. Very deep soils are more than 60 inches deep over bedrock; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Dip slope. A slope of the land surface, roughly determined by and approximately conforming to the dip of the underlying bedrock.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Divided-slope farming. A form of field stripcropping in which crops are grown in a systematic arrangement of two strips, or bands, across the slope to reduce the hazard of water erosion. One strip is in a close-growing crop that provides protection from erosion, and the other strip is in a crop that provides less protection from erosion. This practice is used where slopes are not long enough to permit a full stripcropping pattern to be used.

Dolomite. A common rock-forming rhombohedral carbonate mineral that contains magnesium.

Drainage class (natural). Refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized-*excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained,* and *very poorly drained*. These classes are defined in the "Soil Survey Manual."

Drainage, surface. Runoff, or surface flow of water, from an area.

Draw. A small stream valley that generally is more open and has broader bottomland than a ravine or gulch.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Endosaturation. A type of saturation of the soil in which all horizons between the upper boundary of saturation and a depth of 2 meters are saturated.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Ephemeral stream. A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

Episaturation. A type of saturation indicating a perched water table in a soil in which saturated layers are underlain by one or more unsaturated layers within 2 meters of the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, such as a fire, that exposes the surface.

Erosion pavement. A layer of gravel or stones that remains on the surface after fine particles are removed by sheet or rill erosion.

Escarpment. A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and resulting from erosion or faulting. Synonym: scarp.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Excess sodium (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

Extrusive rock. Igneous rock derived from deep-seated molten matter (magma) emplaced on the earth's surface.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grain is grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fan terrace. A relict alluvial fan, no longer a site of active deposition, incised by younger and lower alluvial surfaces.

Fast intake (in tables). The rapid movement of water into the soil.

Feldspar. A group of abundant rock-forming minerals. Feldspars are the most widespread of any mineral group and constitute 60 percent of the earth's crust. They occur in all types of rock and are white and gray to pink.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity*.

Fill slope. A sloping surface consisting of excavated soil material from a road cut. It commonly is on the downhill side of the road.

Fine textured soil. Sandy clay, silty clay, or clay.

Firebreak. Area cleared of flammable material to stop or help control creeping or running fires. It also serves as a line from which to work and to facilitate the movement of firefighters and equipment. Designated roads also serve as firebreaks.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flaggy soil material. Material that is, by volume, 15 to 35 percent flagstones. Very flaggy soil material has 35 to 60 percent flagstones, and extremely flaggy soil material has more than 60 percent flagstones.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist 6 to 15 inches (15 to 38 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Fluvial. Of or pertaining to rivers; produced by river action, as a fluvial plain.

Foothill. A steeply sloping upland that has relief of as much

as 1,000 feet (300 meters) and fringes a mountain range or high-plateau escarpment.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Fragile (in tables). A soil that is easily damaged by use or disturbance.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gilgai. Commonly, a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of clayey soils that shrink and swell considerably with changes in moisture content.

Glauconite. A green mineral, closely related to the micas and essentially a hydrous potassium iron silicate. It is common in sedimentary rocks from Cambrian to the present.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors.

Gneiss. A foliated rock formed by regional metamorphism in which bands of granular minerals alternate with bands of minerals with flaky or elongate prismatic habit.

Graded stripcropping. Growing crops in strips that grade toward a protected waterway.

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 as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water. Water filling all the unblocked pores of the material below the water table.

Grus. An accumulation of angular, coarse-grained fragments resulting from the granular disintegration of crystalline rocks (especially granite) generally in an arid or semiarid region.

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.

Hard bedrock. Bedrock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

High-residue crops. Such crops as small grain and corn used for grain. If properly managed, residue from these crops can be used to control erosion until the next crop in the rotation is established. These crops return large amounts of organic matter to the soil.

Hill. A natural elevation of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well defined outline; hillsides generally have slopes of more than 15 percent. The distinction between a hill and a mountain is arbitrary and is dependent on local usage.

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 uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the "Soil Survey Manual." The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an A, O, 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 (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

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 overlying soil material. 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, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

Hornblende. The most common mineral of the amphibole group. It is commonly black and occurs in distinct monoclinic crystals or in columnar, fibrous, or granular forms.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties are depth to a seasonal high water table, the infiltration rate and permeability after prolonged wetting, and depth to a very slowly permeable layer. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff.

Igneous rock. Rock formed by solidification from a molten or partially molten state. Major varieties include plutonic and volcanic rock. Examples are andesite, basalt, and granite.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Intermittent stream. A stream, or reach of a stream, that flows for prolonged periods only when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

Intrusion. Denoting igneous rocks derived from molten magmas that invaded pre-existing rocks and cooled below the surface of the earth.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, plants invade following disturbance of the surface.

Iron depletions. Low-chroma zones having a low content of iron and manganese oxide because of chemical reduction and removal, but having a clay content similar to that of the adjacent matrix. A type of redoximorphic depletion.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

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.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Knoll. A small, low, rounded hill rising above adjacent landforms.

Lamella. A thin, discontinuous or continuous, generally horizontal layer of fine material (especially clay and iron oxides) that has been illuviated within a coarser, eluviated layer.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments 3 inches (7.6 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.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low-residue crops. Such crops as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.

Low strength. The soil is not strong enough to support loads.

Marl. An earthy, unconsolidated deposit consisting chiefly of calcium carbonate mixed with clay in approximately equal amounts.

Masses. Concentrations of substances in the soil matrix that do not have a clearly defined boundary with the surrounding soil material and cannot be removed as a discrete unit. Common compounds making up masses are calcium carbonate, gypsum or other soluble salts, iron oxide, and manganese oxide. Masses consisting of iron oxide or manganese oxide generally are considered a type of redoximorphic concentration.

Mechanical treatment. Use of mechanical equipment for seeding, brush management, and other management practices.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mesa. A broad, nearly flat topped and commonly isolated upland mass characterized by summit widths that are more than the heights of bounding erosional scarps.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Mollic epipedon. A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Descriptive terms are as follows: abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Mountain. A natural elevation of the land surface, rising more than 1,000 feet above surrounding lowlands, commonly of restricted summit area (relative to a plateau) and generally having steep sides. A mountain can occur as a single, isolated mass or in a group forming a chain or range.

Mudstone. Sedimentary rock formed by induration of silt and clay in approximately equal amounts.

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Natric horizon. A special kind of argillic horizon that contains enough exchangeable sodium to have an adverse effect on the physical condition of the subsoil.

Neutral soil. A soil having a pH value of 6.6 to 7.3. (See Reaction, soil.)

Nodules. Cemented bodies lacking visible internal structure. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up nodules. If formed in place, nodules of iron oxide or manganese oxide are considered types of redoximorphic concentrations.

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. The content of organic matter in the surface layer is described as follows:

Very low	less than 0.5 percent
Low	0.5 to 1.0 percent
Moderately low	1.0 to 2.0 percent
Moderate	2.0 to 4.0 percent
High	4.0 to 8.0 percent
Very high	more than 8.0 percent

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan*.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedisediment. A thin layer of alluvial material that mantles an erosion surface and has been transported to its present position from higher lying areas of the erosion surface.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affects the specified use.

Permeability. The quality of the soil that enables water or air to move downward through the profile. The rate at which a saturated soil transmits water is accepted as a measure of this quality. In soil physics, the rate is referred to as "saturated hydraulic conductivity," which is defined in the "Soil Survey Manual." In line with conventional usage in the engineering profession and with traditional usage in published soil surveys, this rate of flow continues to be expressed as "permeability." Terms describing permeability, measured in inches per hour, are as follows:

Very slow	less than .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, such as slope, stoniness, and flooding.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plateau. An extensive upland mass with relatively flat summit area that is considerably elevated (more than 100 meters) above adjacent lowlands and separated from them on one or more sides by escarpments.

Playa. The generally dry and nearly level lake plain that occupies the lowest parts of closed depressional areas, such as those on intermontane basin floors. Temporary flooding occurs primarily in response to precipitation and runoff.

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.

Poor filter (in tables). Because of rapid or very rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Potential native plant community. See Climax plant community.

Potential rooting depth (effective rooting depth). Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

Prescribed burning. Deliberately burning an area for specific management purposes, under the appropriate conditions of weather and soil moisture and at the proper time of day.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Proper grazing use. Grazing at an intensity that maintains enough cover to protect the soil and maintain or improve the quantity and quality of the desirable vegetation. This practice increases the vigor and reproduction capacity of the key plants and promotes the accumulation of litter and mulch necessary to conserve soil and water.

Quartz. Crystalline silica, an important rock-forming mineral. It is, next to feldspar, the most common mineral. Quartz forms the major proportion of most sands and has a widespread distribution in igneous, metamorphic, and sedimentary rocks.

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.

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 site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Ultra acid	less than 3.5
Extremely acid	3.5 to 4.4
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly 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

Red beds. Sedimentary strata that are mainly red and are made up largely of sandstone and shale.

Redoximorphic concentrations. Nodules, concretions, soft masses, pore linings, and other features resulting from the accumulation of iron or manganese oxide. An indication of chemical reduction and oxidation resulting from saturation.

Redoximorphic depletions. Low-chroma zones from which iron and manganese oxide or a combination of iron and manganese oxide and clay has been removed. These zones are indications of the chemical reduction of iron resulting from saturation.

Redoximorphic features. Redoximorphic concentrations, redoximorphic depletions, reduced matrices, a positive reaction to alpha,alpha-dipyridyl, and other features indicating the chemical reduction and oxidation of iron and manganese compounds resulting from saturation.

Reduced matrix. A soil matrix that has low chroma in situ because of chemically reduced iron (Fe II). The chemical reduction results from nearly continuous wetness. The matrix undergoes a change in hue or chroma within 30 minutes after exposure to air as the iron is oxidized (Fe III). A type of redoximorphic feature.

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep-sided channel resulting from accelerated erosion. A rill generally is a few inches deep and not wide enough to be an obstacle to farm machinery.

Road cut. A sloping surface produced by mechanical means during road construction. It is commonly on the uphill side of the road.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in

diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Saprolite. Unconsolidated residual material underlying the soil and grading to hard bedrock below.

Saturation. Wetness characterized by zero or positive pressure of the soil water. Under conditions of saturation, the water will flow from the soil matrix into an unlined auger hole.

Scarification. The act of abrading, scratching, loosening, crushing, or modifying the surface to increase water absorption or to provide a more tillable soil.

Schist. A strongly foliated crystalline rock, formed by dynamic metamorphism, that has well-developed parallelism of more than 50 percent of the minerals present, particularly those of lamellar or elongate prismatic habit, e.g. mica and hornblende.

Second bottom. The first terrace above the normal flood plain (or first bottom) of a river.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. 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 (in tables). The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silica-sesquioxide ratio. The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

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.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil generally is silty or clayey, is slippery when wet, and is low in productivity.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Sodic (alkali) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium adsorption ratio (SAR) of a saturation extract,

or the ratio of Na^{+} to Ca^{+++} Mg^{++}. The degrees of sodicity and their respective ratios are:

Slight	less than 13:1
Moderate	13-30:1
Strong	more than 30:1

Soft bedrock. Bedrock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.

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, in millimeters, of separates recognized in the United States are as follows:

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 material below the solum. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

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 erosion 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 erosion and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons, considered collectively. It includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior. Soils are recognized as taxadjuncts only when one or more of their characteristics are slightly outside the range defined for the family of the series for which the soils are named.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field generally is built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are

sand, loamy sand, sandy loam, loam, silt 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 that is too thin for the specified use.

Throw. The amount of vertical displacement on a fault.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Toxicity (in tables). Excessive amount of toxic substances, such as sodium or sulfur, that severely hinder establishment of vegetation or severely restrict plant growth.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland. Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Uplift. A structurally high area in the earth's crust, produced by positive movements that raise or upthrust the rocks, as in a dome or arch.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Water bars. Smooth, shallow ditches or depressional areas that are excavated at an angle across a sloping road. They are used to reduce the downward velocity of water and divert it off and away from the road surface. Water bars can easily be driven over if constructed properly.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1961-90 at Llano, Texas)

Month	Temperature						Precipitation				
				2 years in 10 will have--				2 years in 10 will have--			
	Average daily maximum	Average daily minimum	Average	Maximum temperature higher than--	Minimum temperature lower than--	Average number of growing degree days*	Average	Less than--	More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January	59.1	31.1	45.1	84	11	64	1.18	0.37	1.91	2	0.6
February	63.3	35.2	49.2	88	16	99	1.76	0.59	2.72	3	0.6
March	71.7	44.4	58.1	93	23	285	1.62	0.56	2.49	3	0.0
April	80.0	54.2	67.1	97	32	516	2.50	0.81	3.88	3	0.0
May	85.3	62.2	73.7	100	43	733	3.79	1.96	5.39	5	0.0
June	91.8	69.0	80.4	103	54	912	2.76	1.15	4.29	4	0.0
July	96.2	71.8	84.0	105	61	1053	1.76	0.38	2.84	2	0.0
August	96.0	70.6	83.3	105	60	1032	2.37	0.61	3.77	3	0.0
September	89.3	64.8	77.1	101	44	811	2.99	1.24	4.47	4	0.0
October	80.7	53.7	67.2	96	34	533	2.71	1.10	4.24	3	0.0
November	70.1	42.9	56.5	89	22	239	1.77	0.82	2.82	3	0.0
December	61.9	33.5	47.7	83	14	84	1.24	0.39	1.92	2	0.0
Yearly:											
Average	78.8	52.8	65.8	---	---	---	---	---	---	---	---
Extreme	---	---	---	107	8	---	---	---	---	---	---
Total	---	---	---	---	---	6361	26.44	22.17	30.54	37	1.2

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minumum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 degrees F)

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1961-90 at Llano, 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 9	March 22	April 8
2 years in 10 later than--	March 2	March 15	April 2
5 years in 10 later than--	February 17	March 1	March 21
First freezing temperature in fall:			
1 year in 10 earlier than--	November 21	November 7	October 25
2 years in 10 earlier than--	November 28	November 12	October 31
5 years in 10 earlier than--	December 12	November 23	November 11

TABLE 3.--GROWING SEASON

(Recorded in the period 1961-90 at Llano, 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	271	238	211
8 years in 10	280	248	219
5 years in 10	297	266	235
2 years in 10	315	284	250
1 year in 10	324	293	258

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
BaC	Bastrop loamy fine sand, 1 to 5 percent slopes	1,775	0.3
BmA	Bauman loam, 0 to 2 percent slopes	9,690	1.6
Br	Boerne fine sandy loam, rarely flooded	1,945	0.3
CaB	Campair sand, 1 to 5 percent slopes	8,640	1.4
CeC	Castell sandy loam, 1 to 5 percent slopes	76,667	12.4
ChB	Cho loam, 1 to 3 percent slopes	1,975	0.3
CkC	Click very gravelly coarse sandy loam, 1 to 8 percent slopes	16,247	2.6
EcC	Eckrant-Rock outcrop complex, 1 to 8 percent slopes, extremely stony	5,215	0.8
EcF	Eckrant-Rock outcrop complex, 10 to 40 percent slopes, extremely stony	9,412	1.5
Fe	Fieldcreek fine sandy loam, occasionally flooded	20,305	3.3
HaB	Harper clay, 0 to 3 percent slopes, stony	586	0.1
HaC	Harper-Rock outcrop complex, 1 to 5 percent slopes, very stony	957	0.2
HeB	Hensley loam, 1 to 5 percent slopes, stony	4,228	0.7
HoB	Honeycreek fine sandy loam, 1 to 3 percent slopes	6,326	1.0
HyC	Hye fine sandy loam, 1 to 5 percent slopes	1,867	0.3
KaC	Katemcy sandy loam, 1 to 5 percent slopes	27,988	4.5
KeC	Keese coarse sandy loam, 1 to 8 percent slopes, stony	56,532	9.1
KoC	Keese-Rock outcrop complex, 1 to 8 percent slopes, very stony	53,076	8.6
KoF	Keese-Rock outcrop complex, 12 to 30 percent slopes, very stony	27,910	4.5
KrB	Krum silty clay, 1 to 3 percent slopes	570	0.1
LgC	Ligon fine sandy loam, 1 to 5 percent slopes	45,885	7.4
LgD	Ligon cobbly fine sandy loam, 5 to 12 percent slopes	44,760	7.2
LkB	Loneoak sand, 0 to 3 percent slopes	7,483	1.2
LoB	Lou coarse sandy loam, 1 to 5 percent slopes	35,872	5.8
LuB	Luckenbach clay loam, 0 to 3 percent slopes	2,315	0.4
MaC	Matilo sand, 1 to 5 percent slopes	1,265	0.2
NeF	Nebgen-Rock outcrop complex, 5 to 30 percent slopes, extremely stony	18,485	3.0
NuB	Nuvalde clay loam, 0 to 3 percent slopes	3,025	0.5
ObC	Oben sandy loam, 1 to 5 percent slopes, stony	2,006	0.3
OpC	Oplin-Rock outcrop complex, 1 to 8 percent slopes, stony	1,450	0.2
OpF	Oplin-Rock outcrop complex, 8 to 40 percent slopes, stony	6,017	1.0
PaC	Packsaddle channery loam, 3 to 8 percent slopes	1,975	0.3
PeB	Pedernales fine sandy loam, 1 to 3 percent slopes	740	0.1
PoC	Pontotoc fine sandy loam, 1 to 5 percent slopes	5,940	1.0
ReC	Real gravelly loam, 1 to 8 percent slopes	1,080	0.2
ReG	Real gravelly loam, 20 to 40 percent slopes	2,314	0.4
Rh	Riverwash, frequently flooded	3,317	0.5
Rk	Riverwash-Rock outcrop complex, frequently flooded	3,365	0.5
Ro	Rock outcrop, granite	2,314	0.4
RrC	Roughcreek-Rock outcrop complex, 1 to 8 percent slopes, very stony	10,430	1.7
RrF	Roughcreek-Rock outcrop complex, 8 to 40 percent slopes, very stony	5,370	0.9
RuC	Rumple gravelly clay loam, 1 to 5 percent slopes	5,986	1.0
VeA	Venus loam, 0 to 2 percent slopes	1,728	0.3
Vn	Venus loam, occasionally flooded	1,620	0.3
VoB	Voca gravelly sandy loam, 0 to 3 percent slopes	37,724	6.1
We	Weswood silt loam, rarely flooded	633	0.1
YeC	Yates-Rock outcrop complex, 1 to 8 percent slopes, very stony	6,264	1.0
YeG	Yates-Rock outcrop complex, 12 to 40 percent slopes, very stony	10,044	1.6
	Water greater than 40 acres in size	17,093	2.8
	Total	618,413	100.0

* Less than 0.1 percent.

TABLE 5.--LAND CAPABILITY 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)

Soil name and map symbol	Land capability	Wheat	Oats	Improved bermudagrass	Peanuts
		Bu	Bu	AUM*	Lbs
BaC---------- Bastrop	IIIe	---	---	6.0	1,400
BmA---------- Bauman	IVs	---	---	3.5	---
Br---------- Boerne	IIw	15	40	4.0	---
CaB---------- Campair	IIIe	---	---	6.0	1,200
CeC---------- Castell	IIIe	---	30	3.0	---
ChB---------- Cho	IVs	15	---	---	---
CkC---------- Click	VIs	---	---	---	---
EcC**, EcF**:					
Eckrant----------	VIIs	---	---	---	---
Rock outcrop-----	VIIIs	---	---	---	---
Fe---------- Fieldcreek	IIw	25	50	6.0	---
HaB---------- Harper	VIs	---	---	---	---
HaC**:					
Harper----------	VIs	---	---	---	---
Rock outcrop-----	VIIIs	---	---	---	---
HeB---------- Hensley	VIs	---	---	---	---

See footnotes at end of table.

TABLE 5.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Wheat	Oats	Improved bermudagrass	Peanuts
		Bu	Bu	AUM*	Lbs
HoB---------- Honeycreek	IIIe	---	---	3.0	---
HyC---------- Hye	IIIe	---	---	6.0	1,000
KaC---------- Katemcy	IIIe	16	---	2.5	---
KeC---------- Keese	VIIs	---	---	---	---
KoC**, KoF**:					
Keese----------	VIIs	---	---	---	---
Rock outcrop-----	VIIIs	---	---	---	---
KrB---------- Krum	IIe	40	70	8.0	---
LgC---------- Ligon	IVs	---	---	2.0	---
LgD---------- Ligon	VIs	---	---	---	---
LkB---------- Loneoak	IIIe	---	---	6.0	1,200
LoB---------- Lou	IIIe	15	30	3.0	---
LuB---------- Luckenbach	IIe	30	50	5.0	---
MaC---------- Matilo	IVe	---	---	5.0	1,100
NeF**:					
Nebgen----------	VIIs	---	---	---	---
Rock outcrop-----	VIIIs	---	---	---	---

See footnotes at end of table.

TABLE 5.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Wheat	Oats	Improved bermudagrass	Peanuts
		Bu	Bu	AUM*	Lbs
NuB---------- Nuvalde	IIe	20	50	---	---
ObC---------- Oben	VIs	---	---	---	---
OpC**, OpF**:					
Oplin----------	VIIs	---	---	---	---
Rock outcrop-----	VIIIs	---	---	---	---
PaC---------- Packsaddle	VIs	---	---	---	---
PeB---------- Pedernales	IIe	25	60	4.0	1,000
PoC---------- Pontotoc	IIIe	---	---	5.0	800
ReC---------- Real	VIs	---	---	---	---
ReG---------- Real	VIIs	---	---	---	---
Rh**---------- Riverwash	Vw	---	---	---	---
Rk**:					
Riverwash--------	Vw	---	---	---	---
Rock outcrop-----	VIIIs	---	---	---	---
Ro**---------- Rock outcrop	VIIIs	---	---	---	---
RrC**, RrF**:					
Roughcreek-------	VIs	---	---	---	---
Rock outcrop-----	VIIIs	---	---	---	---

See footnotes at end of table.

TABLE 5.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Wheat	Oats	Improved bermudagrass	Peanuts
		Bu	Bu	AUM*	Lbs
RuC---------- Rumple	VIs	---	---	---	---
VeA---------- Venus	IIe	---	60	7.0	---
Vn---------- Venus	IIw	---	65	7.0	---
VoB---------- Voca	IVs	15	---	3.0	---
We---------- Weswood	I	---	75	8.0	---
YeC**, YeG**: Yates----------	VIIs	---	---	---	---
Rock outcrop-----	VIIIs	---	---	---	---

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--RANGELAND PRODUCTIVITY

(Only the soils that support rangeland vegetation suitable for grazing are listed)

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable Lb/acre	Average Lb/acre	Unfavorable Lb/acre
BaC Bastrop	Sandy Loam	4,000	3,000	2,000
BmA Bauman	Tightland	3,500	2,500	1,500
Br Boerne	Loamy Bottomland	6,000	3,800	2,500
CaB Campair	Sandy Loam	3,200	2,800	1,800
CeC Castell	Sandy Loam	3,200	2,600	1,800
ChB Cho	Shallow	2,500	2,000	1,000
CkC Click	Granite Gravel	1,900	1,600	1,200
EcC*: Eckrant Rock outcrop.	Low Stony Hill	3,000	2,500	1,500
EcF*: Eckrant Rock outcrop.	Steep Rocky	1,800	1,400	800
Fe Fieldcreek	Loamy Bottomland	5,500	4,500	3,000
HaB Harper	Low Stony Hill	3,000	2,500	1,500
HaC*: Harper Rock outcrop.	Low Stony Hill	3,000	2,500	1,500

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
HeB Hensley	Redland	4,000	3,000	2,500
HoB Honeycreek	Sandy Loam	3,300	2,700	1,800
HyC Hye	Red Sandy Loam	4,000	3,500	2,000
KaC Katemcy	Red Savannah	3,500	2,800	1,500
KeC Keese	Shallow Granite	2,500	1,700	1,200
KoC*: Keese	Shallow Granite	2,000	1,600	1,200
Rock outcrop.				
KoF*: Keese	Granite Hill	1,500	1,300	1,000
Rock outcrop.				
KrB Krum	Clay Loam	5,000	4,000	3,000
LgC Ligon	Red Savannah	3,400	2,700	1,000
LgD Ligon	Shallow Ridge	2,500	1,500	1,000
LkB Loneoak	Sandy	4,000	3,000	2,000
LoB Lou	Granite Gravel	2,000	1,800	1,200
LuB Luckenbach	Clay Loam	5,000	4,000	3,000
MaC Matilo	Deep Sand	3,000	2,500	1,500

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
NeF*:				
Nebgen	Sandstone Hill	3,000	2,300	1,500
Rock outcrop.				
NuB	Clay Loam	5,000	4,000	3,000
Nuvalde				
ObC	Red Sandy Loam	3,500	2,800	1,800
Oben				
OpC*:				
Oplin	Low Stony Hill	2,300	1,800	1,200
Rock outcrop.				
OpF*:				
Oplin	Steep Rocky	1,700	1,300	900
Rock outcrop.				
PaC	Shallow Ridge	2,400	1,800	1,000
Packsaddle				
PeB	Tight Sandy Loam	3,200	2,800	1,500
Pedernales				
PoC	Red Sandy Loam	4,000	3,500	2,000
Pontotoc				
ReC	Adobe	3,000	2,100	1,200
Real				
ReG	Steep Adobe	2,400	1,700	900
Real				
RrC*:				
Roughcreek	Redland	3,500	2,700	2,000
Rock outcrop.				
RrF*:				
Roughcreek	Steep Redland	3,000	2,000	1,000
Rock outcrop.				

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
RuC Rumple	Gravelly Redland	3,000	2,000	1,500
VeA Venus	Clay Loam	5,000	4,000	3,000
Vn Venus	Loamy Bottomland	5,500	4,500	3,000
VoB Voca	Gravelly Sandy Loam	3,000	2,000	1,500
We Weswood	Loamy Bottomland	5,500	4,500	3,000
YeC*, YeG*:				
Yates	Very Shallow	2,000	1,500	1,000
Rock outcrop.				

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--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)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
BaC Bastrop	Slight	Slight	Moderate: slope.	Slight	Slight.
BmA Bauman	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight	Severe: excess sodium.
Br Boerne	Severe: flooding.	Slight	Moderate: small stones.	Slight	Slight.
CaB Campair	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty, depth to rock, too sandy.
CeC Castell	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: large stones, droughty.
ChB Cho	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Slight	Severe: cemented pan.
CkC Click	Severe: small stones.	Severe: small stones.	Severe: small stones.	Slight	Severe: small stones, droughty.
EcC*: Eckrant	Severe: depth to rock.	Severe: depth to rock.	Severe: large stones, small stones.	Moderate: large stones.	Severe: large stones, depth to rock.
Rock outcrop	---	---	---	---	---
EcF*: Eckrant	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: large stones, slope.	Severe: slope.	Severe: large stones, slope, depth to rock.

See footnote at end of table.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Rock outcrop	---	---	---	---	---
Fe Fieldcreek	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
HaB Harper	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Moderate: too clayey.	Severe: depth to rock, too clayey.
HaC*: Harper	Severe: depth to rock.	Severe: depth to rock.	Severe: large stones, depth to rock.	Moderate: too clayey.	Severe: depth to rock, too clayey.
Rock outcrop	---	---	---	---	---
HeB Hensley	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Severe: depth to rock.
HoB Honeycreek	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.
HyC Hye	Slight	Slight	Moderate: slope, small stones, depth to rock.	Slight	Moderate: depth to rock.
KaC Katemcy	Slight	Slight	Moderate: slope, small stones, depth to rock.	Slight	Moderate: depth to rock.
KeC Keese	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Severe: depth to rock.
KoC*: Keese	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Severe: depth to rock.

See footnote at end of table.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Rock outcrop	---	---	---	---	---
KoF*:					
Keese	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Moderate: slope.	Severe: slope, depth to rock.
Rock outcrop	---	---	---	---	---
KrB	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope, small stones.	Moderate: too clayey.	Severe: too clayey.
Krum					
LgC	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: depth to rock.
Ligon					
LgD	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: large stones.	Moderate: droughty, slope.
Ligon					
LkB	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty, too sandy.
Loneoak					
LoB	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: droughty, depth to rock.
Lou					
LuB	Slight	Slight	Slight	Slight	Slight.
Luckenbach					
MaC	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: droughty.
Matilo					
NeF*:					
Nebgen	Severe: depth to rock.	Severe: depth to rock.	Severe: large stones, slope, depth to rock.	Severe: large stones.	Severe: large stones, depth to rock.

See footnote at end of table.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Rock outcrop	---	---	---	---	---
NuB Nuvalde	Slight	Slight	Slight	Slight	Slight.
ObC Oben	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Moderate: large stones.	Severe: depth to rock.
OpC*:					
Oplin	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: large stones, small stones.	Slight	Severe: small stones, large stones.
Rock outcrop	---	---	---	---	---
OpF*:					
Oplin	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: large stones, slope.	Moderate: slope.	Severe: small stones.
Rock outcrop	---	---	---	---	---
PaC Packsaddle	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight	Moderate: small stones, droughty, depth to rock.
PeB Pedernales	Slight	Slight	Moderate: slope.	Slight	Slight.
PoC Pontotoc	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: large stones.
ReC Real	Severe: depth to rock.	Severe: depth to rock.	Severe: small stones, depth to rock.	Slight	Severe: depth to rock.
ReG Real	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope.	Severe: slope, depth to rock.

See footnote at end of table.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Rh* Riverwash	Severe: flooding, small stones.	Severe: small stones.	Severe: small stones, flooding.	Severe: small stones.	Severe: small stones, large stones, flooding.
Rk*: Riverwash	Severe: flooding, small stones.	Severe: small stones.	Severe: small stones, flooding.	Severe: small stones.	Severe: small stones, large stones, flooding.
Rock outcrop	---	---	---	---	---
Ro* Rock outcrop	---	---	---	---	---
RrC*: Roughcreek	Severe: depth to rock.	Severe: depth to rock.	Severe: large stones, depth to rock.	Severe: large stones.	Severe: large stones, depth to rock.
Rock outcrop	---	---	---	---	---
RrF*: Roughcreek	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: large stones, slope, depth to rock.	Severe: large stones.	Severe: large stones, slope, depth to rock.
Rock outcrop	---	---	---	---	---
RuC Rumple	Severe: small stones.	Severe: small stones.	Severe: small stones.	Slight	Severe: small stones, droughty.
VeA Venus	Slight	Slight	Slight	Slight	Slight.
Vn Venus	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.

See footnote at end of table.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
VoB Voca	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight	Moderate: small stones, droughty.
We Weswood	Severe: flooding.	Slight	Slight	Slight	Slight.
YeC*: Yates	Severe: depth to rock.	Severe: depth to rock.	Severe: large stones, small stones.	Severe: large stones.	Severe: large stones, depth to rock.
Rock outcrop	---	---	---	---	---
YeG*: Yates	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: large stones, slope, small stones.	Severe: large stones, slope.	Severe: large stones, slope, depth to rock.
Rock outcrop	---	---	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
BaC---Bastrop	Fair	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
BmA---Bauman	Poor	Poor	Fair	Poor	Poor	Fair	Poor	Poor	Fair.
Br---Boerne	Fair	Fair	Good	Fair	Poor	Very poor	Fair	Very poor	Fair.
CaB---Campair	Fair	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
CeC---Castell	Fair	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
ChB---Cho	Fair	Poor	Poor	Poor	Poor	Very poor	Poor	Very poor	Poor.
CkC---Click	Poor	Poor	Fair	Good	Poor	Very poor	Poor	Very poor	Fair.
EcC*, EcF*:									
Eckrant	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
Rock outcrop	---	---	---	---	---	---	---	---	---
Fe---Fieldcreek	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
HaB---Harper	Poor	Poor	Poor	Fair	Poor	Very poor	Poor	Very poor	Poor.
HaC*:									
Harper	Poor	Poor	Poor	Fair	Poor	Very poor	Poor	Very poor	Poor.
Rock outcrop	---	---	---	---	---	---	---	---	---
HeB---Hensley	Poor	Poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.

See footnote at end of table.

TABLE 8.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
HoB---------- Honeycreek	Fair	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
HyC---------- Hye	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
KaC---------- Katemcy	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
KeC---------- Keese	Very poor	Very poor	Poor	Fair	Poor	Very poor	Very poor	Very poor	Poor.
KoC*, KoF*:									
Keese----------	Very poor	Very poor	Poor	Fair	Poor	Very poor	Very poor	Very poor	Poor.
Rock outcrop------	---	---	---	---	---	---	---	---	---
KrB---------- Krum	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
LgC, LgD---------- Ligon	Poor	Poor	Fair	Fair	Poor	Very poor	Poor	Very poor	Fair.
LkB---------- Lonecak	Fair	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
LoB---------- Lou	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
LuB---------- Luckenbach	Good	Good	Fair	Good	Poor	Very poor	Good	Very poor	Fair.
MaC---------- Matilo	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
NeF*:									
Nebgen----------	Very poor	Very poor	Poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor.
Rock outcrop------	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 8.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
NuB---------- Nuvalde	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
ObC---------- Oben	Poor	Poor	Fair	Fair	Poor	Very poor	Poor	Very poor	Fair.
OpC*, OpF*:									
Oplin----------	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
Rock outcrop------	---	---	---	---	---	---	---	---	---
PaC---------- Packsaddle	Poor	Poor	Fair	Good	Very poor	Very poor	Poor	Very poor	Fair.
PeB---------- Pedernales	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
PoC---------- Pontotoc	Fair	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
ReC---------- Real	Very poor	Poor	Poor	Fair	Poor	Very poor	Poor	Very poor	Poor.
ReG---------- Real	Very poor	Very poor	Poor	Fair	Very poor	Very poor	Very poor	Very poor	Poor.
Rh*---------- Riverwash	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor.
Rk*:									
Riverwash---------	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor.
Rock outcrop.									
Ro*---------- Rock outcrop	---	---	---	---	---	---	---	---	---
RrC*, RrF*:									
Roughcreek--------	Poor	Poor	Fair	Good	Poor	Very poor	Poor	Very poor	Fair.
Rock outcrop------	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 8.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
RuC---------- Rumple	Poor	Poor	Fair	Fair	Poor	Very poor	Poor	Very poor	Fair.
VeA, Vn---------- Venus	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
VoB---------- Voca	Fair	Poor	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
We---------- Weswood	Good	Good	Fair	Good	Poor	Very poor	Good	Very poor	Fair.
YeC*, YeG*:									
Yates----------	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
Rock outcrop------	---	---	---	---	---	---	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--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 but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
BaC Bastrop	Slight	Slight	Slight	Slight	Moderate: low strength.	Slight.
BmA Bauman	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: excess sodium.
Br Boerne	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Slight.
CaB Campair	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: droughty, depth to rock, too sandy.
CeC Castell	Moderate: depth to rock, too clayey.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, low strength.	Moderate: large stones, droughty.
ChB Cho	Severe: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.	Moderate: cemented pan.	Moderate: cemented pan.	Severe: cemented pan.
CkC Click	Slight	Slight	Slight	Moderate: slope.	Slight	Severe: small stones, droughty.
EcC*: Eckrant	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.
Rock outcrop	---	---	---	---	---	---
EcF*: Eckrant	Severe: depth to rock, large stones, slope.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, low strength, slope.	Severe: large stones, slope, depth to rock.

See footnote at end of table.

TABLE 9.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Rock outcrop	---	---	---	---	---	---
Fe Fieldcreek	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
HaB Harper	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, shrink-swell, low strength.	Severe: depth to rock, too clayey.
HaC*: Harper	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, shrink-swell, low strength.	Severe: depth to rock, too clayey.
Rock outcrop	---	---	---	---	---	---
HeB Hensley	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, low strength.	Severe: depth to rock.
HoB Honeycreek	Slight	Slight	Slight	Slight	Slight	Slight.
HyC Hye	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Slight	Slight	Moderate: depth to rock.
KaC Katemcy	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Moderate: depth to rock.
KeC Keese	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock.	Severe: depth to rock.
KoC*: Keese	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock.	Severe: depth to rock.
Rock outcrop	---	---	---	---	---	---

See footnote at end of table.

TABLE 9.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
KoF*:						
Keese	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, depth to rock.
Rock outcrop	---	---	---	---	---	---
KrB	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
Krum						
LgC	Moderate: depth to rock, too clayey.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Moderate: depth to rock.
Ligon						
LgD	Moderate: depth to rock, too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: depth to rock, slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: droughty, slope.
Ligon						
LkB	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Moderate: droughty, too sandy.
Loneoak						
LoB	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Slight	Slight	Moderate: droughty, depth to rock.
Lou						
LuB	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
Luckenbach						
MaC	Severe: cutbanks cave.	Slight	Moderate: wetness.	Slight	Slight	Severe: droughty.
Matilo						
NeF*:						
Nebgen	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: large stones, depth to rock.
Rock outcrop	---	---	---	---	---	---

See footnote at end of table.

TABLE 9.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
NuB Nuvalde	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
ObC Oben	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.
OpC*: Oplin	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: small stones, large stones.
Rock outcrop	---	---	---	---	---	---
OpF*: 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: small stones.
Rock outcrop	---	---	---	---	---	---
PaC Packsaddle	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Moderate: slope.	Slight	Moderate: small stones, droughty, depth to rock.
PeB Pedernales	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
PoC Pontotoc	Slight	Slight	Slight	Slight	Slight	Moderate: large stones.
ReC Real	Severe: depth to rock, cemented pan.	Moderate: depth to rock, cemented pan.	Severe: depth to rock, cemented pan.	Moderate: slope, depth to rock, cemented pan.	Moderate: depth to rock, cemented pan.	Severe: depth to rock.
ReG Real	Severe: depth to rock, cemented pan, slope.	Severe: slope.	Severe: depth to rock, cemented pan, slope.	Severe: slope.	Severe: slope.	Severe: slope, depth to rock.

See footnote at end of table.

TABLE 9.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Rh* Riverwash	Moderate: large stones, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Rk*: Riverwash	Moderate: large stones, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Rock outcrop	---	---	---	---	---	---
Ro* Rock outcrop	---	---	---	---	---	---
RrC*: Roughcreek	Severe: depth to rock, large stones.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, shrink-swell, large stones.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, low strength, shrink-swell.	Severe: large stones, depth to rock
Rock outcrop	---	---	---	---	---	---
RrF*: Roughcreek	Severe: depth to rock, large stones, slope.	Severe: shrink-swell, slope, depth to rock.	Severe: depth to rock, slope, shrink-swell.	Severe: shrink-swell, slope, depth to rock.	Severe: depth to rock, low strength, shrink-swell.	Severe: large stones, slope, depth to rock
Rock outcrop	---	---	---	---	---	---
RuC Rumple	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Moderate: depth to rock, shrink-swell.	Severe: small stones, droughty.
VeA Venus	Slight	Slight	Slight	Slight	Moderate: low strength.	Slight.
Vn Venus	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.

See footnote at end of table.

TABLE 9.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
VoB Voca	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Moderate: small stones, droughty.
We Weswood	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.	Slight.
YeC*: Yates	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, large stones.	Severe: large stones, depth to rock.
Rock outcrop	---	---	---	---	---	---
YeG*: Yates	Severe: depth to rock, large stones, slope.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: large stones, slope, depth to rock.
Rock outcrop	---	---	---	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--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 but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
BaC Bastrop	Moderate: percs slowly.	Severe: seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
BmA Bauman	Severe: percs slowly.	Moderate: depth to rock.	Severe: depth to rock, excess sodium.	Moderate: depth to rock.	Poor: excess sodium.
Br Boerne	Moderate: flooding.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
CaB Campair	Severe: depth to rock.	Severe: seepage, depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
CeC Castell	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
ChB Cho	Severe: cemented pan.	Severe: cemented pan.	Moderate: cemented pan, too clayey.	Severe: cemented pan.	Poor: cemented pan, small stones.
CkC Click	Severe: poor filter.	Severe: seepage.	Severe: depth to rock, seepage.	Severe: seepage.	Poor: small stones.
EcC*: Eckrant	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.
Rock outcrop	---	---	---	---	---

See footnote at end of table.

TABLE 10.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
EcF*:					
Eckrant	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: depth to rock, too clayey, hard to pack.
Rock outcrop	---	---	---	---	---
Fe	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding, seepage.	Good.
Fieldcreek					
HaB	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
Harper					
HaC*:					
Harper	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
Rock outcrop	---	---	---	---	---
HeB	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
Hensley					
HoB	Moderate: depth to rock, percs slowly.	Moderate: seepage, depth to rock, slope.	Severe: depth to rock.	Moderate: depth to rock.	Fair: depth to rock, thin layer.
Honeycreek					
HyC	Severe: depth to rock.	Severe: seepage, depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
Hye					
KaC	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock, hard to pack, small stones.
Katemcy					

See footnote at end of table.

TABLE 10.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
KeC	Severe: depth to rock.	Severe: seepage, depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock.	Poor: depth to rock, seepage, small stones.
Keese					
KoC*:					
Keese	Severe: depth to rock.	Severe: seepage, depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock.	Poor: depth to rock, seepage, small stones.
Rock outcrop	---	---	---	---	---
KoF*:					
Keese	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, slope.	Poor: depth to rock, seepage, small stones.
Rock outcrop	---	---	---	---	---
KrB	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
Krum					
LgC	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey.
Ligon					
LgD	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
Ligon					
LkB	Severe: percs slowly.	Severe: seepage.	Severe: depth to rock.	Severe: seepage.	Poor: hard to pack.
Loneoak					
LoB	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
Lou					
LuB	Severe: percs slowly.	Moderate: seepage.	Severe: too clayey.	Slight	Poor: too clayey.
Luckenbach					

See footnote at end of table.

TABLE 10.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
MaC	Severe:	Severe:	Severe:	Severe:	Poor:
Matilo	poor filter.	seepage.	too sandy.	seepage.	too sandy.
NeF*:					
Nebgen	Severe:	Severe:	Severe:	Severe:	Poor:
	depth to rock, large stones.	depth to rock, slope, large stones.	depth to rock, seepage.	depth to rock.	depth to rock, large stones.
Rock outcrop	---	---	---	---	---
NuB	Moderate:	Moderate:	Moderate:	Slight	Fair:
Nuvalde	percs slowly.	seepage.	too clayey.		too clayey.
ObC	Severe:	Severe:	Severe:	Severe:	Poor:
Oben	depth to rock.	depth to rock.	depth to rock.	depth to rock.	depth to rock.
OpC*:					
Oplin	Severe:	Severe:	Severe:	Severe:	Poor:
	depth to rock.	depth to rock, large stones.	depth to rock, large stones.	depth to rock.	depth to rock.
Rock outcrop	---	---	---	---	---
OpF*:					
Oplin	Severe:	Severe:	Severe:	Severe:	Poor:
	depth to rock, slope.	depth to rock, slope.	depth to rock, slope.	depth to rock, slope.	depth to rock, slope.
Rock outcrop	---	---	---	---	---
PaC	Severe:	Severe:	Severe:	Severe:	Poor:
Packsaddle	depth to rock, percs slowly.	depth to rock.	depth to rock.	depth to rock.	depth to rock, small stones.
PeB	Severe:	Moderate:	Severe:	Slight	Poor:
Pedernales	percs slowly.	slope.	too clayey.		too clayey, hard to pack.
PoC	Moderate:	Severe:	Slight	Severe:	Good.
Pontotoc	percs slowly.	seepage.		seepage.	

See footnote at end of table.

TABLE 10.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
ReC---------- Real	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.
ReG---------- Real	Severe: depth to rock, cemented pan, slope.	Severe: depth to rock, cemented pan, slope.	Severe: depth to rock, slope.	Severe: depth to rock, cemented pan, slope.	Poor: depth to rock, small stones, slope.
Rh*---------- Riverwash	Severe: flooding.	Severe: flooding, large stones.	Severe: flooding, large stones.	Severe: flooding.	Poor: seepage, small stones.
Rk*:					
Riverwash----------	Severe: flooding.	Severe: flooding, large stones.	Severe: flooding, large stones.	Severe: flooding.	Poor: seepage, small stones.
Rock outcrop-------	---	---	---	---	---
Ro*----------					
Rock outcrop-------	---	---	---	---	---
RrC*:					
Roughcreek---------	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.
Rock outcrop-------	---	---	---	---	---
RrF*:					
Roughcreek---------	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: depth to rock, too clayey, hard to pack.
Rock outcrop-------	---	---	---	---	---
RuC---------- Rumple	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, small stones.

See footnote at end of table.

TABLE 10.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
VeA---------- Venus	Moderate: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight----------	Fair: too clayey.
Vn---------- Venus	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
VoB---------- Voca	Severe: percs slowly.	Moderate: depth to rock.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, hard to pack.
We---------- Weswood	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
YeC*:					
Yates----------	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: depth to rock.
Rock outcrop-------	---	---	---	---	---
YeG*:					
Yates----------	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope.	Poor: depth to rock, slope.
Rock outcrop-------	---	---	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--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 but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
BaC---Bastrop	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
BmA---Bauman	Poor: thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, excess sodium.
Br---Boerne	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
CaB---Campair	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
CeC---Castell	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones.
ChB---Cho	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: cemented pan, small stones, area reclaim.
CkC---Click	Fair: depth to rock, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
EcC*:				
Eckrant	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.
Rock outcrop	---	---	---	---

See footnote at end of table.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
EcF*:				
Eckrant	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.
Rock outcrop	---	---	---	---
Fe	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, area reclaim.
Fieldcreek				
HaB	Poor: depth to rock, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, too clayey, small stones.
Harper				
HaC*:				
Harper	Poor: depth to rock, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, too clayey, small stones.
Rock outcrop	---	---	---	---
HeB	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, too clayey, small stones.
Hensley				
HoB	Fair: depth to rock, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, area reclaim.
Honeycreek				
HyC	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, small stones, thin layer.
Hye				
KaC	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones.
Katemcy				

See footnote at end of table.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
KeC Keese	Poor: depth to rock.	Improbable: thin layer.	Improbable: thin layer.	Poor: depth to rock, small stones.
KoC*: Keese	Poor: depth to rock.	Improbable: thin layer.	Improbable: thin layer.	Poor: depth to rock, small stones.
Rock outcrop	---	---	---	---
KoF*: Keese	Poor: depth to rock.	Improbable: thin layer.	Improbable: thin layer.	Poor: depth to rock, small stones, slope.
Rock outcrop	---	---	---	---
KrB Krum	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
LgC Ligon	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, too clayey.
LgD Ligon	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones.
LkB Loneoak	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
LoB Lou	Poor: depth to rock.	Improbable: excess fines.	Probable	Improbable: excess fines.
LuB Luckenbach	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.

See footnote at end of table.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
MaC Matilo	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
NeF*: Nebgen	Poor: depth to rock, large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: depth to rock, large stones.
Rock outcrop	---	---	---	---
NuB Nuvalde	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
ObC Oben	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, large stones.
OpC*: Oplin	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones.
Rock outcrop	---	---	---	---
OpF*: Oplin	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones, slope.
Rock outcrop	---	---	---	---
PaC Packsaddle	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
PeB Pedernales	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
PoC Pontotoc	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.

See footnote at end of table.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
ReC---------- Real	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, cemented pan, small stones.
ReG---------- Real	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, cemented pan, small stones.
Rh*---------- Riverwash	Fair: large stones.	Improbable: small stones.	Probable----------	Poor: small stones, area reclaim.
Rk*: Riverwash----------	Fair: large stones.	Improbable: small stones.	Probable----------	Poor: small stones, area reclaim.
Rock outcrop---------	---	---	---	---
Ro*---------- Rock outcrop	---	---	---	---
RrC*: Roughcreek----------	Poor: depth to rock, shrink-swell, low strength.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: depth to rock, too clayey, large stones.
Rock outcrop---------	---	---	---	---
RrF*: Roughcreek----------	Poor: depth to rock, shrink-swell, low strength.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: depth to rock, too clayey, large stones.
Rock outcrop---------	---	---	---	---
RuC---------- Rumple	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones.

See footnote at end of table.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
VeA, Vn Venus	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
VoB Voca	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones, area reclaim.
We Weswood	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
YeC*:				
Yates	Poor: depth to rock, large stones.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, large stones.
Rock outcrop	---	---	---	---
YeG*:				
Yates	Poor: depth to rock, large stones, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, large stones, slope.
Rock outcrop	---	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--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 but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
BaC---Bastrop	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope, fast intake, soil blowing.	Soil blowing	Favorable.
BmA---Bauman	Moderate: depth to rock.	Severe: excess sodium.	Deep to water	Droughty, percs slowly, erodes easily.	Erodes easily	Excess sodium, erodes easily, droughty.
Br---Boerne	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing	Soil blowing	Favorable.
CaB---Campair	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Deep to water	Slope, droughty, fast intake.	Depth to rock, soil blowing.	Droughty, depth to rock.
CeC---Castell	Moderate: depth to rock.	Severe: thin layer.	Deep to water	Slope, droughty.	Large stones, depth to rock, soil blowing.	Large stones, droughty, depth to rock.
ChB---Cho	Severe: cemented pan.	Severe: thin layer.	Deep to water	Droughty, cemented pan.	Cemented pan	Droughty, cemented pan.
CkC---Click	Severe: seepage.	Moderate: thin layer.	Deep to water	Slope, droughty.	Favorable	Droughty.
EcC*:						
Eckrant	Severe: depth to rock.	Severe: hard to pack, large stones.	Deep to water	Slope, large stones, droughty.	Large stones, depth to rock.	Large stones, droughty.
Rock outcrop	---	---	---	---	---	---
EcF*:						
Eckrant	Severe: depth to rock, slope.	Severe: hard to pack, large stones.	Deep to water	Slope, large stones, droughty.	Slope, large stones, depth to rock.	Large stones, slope, droughty.

See footnote at end of table.

TABLE 12.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
Rock outcrop	---	---	---	---	---	---
Fe Fieldcreek	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, flooding.	Soil blowing	Favorable.
HaB Harper	Severe: depth to rock.	Severe: hard to pack.	Deep to water	Droughty, slow intake.	Depth to rock	Droughty, depth to rock.
HaC*: Harper	Severe: depth to rock.	Severe: hard to pack.	Deep to water	Slope, droughty, slow intake.	Depth to rock	Droughty, depth to rock.
Rock outcrop	---	---	---	---	---	---
HeB Hensley	Severe: depth to rock.	Severe: thin layer.	Deep to water	Slope, droughty, percs slowly.	Depth to rock, erodes easily.	Erodes easily, droughty.
HoB Honeycreek	Moderate: seepage, depth to rock.	Moderate: thin layer, piping.	Deep to water	Soil blowing	Soil blowing	Favorable.
HyC Hye	Moderate: seepage, depth to rock, slope.	Moderate: thin layer.	Deep to water	Slope, soil blowing, depth to rock.	Depth to rock, soil blowing.	Depth to rock.
KaC Katemcy	Moderate: depth to rock, slope.	Severe: hard to pack.	Deep to water	Slope, soil blowing, depth to rock.	Depth to rock, soil blowing.	Depth to rock.
KeC Keese	Severe: depth to rock.	Severe: seepage.	Deep to water	Slope, droughty, depth to rock.	Depth to rock	Droughty, depth to rock.
KoC*: Keese	Severe: depth to rock.	Severe: seepage.	Deep to water	Slope, droughty, depth to rock.	Depth to rock	Droughty, depth to rock.
Rock outcrop	---	---	---	---	---	---

See footnote at end of table.

TABLE 12.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
KoF*:						
Keese	Severe: depth to rock, slope.	Severe: seepage.	Deep to water	Slope, droughty, depth to rock.	Slope, depth to rock.	Slope, droughty, depth to rock.
Rock outcrop	---	---	---	---	---	---
KrB Krum	Slight	Severe: hard to pack.	Deep to water	Slow intake	Favorable	Favorable.
LgC Ligon	Severe: depth to rock.	Severe: thin layer.	Deep to water	Slope, depth to rock.	Depth to rock, soil blowing.	Depth to rock.
LgD Ligon	Severe: depth to rock.	Severe: thin layer.	Deep to water	Slope, droughty, depth to rock.	Slope, depth to rock.	Slope, droughty, depth to rock.
LkB Loneoak	Severe: seepage.	Moderate: thin layer, hard to pack.	Deep to water	Droughty, fast intake, soil blowing.	Soil blowing, percs slowly.	Droughty, percs slowly.
LoB Lou	Moderate: seepage, depth to rock.	Severe: thin layer.	Deep to water	Slope, droughty, soil blowing.	Depth to rock, soil blowing.	Droughty, depth to rock.
LuB Luckenbach	Slight	Slight	Deep to water	Erodes easily	Erodes easily	Erodes easily.
MaC Matilo	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.	Droughty.
NeF*:						
Nebgen	Severe: depth to rock, slope.	Severe: piping, large stones.	Deep to water	Slope, large stones, droughty.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Rock outcrop	---	---	---	---	---	---
NuB Nuvalde	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable	Favorable	Favorable.

See footnote at end of table.

TABLE 12.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
ObC---------- Oben	Severe: depth to rock.	Severe: thin layer.	Deep to water	Slope, droughty, depth to rock.	Large stones, depth to rock.	Large stones, droughty, depth to rock.
OpC*:						
Oplin----------	Severe: depth to rock.	Severe: large stones.	Deep to water	Slope, large stones, depth to rock.	Large stones, depth to rock.	Large stones, depth to rock.
Rock outcrop-----	---	---	---	---	---	---
OpF*:						
Oplin----------	Severe: depth to rock, slope.	Severe: large stones.	Deep to water	Slope, large stones, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
Rock outcrop-----	---	---	---	---	---	---
PaC---------- Packsaddle	Moderate: depth to rock, slope.	Severe: thin layer.	Deep to water	Slope, droughty, depth to rock.	Depth to rock	Droughty, depth to rock.
PeB---------- Pedernales	Slight---------	Moderate: hard to pack.	Deep to water	Soil blowing---	Soil blowing---	Favorable.
PoC---------- Pontotoc	Severe: seepage.	Slight---------	Deep to water	Droughty, soil blowing, slope.	Soil blowing---	Favorable.
ReC---------- Real	Severe: depth to rock, cemented pan.	Severe: thin layer.	Deep to water	Slope, droughty, depth to rock.	Depth to rock, cemented pan.	Droughty, depth to rock.
ReG---------- Real	Severe: depth to rock, cemented pan, slope.	Severe: thin layer.	Deep to water	Slope, droughty, depth to rock.	Slope, depth to rock, cemented pan.	Slope, droughty, depth to rock.
Rh*---------- Riverwash	Slight---------	Severe: seepage, large stones.	Deep to water	Large stones, droughty, flooding.	Large stones---	Large stones, droughty.

See footnote at end of table.

TABLE 12.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
Rk*:						
Riverwash	Slight	Severe: seepage, large stones.	Deep to water	Large stones, droughty, flooding.	Large stones	Large stones, droughty.
Rock outcrop	---	---	---	---	---	---
Ro*	Severe:	Slight	Deep to water	Slope	Slope	Slope
Rock outcrop	---	---	---	---	---	---
RrC*:						
Roughcreek	Severe: depth to rock.	Severe: hard to pack, large stones.	Deep to water	Slope, large stones, percs slowly.	Large stones, depth to rock.	Large stones, depth to rock.
Rock outcrop	---	---	---	---	---	---
RrF*:						
Roughcreek	Severe: depth to rock, slope.	Severe: hard to pack, large stones.	Deep to water	Slope, large stones, percs slowly.	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
Rock outcrop	---	---	---	---	---	---
RuC	Moderate:	Severe:	Deep to water	Slope,	Depth to rock	Droughty,
Rumple	depth to rock.	thin layer.		droughty, depth to rock.		depth to rock.
VeA	Moderate:	Severe:	Deep to water	Favorable	Favorable	Favorable.
Venus	seepage.	piping.				
Vn	Moderate:	Severe:	Deep to water	Flooding	Favorable	Favorable.
Venus	seepage.	piping.				
VoB	Moderate:	Moderate:	Deep to water	Droughty	Percs slowly	Droughty,
Voca	depth to rock.	thin layer, hard to pack.				percs slowly.
We	Moderate:	Severe:	Deep to water	Erodes easily	Erodes easily	Erodes easily.
Weswood	seepage.	piping.				

See footnote at end of table.

TABLE 12.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
YeC*:						
Yates	Severe: depth to rock.	Severe: large stones.	Deep to water	Slope, large stones, droughty.	Large stones, depth to rock.	Large stones, droughty.
Rock outcrop	---	---	---	---	---	---
YeG*:						
Yates	Severe: depth to rock, slope.	Severe: large stones.	Deep to water	Slope, large stones, droughty.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Rock outcrop	---	---	---	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification		Fragments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
BaC	0-13	Loamy fine sand	SM, SC-SM	A-2-4, A-4	0	96-100	96-100	75-95	20-50	16-20	NP-4
Bastrop	13-48	Sandy clay loam, clay loam, loam.	CL, SC	A-6	0	96-100	96-100	75-100	40-70	26-40	11-22
	48-80	Loam, sandy clay loam, clay loam.	CL, SC	A-6	0	96-100	75-100	65-100	40-70	26-40	11-22
BmA	0-6	Loam	CL-ML, CL	A-4, A-6	0-1	90-100	85-100	70-90	51-70	21-32	4-11
Bauman	6-20	Clay loam	CL, SC, CH	A-7	0	85-98	70-90	55-80	40-65	41-60	22-38
	20-26	Clay loam, sandy clay loam.	CL, SC, CH	A-7	0	85-98	70-90	50-70	40-60	41-60	22-38
	26-42	Gravelly sandy clay loam, gravelly clay loam.	GC, GP-GC, SC, SP-SC	A-2-7, A-7-6	0	50-85	50-80	45-80	25-65	41-55	20-32
	42-72	Weathered bedrock	---	---	---	---	---	---	---	---	---
Br	0-10	Fine sandy loam	CL, SC, CL-ML, SC-SM	A-4, A-6	0-3	95-100	85-100	60-95	36-65	22-32	4-12
Boerne	10-50	Fine sandy loam, loam.	CL, SC, CL-ML, SC-SM	A-4, A-6	0-5	95-100	85-100	60-95	36-75	22-35	4-15
	50-62	Fine sandy loam, loam.	CL, SC, CL-ML, SC-SM	A-4, A-6	0-5	90-100	80-100	60-95	36-75	22-35	4-15
CaB	0-11	Sand	SP, SW-SM, SP-SM	A-3, A-2-4	0	98-100	98-100	50-70	4-10	16-25	NP-5
Campair	11-14	Sand, loamy sand	SM, SC-SM, SP-SM	A-2-4, A-3	0	98-100	95-100	50-70	4-18	16-25	NP-7
	14-38	Sandy clay loam, clay loam.	SC	A-6, A-4, A-2-6	0	98-100	95-100	50-80	30-49	25-40	8-15
	38-42	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
CeC----------	0-8	Sandy loam-------	SM, SC-SM, SP-SM	A-2-4	0-15	87-100	80-90	51-75	12-25	16-25	NP-7
Castell	8-30	Clay, clay loam, sandy clay, gravelly clay.	SC, CL, CH	A-2-7, A-7-6	0-20	75-100	55-90	40-80	20-65	45-65	21-39
	30-42	Weathered bedrock	---	---	---	---	---	---	---	---	---
ChB----------	0-14	Loam----------	CL, CH	A-6, A-7-6	0-3	80-100	80-100	65-96	55-84	35-55	15-30
Cho	14-16	Indurated--------	---	---	---	---	---	---	---	---	---
	16-45	Gravelly loam, gravelly clay loam, very gravelly loam.	SC, GC, GM-GC, SC-SM	A-2, A-4, A-6, A-7-6	0-5	50-85	35-80	20-60	15-60	24-47	5-22
CkC----------	0-11	Very gravelly coarse sandy loam.	SM, SC-SM	A-1, A-2	0-5	75-95	45-65	20-50	15-35	15-23	NP-7
Click	11-46	Very gravelly coarse sandy loam, very gravelly sandy clay loam.	SC, GC, SC-SM, GM-GC	A-1, A-2	0-5	50-90	27-50	20-50	15-35	18-28	4-10
	46-53	Weathered bedrock	---	---	---	---	---	---	---	---	---
EcC*:											
Eckrant---------	0-4	Very cobbly clay	CL, CH, GC, SC	A-7-6	10-50	70-95	50-95	45-95	45-94	41-60	24-40
	4-11	Very cobbly clay, very stony clay, extremely stony clay.	CL, GC, CH, SC	A-7-6	15-75	56-85	50-79	45-75	44-74	47-73	25-45
	11-13	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop----	---	---	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
EcF*:											
Eckrant	0-4	Very cobbly clay	CL, CH, GC, SC	A-7-6	10-50	70-95	50-95	45-95	45-94	41-60	24-40
	4-13	Very cobbly clay, very stony clay, extremely stony clay.	CL, GC, CH, SC	A-7-6	15-75	56-85	50-79	45-75	44-74	47-73	25-45
	13-14	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop	---	---	---	---	---	---	---	---	---	---	---
Fe	0-8	Fine sandy loam	SM, SC-SM, ML, CL-ML	A-4	0	95-100	95-100	75-90	40-55	16-30	NP-7
Fieldcreek	8-25	Fine sandy loam, loam.	SM, SC, ML, CL	A-4	0	95-100	90-100	70-95	40-75	16-28	NP-10
	25-48	Fine sandy loam, sandy loam, loam.	SM, SC, ML, CL	A-4, A-2-4	0	95-100	90-100	60-95	30-75	16-28	NP-10
	48-80	Fine sandy loam, gravelly sandy loam.	SM, SC, GM, GC	A-4, A-2-4, A-1-B	0-3	55-95	50-100	35-80	13-50	16-28	NP-10
HaB	0-5	Clay	CH	A-7-6	0-20	80-90	80-90	75-85	60-70	55-75	33-49
Harper	5-11	Clay	CH	A-7-6	0-10	90-100	85-100	85-100	75-95	55-75	33-49
	11-15	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
HaC*:											
Harper	0-5	Clay	CH	A-7-6	0-20	80-90	80-90	75-85	60-70	55-75	33-49
	5-10	Clay	CH	A-7-6	0-10	90-100	85-100	85-100	75-95	55-75	33-49
	10-13	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop	---	---	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
HeB---------	0-5	Loam----------	CL, CL-ML	A-4, A-6	5-10	80-100	75-100	70-100	60-90	20-40	5-20
Hensley	5-18	Clay, clay loam	CL, CH	A-6, A-7	0-10	80-100	75-100	70-100	65-95	35-55	18-35
	18-20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
HoB---------	0-9	Fine sandy loam	SM, SC-SM, CL, CL-ML	A-4	0-2	90-100	80-100	70-75	40-60	21-28	NP-7
Honeycreek	9-25	Fine sandy loam, sandy loam.	SM, SC-SM, CL, CL-ML	A-4	0-2	85-100	80-100	70-95	40-60	23-30	NP-7
	25-50	Sandy clay loam, fine sandy loam, gravelly sandy clay loam.	SC, CL	A-4, A-6	0-2	85-100	50-100	45-95	25-60	25-40	8-21
	50-56	Gravelly sandy clay loam, gravelly fine sandy loam.	SC	A-2-6, A-6, A-4	0-5	75-90	50-90	40-85	25-50	20-40	8-21
	56-66	Weathered bedrock	---	---	---	---	---	---	---	---	---
HyC---------	0-10	Fine sandy loam	SC-SM, SC	A-2, A-4	0-5	85-100	80-100	70-95	25-50	20-30	4-10
Hye	10-31	Sandy clay loam, fine sandy loam, gravelly sandy clay loam.	SC	A-4, A-6, A-2-4, A-2-6	0-5	85-100	55-100	50-95	25-50	27-40	8-21
	31-38	Weathered bedrock	---	---	---	---	---	---	---	---	---
KaC---------	0-9	Sandy loam-------	SC, SC-SM	A-4, A-2-4, A-2-6	0-2	95-100	80-98	60-85	30-50	21-29	4-11
Katemcy	9-20	Sandy clay loam, sandy clay, clay.	CL, SC, CH	A-6, A-7-6	0-2	94-99	80-98	65-90	40-75	38-67	20-44
	20-38	Gravelly sandy clay loam, gravelly sandy clay, channery sandy clay loam.	CL, SC, CH	A-7-6, A-6	0-15	85-95	50-76	40-65	40-60	38-67	20-44
	38-79	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
KeC----------	0-12	Coarse sandy	SC-SM,	A-2-4,	2-15	80-90	80-90	30-45	10-20	16-25	NP-7
Keese		loam.	SP-SM, SM	A-1-B							
	12-16	Gravelly sandy	SW-SM, SM,	A-1,	5-15	70-90	55-90	30-60	10-35	16-25	NP-7
		loam, gravelly	SC-SM	A-2-4							
		coarse sandy									
		loam, coarse									
		sandy loam.									
	16-20	Weathered bedrock	---	---	---	---	---	---	---	---	---
KoC*:											
Keese----------	0-10	Coarse sandy	SC-SM, SM,	A-2-4,	5-15	80-90	75-90	30-45	10-20	16-25	NP-7
		loam.	SP-SM	A-1-B							
	10-14	Gravelly sandy	SW-SM, SM,	A-1,	5-15	70-90	55-75	30-45	10-20	16-25	NP-7
		loam, gravelly	SC-SM	A-2-4							
		coarse sandy									
		loam.									
	14-16	Weathered bedrock	---	---	---	---	---	---	---	---	---
Rock outcrop----	---	---	---	---	---	---	---	---	---	---	---
KoF*:											
Keese----------	0-14	Very stony coarse	SC-SM, SM,	A-2-4,	5-15	80-90	75-90	30-45	10-20	16-25	NP-7
		sandy loam.	SP-SM	A-1-B							
	14-20	Weathered bedrock	---	---	---	---	---	---	---	---	---
Rock outcrop----	---	---	---	---	---	---	---	---	---	---	---
KrB----------	0-12	Silty clay-------	CH, CL	A-7-6	0	95-100	85-100	85-100	85-95	47-65	25-42
Krum	12-40	Silty clay, clay	CH	A-7-6	0	95-100	85-100	80-100	65-95	51-74	28-50
	40-80	Silty clay loam,	CH, CL	A-7-6,	0	85-100	75-100	70-99	65-95	36-60	20-39
		silty clay,		A-6							
		clay, clay loam.									

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
LgC--- Ligon	0-4	Fine sandy loam	SC, CL, CL-ML, SC-SM	A-4	0-3	90-100	80-100	60-80	36-55	18-24	4-10
	4-23	Sandy clay loam, clay loam, clay.	CL, CH	A-6, A-7-6	0-3	90-98	80-98	70-95	55-80	38-52	20-32
	23-51	Weathered bedrock	---	---	---	---	---	---	---	---	---
LgD--- Ligon	0-3	Cobbly fine sandy loam.	SC, CL, CL-ML, SC-SM	A-4, A-6	15-35	85-95	80-95	60-80	45-80	21-40	4-22
	3-26	Sandy clay loam, clay loam, clay.	CL, SC, CH	A-6, A-7-6	0-3	75-100	75-98	60-95	45-85	38-52	20-32
	26-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
LkB--- Loneoak	0-5	Sand---	SP, SW-SM, SP-SM	A-3, A-2-4	0	98-100	98-100	50-70	4-10	16-25	NP-5
	5-28	Sand, loamy sand	SP, SW-SM, SM, SC-SM	A-3, A-2-4	0	98-100	98-100	50-78	4-16	16-25	NP-6
	28-57	Sandy clay loam, sandy clay, clay.	SC, CL, CH	A-7-6, A-6, A-2-7	0	95-100	75-100	45-95	35-85	39-55	26-40
	57-64	Weathered bedrock	---	---	---	---	---	---	---	---	---
LoB--- Lou	0-7	Coarse sandy loam	SM, SC-SM	A-2-4, A-1-B	0-3	85-98	75-98	30-50	20-35	18-30	NP-7
	7-38	Gravelly sandy clay loam, gravelly coarse sandy loam.	SC, CL, GC	A-2-6, A-6, A-2-7	0-3	55-85	50-75	35-70	25-55	30-45	12-24
	38-75	Weathered bedrock	---	---	---	---	---	---	---	---	---
LuB--- Luckenbach	0-9	Clay loam---	CL	A-6	0-3	95-100	95-100	85-95	65-75	29-40	14-25
	9-39	Clay loam, clay	CL, CH	A-7	0-3	80-100	75-100	70-100	60-85	40-55	22-35
	39-64	Clay loam, clay	CL	A-6, A-7	0-5	70-100	70-100	65-95	50-85	35-45	20-30

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
MaC----------	0-18	Sand----------	SP, SW-SM, SP-SM	A-3, A-2-4	0	98-100	98-100	50-70	4-10	<25	NP-5
Matilo	18-45	Sand, loamy sand	SP, SM, SW-SM	A-3, A-2-4	0	98-100	98-100	50-70	4-16	<25	NP-6
	45-71	Sandy loam, sandy clay loam.	SC, SC-SM	A-4, A-2-4, A-2-6, A-6	0	95-100	90-100	55-75	15-40	18-39	6-22
	71-73	Weathered bedrock	---	---	---	---	---	---	---	---	---
NeF*:											
Nebgen----------	0-11	Sandy loam.	SM, SC-SM	A-2-4, A-4	0-5	95-100	90-100	60-65	25-40	15-25	NP-7
	11-15	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop----	---	---	---	---	---	---	---	---	---	---	---
NuB----------	0-14	Clay loam--------	CH, CL	A-7-6, A-6	0	95-100	95-100	90-99	80-96	38-60	20-38
Nuvalde	14-39	Clay loam, silty clay loam, clay.	CH, CL	A-7-6, A-6	0	95-100	95-100	85-100	70-98	38-58	20-36
	39-65	Loam, clay loam, silty clay loam.	CL	A-6, A-7-6	0	85-100	85-100	75-98	65-90	30-50	14-30
ObC----------	0-7	Sandy loam-------	SC, CL, SC-SM, CL-ML	A-4	0-5	90-100	90-100	70-85	40-55	16-28	NP-10
Oben	7-18	Sandy loam, sandy clay loam.	SC, CL	A-4, A-6	0-15	90-100	90-100	80-95	45-75	26-36	8-15
	18-24	Weathered bedrock	---	---	---	---	---	---	---	---	---
OpC*:											
Oplin----------	0-10	Very 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
	10-20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Rock outcrop----	---	---	---	---	---	---	---	---	---	---	---
OpF*:											
Oplin----------	0-10	Very 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
	10-20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop----	---	---	---	---	---	---	---	---	---	---	---
PaC----------	0-6	Channery loam----	GM, SM, SC-SM, ML	A-2-4, A-4	0-2	65-80	60-75	55-75	20-60	20-30	2-7
Packsaddle	6-13	Very channery sandy clay loam, very channery clay loam.	GC, SC	A-2-4, A-2-6, A-4, A-6	0-5	45-75	40-65	35-60	20-50	28-38	8-18
	13-28	Very channery sandy clay loam, very channery clay loam.	GC, SC	A-2-4, A-2-6, A-4, A-6	0-10	40-75	30-65	30-60	20-40	28-38	8-18
	28-36	Weathered bedrock	---	---	---	---	---	---	---	---	---
PeB----------	0-7	Fine sandy loam	SM, ML, CL-ML, SC-SM	A-4	0	95-100	90-100	70-85	35-55	<25	NP-7
Pedernales	7-55	Sandy clay, clay	CH, CL, SC	A-7, A-6	0	90-100	90-100	80-100	45-85	38-60	20-36
	55-80	Sandy clay loam, clay loam, sandy clay.	SC, CL, CH	A-6, A-7	0-5	90-100	90-100	80-100	45-80	32-55	13-30

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
PoC----------	0-19	Fine sandy loam	SM, SC-SM	A-2, A-4	0-10	90-100	87-100	70-90	25-40	<25	NP-7
Pontotoc	19-65	Fine sandy loam, sandy clay loam.	SC, SC-SM	A-4, A-6	0-10	90-100	87-100	75-90	36-45	23-40	6-19
	65-72	Weathered bedrock.	---	---	---	---	---	---	---	---	---
ReC----------	0-8	Gravelly loam----	SM, GM, ML, CL	A-4, A-6, A-7	1-5	65-90	50-77	45-65	36-60	30-55	8-25
Real	8-15	Extremely gravelly loam, extremely gravelly clay loam, very gravelly clay loam.	GM, GC, SM, SC	A-2, A-4, A-6, A-7	0-15	25-75	20-50	20-45	20-40	30-55	8-25
	15-17	Cemented---------	---	---	---	---	---	---	---	---	---
	17-22	Weathered bedrock, variable.	---	---	---	---	---	---	---	---	---
ReG----------	0-4	Gravelly loam----	SM, GM, ML, CL	A-4, A-6, A-7	1-5	65-90	50-77	45-65	36-60	30-55	8-25
Real	4-12	Extremely gravelly loam, extremely gravelly clay loam, very gravelly clay loam.	GM, GC, SM, SC	A-2, A-4, A-6, A-7	0-15	25-75	20-50	20-45	20-40	30-55	8-25
	12-14	Cemented---------	---	---	---	---	---	---	---	---	---
	14-20	Weathered bedrock, variable.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
Rh* Riverwash	0-60	Extremely gravelly fragmental material.	GW, GP	A-1-A	2-40	5-15	0-10	0-5	0-3	16-25	NP-3
Rk*: Riverwash	0-60	Extremely gravelly fragmental material.	GW, GP	A-1-A	2-40	5-15	0-10	0-5	0-3	16-25	NP-3
Rock outcrop	---	---	---	---	---	---	---	---	---	---	---
Ro* Rock outcrop	---	---	---	---	---	---	---	---	---	---	---
RrC*:											
Roughcreek	0-5	Very stony clay loam.	CL, CH	A-7	25-70	85-100	80-98	75-95	65-90	40-60	20-35
	5-16	Very cobbly clay, stony clay.	CH	A-7	25-70	85-100	85-100	85-100	60-95	51-75	35-50
	16-20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop	---	---	---	---	---	---	---	---	---	---	---
RrF*:											
Roughcreek	0-6	Very stony clay loam.	CL, CH	A-7	25-70	85-100	80-98	75-95	65-90	40-60	20-35
	6-15	Very cobbly clay, stony clay.	CH	A-7	25-70	85-100	85-100	85-100	60-95	51-75	35-50
	15-20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop	---	---	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO	3-10 inches	4	10	40	200		
	In				Pct					Pct	
RuC---------	0-8	Gravelly clay loam.	GC, CL, SC	A-2-6, A-6	0-10	40-90	35-75	35-70	25-65	30-40	13-22
Rumple	8-24	Very gravelly clay, very gravelly clay loam.	GC, SC, GP-GC, SP-SC	A-2-7, A-7-6	0-10	20-75	15-50	15-50	10-45	41-86	20-60
	24-27	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
VeA---------	0-15	Loam---------	CL, CL-ML	A-4, A-6	0	100	95-100	85-100	50-80	20-40	5-22
Venus	15-54	Loam, clay loam, sandy clay loam.	CL, CL-ML	A-4, A-6	0	95-100	95-100	85-100	50-80	20-40	5-24
	54-62	Fine sandy loam, loam, sandy clay loam.	SC, SC-SM, CL, CL-ML	A-4, A-6	0	80-100	70-100	65-100	44-73	20-40	5-20
Vn---------	0-18	Loam---------	CL, CL-ML	A-4, A-6	0	100	95-100	85-100	50-80	20-40	5-22
Venus	18-46	Loam, clay loam, sandy clay loam.	CL, CL-ML	A-4, A-6	0	95-100	95-100	85-100	50-80	20-40	5-24
	46-62	Fine sandy loam, loam, sandy clay loam.	SC, SC-SM, CL, CL-ML	A-4, A-6	0	80-100	70-100	65-100	40-80	20-40	5-20
VoB---------	0-14	Gravelly sandy loam.	SM, SC-SM	A-2-4, A-1-B	0-5	70-95	60-75	30-50	20-35	<25	NP-7
Voca	14-34	Gravelly clay, gravelly sandy clay.	SC, GC, CH	A-7-6	0-8	65-85	60-75	45-60	40-60	51-65	27-40
	34-48	Very gravelly sandy clay loam, very gravelly clay, gravelly sandy clay.	GC, SC	A-2-7, A-7-6	0-10	35-85	30-60	30-50	30-45	45-60	25-35
	48-80	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
We	0-17	Silt loam	CL, CL-ML	A-4, A-6	0	100	98-100	90-100	65-95	20-35	5-18
Weswood	17-80	Very fine sandy loam, silty clay loam, silt loam.	CL, CL-ML	A-4, A-6	0	100	98-100	95-100	70-98	20-40	5-22
YeC*:											
Yates	0-12	Very stony loam	GC, SC, GM-GC, SC-SM	A-4, A-6	35-60	55-90	55-90	55-85	36-65	20-35	5-15
	12-18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
YeC*:											
Rock outcrop	---	---	---	---	---	---	---	---	---	---	---
YeG*:											
Yates	0-10	Very stony loam	GC, SC, GM-GC, SC-SM	A-4, A-6	35-60	55-90	55-90	55-85	36-65	20-35	5-15
	10-15	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop	---	---	---	---	---	---	---	---	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cc	In/hr	In/in	pH	mmhos/cm					Pct
BaC	0-13	3-12	1.55-1.65	2.0-6.0	0.07-0.11	5.6-7.3	0-2	Low	0.28	5	2	.5-1
Bastrop	13-48	20-35	1.55-1.65	0.6-2.0	0.15-0.19	5.6-8.4	0-2	Low	0.32			
	48-80	18-39	1.55-1.70	0.6-2.0	0.12-0.16	6.1-8.4	0-2	Low	0.32			
BmA	0-6	10-20	1.45-1.65	0.6-2.0	0.15-0.20	6.1-7.3	0-2	Low	0.37	3	5	1-2.5
Bauman	6-20	26-40	1.40-1.60	0.06-0.2	0.12-0.18	6.6-7.8	0-2	High	0.28			
	20-26	26-35	1.40-1.60	0.06-0.2	0.11-0.17	7.4-7.8	2-4	High	0.28			
	26-42	26-35	1.30-1.50	0.2-0.6	0.04-0.09	7.4-8.4	8-16	Moderate	0.10			
	42-72	---	---	0.01-2.0	---	---	---	---	---			
Br	0-10	12-20	1.40-1.55	2.0-6.0	0.10-0.14	7.9-8.4	0-2	Low	0.28	5	3	.5-1
Boerne	10-50	12-23	1.40-1.55	2.0-6.0	0.10-0.15	7.9-8.4	0-2	Low	0.28			
	50-62	12-23	1.40-1.55	2.0-6.0	0.10-0.15	7.9-8.4	0-2	Low	0.28			
CaB	0-11	1-6	1.50-1.69	6.0-20	0.04-0.08	6.1-7.3	0-2	Low	0.10	2	1	.5-1
Campair	11-14	1-10	1.25-1.45	2.0-6.0	0.07-0.13	6.1-7.3	0-2	Low	0.15			
	14-38	18-35	1.35-1.69	0.6-2.0	0.12-0.17	5.6-7.3	0-2	Low	0.32			
	38-42	---	---	0.2-2.0	---	---	---	---	---			
CeC	0-8	6-20	1.40-1.60	2.0-6.0	0.09-0.13	5.6-7.3	0-2	Low	0.20	3	3	.5-1
Castell	8-30	35-50	1.35-1.60	0.06-0.2	0.10-0.17	5.6-7.8	0-2	Moderate	0.32			
	30-42	---	---	0.01-2.0	---	---	---	---	---			
ChB	0-14	15-25	1.30-1.50	0.6-2.0	0.10-0.15	7.9-8.4	0-2	Moderate	0.28	2	4L	1-2
Cho	14-16	---	---	0.01-2.0	---	---	0-2	---	---			
	16-45	20-35	1.40-1.60	0.6-2.0	0.05-0.10	7.9-8.4	0-2	Low	0.15			
CkC	0-11	5-13	1.40-1.60	6.0-20	0.03-0.08	6.1-7.3	0-2	Low	0.15	4	8	.5-1
Click	11-46	12-21	1.45-1.65	6.0-20	0.04-0.09	6.1-7.3	0-2	Low	0.10			
	46-53	---	---	0.01-20	---	---	---	---	---			
EcC*:												
Eckrant	0-4	35-45	1.35-1.55	0.2-0.6	0.05-0.12	6.6-8.4	0-2	Moderate	0.15	1	8	2-11
	4-11	40-60	1.35-1.60	0.2-0.6	0.05-0.12	6.6-8.4	0-2	Moderate	0.10			
	11-13	---	---	0.06-2.0	---	---	---	---	---			
Rock outcrop	---	---	---	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cc	In/hr	In/in	pH	mmhos/cm					Pct
EcF*:												
Eckrant	0-4	35-45	1.35-1.55	0.2-0.6	0.05-0.12	6.6-8.4	0-2	Moderate	0.15	1	8	2-11
	4-13	40-60	1.35-1.60	0.2-0.6	0.05-0.12	6.6-8.4	0-2	Moderate	0.10			
	13-14	---	---	0.06-2.0	---	---	---	---	---			
Rock outcrop	---	---	---	---	---	---	---	---	---	---	---	---
Fe	0-8	8-20	1.20-1.45	2.0-6.0	0.11-0.15	6.1-7.8	0-2	Low	0.24	5	3	1-3
Fieldcreek	8-25	10-18	1.30-1.50	2.0-6.0	0.11-0.15	6.1-7.8	0-2	Low	0.24			
	25-48	10-18	1.30-1.55	2.0-6.0	0.11-0.15	6.6-8.4	0-2	Low	0.24			
	48-80	10-18	1.30-1.55	2.0-6.0	0.08-0.15	6.6-8.4	0-2	Low	0.24			
HaB	0-5	40-60	1.25-1.45	0.2-0.6	0.08-0.15	7.4-8.4	0-2	High	0.15	1	8	2-10
Harper	5-11	40-60	1.45-1.65	0.2-0.6	0.08-0.13	7.4-8.4	0-2	High	0.15			
	11-15	---	---	0.06-2.0	---	---	---	---	---			
HaC*:												
Harper	0-5	40-60	1.25-1.45	0.2-0.6	0.08-0.15	7.4-8.4	0-2	High	0.15	1	8	2-10
	5-10	40-60	1.45-1.65	0.2-0.6	0.08-0.13	7.4-8.4	0-2	High	0.15			
	10-13	---	---	0.06-2.0	---	---	---	---	---			
Rock outcrop	---	---	---	---	---	---	---	---	---	---	---	---
HeB	0-5	15-30	1.35-1.55	0.2-0.6	0.08-0.16	6.1-7.8	0-2	Low	0.20	1	8	.5-2
Hensley	5-18	35-55	1.40-1.65	0.06-0.2	0.10-0.20	6.6-8.4	0-2	Moderate	0.43			
	18-20	---	---	0.06-2.0	---	---	---	---	---			
HoB	0-9	10-18	1.45-1.55	0.6-2.0	0.10-0.15	6.1-7.3	0-2	Low	0.24	4	3	.5-2
Honeycreek	9-25	12-20	1.45-1.55	0.6-2.0	0.10-0.15	6.1-7.3	0-2	Low	0.24			
	25-50	18-30	1.40-1.60	0.6-2.0	0.11-0.17	6.1-7.8	0-2	Low	0.28			
	50-56	18-30	1.40-1.60	0.6-2.0	0.08-0.13	6.1-7.8	0-2	Low	0.10			
	56-66	---	---	0.01-2.0	---	---	---	---	---			
HyC	0-10	10-18	1.30-1.50	2.0-6.0	0.11-0.15	6.1-7.3	0-2	Low	0.24	3	3	.5-1
Hye	10-31	18-35	1.35-1.55	0.6-2.0	0.12-0.17	6.1-7.3	0-2	Low	0.32			
	31-38	---	---	0.2-2.0	---	---	---	---	---			
KaC	0-9	10-20	1.40-1.65	0.6-2.0	0.10-0.16	6.1-7.8	0-2	Low	0.28	3	3	1-3
Katemcy	9-20	30-45	1.45-1.65	0.2-0.6	0.12-0.15	6.1-7.8	0-2	Moderate	0.32			
	20-38	25-40	1.40-1.65	0.2-0.6	0.09-0.15	6.1-7.8	0-2	Moderate	0.24			
	38-79	---	---	0.06-0.2	---	---	---	---	---			

See footnote at end of table.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cc	In/hr	In/in	pH	mmhos/cm					Pct
KeC	0-12	5-20	1.45-1.80	2.0-6.0	0.07-0.12	5.6-6.5	0-2	Low	0.10	2	8	.5-1
Keese	12-16	5-20	1.45-1.80	2.0-6.0	0.05-0.10	5.6-6.5	0-2	Low	0.10			
	16-20	---	---	0.01-2.0	---	---	---		---			
KoC*:												
Keese	0-10	5-20	1.45-1.80	2.0-6.0	0.06-0.11	5.6-6.5	0-2	Low	0.10	2	8	.5-1
	10-14	5-20	1.45-1.80	2.0-6.0	0.05-0.10	5.6-6.5	0-2	Low	0.10			
	14-16	---	---	0.01-2.0	---	---	---		---			
Rock outcrop	---	---	---	---	---	---	---	---	---	---	---	---
KoF*:												
Keese	0-14	5-20	1.45-1.80	2.0-6.0	0.06-0.11	5.6-6.5	0-2	Low	0.10	2	8	.5-1
	14-20	---	---	0.01-2.0	---	---	---		---			
Rock outcrop	---	---	---	---	---	---	---	---	---	---	---	---
KrB	0-12	40-55	1.35-1.55	0.2-0.6	0.15-0.20	7.4-8.4	0-2	High	0.32	5	4	1-3
Krum	12-40	40-60	1.25-1.50	0.2-0.6	0.12-0.18	7.4-8.4	0-2	High	0.32			
	40-80	35-60	1.30-1.55	0.2-0.6	0.07-0.18	7.9-8.4	0-2	High	0.32			
LgC	0-4	15-20	1.45-1.65	0.6-2.0	0.10-0.15	5.6-7.8	0-2	Low	0.28	3	3	1-3
Ligon	4-23	35-45	1.30-1.55	0.2-0.6	0.10-0.15	5.6-7.8	0-2	Moderate	0.32			
	23-51	---	---	0.01-2.0	---	---	---		---			
LgD	0-3	15-30	1.45-1.65	0.6-2.0	0.06-0.10	6.1-7.8	0-2	Low	0.17	3	8	1-3
Ligon	3-26	35-45	1.50-1.65	0.2-0.6	0.10-0.15	6.1-7.8	0-2	Moderate	0.32			
	26-60	---	---	0.01-2.0	---	---	---		---			
LkB	0-5	0-6	1.55-1.69	6.0-20	0.04-0.08	5.6-7.3	0-2	Low	0.10	4	1	.1-1
Loneoak	5-28	0-10	1.55-1.69	6.0-20	0.04-0.09	5.6-7.3	0-2	Low	0.15			
	28-57	27-45	1.45-1.69	0.06-0.2	0.11-0.16	6.1-7.8	0-2	Moderate	0.32			
	57-64	---	---	0.01-0.6	---	---	---		---			
LoB	0-7	6-12	1.40-1.60	2.0-6.0	0.10-0.14	6.1-7.3	0-2	Low	0.20	3	3	1-2
Lou	7-38	18-35	1.45-1.65	0.6-2.0	0.08-0.12	6.1-7.3	0-2	Low	0.28			
	38-75	---	---	0.01-2.0	---	---	---		---			
LuB	0-9	20-35	1.35-1.55	0.6-2.0	0.15-0.18	6.1-7.8	0-2	Low	0.37	5	6	1-3
Luckenbach	9-39	35-55	1.35-1.60	0.2-0.6	0.13-0.18	7.4-8.4	0-2	Moderate	0.32			
	39-64	30-50	1.40-1.60	0.2-0.6	0.10-0.15	7.9-8.4	0-2	Moderate	0.28			

See footnote at end of table.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
									K	T		
	In	Pct	G/cc	In/hr	In/in	pH	mmhos/cm					Pct
MaC	0-18	2-6	1.55-1.69	6.0-20	0.04-0.08	5.6-6.5	0-2	Low	0.15	5	1	<1
Matilo	18-45	2-15	1.55-1.69	6.0-20	0.04-0.10	5.6-6.5	0-2	Low	0.15			
	45-71	10-25	1.55-1.70	0.6-2.0	0.10-0.16	5.6-7.3	0-2	Low	0.32			
	71-73	---	---	0.2-2.0	---	---	---	---	---			
NeF*:												
Nebgen	0-11	8-18	1.45-1.60	2.0-6.0	0.09-0.14	6.1-7.3	0-2	Low	0.15	1	8	.5-1
	11-15	---	---	0.2-2.0	---	---	---	---	---			
Rock outcrop	---	---	---	---	---	---	---	---	---	---	---	---
NuB	0-14	30-45	1.10-1.40	0.6-2.0	0.14-0.20	7.9-8.4	0-2	High	0.24	5	4L	1-3
Nuvalde	14-39	30-45	1.20-1.45	0.6-2.0	0.12-0.18	7.9-8.4	0-2	High	0.28			
	39-65	24-40	1.25-1.45	0.6-2.0	0.12-0.18	7.9-8.4	0-2	Moderate	0.32			
ObC	0-7	8-18	1.30-1.55	0.6-2.0	0.08-0.14	6.1-7.3	0-2	Low	0.15	2	8	.1-1
Oben	7-18	16-25	1.45-1.65	0.6-2.0	0.08-0.16	6.1-7.3	0-2	Low	0.32			
	18-24	---	---	0.2-2.0	---	---	---	---	---			
OpC*, OpF*:												
Oplin	0-10	20-35	1.35-1.55	0.6-2.0	0.10-0.15	7.9-8.4	0-2	Low	0.10	1	8	2-10
	10-20	---	---	0.2-2.0	---	---	---	---	---			
Rock outcrop	---	---	---	---	---	---	---	---	---	---	---	---
PaC	0-6	12-20	1.20-1.35	0.6-2.0	0.10-0.16	6.1-7.3	0-2	Low	0.24	3	8	2-8
Packsaddle	6-13	20-35	1.25-1.45	0.2-0.6	0.08-0.13	5.6-7.3	0-2	Low	0.20			
	13-28	20-35	1.30-1.55	0.2-0.6	0.06-0.10	5.6-7.3	0-2	Low	0.20			
	28-36	---	---	0.01-2.0	---	---	---	---	---			
PeB	0-7	5-20	1.40-1.50	0.6-2.0	0.12-0.15	6.1-7.8	0-2	Low	0.28	5	3	.5-1
Pedernales	7-55	35-55	1.45-1.60	0.2-0.6	0.13-0.18	6.1-7.8	0-4	Moderate	0.32			
	55-80	20-50	1.45-1.60	0.2-0.6	0.13-0.18	7.9-8.4	0-4	Moderate	0.28			
PoC	0-19	8-15	1.50-1.70	2.0-6.0	0.11-0.15	6.1-7.3	0-2	Low	0.24	5	3	.5-1
Pontotoc	19-65	18-22	1.50-1.70	0.6-2.0	0.11-0.16	6.1-7.3	0-2	Low	0.24			
	65-72	---	---	0.2-2.0	---	---	---	---	---			
ReC	0-8	22-40	1.25-1.55	0.6-2.0	0.05-0.10	7.9-8.4	0-2	Low	0.15	2	8	2-10
Real	8-15	22-40	1.25-1.55	0.6-2.0	0.05-0.10	7.9-8.4	0-2	Low	0.10			
	15-17	---	---	0.2-2.0	---	---	0-2	---	---			
	17-22	---	---	0.2-2.0	---	---	---	---	---			

See footnote at end of table.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cc	In/hr	In/in	pH	mmhos/cm					Pct
ReG	0-4	22-40	1.25-1.55	0.6-2.0	0.05-0.10	7.9-8.4	0-2	Low	0.15	2	8	2-10
Real	4-12	22-40	1.25-1.55	0.6-2.0	0.05-0.10	7.9-8.4	0-2	Low	0.10			
	12-14	---	---	0.2-2.0	---	---	0-2	---	---			
	14-20	---	---	0.2-2.0	---	---	---	---	---			
Rh*	0-60	0-2	---	6.0-20	0.0-0.05	7.9-8.4	0-2	Low	0.02	5	8	0-1
Riverwash												
Rk*:												
Riverwash	0-60	0-2	---	6.0-20	0.0-0.05	7.9-8.4	0-2	Low	0.02	5	8	0-1
Rk*:												
Rock outcrop	---	---	---	---	---	---	---	---	---	---	---	---
Ro*	---	---	---	---	---	---	---	---	---	---	---	---
Rock outcrop												
RrC*:												
Roughcreek	0-5	30-40	1.35-1.55	0.2-0.6	0.10-0.16	6.1-7.8	0-2	High	0.10	1	8	1-3
	5-16	40-60	1.40-1.60	0.06-0.2	0.10-0.18	6.1-7.8	0-2	High	0.10			
	16-20	---	---	0.06-2.0	---	---	---	---	---			
Rock outcrop	---	---	---	---	---	---	---	---	---	---	---	---
RrF*:												
Roughcreek	0-6	30-40	1.35-1.55	0.2-0.6	0.10-0.16	6.1-7.8	0-2	High	0.10	1	8	1-3
	6-15	40-60	1.40-1.60	0.06-0.2	0.10-0.18	6.1-7.8	0-2	High	0.10			
	15-20	---	---	0.06-2.0	---	---	---	---	---			
Rock outcrop	---	---	---	---	---	---	---	---	---	---	---	---
RuC	0-8	20-40	1.35-1.55	0.2-0.6	0.03-0.07	6.1-7.8	0-2	Low	0.17	2	8	1-3
Rumple	8-24	35-60	1.35-1.55	0.2-0.6	0.03-0.07	6.1-8.4	0-2	Moderate	0.10			
	24-27	---	---	0.2-2.0	---	---	---	---	---			
VeA	0-15	18-30	1.20-1.50	0.6-2.0	0.15-0.20	7.9-8.4	0-2	Low	0.28	5	4L	1-2
Venus	15-54	18-35	1.20-1.50	0.6-2.0	0.15-0.20	7.9-8.4	0-2	Low	0.28			
	54-62	18-35	1.30-1.60	0.6-2.0	0.13-0.18	7.9-8.4	0-2	Low	0.28			
Vn	0-18	18-30	1.20-1.50	0.6-2.0	0.15-0.20	7.9-8.4	0-2	Low	0.28	5	4L	1-3
Venus	18-46	18-35	1.20-1.50	0.6-2.0	0.15-0.20	7.9-8.4	0-2	Low	0.28			
	46-62	18-35	1.30-1.60	0.6-2.0	0.13-0.18	7.9-8.4	0-2	Low	0.28			

See footnote at end of table.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cc	In/hr	In/in	pH	mmhos/cm					Pct
VoB	0-14	10-19	1.45-1.60	2.0-6.0	0.08-0.12	6.1-7.8	0-2	Low	0.20	4-3	8	.5-2
Voca	14-34	35-60	1.35-1.55	0.06-0.2	0.10-0.15	5.6-7.3	0-2	High	0.15			
	34-48	25-40	1.30-1.50	0.06-0.2	0.05-0.13	5.6-7.3	0-2	Moderate	0.10			
	48-80	---	---	0.01-2.0	---	---	---					
We	0-17	8-26	1.20-1.35	0.6-2.0	0.12-0.20	7.4-8.4	0-2	Low	0.43	5	6	1-4
Weswood	17-80	10-20	1.30-1.55	0.6-2.0	0.12-0.20	7.4-8.4	0-2	Low	0.43			
YeC*:												
Yates	0-12	10-26	1.35-1.50	0.6-2.0	0.06-0.12	6.6-8.4	0-2	Low	0.10	1	8	<1
	12-18	---	---	0.06-2.0	---	---	---					
Rock outcrop	---	---	---	---	---	---	---				---	---
YeG*:												
Yates	0-10	10-26	1.35-1.50	0.6-2.0	0.06-0.12	6.6-8.4	0-2	Low	0.10	1	8	<1
	10-15	---	---	0.06-2.0	---	---	---					
Rock outcrop	---	---	---	---	---	---	---				---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Depth	Thickness	Uncoated steel	Concrete
					Ft			In		In			
BaC---------- Bastrop	B	None	---	---	>6.0	---	---	>60	---	---	---	Moderate	Low.
BmA---------- Bauman	C	None	---	---	>6.0	---	---	40-60	Soft	---	---	High	Low.
Br---------- Boerne	B	Rare	---	---	>6.0	---	---	>60	---	---	---	Moderate	Low.
CaB---------- Campair	C	None	---	---	>6.0	---	---	20-40	Hard	---	---	High	Moderate.
CeC---------- Castell	C	None	---	---	>6.0	---	---	20-40	Soft	---	---	High	Low.
ChB---------- Cho	C	None	---	---	>6.0	---	---	>60	---	7-20	Thin	High	Low.
CkC---------- Click	A	None	---	---	>6.0	---	---	40-60	Soft	---	---	Low	Low.
EcC*, EcF*:													
Eckrant----------	D	None	---	---	>6.0	---	---	8-20	Hard	---	---	High	Low.
Rock outcrop-----	---	---	---	---	---	---	---	---	---	---	---	---	---
Fe---------- Fieldcreek	B	Occasional	Very brief	Apr-Oct	>6.0	---	---	>60	---	---	---	Moderate	Low.

See footnote at end of table.

TABLE 15.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Depth	Thickness	Uncoated steel	Concrete
					Ft			In		In			
HaB---------- Harper	D	None	---	---	>6.0	---	---	11-20	Hard	---	---	High	Low.
HaC*:													
Harper----------	D	None	---	---	>6.0	---	---	11-20	Hard	---	---	High	Low.
Rock outcrop-----	---	---	---	---	---	---	---	---	---	---	---	---	---
HeB---------- Hensley	D	None	---	---	>6.0	---	---	10-20	Hard	---	---	High	Low.
HoB---------- Honeycreek	B	None	---	---	>6.0	---	---	40-60	Soft	---	---	Low	Low.
HyC---------- Hye	B	None	---	---	>6.0	---	---	20-40	Soft	---	---	Moderate	Low.
KaC---------- Katemcy	C	None	---	---	>6.0	---	---	20-40	Soft	---	---	High	Low.
KeC---------- Keese	D	None	---	---	>6.0	---	---	11-20	Soft	---	---	Low	Low.
KoC*, KoF*:													
Keese----------	D	None	---	---	>6.0	---	---	11-20	Soft	---	---	Low	Low.
Rock outcrop-----	---	---	---	---	---	---	---	---	---	---	---	---	---
KrB---------- Krum	D	None	---	---	>6.0	---	---	>60	---	---	---	High	Low.
LgC, LgD---------- Ligon	D	None	---	---	>6.0	---	---	20-40	Soft	---	---	Moderate	Low.

See footnote at end of table.

TABLE 15.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Depth	Thickness	Uncoated steel	Concrete
					Ft			In		In			
LkB--Loneoak	C	None	---	---	>6.0	---	---	40-60	Soft	---	---	High	Moderate.
LoB--Lou	B	None	---	---	>6.0	---	---	20-40	Soft	---	---	Moderate	Low.
LuB--Luckenbach	C	None	---	---	>6.0	---	---	>60	---	---	---	Moderate	Low.
MaC--Matilo	B	None	---	---	4.0-6.0	Perched	Jan-May	>60	---	---	---	High	Moderate.
NeF*:													
Nebgen	D	None	---	---	>6.0	---	---	4-14	Hard	---	---	Low	Low.
Rock outcrop	---	---	---	---	---	---	---	---	---	---	---	---	---
NuB--Nuvalde	B	None	---	---	>6.0	---	---	>60	---	---	---	High	Low.
ObC--Oben	C	None	---	---	>6.0	---	---	9-20	Soft	---	---	Low	Low.
OpC*, OpF*:													
Oplin	C	None	---	---	>6.0	---	---	7-20	Hard	---	---	Moderate	Low.
Rock outcrop	---	---	---	---	---	---	---	---	---	---	---	---	---
PaC--Packsaddle	C	None	---	---	>6.0	---	---	20-40	Soft	---	---	Low	Low.
PeB--Pedernales	C	None	---	---	>6.0	---	---	>60	---	---	---	High	Low.

See footnote at end of table.

TABLE 15.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Depth	Thickness	Uncoated steel	Concrete
					Ft			In		In			
PoC Pontotoc	B	None	---	---	>6.0	---	---	>60	---	---	---	Low	Low.
ReC, ReG Real	D	None	---	---	>6.0	---	---	8-20	Soft	7-19	Thin	High	Low.
Rh* Riverwash	A	Frequent	Very brief to brief.	May-Sep	>6.0	---	---	>60	---	---	---	Low	Low.
Rk*: Riverwash	A	Frequent	Very brief to brief.	May-Sep	>6.0	---	---	>60	---	---	---	Low	Low.
Rock outcrop	---	---	---	---	---	---	---	---	---	---	---	---	---
Ro* Rock outcrop	---	---	---	---	---	---	---	---	---	---	---	---	---
RrC*, RrF*: Roughcreek	D	None	---	---	>6.0	---	---	10-20	Hard	---	---	High	Low.
Rock outcrop	---	---	---	---	---	---	---	---	---	---	---	---	---
RuC Rumple	C	None	---	---	>6.0	---	---	20-40	Hard	---	---	High	Low.
VeA Venus	B	None	---	---	>6.0	---	---	>60	---	---	---	High	Low.
Vn Venus	B	Occasional	Very brief	Mar-May	>6.0	---	---	>60	---	---	---	High	Low.

See footnote at end of table.

TABLE 15.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Depth	Thickness	Uncoated steel	Concrete
					Ft			In		In			
VoB---------- Voca	C	None---------	---	---	>6.0	---	---	40-60	Soft	---	---	High-----	Low.
We---------- Weswood	B	Rare---------	---	---	>6.0	---	---	>60	---	---	---	High-----	Low.
YeC*, YeG*: Yates----------	D	None---------	---	---	>6.0	---	---	4-14	Hard	---	---	Moderate	Low.
Rock outcrop-----	---	---	---	---	---	---	---	---	---	---	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--PHYSICAL ANALYSES OF SELECTED SOILS

(Analysis by National Soil Survey Laboratory, Natural Resources Conservation Service, Lincoln, Nebraska. Dash indicates the determination was not made.)

Soil name and sample number	Depth	Horizon	Particle-size distribution: Sand: Very coarse (2-1 mm)	Sand: Coarse (1-0.5 mm)	Sand: Medium (0.5-0.25 mm)	Sand: Fine (0.25-0.1 mm)	Sand: Very fine (0.1-0.05 mm)	Sand: Total (2-0.05 mm)	Silt (0.05-0.002 mm)	Clay (<0.002 mm)	COLE[1]	Bulk density 1/3-bar	Water content 1/3-bar
	In		Pct	Pct	Pct	Pct	Pct	Pct	Pct	Pct	Cm/cm	g/cc	Pct(wt)
Bauman:[2]	0-4	A	1.2	7.6	11.3	13.0	9.7	42.8	40.7	16.5	0.024	1.58	16.0
(S82TX-299-001)	4-6	E	2.4	9.1	13.0	14.3	9.9	48.7	37.5	13.8	0.018	1.61	13.8
	6-11	Btn1	10.8	11.6	8.3	8.1	5.5	44.3	24.0	31.7	0.056	1.50	22.4
	11-20	Btn2	10.2	9.3	7.9	8.2	5.7	41.3	23.4	35.3	0.080	1.44	28.1
	20-26	Btkn	14.0	9.7	8.3	7.6	5.4	45.0	23.4	31.6	0.066	1.42	26.7
	26-36	Btkng[4]	20.4	15.2	8.6	6.9	4.3	55.4	15.5	29.1	0.031	1.50	20.7
	36-42	Btkng[4]	18.3	13.9	9.4	8.7	5.9	56.2	15.7	28.1	0.075	1.34	30.7
	42-60	2Crt[4]	23.3	19.9	15.6	12.0	5.7	76.5	7.8	15.7	---	---	---
	60-72	2Crt[4]	22.1	18.9	13.7	10.5	5.4	70.6	10.9	18.5	---	---	---
Click:[2]	0-11	A	19.2	14.1	12.6	13.4	8.2	67.5	25.5	7.0	0.007	1.44	11.5
(S87TX-299-004)	11-18	Bt1	29.6	16.2	9.0	8.0	5.0	67.8	17.2	15.0	0.016	1.53	11.1
	18-29	Bt2	19.3	15.6	13.2	10.9	6.1	65.1	14.4	20.5	0.009	1.55	16.6
	29-46	Bt3	22.4	18.1	15.0	10.7	5.5	71.7	11.9	16.4	0.006	1.65	15.8
	46-53	Cr	20.6	22.3	18.0	12.9	5.6	79.4	11.4	9.2	0.006	1.64	15.2
Katemcy:[2]	0-3	A1	3.8	10.5	18.8	24.1	15.1	72.3	15.9	11.8	0.026	1.51	15.9
(S87TX-299-002)	3-9	A2	3.6	7.2	14.7	23.4	15.6	64.5	16.6	18.9	0.032	1.60	17.8
	9-11	Bt1	4.5	7.5	11.8	19.9	11.8	55.5	13.6	30.9	0.036	1.52	20.9
	11-20	Bt2	6.1	7.9	10.4	14.9	8.9	48.2	12.5	39.3	0.051	1.50	24.8
	20-27	Bt3	13.7	10.2	7.8	10.3	7.8	49.8	11.5	38.7	0.042	1.52	24.0
	27-38	BCt	8.0	7.7	7.9	20.8	18.7	63.1	13.5	23.4	0.050	1.55	24.7
	38-79	Cr	9.7	13.9	14.6	23.9	17.9	80.0	10.9	9.1	---	---	---

See footnotes at end of table.

TABLE 16.--PHYSICAL ANALYSES OF SELECTED SOILS--Continued

Soil name and sample number	Depth	Horizon	Particle-size distribution: Sand: Very coarse (2-1 mm)	Sand: Coarse (1-0.5 mm)	Sand: Medium (0.5-0.25 mm)	Sand: Fine (0.25-0.1 mm)	Sand: Very fine (0.1-0.05 mm)	Sand: Total (2-0.05 mm)	Silt (0.05-0.002 mm)	Clay (<0.002 mm)	COLE[1]	Bulk density 1/3-bar	Water content 1/3-bar
	In		Pct	Pct	Pct	Pct	Pct	Pct	Pct	Pct	Cm/cm	g/cc	Pct(wt)
Ligon:[2]	0-4	A	2.4	3.6	11.7	31.9	17.5	67.1	11.4	21.2	0.065	1.28	20.0
(S86TX-299-004)	4-7	Bt1	5.5	3.8	6.5	14.9	8.0	38.7	11.3	50.0	0.045	1.44	23.1
	7-18	Bt2	1.8	2.4	4.8	14.2	10.5	33.7	16.6	49.7	0.060	1.33	31.1
	18-23	Bt/C	2.4	2.7	10.8	25.8	15.6	56.8	17.3	25.9	0.053	1.48	22.9
	23-32	C	5.2	4.9	13.7	31.9	17.3	73.0	13.2	13.8	0.029	1.73	16.2
	32-51	Cr	2.5	8.9	36.5	35.6	8.9	92.4	4.3	3.3	0.014	2.11	7.8
Lou:[2]	0-7	A1	20.0	19.4	13.6	11.9	7.1	72.0	22.3	5.7	0.009	1.55	13.5
(S87TX-299-002)	7-12	A2	19.1	19.4	13.5	12.9	7.6	72.5	21.0	6.5	0.002	1.64	7.8
	12-20	Bt1	20.9	20.8	11.9	10.8	6.3	70.7	19.7	9.6	0.013	1.48	8.5
	20-30	Bt2	17.8	14.2	9.4	9.0	6.5	56.9	18.9	24.2	0.017	1.63	13.5
	30-38	Bt3	18.6	15.1	10.0	9.7	6.0	59.4	18.2	22.4	0.013	1.53	13.0
	38-52	Cr[4]	25.0	24.0	18.4	12.8	4.4	84.6	4.2	11.2	---	---	---
	52-75	Cr[4]	19.6	22.8	20.7	16.4	5.9	85.4	4.1	10.5	---	---	---
Pontotoc:[3]	0-4	A1	2.0	7.3	19.1	28.9	23.1	80.4	11.7	7.9	0.004	1.57	7.6
(S82TX-299-005)	4-19	A2	2.1	10.2	21.7	26.4	19.9	80.3	10.9	8.8	0.008	1.58	7.7
	19-32	Bt1	1.5	7.3	19.4	26.3	20.2	74.7	11.0	14.3	0.013	1.57	8.8
	32-43	Bt2	1.5	6.6	17.3	23.3	21.3	70.0	12.1	17.9	0.014	1.67	10.8
	43-65	Bt3	2.3	8.2	17.3	20.2	19.7	67.7	13.5	18.8	---	1.70	10.8
	65-73	2Bt1	5.9	12.0	16.5	15.4	13.0	62.8	13.1	24.1	0.028	1.74	14.4
	73-78	2Bt2	8.5	14.0	18.6	14.8	6.6	62.5	8.4	29.1	0.025	1.78	15.2
	78-90	2Bt3	12.3	14.6	14.5	16.0	3.1	60.5	9.5	30.0	0.031	1.74	16.6
	90-97	2Bt4	3.0	8.6	14.4	30.6	8.5	65.1	11.7	23.2	0.041	1.56	20.8

See footnotes at end of table.

TABLE 16.--PHYSICAL ANALYSES OF SELECTED SOILS--Continued

Soil name and sample number	Depth	Horizon	Particle-size distribution										
			Sand						Silt (0.05-0.002 mm)	Clay (<0.002 mm)	COLE[1]	Bulk density 1/3-bar	Water content 1/3-bar
			Very coarse (2-1 mm)	Coarse (1-0.5 mm)	Medium (0.5-0.25 mm)	Fine (0.25-0.1 mm)	Very fine (0.1-0.05 mm)	Total (2-0.05 mm)					
	In		Pct	Pct	Pct	Pct	Pct	Pct	Pct	Pct	Cm/cm	g/cc	Pct(wt)
Voca:[2] (S87TX-299-001)	0-5	A1	2.2	9.6	17.6	19.4	13.6	62.4	25.4	12.2	0.021	1.53	15.9
	5-14	A2	2.7	8.1	15.6	18.4	12.3	57.1	26.0	16.9	0.031	1.49	18.8
	14-25	Bt1	14.5	8.9	6.8	7.0	5.4	42.6	12.5	44.9	0.056	1.37	31.1
	25-34	Bt2	6.4	7.7	11.1	11.8	10.0	47.0	15.6	37.4	0.053	1.51	24.4
	34-43	Bt3	8.2	13.8	15.1	11.0	8.5	56.6	12.6	30.8	0.035	14.8	20.6
	43-48	BCt	10.7	15.7	13.7	9.2	6.6	55.9	9.5	34.6	0.021	1.27	28.6
	48-80	Cr	10.7	20.5	21.3	16.4	7.5	76.4	12.7	10.9	0.030	1.44	23.6

[1] Coefficient of linear extensibility.

[2] Location of pedon sample is same as the pedon given as typical for series in "Soil Series and Their Morphology."

[3] Location: From intersection of State Highway 16 and State Highway 29 in Llano, 2.2 miles east on State Highway 29, 6 miles northeast on Ranch Road 2241 to Lone Grove, 1.9 miles north, 1.8 miles northeast on county road, 300 feet south in rangeland.

[4] Horizon was subdivided for sampling purposes.

TABLE 17.--CHEMICAL ANALYSES OF SELECTED SOILS

(Analysis by National Soil Survey Laboratory, Natural Resources Conservation Service, Lincoln, Nebraska. Dash indicates the determination was not made. TR means trace.)

Soil name and sample number	Depth	Horizon	Extractable bases: Ca	Mg	K	Na	CEC (Sum of cations): SUM CATS	NH4 OAC	Base saturation: SUM	NH4 OAC	Reaction 1:1 Soil:water	Organic carbon	SAR	Exchangeable Sodium
	In										pH	Pct	Pct	Pct
Bauman:[1]	0-4	A	8.9	2.3	0.4	0.4	14.6	12.7	82	94	6.4	1.37	---	---
(S82TX-299-001)	4-6	E	6.5	1.5	0.2	0.6	10.9	9.8	84	90	6.3	0.71	---	---
	6-11	Btn1	16.9	4.3	0.4	3.0	27.1	24.0	91	100	7.1	0.75	8	11
	11-20	Btn2	20.6	5.4	0.4	4.6	32.0	26.9	97	100	7.3	0.68	11	14
	20-26	Btkn	27.0	4.9	0.3	5.9	38.6	22.9	99	100	7.8	0.48	14	19
	26-36	Btkng[3]	30.0	4.6	0.3	7.2	42.4	19.3	99	100	7.7	0.28	15	20
	36-42	Btkng[3]	18.7	3.7	0.2	7.0	30.1	17.9	98	100	7.6	0.14	15	20
	42-60	2Crt[3]	19.2	2.6	0.1	5.6	27.6	13.9	100	100	7.8	0.11	19	23
	60-72	2Crt[3]	25.1	3.3	0.2	6.9	35.6	16.6	100	100	7.7	0.18	19	24
Click:[1]	0-11	A	2.7	0.3	TR	---	5.8	3.9	52	77	5.9	0.27	---	---
(S87TX-299-004)	11-18	Bt1	3.6	0.6	0.1	---	6.6	5.0	65	86	6.3	0.16	---	---
	18-29	Bt2	7.2	1.2	0.1	---	10.5	8.5	81	100	6.7	0.17	---	---
	29-46	Bt3	4.7	1.3	0.1	---	8.0	7.1	76	86	6.6	0.11	---	---
	46-53	Cr	4.1	1.3	0.1	---	7.6	5.7	72	96	5.7	0.11	---	---
Katemcy:[1]	0-3	A1	9.3	2.7	0.4	---	15.9	12.0	78	100	6.6	1.40	---	---
(S87TX-299-002)	3-9	A2	8.4	2.8	0.4	---	15.4	12.1	75	96	6.5	0.91	---	---
	9-11	Bt1	12.0	4.5	0.3	---	22.5	16.8	75	100	6.5	0.71	---	---
	11-20	Bt2	13.5	6.1	0.3	---	26.3	20.7	76	96	6.5	0.69	---	---
	20-27	Bt3	13.5	6.8	0.3	TR	26.5	21.2	78	97	6.8	0.49	---	---
	27-38	BCt	10.8	6.2	0.2	0.1	21.4	17.9	81	97	7.1	0.21	---	---
	38-79	Cr	10.6	4.9	0.1	TR	17.9	14.4	87	100	7.5	0.04	---	---
Ligon:[1]	0-4	A	8.3	2.7	0.9	---	15.1	12.4	79	96	6.5	1.82	---	---
(S86TX-299-004)	4-7	Bt1	13.7	5.1	0.7	TR	26.0	22.4	75	86	6.5	1.58	---	---
	7-18	Bt2	18.8	7.2	0.4	0.1	32.5	26.6	82	99	6.9	1.22	---	---
	18-23	Bt/C	16.1	6.3	0.2	0.1	26.7	20.2	85	100	7.0	0.54	---	---
	23-32	C	14.4	5.5	0.2	TR	22.8	16.5	88	100	7.3	0.28	---	---
	32-51	Cr	6.7	2.0	TR	0.1	9.6	7.1	92	100	7.2	0.14	---	---
													---	---

See footnote at end of table.

TABLE 17.--CHEMICAL ANALYSES OF SELECTED SOILS--Continued

Soil name and sample number	Depth	Horizon	Extractable bases: Ca	Mg	K	Na	CEC (Sum of cations): SUM CATS	CEC (Sum of cations): NH4 OAC	Base saturation: SUM	Base saturation: NH4 OAC	Reaction 1:1 Soil:water	Organic carbon	SAR	Exchangeable Sodium
	In										pH	Pct	Pct	Pct
Lou:[1]	0-7	A1	5.9	0.8	0.4	0.1	8.5	5.9	85	100	6.6	1.44	---	---
(S82TX-299-002)	7-12	A2	2.1	0.4	0.2	0.1	3.3	2.6	85	100	6.6	0.35	---	---
	12-20	Bt1	2.7	0.3	0.3	0.1	3.7	2.9	92	100	6.7	0.30	---	---
	20-30	Bt2	5.0	0.9	0.5	0.1	8.3	6.8	78	96	6.7	0.24	---	---
	30-38	Bt3	4.2	0.8	0.2	0.1	8.0	5.7	66	93	6.4	0.18	---	---
	38-52	Cr[3]	4.3	1.0	0.1	0.2	6.8	5.1	82	100	6.4	0.09	---	---
	52-75	Cr[3]	4.8	1.1	0.2	0.1	7.4	5.2	84	100	6.4	0.07	---	---
Pontotoc:[2]	0-4	A1	4.7	0.7	0.4	---	6.1	5.3	95	100	6.1	0.98	---	---
(S82TX-299-005)	4-19	A2	4.1	0.4	0.3	---	5.4	4.5	89	100	6.5	0.47	---	---
	19-32	Bt1	5.7	0.6	0.3	---	7.7	6.0	86	100	6.9	0.33	---	---
	32-43	Bt2	7.1	0.9	0.4	TR	9.3	7.8	90	100	7.0	0.28	---	---
	43-65	Bt3	7.3	1.1	0.4	---	10.0	8.4	88	100	7.0	0.20	---	---
	65-73	2Bt1	10.6	1.7	0.5	TR	15.2	12.6	84	100	7.2	0.19	---	---
	73-78	2Bt2	13.2	2.2	0.5	TR	17.0	15.9	94	100	7.3	0.18	---	---
	78-90	2Bt3	16.7	2.4	0.4	0.1	21.3	19.0	92	100	7.3	0.14	---	---
	90-97	2Bt4	28.0	2.1	0.3	0.1	30.8	18.1	99	100	7.8	0.16	---	---
Voca:[1]	0-5	A1	7.1	0.9	0.4	---	11.3	8.0	74	100	6.7	0.71	---	---
(S87TX-299-001)	5-14	A2	10.7	1.2	0.5	---	15.3	11.0	81	100	6.7	0.67	---	---
	14-25	Bt1	25.2	3.1	0.9	---	34.5	30.7	85	95	6.9	0.58	---	---
	25-34	Bt2	25.2	2.4	0.6	TR	31.2	26.8	90	100	7.4	0.46	---	---
	34-43	Bt3	17.5	1.5	0.5	0.2	22.1	18.8	89	100	7.7	0.23	---	---
	43-48	BCt	20.9	1.5	0.5	0.2	25.6	19.1	90	100	7.7	0.16	---	---
	48-80	Cr		1.3	0.3	TR		15.2	100	100	8.3	0.04	---	---

TABLE 18.--CLAY MINERALOGY OF SELECTED SOILS

(Analysis by National Soil Survey Laboratory, Natural Resources Conservation Service, Lincoln, Nebraska. Dashes indicate that none of the mineral was detected)

Soil name and sample number	Depth	Horizon	Clay minerals[1] (X-ray diffraction)					
			GE	MI	MT	KK	QZ	MM
	In							
Bauman:[2]	6-11	Btn1	---	2	4	2	---	---
(S82TX-299-001)	35-42	Btkng	---	3	4	3	---	---
	59-72	2Crt	---	3	5	2	---	---
			---	---	---	---	---	
			---	---	---	---	---	
Click:[2]	0-11	A	---	2	---	2	1	---
(S87TX-200-004)	18-29	Bt2	---	2	1	3	1	---
Katemcy:[2]	0-3	A1	1	3	---	2	---	2
(S87TX-299-002)	11-20	Bt2	1	1	2	2	---	1
Ligon:[2]	7-18	Bt2	---	1	---	3	---	2
(S86TX-299-004)			---	---	---	---	---	---
Lou:[2]	12-20	Bt1	---	3	1	2	---	---
(S82TX-299-002)	52-75	Cr	---	3	---	2	---	---
Pontotoc:[3]	19-32	Bt1	---	2	---	1	---	---
(S82TX-299-005)	90-97	2Bt4	---	2	---	1	---	---
Voca:[2]	0-5	A1	---	3	2	2	1	---
(S87TX-299-001)	25-34	Bt2	---	3	3	2	1	2

[1] Relative amounts: 5 dominant; 4 abundant; 3 moderate; 2 small; 1 trace. GE=geothite, MI=mica, MT=montmorillonite, KK=kaolinite, QZ=quartz, and MM=montmorillonite-mica.

[2] Location of pedon sample is same as the pedon given as typical for series in "Soil Series and Their Morphology."

[3] Location: From intersection of Texas Highways 16 and 29 in Llano, 2.2 miles east on Texas Highway 29, 6 miles northeast on Ranch Road 2241 to Lone Grove, 1.9 miles north, 1.8 miles northeast on county road, 300 feet south in rangeland.

TABLE 19.--SAND MINERALOGY OF SELECTED SOILS

(Analysis by the National Soil Survey Laboratory, Lincoln, Nebraska.)

Soil name and sample number	Depth	Horizon	Minerals[1] (% by optical analysis - TR=trace)																						
			QZ	FK	FP	OT	BT	CL	OP	GS	ZR	MS	HN	PO	PR	CB	AR	CA	AU	GN	FE	EP	GE	SP	TM
	In																								
Bauman:[2]	6-11	Btn1	30	50	20		<1		<1		<1		<1		<1						1				
(S82TX-299-001)	42-60	2Crt[4]	17	55	18		7		<1			<1				1	1								
	60-72	2Crt[4]	17	14	3		46		6		1	1	10			2									
Click:[2]	0-11	A	68	21	5	2	2	1	1	Tr	Tr	Tr	Tr	Tr											
(S87TX-299-002)	18-29	Bt2	40	7	Tr		47	2	1		Tr	4	Tr		Tr										
Katemcy:[2]	0-3	A1	49	6	Tr	2	3	Tr	7	Tr	2	1	29		1										
(S87TX-299-002)	11-20	Bt2	58	9	1	1	1		6		2	Tr	21	Tr	1										
Ligon:[2]	0-4	A	46	13	9		8		7		Tr		13							Tr		2			
(S86TX-299-002)	7-18	Bt2	8	4	22		31		3				29	1								Tr		1	Tr
Lou:[2]	12-20	Bt1	12	43	26		11		2		<1	1	3								2				
(S82TX-299-002)	52-75	Cr	5	8	19		48		1		3		14									1			
Pontotoc:[3]	19-32	Bt1	85	12					2		<1	<1									<1				
(S82TX-299-005)	90-97	2Bt4	73	17			1		4												4				

See footnotes at end of table.

TABLE 19.--SAND MINERALOGY OF SELECTED SOILS--Continued

Soil name and sample number	Depth	Horizon	Minerals[1] (% by optical analysis - TR=trace)																					
			QZ	FK	EP	OT	BT	CL	OP	GS	ZR	MS	HN	PO	PR	CB	AR	CA	AU	GN	FE	EP	GE	SP	TM
	In																							
Voca:[2]	43-48	BCt	51	31	2	1	7	Tr	6		Tr	Tr	1	Tr	Tr									
(S82TX-299-001)	48-80	Cr	47	4	1	3	34	3	4		Tr	1						2	1	Tr			1	

[1] QZ=Quartz, FK=potassium-feldspar, FP=plagioclase, OT=other, BT=biotite, CL=chlorite, OP=opaques, GS=glass, ZR=zircon, MS=muscovite, HN=hornblende, PO=plant opal, PR=pyroxene, CB=carbonate aggregates, AR=weathered aggregates, CA=calcite, AU=augite, GN=garnet, FE=iron oxides, EP=epidote, GE=goethite, SP=phene, TM=tourmaline.

[2] Location of the pedon sampled is the same as the pedon given as typical for series in "Soil Series and Their Morphology."

[3] Location: From intersection of Texas Highways 16 and 29 in Llano, 2.2 miles east on Texas Highway 29, 6 miles northeast on Ranch Road 2241 to Lone Grove, 1.9 miles north, 1.8 miles mortheast on county road, 300 feet south in rangeland.

[4] Horizon was subdivided for sampling purposes.

TABLE 20.--ENGINEERING INDEX TEST DATA

Soil name, sample number, horizon, and depth in inches	Classification		Grain-size distribution									Liquid limit	Plasticity index	Specific gravity	Shrinkage		
			Percentage passing sieve--						Percentage smaller than								
	AASHTO	Unified	5/8 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm				Limit	Linear	Ratio
												Pct		g/cc	Pct	Pct	
Bauman:[1]																	
(S82TX-299-001)																	
A---------- 0-4	A-6(3)	CL	100	100	100	96	81	55	49	23	18	28	11	2.55	16	6.7	1.82
Btn2---------- 11-20	A-7-6(13)	SC	100	97	91	78	60	48	46	34	30	59	37	2.66	10	20.8	2.08
Btkng--------- 26-42	A-7-6(12)	SC	100	99	94	83	63	46	46	33	30	58	37	2.69	16	18.0	1.93
2Crt---------- 60-72	A-2-7(0)	GW-GC	91	75	50	30	13	7	7	5	4	51	25	2.78	20	13.9	1.80
Campair:[2]																	
(S82TX-299-004)																	
A2---------- 5-11	A-2-4(0)	SM	100	100	100	97	66	18	14	7	5	18	3	2.58	18	0.0	1.73
Bt3[7]---------- 29-38	A-7-6(9)	SC	100	100	100	96	74	45	35	32	32	57	31	2.71	12	18.9	1.97
Castell:[3]																	
(S82TX-299-003)																	
A2---------- 4-12	A-2-4(0)	SM	100	98	96	92	73	20	19	10	8	20	3	2.63	17	2.1	1.81
Bt3---------- 22-26	A-7-6(8)	SC	93	91	89	86	71	47	45	38	36	49	26	2.70	16	15.0	1.89
Cr---------- 32-42	A-2-6(0)	SC	100	100	99	93	59	21	21	15	14	40	17	2.65	21	8.7	1.69
Keese:[4]																	
(S82TX-299-002)																	
Bw---------- 9-16	A-1-6(0)	SM	100	95	93	87	45	15	14	6	5	18	2	2.64	19	0.0	1.69
Ligon:[1]																	
(S86TX-299-004)																	
Bt1---------- 4-7	A-7-6(9)	SC	100	94	85	77	66	46	41	34	30	51	29	2.73	15	15.5	1.91
Bt2---------- 7-18	A-7-6(21)	CH	100	100	99	97	92	71	70	54	48	52	31	2.71	15	16.5	1.91
C---------- 23-32	A-6(5)	SC	100	98	96	93	84	41	41	26	22	40	24	2.83	15	11.9	1.90

See footnotes at end of table.

TABLE 20.--ENGINEERING INDEX TEST DATA--Continued

Soil name, sample number, horizon, and depth in inches		Classification		Grain-size distribution									Liquid limit	Plasticity index	Specific gravity	Shrinkage		
				Percentage passing sieve--						Percentage smaller than						Limit	Linear	Ratio
		AASHTO	Unified	5/8 inch	3/8 inch	No. 4	No. 10	No. 40	No. 200	.05 mm	.005 mm	.002 mm						
													Pct		g/cc	Pct	Pct	
Ligon:[5]																		
(S86TX-299-001)																		
A	0-4	A-2-4(0)	SC	100	93	87	82	72	31	27	16	13	27	8	2.65	17	4.9	1.77
Bt2	8-15	A-7-6(14)	CH	100	100	99	88	87	55	54	45	41	55	30	2.58	15	16.9	1.86
Lou:[1]																		
(S86TX-299-002)																		
A1	0-7	A-1-B(0)	SM-SC	99	98	94	78	42	33	20	8	5	26	6	2.64	20	3.2	1.74
Bt3	30-38	A-2-6(0)	SC	99	95	82	60	36	27	25	17	16	39	20	2.67	14	12.3	1.95
Cr	52-75	A-2-6(0)	SW-SC	97	86	58	32	11	5	4	3	3	37	16	2.77	19	8.8	1.80
Pontotoc:[6]																		
(S82TX-299-005)																		
A2	4-19	A-2-4(0)	SM-SC	100	100	100	99	86	32	16	9	6	20	4	2.65	21	1.6	1.80
Btc3	43-61	A-6(1)	SC	100	100	100	98	83	40	35	18	18	26	11	2.70	17	5.1	1.85
2Btc2	72-89	A-7-6(9)	SC	100	100	100	85	63	47	24	19	19	47	28	2.66	12	16.1	2.01

[1] Location of pedon sample is the same as typical for the series in "Soil Series and Their Morphology"

[2] Location of pedon sample: From the intersection of Texas Highway 71 and Texas Highway 16 in Llano, 12.0 miles northwest on Texas Highway 71, 0.5 mile east on county road, 0.4 mile north in rangeland.

[3] Location of pedon sample: From the intersection of Texas Highway 16 and Texas Highway 29, 8 miles west on Texas Highway 29, 4.6 miles north on county road, 300 feet east in rangeland.

[4] Location of pedon sample: From the intersection of Texas Highway 16 and Farm Road 2323 in Llano, 11.6 miles southwest on Farm Road 2323, 3.5 miles west on county road, 0.6 mile south on private road, 450 feet east in rangeland.

[5] Location of pedon sample: From the intersection of Texas Highway 16 and Farm Road 2323 in Llano, 11.6 miles southwest on Farm Road 2323, 3.5 miles on county road, 1.3 miles west and south on private road, 104 feet east in rangeland.

[6] Location of pedon sample: From the intersection of Texas Highway 16 and Texas Highway 29 in Llano, 2.2 miles east on Texas Highway 29, 6.0 miles northwest on Ranch Road 2241, 1.9 miles north on county road, 1.8 miles northeast on county road, 300 feet south in rangeland.

[7] AASHTO, Liquid limit, and Plasticity index are outside range for the series.

TABLE 21.--CLASSIFICATION OF THE SOILS

(An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series)

Soil name	Family or higher taxonomic class
*Bastrop	Fine-loamy, mixed, thermic Udic Paleustalfs
Bauman	Fine-loamy, mixed, thermic Typic Natrustalfs
Boerne	Coarse-loamy, carbonatic, thermic Fluventic Ustochrepts
Campair	Fine-loamy, siliceous, thermic Typic Haplustalfs
Castell	Fine, mixed, thermic Typic Paleustalfs
Cho	Loamy, carbonatic, thermic, shallow Petrocalcic Calciustolls
Click	Loamy-skeletal, mixed, thermic Typic Haplustalfs
Eckrant	Clayey-skeletal, montmorillonitic, thermic Lithic Haplustolls
Fieldcreek	Coarse-loamy, mixed, thermic Cumulic Haplustolls
Harper	Clayey, montmorillonitic, thermic Lithic Haplustolls
Hensley	Clayey, mixed, thermic Lithic Rhodustalfs
Honeycreek	Fine-loamy, mixed, thermic Typic Haplustalfs
Hye	Fine-loamy, mixed, thermic Typic Haplustalfs
Katemcy	Fine, mixed, thermic Typic Haplustalfs
Keese	Loamy, mixed, thermic, shallow Typic Ustochrepts
*Krum	Fine, montmorillonitic, thermic Udertic Haplustolls
Ligon	Fine, mixed, thermic Typic Rhodustalfs
Loneoak	Loamy, siliceous, thermic Arenic Paleustalfs
Lou	Fine-loamy, mixed, thermic Typic Haplustalfs
Luckenbach	Fine, mixed, thermic Typic Argiustolls
Matilo	Loamy, siliceous, thermic Grossarenic Paleustalfs
Nebgen	Loamy, mixed, nonacid, thermic Lithic Ustorthents
Nuvalde	Fine-silty, mixed, thermic Typic Calciustolls
Oben	Loamy, mixed, thermic, shallow Typic Haplustalfs
Oplin	Loamy-skeletal, carbonatic, thermic Lithic Calciustolls
Packsaddle	Loamy-skeletal, mixed, thermic Typic Argiustolls
Pedernales	Fine, mixed, thermic Typic Paleustalfs
Pontotoc	Coarse-loamy, mixed, thermic Rhodic Paleustalfs
Real	Loamy-skeletal, carbonatic, thermic, shallow Petrocalcic Calciustolls
Roughcreek	Clayey-skeletal, montmorillonitic, thermic Lithic Argiustolls
Rumple	Clayey-skeletal, mixed, thermic Typic Argiustolls
*Venus	Fine-loamy, mixed, thermic Udic Calciustolls
Voca	Fine, mixed, thermic Typic Paleustalfs
*Weswood	Fine-silty, mixed, thermic Udifluventic Ustochrepts
Yates	Loamy-skeletal, mixed, nonacid, thermic Lithic Ustorthents

Link to Soil Survey

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