



United States
Department of
Agriculture

Soil
Conservation
Service

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

Soil Survey of La Salle County, Texas



ELECTRONIC VERSION

This soil survey is an electronic version of the original printed copy, dated October 1994. It has been formatted for electronic delivery. Additional and updated information may be available from the Web Soil Survey. In Web Soil Survey, identify an Area of Interest (AOI) and navigate through the AOI Properties panel to learn what soil data is available.

How To Use This Soil Survey

General Soil Map

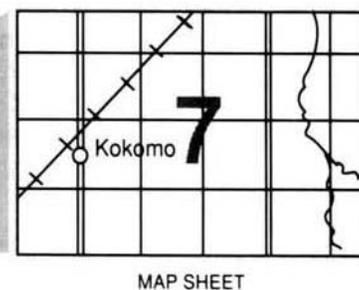
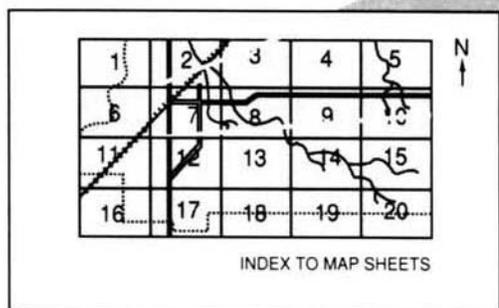
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

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

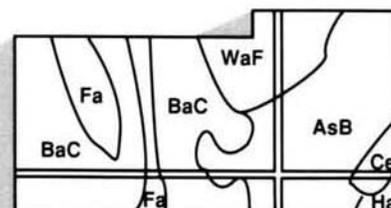
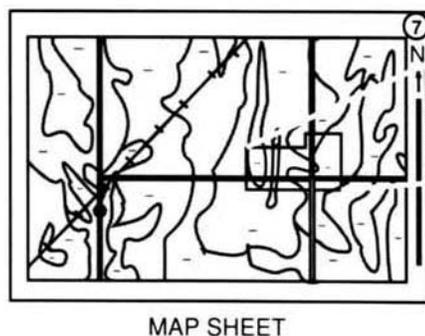
Detailed Soil Maps

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

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



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



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

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

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1986. Soil names and descriptions were approved in 1988. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1986. This soil survey was made cooperatively by the Soil Conservation Service and the Texas Agricultural Experiment Station and the Texas State Soil and Water Conservation Board. It is part of the technical assistance furnished to the La Salle 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.

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

Cover: Huisache, mesquite, retama, and gulf cordgrass in an area of Coquet clay, frequently flooded, on the flood plain along the Nueces River. The brush canopy is typical for this soil.

Contents

Index to map units	v
Summary of tables	vi
Foreword	viii
General nature of the county	2
How this survey was made	4
Map unit composition	5
General soil map units	6
Detailed soil map units	21
Prime farmland	85
Use and management of the soils	86
Crops and pasture	86
Rangeland	90
Recreation	101
Wildlife habitat	102
Engineering	105
Soil properties	111
Engineering index properties	111
Physical and chemical properties	112
Soil and water features	114
Engineering index test data	116
Classification of the soils	116
Soil series and their morphology	117
Aguilares series	117
Altita series	119
Arroyada series	120
Bookout series	121
Brundage series	122
Brystal series	125
Caid series	126
Catarina series	127
Chacon series	128
Charco series	129
Cochina series	131
Copita series	132
Coquat series	133
Cotulla series	134
Dilley series	135
Divot series	137
Duval series	138
Goldfinch series	140
Hindes series	142
Imogene series	143
Lasalle series	144
Mata series	145
Maverick series	146
Moglia series	147
Montell series	149
Monteola series	150
Poteet series	151
Tela series	152
Tiocono series	153

Viboras series	154
Webb series	155
Yologo series	157
Zavco series	158
Formation of the soils	160
Factors of soil formation	160
Soil horizons	162
Surface geology	162
References	165
Glossary	166
Tables	177

Issued October 1994

Index to Map Units

AGB—Aguilares sandy clay loam, gently undulating	21
ARB—Arroyada clay, frequently flooded	22
BkA—Bookout clay loam, 0 to 1 percent slopes	24
BkB—Bookout clay loam, 1 to 3 percent slopes	25
BOB—Bookout clay loam, gently undulating	26
BrB—Brundage very fine sandy loam, 0 to 2 percent slopes	27
ByB—Brystal very fine sandy loam, 1 to 3 percent slopes	29
BZB—Brystal very fine sandy loam, gently undulating	30
CaA—Caid very fine sandy loam, 0 to 1 percent slopes	31
CaB—Caid very fine sandy loam, 1 to 3 percent slopes	33
CBB—Caid very fine sandy loam, gently undulating	34
CCA—Catarina clay, nearly level	35
CdA—Chacon clay loam, 0 to 1 percent slopes	36
CDB—Chacon clay loam, gently undulating	38
CEB—Charco-Altita complex, nearly level	39
Ch—Cochina clay, occasionally flooded	41
Cn—Cochina clay, frequently flooded	42
CPB—Copita fine sandy loam, gently undulating	44
Cq—Coquat clay, frequently flooded	45
CtA—Cotulla clay, 0 to 1 percent slopes	47
CUA—Cotulla clay, nearly level	49
DLC—Dilley fine sandy loam, gently undulating	50
Dm—Divot silty clay loam, occasionally flooded	51
Dn—Divot silty clay loam, frequently flooded	53
DsC—Duval loamy fine sand, 0 to 5 percent slopes	54
DvA—Duval very fine sandy loam, 0 to 1 percent slopes	56
DvB—Duval very fine sandy loam, 1 to 3 percent slopes	57
DVC—Duval very fine sandy loam, gently undulating	58
GDD—Goldfinch very gravelly sandy loam, undulating	59
HYD—Hindes-Yologo complex, undulating	61
Im—Imogene very fine sandy loam, occasionally flooded	63
LaA—Lasalle clay, 0 to 1 percent slopes	64
LAB—Lasalle clay, gently undulating	65
MAC—Mata gravelly sandy clay loam, gently undulating	67
MCC—Maverick clay, gently undulating	68
MGC—Moglia clay loam, gently undulating	69
MNA—Montell clay, saline, nearly level	71

Mn—Montell clay, saline, occasionally flooded	72
MTC—Monteola clay, saline, gently undulating	73
Pt—Poteet very fine sandy loam, occasionally flooded	74
Ta—Tela sandy clay loam, frequently flooded	76
Tc—Tiocono clay	77
VBB—Viboras clay, gently undulating	78
WbA—Webb very fine sandy loam, 0 to 1 percent slopes	80
WbB—Webb very fine sandy loam, 1 to 3 percent slopes	81
WCB—Webb very fine sandy loam, gently undulating	82
ZVB—Zavco sandy clay loam, gently undulating.....	84

Summary of Tables

Temperature and precipitation (table 1)	178
Freeze dates in spring and fall (table 2)	179
Growing season (table 3).....	179
Acreage and proportionate extent of the soils (table 4).....	180
Prime farmland (table 5)	181
Land capability and yields per acre of crops and pasture (table 6)	182
Rangeland productivity (table 7)	185
Recreational development (table 8)	187
Wildlife habitat (table 9)	190
Building site development (table 10)	192
Sanitary facilities (table 11).....	195
Construction materials (table 12)	198
Water management (table 13)	201
Engineering index properties (table 14)	204
Physical and chemical properties of the soils (table 15)	209
Soil and water features (table 16)	212
Engineering index test data (table 17).....	214
Classification of the soils (table 18).....	216

Foreword

This soil survey contains information that can be used in land-planning programs in La Salle 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.

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

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

Harry W. Oneth
State Conservationist
Soil Conservation Service

Soil Survey of La Salle County, Texas

By Wayne J. Gabriel, Daniel Arriaga, and Jack W. Stevens, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service
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Conservation Board

LA SALLE COUNTY is in the southern part of Texas (fig. 1). It borders Frio County in the north, McMullen County in the east, Webb County in the south and west, and Dimmit County in the west. La Salle County is rectangular. It is about 42 miles from north to south and 36 miles from east to west. It has an area of 971,475 acres, or about 1,518 square miles.

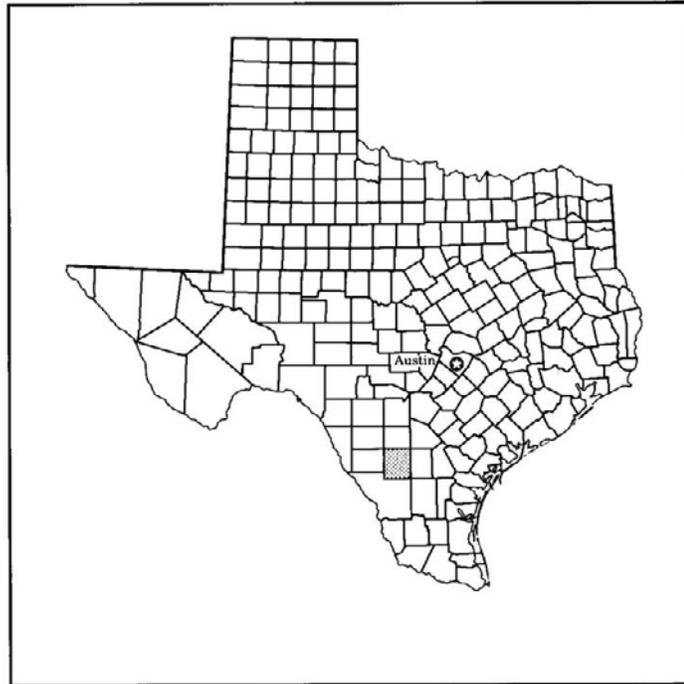


Figure 1.—Location of La Salle County in Texas.

La Salle County is in the Northern Rio Grande Plain and Western Rio Grande Plain major land resource areas. The land surface is nearly level to undulating and generally slopes to the southeast. Elevations range from 300 to 600 feet above sea level (4).

The major drainage systems in La Salle County are the Frio River, which flows from the north-central part of the county to the eastern part, and the Nueces River, which flows from the west-central part of the county to the southeastern part. Cibolo Creek, which is a tributary of the Frio River, drains the northern part of the county. Caiman and Los Raices Creeks, which are tributaries of the Nueces River, drain the

southwestern part of the county. Los Olmos, San Casimiro, and Black Creeks, which also are tributaries of the Nueces River, drain the southeastern part of the county.

The major land uses in La Salle County are rangeland and cropland.

Approximately 887,520 acres in the county is used as rangeland, 70,000 acres as cropland, and 5,000 acres as pasture and hayland. About 20 acres is used for orchards, 8,000 acres as urban or built-up land, 835 acres for farm ponds that are larger than 40 acres, and 100 acres for confined livestock feeding enterprises.

General Nature of the County

This section gives general information about the county. It describes history, climate, economic enterprises, natural resources, and transportation facilities.

History

Indian tribes had inhabited this survey area for thousands of years prior to exploration by French and Spanish explorers in the late 1600's. In the period following the early explorations, most of the area was a vast open range used by settlers who owned or controlled large tracts. Large numbers of longhorn cattle and horses were raised in the area and driven overland each year to distant markets. The Texas Rangers established Ft. Ewell in May 1852 to ease the conflict between settlers and Indians (6).

In 1858, the Texas Legislature approved a bill providing for the organization of La Salle County. The county, however, did not organize until 1880 because of a lack of permanent residents. The county was named in honor of Robert Cavalier Sieur de La Salle, a French explorer who died in Texas (4).

By 1860, several small settlements, mainly ranch headquarters and trading centers, were located along the streams and rivers in the area (6). In 1870, the area of the proposed county had only 69 permanent inhabitants.

In 1881, Joseph Cotulla gave 120 acres for a town site in order to induce the railroad into La Salle County. He named the town Cotulla, which later became the county seat (6). In 1883, the International Great Northern Railroad extended its line from San Antonio to Laredo and Cotulla prospered near the line. Today, Cotulla is the center of industry and trade for the county.

After the advent of barbed wire in the 1870's, large blocks of rangeland were fenced and improved breeds of beef cattle were gradually introduced. At one time sheep ranching was locally important, but low prices caused this industry to decline. Since 1883, little of the rangeland in the county has been used for sheep ranching.

After the construction of the railroad in 1883, farmers began to move into the northern part of the county near Dilley in Frio County. Cotton was the major cash crop. Before the drilling of the first artesian wells, only dryland crops were grown, except near the Frio and Nueces Rivers. Since then, many farmers in the northern part of the county have drilled wells into the underlying aquifer and are able to pump water for irrigation. During the 1930's, farmers began to replace cotton with peanuts.

In 1980, the population of La Salle County was 5,500. Cotulla, the county seat, had a population of about 3,900. Encinal, the second largest town, had a population of about 700. Other communities in the county include Fowlerton, Gardendale, Los Angeles, Millett, and Woodward.

The Dos Rios Soil and Water Conservation District was formed in April 1946. In 1990, its name was changed to the La Salle County Soil and Water Conservation District.

Climate

Table 1 gives data on temperature and precipitation for the survey area as recorded at Cotulla Airport in the period 1951 to 1984. Table 2 shows probable dates

of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 55 degrees F and the average daily minimum temperature is 44 degrees. The lowest temperature on record, which occurred at Cotulla on January 12, 1962, is 7 degrees. In summer, the average temperature is 85 degrees and the average daily maximum temperature is 97 degrees. The highest recorded temperature, which occurred at Cotulla on July 30, 1960, is 111 degrees.

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

The total annual precipitation is 21.85 inches. Of this, about 14 inches, or 65 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 3 inches. The heaviest 1-day rainfall during the period of record was 6.09 inches at Cotulla on October 5, 1971. Thunderstorms occur on about 36 days each year.

Snowfall is rare. The average seasonal snowfall is less than 1 inch. In most of the winters, there is no measurable snowfall. The greatest snow depth at any one time during the period of record was 1 inch.

The average relative humidity in mid afternoon is about 55 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 70 percent of the time possible in summer and 50 percent in winter. The prevailing wind is from the southeast. Average wind speed is highest, 11 miles per hour, in spring.

Economic Enterprises

Agriculture, agribusiness, and oil and gas production are the principal industries in La Salle County. Other industries include oil field service and retail trade.

Cattle sales and hunting leases are the largest sources of agricultural revenue in the county. Other important agricultural products include feed grain, peanuts, melons, and vegetables.

The major agribusinesses in the county include livestock sales and shipping and farm and ranch supplies.

Natural Resources

The most important natural resources in La Salle County are soil, water, wildlife, petroleum, and natural gas. Also, deposits of gravel, caliche, and clay are used for the construction of roads, buildings, and ponds.

Most of the soils in the county are very deep to moderately deep. The nonsaline soils are capable of producing large amounts of forage and a variety of crops if properly managed. The saline soils and the shallow and very shallow soils are used primarily as rangeland.

The largest supply of good-quality water in the county is in the Carrizo Sand Aquifer. Wells in this aquifer supply water for domestic use, livestock, and irrigation. The Nueces and Frio Rivers also provide water for irrigation.

Wildlife in the county provide opportunities for recreation and income. White-tailed deer, javelina, quail, dove, and turkey are the major game species in the county. Farm ponds and the Frio and Nueces Rivers provide habitat for game fish.

Transportation Facilities

Interstate Highway 35 crosses the middle of La Salle County, passing north to south through Millett, Gardendale, Cotulla, Artesia Wells, and Encinal. U.S. Highway 81 parallels Interstate 35. Texas Highway 97 connects Cotulla, Los Angeles, and Fowlerton. Farm Roads 117, 133, 468, 469, 624, 863, 1582, and 3408 and many county roads provide ready access to agricultural markets.

The Missouri-Pacific Railroad is the only railroad in the county. It connects Laredo with San Antonio, connects Gardendale with Big Wells, and parallels U.S. Highway 81 in La Salle County. Air service, which is limited to small aircraft, is provided mainly by the Cotulla Airport.

How This Survey Was Made

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

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

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

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, 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. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area are generally collected for laboratory analyses and for engineering tests. Soil scientists 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 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 assure that a high water table will always be at a specific level in the soil on a specific date.

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

Map Unit Composition

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

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

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

Survey Procedures

Before fieldwork for this soil survey began, preliminary boundaries of slopes and landforms were plotted stereoscopically on aerial photographs. Soil scientists studied

U.S. Geological Survey topographic maps and photographs, relating land and image features.

The soil scientists made traverses by truck on the existing network of roads and trails. Where there were no roads or trails, traverses were made on foot. Soil examinations along the traverses were made about 50 to 1,000 yards apart, depending on the landscape and soil pattern. The soil was examined with the aid of a hand auger, spade, or power probe to a depth of 5 to 7 feet or to bedrock within a depth of 7 feet. Many typical pedons were observed and studied in small pits that were dug by hand. Observations of landforms, geology, vegetation, roadcuts, excavations, and animal burrows were made continuously without regard to spacing. Soil boundaries were determined on the basis of soil examinations, observations, and photo interpretation.

The soil scientists transected some of the map units to determine the composition of the units and record the kind of vegetation. They chose at least three delineations of each transected map unit to be representative of the unit. At least 10 observations 40 to 300 feet apart were made for most transects.

Samples for most of the engineering index test data in table 17 were taken from the sites of typical pedons of the major soils in the county. The analyses in table 17 were made by the Texas State Department of Highways and Public Transportation, Austin, Texas.

After completion of the soil mapping, map unit delineations were transferred by hand to high-altitude aerial photographs at a scale of 1:24,000. Surface drainage and cultural features were transferred from 7 1/2-minute U.S. Geological Survey topographic maps and were recorded from visual observations in the field.

Data on soil interpretations were assembled from a variety of sources, such as research, farm records, field experience, laboratory data, and consultation with state and local specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from the results of consultation with local farmers and field or plot experiments. After the soils had been described, delineated, named, analyzed, and interpreted, the information was organized so that it can be used by farmers, ranch managers, engineers, planners, developers, builders, home buyers, and others.

General Soil Map Units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, it consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in 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 a building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Each map unit is rated for most agricultural uses, rangeland productivity, urban uses, and recreation areas. Agricultural uses include production of cultivated crops, irrigated pasture, and rangeland forage. Urban uses include residential, commercial, and industrial developments. Intensive recreation areas are campsites, picnic areas, ballfields, and other areas that are subject to heavy foot traffic. Extensive recreation areas are those used for nature study and as wilderness.

Very Deep and Moderately Deep, Clayey and Loamy Soils on Uplands, Stream Terraces, and Flood Plains

These soils make up 467,745 acres, or about 48.2 percent of the county. The major soils are those in the Aguilares, Brundage, Cotulla, Imogene, Maverick, Moglia, Montell, Monteola, and Viboras series. They are on nearly level to gently undulating plains. The Aguilares, Maverick, and Moglia soils are well drained, and the other soils are moderately well drained. The Aguilares soils are moderately permeable, the Moglia soils are moderately slowly permeable, the Maverick soils are slowly permeable, and the other soils are very slowly permeable.

These soils generally are poorly suited to most agricultural uses. Most areas are used as rangeland and wildlife habitat. Salinity is the main limitation. A few areas of the Cotulla soils are used as nonirrigated cropland. The main crops in these areas are forage sorghum, grain sorghum, oats, and wheat.

1. Cotulla-Brundage-Moglia

Nearly level to gently undulating, very slowly permeable and moderately slowly permeable soils that have a clayey or loamy surface layer and a saline, clayey or loamy subsoil

This unit makes up 353,290 acres, or about 36.4 percent of the county. It is about 20 percent Cotulla soils, 16 percent Brundage soils, 16 percent Moglia soils, and 48 percent minor soils (fig. 2).

The landscape consists of broad, smooth plains dissected by the broad and narrow valleys of large creeks and by small drainageways on uplands. The Cotulla and Moglia soils are mainly on the upland plains, and the Brundage soils are on the upland plains and on terraces along creeks.

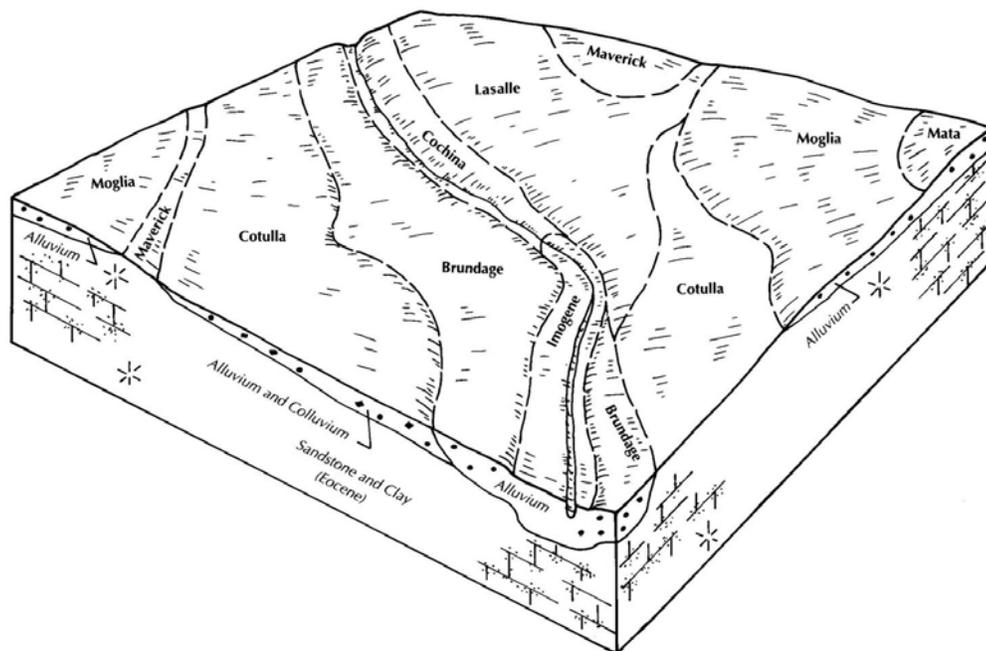


Figure 2.—Typical pattern of soils and underlying material in the Cotulla-Brundage-Moglia general soil map unit.

The Cotulla soils are very deep, moderately well drained, and very slowly permeable. Typically, the surface layer is grayish brown clay in the upper 7 inches and grayish brown, saline clay from a depth of 7 to 18 inches. The upper part of the subsoil, from a depth of 18 to 28 inches, is light brownish gray, saline clay. The next part, from a depth of 28 to 50 inches, is brown and pale brown, saline clay. The lower part, from a depth of 50 to 72 inches, is light yellowish brown, saline clay.

The Brundage soils are very deep, moderately well drained, and very slowly permeable. Typically, the surface layer is light brownish gray very fine sandy loam about 2 inches thick. The upper part of the subsoil, from a depth of 2 to 18 inches, is dark grayish brown and light brownish gray, saline sandy clay loam. The lower part, from a depth of 18 to 58 inches, is pale brown and very pale brown, mottled, saline sandy clay loam and clay loam. The substratum, from a depth of 58 to 80 inches, is light gray, saline clay loam intermingled with white, saline, soft shale bedrock.

The Moglia soils are very deep, well drained, and moderately slowly permeable. Typically, the surface layer is grayish brown clay loam about 12 inches thick. The upper part of the subsoil, from a depth of 12 to 20 inches, is very pale brown clay loam. The lower part, from a depth of 20 to 72 inches, is very pale brown, saline clay loam.

The minor soils in this unit consist of about 15 percent Lasalle soils, 10 percent Imogene soils, 7 percent Cochina soils, 6 percent Maverick soils, 3 percent Mata soils, 1 percent Altita soils, 1 percent Brystal soils, 1 percent Caid soils, 1 percent Charco soils, and 3 percent Bookout, Chacon, Copita, Coquat, Dilley, Duval, Poteet, Webb, Zavco, and other soils.

The Altita, Brystal, Charco, Copita, Duval, Imogene, Lasalle, Mata, Webb, and Zavco soils are in landscape positions similar to those of the major soils. The Dilley soils are on hills and ridges. The Bookout, Caid, and Chacon soils are on stream terraces. The Cochina, Coquat, Imogene, and Poteet soils are on flood plains along creeks, on low stream terraces, and along small drainageways on uplands.

The major soils are used mainly as rangeland and wildlife habitat. A few areas of the Cotulla soils are used as nonirrigated cropland. The Cotulla soils are poorly suited to nonirrigated crops, and the Brundage and Moglia soils are not suited. The Cotulla soils are moderately suited to irrigated crops, and the Brundage and Moglia soils are poorly suited. The salinity and the hazards of water erosion and wind erosion are the main management concerns.

Rangeland productivity is medium in areas of the Cotulla and Moglia soils and low in areas of the Brundage soils. When properly managed, areas of native vegetation produce a variety of grasses, forbs, and browse plants for livestock and wildlife. Areas of the Cotulla soils are used by deer, quail, dove, and turkey, but they are not the preferred sites. Areas of the Brundage and Moglia soils are preferred sites for deer, are good sites for quail, and are used by dove and turkey.

The Cotulla and Moglia soils are poorly suited to most urban uses, and the Brundage soils are moderately suited. The Cotulla and Moglia soils are moderately suited to most recreational uses, and the Brundage soils are poorly suited.

2. Maverick

Gently undulating, slowly permeable soils that have a saline, clayey surface layer and subsoil

This unit makes up 95,020 acres, or about 9.8 percent of the county. It is about 81 percent Maverick soils and 19 percent minor soils (fig. 3).

The landscape consists of broad, smooth plains on interstream divides dissected by the broad and narrow valleys of large creeks and by small drainageways on uplands. The Maverick soils are mainly on the upland plains.

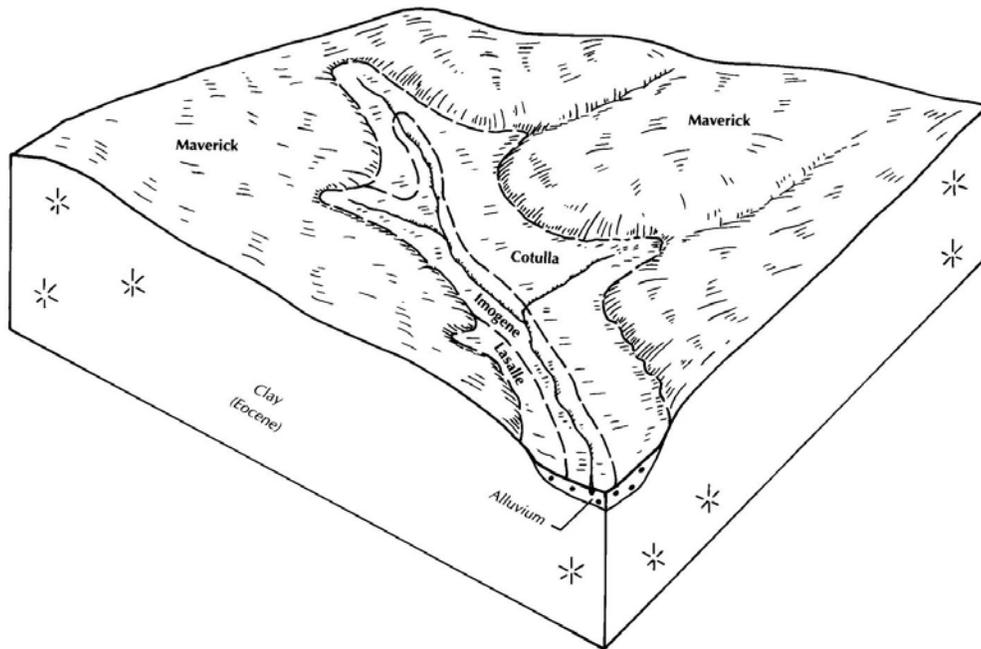


Figure 3.—Typical pattern of soils and underlying material in the Maverick general soil map unit.

The Maverick soils are moderately deep, well drained, and slowly permeable. Typically, the surface layer is grayish brown, saline clay about 8 inches thick. The upper part of the subsoil, from a depth of 8 to 16 inches, is light brownish gray, saline clay. The lower part, from a depth of 16 to 28 inches, is pale brown, saline clay. The substratum, from a depth of 28 to 60 inches, is light gray, saline, soft shale bedrock.

The minor soils in this unit consist of about 7 percent Cotulla soils, 4 percent Imogene soils, 2 percent Cochina soils, 1 percent Brundage soils, 1 percent Chacon soils, 1 percent Lasalle soils, 1 percent Moglia soils, 1 percent Webb soils, and 1 percent Dilley, Duval, Mata, Poteet, and other soils.

The Mata and Moglia soils are in landscape positions similar to those of the Maverick soils. The Dilley soils are on hills and ridges. The Cotulla, Brundage, Duval, Lasalle, and Webb soils are on the lower plains. The Chacon soils are on stream terraces. The Cochina, Imogene, and Poteet soils are on flood plains along creeks, on low stream terraces, and along small drainageways on uplands.

The Maverick soils are used mainly as rangeland and wildlife habitat. They are not suited to nonirrigated crops and are poorly suited to irrigated crops. The salinity and the hazards of water erosion and wind erosion are the main management concerns.

Rangeland productivity is low. When properly managed, areas of native vegetation produce a variety of grasses, forbs, and browse plants for livestock and wildlife. Areas of the Maverick soils are used by deer, quail, dove, and turkey, but they are not the preferred sites.

The Maverick soils are poorly suited to most urban uses and moderately suited to most recreational uses.

3. Brundage-Imogene-Monteola

Nearly level to gently undulating, very slowly permeable soils that have a loamy or clayey surface layer and a saline, loamy or clayey subsoil

This unit makes up 13,800 acres, or about 1.4 percent of the county. It is about 38 percent Brundage soils, 20 percent Imogene soils, 17 percent Monteola soils, and 25 percent minor soils.

The landscape consists of broad, smooth plains dissected by the broad and narrow valleys of large creeks and by small drainageways on uplands. The Monteola soils are mainly on the upland plains, the Brundage soils are on the plains on terraces along creeks, and the Imogene soils are mainly on flood plains and low terraces along creeks.

The Brundage soils are very deep, moderately well drained, and very slowly permeable. Typically, the surface layer is light brownish gray very fine sandy loam about 2 inches thick. The upper part of the subsoil, from a depth of 2 to 18 inches, is dark grayish brown and light brownish gray, saline sandy clay loam. The lower part, from a depth of 18 to 58 inches, is pale brown and very pale brown, mottled, saline sandy clay loam and clay loam. The substratum, from a depth of 58 to 80 inches, is light gray, saline clay loam intermingled with white, saline, soft shale bedrock.

The Imogene soils are very deep, moderately well drained, and very slowly permeable. Typically, the surface layer is grayish brown very fine sandy loam about 4 inches thick. The upper part of the subsoil, from a depth of 4 to 48 inches, is grayish brown and light gray, saline sandy clay loam. The lower part, from a depth of 48 to 64 inches, is light gray, saline loam. The substratum, from a depth of 64 to 80 inches, is white, saline loam.

The Monteola soils are very deep, moderately well drained, and very slowly permeable. Typically, the surface layer is dark gray clay about 15 inches thick. The subsoil is saline clay. From a depth of 15 to 24 inches, it is dark gray. From a depth of 24 to 37 inches, it is grayish brown. From a depth of 37 to 57 inches, it is light yellowish brown. From a depth of 57 to 62 inches, it is brownish yellow.

The minor soils in this unit consist of about 8 percent Charco soils, 6 percent Altita soils, 5 percent Chacon soils, 4 percent Cotulla soils, 1 percent Moglia soils, and 1 percent other soils. The Altita, Chacon, Charco, Cotulla, and Moglia soils are in landscape positions similar to those of the Brundage and Monteola soils.

The major soils are used mainly as rangeland and wildlife habitat. The Brundage soils are not suited to nonirrigated crops, and the Imogene and Monteola soils are poorly suited. The Brundage and Monteola soils are poorly suited to irrigated crops, and the Imogene soils are moderately suited. The salinity and the hazards of water erosion and wind erosion are the main management concerns.

Rangeland productivity is low in areas of the Brundage soils and medium in areas of the Imogene and Monteola soils. When properly managed, areas of native vegetation produce a variety of grasses, forbs, and browse plants for livestock and wildlife. Areas of the Brundage and Imogene soils are preferred sites for deer, are good sites for quail, and are used by dove and turkey. Areas of the Monteola soils are used by deer, quail, dove, and turkey, but they are not the preferred sites.

The Brundage soils are moderately suited to most urban uses, and the Monteola soils are poorly suited. The Imogene soils are severely limited as sites for these uses. The Brundage and Imogene soils are poorly suited to most recreational uses, and the Monteola soils are moderately suited. Flooding is the main hazard in areas of the Imogene soils.

4. Montell-Moglia-Viboras

Nearly level to gently undulating, very slowly permeable and moderately slowly permeable soils that have a clayey or loamy surface layer and a saline, clayey or loamy subsoil

This unit makes up 5,010 acres, or about 0.5 percent of the county. It is about 29 percent Montell soils, 26 percent Moglia soils, 12 percent Viboras soils, and 33 percent minor soils.

The landscape consists of broad, smooth plains dissected by the broad and narrow valleys of large creeks and by small drainageways on uplands. The Moglia and Viboras soils are mainly on the upland plains. The Montell soils are on flood plains and terraces along creeks.

The Montell soils are very deep, moderately well drained, and very slowly permeable. Typically, the surface layer is gray clay about 12 inches thick. The upper part of the subsoil, from a depth of 12 to 30 inches, is gray, saline clay. The lower part, from a depth of 30 to 70 inches, is light gray and light brownish gray, saline clay.

The Moglia soils are very deep, well drained, and moderately slowly permeable. Typically, the surface layer is grayish brown clay loam about 12 inches thick. The upper part of the subsoil, from a depth of 12 to 20 inches, is very pale brown clay loam. The lower part, from a depth of 20 to 72 inches, is very pale brown, saline clay loam.

The Viboras soils are moderately deep, moderately well drained, and very slowly permeable. Typically, the surface layer is reddish brown clay about 8 inches thick. The upper part of the subsoil, from a depth of 8 to 34 inches, is reddish brown, saline clay. The lower part, from a depth of 34 to 38 inches, is light reddish brown, saline clay. The substratum, from a depth of 38 to 60 inches, is light reddish brown, saline, soft shale bedrock intermingled with clay.

The minor soils in this unit consist of about 6 percent Arroyada soils, 6 percent Catarina soils, 5 percent Brundage soils, 5 percent Imogene soils, 5 percent Maverick soils, 3 percent Cochina soils, 1 percent Copita soils, and 2 percent small areas of other soils.

The Brundage, Catarina, Copita, and Maverick soils are in landscape positions similar to those of the major soils. The Arroyada, Cochina, and Imogene soils are on flood plains along creeks, on low stream terraces, and along small drainageways on uplands.

The major soils are used mainly as rangeland and wildlife habitat. They are not suited to nonirrigated crops. The Moglia soils are poorly suited to irrigated crops. The salinity and the hazards of water erosion and wind erosion are the main management concerns.

Rangeland productivity is medium in areas of the Montell and Moglia soils and low in areas of the Viboras soils. When properly managed, areas of native vegetation produce a variety of grasses, forbs, and browse plants for livestock and wildlife. Areas of the Montell and Viboras soils are used by deer, quail, dove, and turkey, but they are not the preferred sites. Areas of the Moglia soils are preferred sites for deer, are good sites for quail, and are used by dove and turkey.

The major soils are poorly suited to most urban uses. The occasionally flooded Montell soils are severely limited as sites for these uses because of the hazard of flooding. The Montell and Moglia soils are moderately suited to most recreational uses, and the Viboras soils are poorly suited.

5. Aguilares-Montell

Nearly level to gently undulating, moderately permeable and very slowly permeable soils that have a loamy or clayey surface layer and a nonsaline or saline, loamy or clayey subsoil

This unit makes up 625 acres, or about 0.1 percent of the county. It is about 49 percent Aguilares soils, 39 percent Montell soils, and 12 percent minor soils.

The landscape consists of broad, smooth plains dissected by the broad and narrow valleys of large creeks and by small drainageways on uplands. The Aguilares soils are mainly on the upland plains, and the Montell soils are on flood plains and terraces along creeks.

The Aguilares soils are very deep, well drained, and moderately permeable. Typically, the surface layer is grayish brown sandy clay loam about 9 inches thick. The upper part of the subsoil, from a depth of 9 to 24 inches, is light brownish gray and pale brown clay loam. The lower part, from a depth of 24 to 35 inches, is pale brown, saline clay loam. The substratum, from a depth of 35 to 72 inches, is very pale brown, saline sandy clay loam.

The Montell soils are very deep, moderately well drained, and very slowly permeable. Typically, the surface layer is gray clay about 12 inches thick. The upper part of the subsoil, from a depth of 12 to 30 inches, is gray, saline clay. The lower part, from a depth of 30 to 70 inches, is light gray and light brownish gray, saline clay.

The minor soils in this unit consist of about 9 percent Maverick soils, 3 percent Moglia soils, and small areas of other soils. The Maverick and Moglia soils are in landscape positions similar to those of the major soils.

The major soils are used mainly as rangeland and wildlife habitat. The Aguilares soils are poorly suited to nonirrigated crops and moderately suited to irrigated crops. The Montell soils are not suited to nonirrigated or irrigated crops. The salinity and the hazards of water erosion and wind erosion are the main management concerns.

Rangeland productivity is medium. When properly managed, areas of native vegetation produce a variety of grasses, forbs, and browse plants for livestock and wildlife. Areas of the Aguilares soils are preferred sites for deer, are good sites for quail, and are used by dove and turkey. Areas of the Montell soils are used by deer, quail, dove, and turkey, but they are not the preferred sites.

The Aguilares soils are moderately suited to most urban uses, and the Montell soils are poorly suited. The occasionally flooded Montell soils are severely limited as sites for these uses because of the hazard of flooding. The Montell soils are moderately suited to most recreational uses, and the Aguilares soils are well suited.

Very Deep and Deep, Loamy Soils on Uplands

These soils make up 306,000 acres, or about 31.5 percent of the county. The major soils are those in the Brystal, Duval, Poteet, Webb, and Zavco series. They are on nearly level to gently undulating plains. All of these soils are well drained, except for Poteet soils, which are moderately well drained. The soils are moderately permeable to slowly permeable.

These soils generally are well suited to most agricultural uses. Most areas are used as rangeland and wildlife habitat. A large acreage is used for corn, cowpeas, forage sorghum, grain sorghum, oats, peanuts, wheat, potatoes, or watermelons. Some areas are used as irrigated pasture and hayland.

6. Duval-Brystal-Webb

Nearly level to gently undulating, moderately permeable and moderately slowly permeable soils that have a loamy surface layer and a loamy or clayey subsoil

This unit makes up 263,400 acres, or about 27.1 percent of the county. It is about 35 percent Duval soils, 16 percent Brystal soils, 15 percent Webb soils, and 34 percent minor soils (fig. 4).

The landscape consists of broad, smooth plains dissected by the narrow valleys of creeks and by small drainageways on uplands. The Duval, Brystal, and Webb soils are mainly on the upland plains.

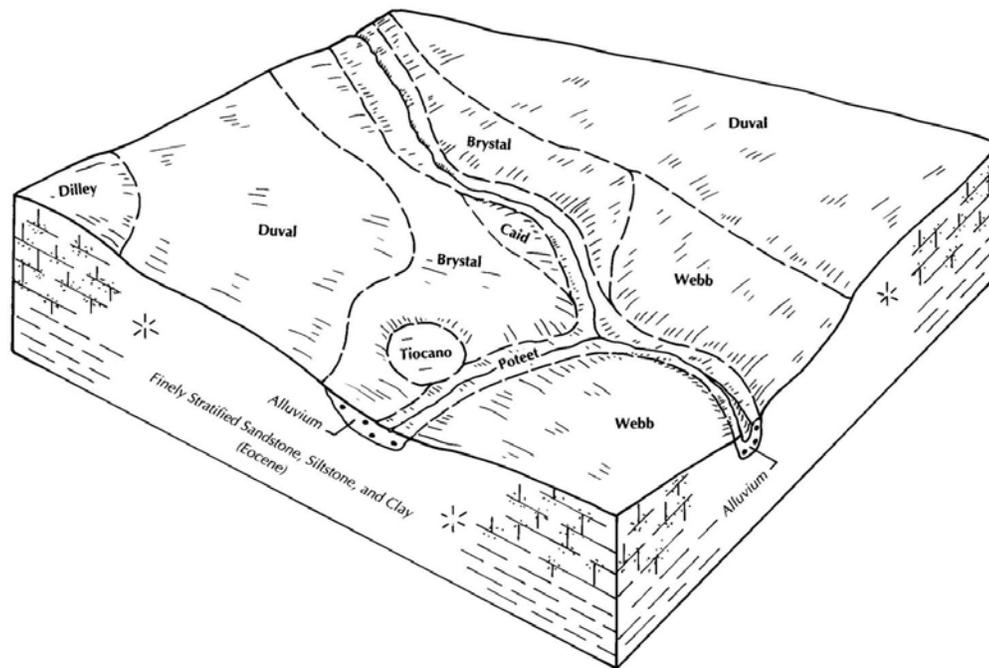


Figure 4.—Typical pattern of soils and underlying material in the Duval-Brystal-Webb general soil map unit.

The Duval soils are deep, well drained, and moderately permeable. Typically, the surface layer is reddish brown very fine sandy loam about 10 inches thick. The upper part of the subsoil, from a depth of 10 to 18 inches, is reddish brown very fine sandy loam. The lower part, from a depth of 18 to 48 inches, is yellowish red sandy clay loam. The substratum, from a depth of 48 to 60 inches, is light yellowish brown, soft sandstone bedrock.

The Brystal soils are very deep, well drained, and moderately permeable. Typically, the surface layer is dark brown very fine sandy loam about 9 inches thick. The subsoil, from a depth of 9 to 64 inches, is reddish brown, light brown, and reddish yellow sandy clay loam.

The Webb soils are very deep, well drained, and moderately slowly permeable. Typically, the surface layer is reddish brown very fine sandy loam about 14 inches thick. The upper part of the subsoil, from a depth of 14 to 28 inches, is reddish brown sandy clay. The lower part, from a depth of 28 to 64 inches, is yellowish red, reddish yellow, and yellow sandy clay loam.

The minor soils in this unit consist of about 11 percent Poteet soils, 9 percent Dille soils, 2 percent Caid soils, 2 percent Chacon soils, 2 percent Maverick soils, 1 percent Bookout soils, 1 percent Goldfinch soils, 1 percent Mata soils, 1 percent Moglia soils, 1 percent Zavco soils, and 3 percent Altita, Charco, Cotulla, Divot, Hinds, Imogene, Tela, Tiocano, Yologo, and other soils.

The Altita, Caid, Chacon, Charco, Cotulla, Mata, Maverick, Moglia, and Zavco soils are in landscape positions similar to those of the major soils or are in the slightly lower positions. The Dille, Goldfinch, Hinds, and Yologo soils are on hills and ridges. The Bookout and Tiocano soils are in the lower positions. The Divot, Imogene, Poteet, and Tela soils are on flood plains along creeks and along small drainageways on uplands.

The major soils are used as cropland, pasture, rangeland, or wildlife habitat. They are moderately suited to nonirrigated crops and well suited to irrigated crops. The hazards of water erosion and wind erosion are the main management concerns.

Rangeland productivity is medium. When properly managed, areas of native vegetation produce a wide variety of grasses, forbs, and browse plants for livestock and wildlife. These areas are preferred sites for deer, are good sites for quail, and are used by dove and turkey.

The major soils are moderately suited to most recreational uses. The Webb soils are moderately suited to most urban uses, and the Duval and Brystal soils are well suited.

7. Webb-Zavco-Poteet

Nearly level to gently undulating, moderately slowly permeable and slowly permeable soils that have a loamy surface layer and a clayey or loamy subsoil

This unit makes up 42,600 acres, or about 4.4 percent of the county. It is about 54 percent Webb soils, 12 percent Zavco soils, 10 percent Poteet soils, and 24 percent minor soils.

The landscape consists of broad, smooth plains dissected by the narrow valleys of creeks and by small drainageways on uplands. The Webb and Zavco soils are mainly on the upland plains, and the Poteet soils are on flood plains along creeks and along small drainageways on uplands.

The Webb soils are very deep, well drained, and moderately slowly permeable. Typically, the surface layer is reddish brown very fine sandy loam about 14 inches thick. The upper part of the subsoil, from a depth of 14 to 28 inches, is reddish brown sandy clay. The lower part, from a depth of 28 to 64 inches, is yellowish red, reddish yellow, and yellow sandy clay loam.

The Zavco soils are very deep, well drained, and moderately slowly permeable. Typically, the surface layer is very dark grayish brown and reddish brown sandy clay loam about 15 inches thick. The upper part of the subsoil, from a depth of 15 to 28 inches, is reddish brown and yellowish red sandy clay. The lower part, from a depth of 28 to 64 inches, is reddish yellow sandy clay loam.

The Poteet soils are very deep, moderately well drained, and slowly permeable. Typically, the surface layer is reddish brown very fine sandy loam about 22 inches thick. The upper part of the subsoil, from a depth of 22 to 34 inches, is reddish brown, mottled sandy clay loam. The next part, from a depth of 34 to 48 inches, is yellowish red, mottled sandy clay. The lower part, from a depth of 48 to 64 inches, is reddish yellow, mottled sandy clay loam.

The minor soils in this unit consist of about 7 percent Brystal soils, 5 percent Dilley soils, 4 percent Duval soils, 2 percent Chacon soils, 1 percent Altita soils, 1 percent Caid soils, 1 percent Charco soils, 1 percent Cotulla soils, 1 percent Mata soils, and 1 percent Tiocano and other soils.

All of the minor soils are higher on the landscape than the Poteet soils. The Altita, Brystal, Caid, Chacon, Charco, Cotulla, Duval, and Mata soils are in landscape positions similar to those of the Webb and Zavco soils. The Dilley soils are on hills and ridges. The Tiocano soils are in the lower positions.

The major soils are used as cropland, pasture, rangeland, or wildlife habitat. The Webb and Zavco soils are moderately suited to nonirrigated crops, and the Poteet soils are well suited. All three soils are well suited to irrigated crops. The hazards of water erosion and wind erosion are the main management concerns.

Rangeland productivity is medium in areas of the Webb and Zavco soils and high in areas of the Poteet soils. When properly managed, areas of native vegetation produce a wide variety of grasses, forbs, and browse plants for livestock and wildlife.

These areas are preferred sites for deer, are good sites for quail, and are used by dove and turkey.

The Webb and Zavco soils are moderately suited to most urban uses. The Poteet soils are severely limited as sites for these uses because of the hazard of flooding. The Webb and Poteet soils are moderately suited to most recreational uses, and the Zavco soils are well suited.

Deep, Sandy Soils on Uplands

These soils make up 69,490 acres, or about 7.1 percent of the county. The major soils are those in the Duval series. They are on nearly level to gently undulating plains. They are well drained and moderately permeable.

These soils generally are moderately suited to most agricultural uses. Most areas are used for corn, cowpeas, forage sorghum, grain sorghum, oats, peanuts, wheat, potatoes, or watermelons. Some areas are used as irrigated pasture and hayland. The remaining acreage is used mainly as rangeland and wildlife habitat.

8. Duval

Nearly level to gently undulating, moderately permeable soils that have a sandy surface layer and a loamy subsoil

This unit makes up 69,490 acres, or about 7.1 percent of the county. It is about 88 percent Duval soils and 12 percent minor soils.

The landscape consists of broad, smooth plains dissected by the narrow valleys of creeks and by small drainageways on uplands. A few hills and ridges are in scattered areas. The Duval soils are mainly on the upland plains.

The Duval soils are deep, well drained, and moderately permeable. Typically, the surface layer is reddish brown loamy fine sand about 14 inches thick. The subsoil, from a depth of 14 to 46 inches, is red and yellowish red sandy clay loam. The substratum, from a depth of 46 to 64 inches, is reddish yellow, soft sandstone bedrock.

The minor soils in this unit consist of about 5 percent Dilley soils, 5 percent Poteet soils, 1 percent Webb soils, and 1 percent Brystal, Goldfinch, Tiocano, and other soils. The Brystal and Webb soils are in landscape positions similar to those of the Duval soils or are in the slightly lower positions. The Poteet soils are in drainageways on uplands. The Tiocano soils are in playas. The Dilley and Goldfinch soils are on hills and ridges.

The Duval soils are used mainly as cropland or pasture. They are moderately suited to nonirrigated and irrigated crops. The main management concerns are the hazards of water erosion and wind erosion and a low available water capacity.

Rangeland productivity is medium. When properly managed, areas of native vegetation produce a variety of grasses and forbs for livestock. These areas are preferred sites for quail and dove and are used by turkey. The density of the deer population generally is lower in the more extensive areas, which support a limited variety of browse plants.

The Duval soils are well suited to most urban uses and moderately suited to most recreational uses.

Very Deep, Loamy Soils on Stream Terraces

These soils make up 67,830 acres, or about 7.0 percent of the county. The major soils are those in the Caid and Bookout series. They are on nearly level to gently undulating plains on stream terraces above present-day flood plains. These soils are well drained and moderately permeable.

These soils generally are well suited to most agricultural uses. Most areas are used as rangeland and wildlife habitat. A large acreage is used for corn, forage sorghum, grain sorghum, oats, wheat, or vegetables.

9. Caid-Bookout

Nearly level to gently undulating, moderately permeable soils that have a loamy surface layer and subsoil

This unit makes up 67,830 acres, or about 7.0 percent of the county. It is about 43 percent Caid soils, 33 percent Bookout soils, and 24 percent minor soils (fig. 5).

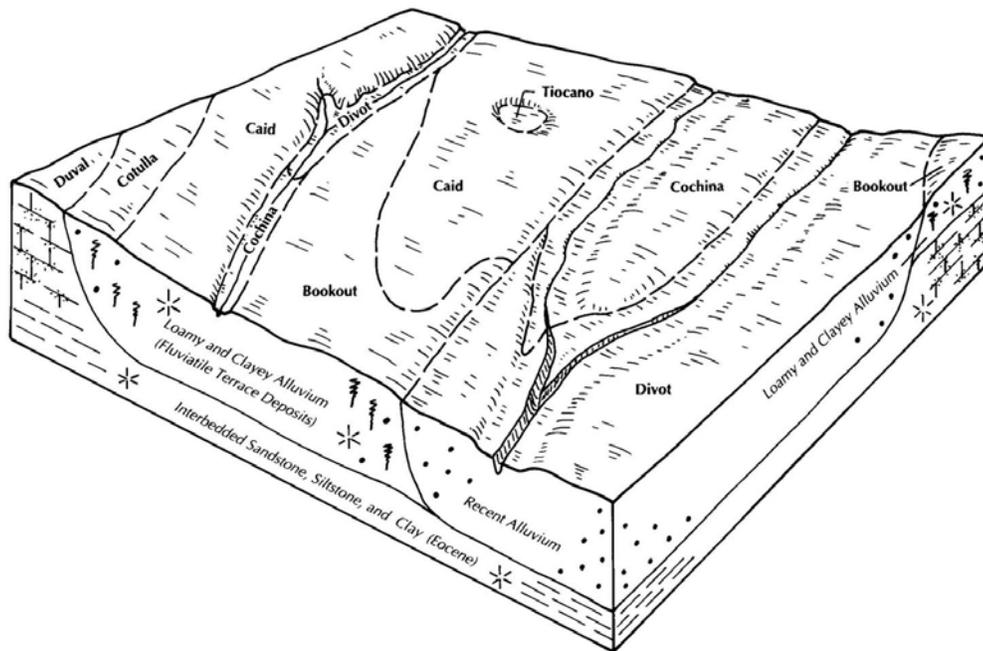


Figure 5.—Typical pattern of soils and underlying material in the Caid-Bookout and Divot-Cochina general soil map units.

The landscape consists of broad, smooth plains on terraces along rivers and large creeks. The plains are dissected by the narrow flood plains along creeks and sloughs. The Caid and Bookout soils are mainly on the terrace plains.

The Caid soils are very deep, well drained, and moderately permeable. Typically, the surface layer is very dark grayish brown and dark grayish brown very fine sandy loam about 17 inches thick. The upper part of the subsoil, from a depth of 17 to 36 inches, is brown and light brown sandy clay loam. The lower part, from a depth of 36 to 64 inches, is reddish yellow sandy clay loam.

The Bookout soils are very deep, well drained, and moderately permeable. Typically, the surface layer is pale brown clay loam about 16 inches thick. The subsoil, from a depth of 16 to 65 inches, is light yellowish brown and very pale brown clay loam.

The minor soils in this unit consist of about 7 percent Cotulla soils, 6 percent Cochina soils, 4 percent Divot soils, 1 percent Brystal soils, 1 percent Tiocano soils, and 5 percent Altita, Chacon, Charco, Dilley, Divot, Duval, Goldfinch, Hindes, Imogene, Moglia, Poteet, Webb, Yologo, Zavco, and other soils.

The Chacon and Cotulla soils are in landscape positions similar to those of the major soils or are in the slightly higher positions. The Tiocano soils are in playas in the slightly lower positions. The Cochina, Divot, Imogene, and Poteet soils are on narrow flood plains along creeks and sloughs. The Dilley, Goldfinch, Hindes, and Yologo soils are on hills and ridges at the higher elevations near the perimeter of the unit. The Altita, Charco, Brystal, Duval, Moglia, Webb, and Zavco soils are on plains at the higher elevations.

The major soils are used mainly as rangeland and wildlife habitat. In some areas they are used as cropland or irrigated pasture. They are moderately suited to nonirrigated crops and well suited to irrigated crops. The hazards of water erosion and wind erosion are the main management concerns.

Rangeland productivity is medium. When properly managed, areas of native vegetation produce a wide variety of grasses, forbs, and browse plants for livestock and wildlife. These areas are preferred sites for deer, are good sites for quail, and are used by dove and turkey.

The major soils are moderately suited to most urban and recreational uses.

Very Deep, Clayey and Loamy Soils on Flood Plains

These soils make up 56,690 acres, or about 5.8 percent of the county. The major soils are those in the Cochina, Coquat, and Divot series. They are on nearly level flood plains along rivers and large creeks. These soils are well drained to somewhat poorly drained. They are moderately slowly permeable and very slowly permeable. These soils are occasionally flooded or frequently flooded.

These soils generally are poorly suited to cropland and well suited to rangeland and wildlife habitat. Most areas are used as rangeland and wildlife habitat. Some areas of the occasionally flooded soils are used as cropland. The main crops in these areas are grain sorghum, forage sorghum, oats, and wheat.

10. Coquat-Cochina

Nearly level, very slowly permeable soils that have a clayey surface layer and a nonsaline or saline, clayey subsoil

This unit makes up 40,030 acres, or about 4.1 percent of the county. It is about 68 percent Coquat soils, 23 percent Cochina soils, and 9 percent minor soils.

The landscape consists of broad flood plains along rivers and large creeks. It is dissected by numerous sloughs and braided stream channels. Stream terraces, plains, hills, and ridges are near the boundary of the unit. The Coquat and Cochina soils are on the flood plains.

The Coquat soils are very deep, somewhat poorly drained, and very slowly permeable. Typically, the surface layer is grayish brown clay about 5 inches thick. The upper part of the subsoil, from a depth of 5 to 36 inches, is light brownish gray clay. The lower part, from a depth of 36 to 74 inches, is pale brown and light yellowish brown, saline clay.

The Cochina soils are very deep, moderately well drained, and very slowly permeable. Typically, the surface layer is grayish brown clay about 9 inches thick. The upper part of the subsoil, from a depth of 9 to 24 inches, is grayish brown, saline clay. The lower part, from a depth of 24 to 72 inches, is brown, yellowish brown, and light yellowish brown, saline clay.

The minor soils in this unit consist of about 3 percent Arroyada soils, 1 percent Bookout soils, 1 percent Caid soils, 2 percent Lasalle soils, 1 percent Moglia soils, and 1 percent Brundage, Cotulla, Divot, and other soils. The Arroyada and Divot soils are in landscape positions similar to those of the major soils. The Bookout, Brundage, and Caid soils are on the higher stream terraces. The Cotulla, Lasalle, and Moglia soils are on the higher plains.

The major soils are used mainly as rangeland and wildlife habitat. A few areas of the occasionally flooded Cochina soils are used as cropland or irrigated pasture. The Coquat soils and the frequently flooded Cochina soils are not suited to nonirrigated or irrigated crops, and the occasionally flooded Cochina soils are poorly suited. The hazard of flooding and the salinity are the main management concerns.

Rangeland productivity is very high in areas of the Coquat soils, but gulf cordgrass in these areas has low palatability most of the year. These areas provide very little brush cover and are used only to a limited extent by deer, quail, dove, and turkey. Rangeland productivity is medium in areas of the Cochina soils. When properly managed, areas of native vegetation on these soils provide a wide variety of forage for livestock and excellent food and cover for wildlife. These areas are preferred sites for turkey and deer and are used by quail and dove. The nearby rivers and creeks provide water for wildlife.

This map unit is severely limited as a site for most urban uses because of the hazard of flooding. It is poorly suited or moderately suited to most recreational uses.

11. Divot-Cochina

Nearly level, moderately slowly permeable and very slowly permeable soils that have a loamy or clayey surface layer and a nonsaline or saline, clayey or loamy subsoil

This unit makes up 8,390 acres, or about 0.9 percent of the county. It is about 74 percent Divot soils, 18 percent Cochina soils, and 8 percent minor soils (fig. 5).

The landscape consists of broad flood plains along rivers and large creeks. It is dissected by numerous sloughs and braided stream channels. Stream terraces, plains, hills, and ridges are near the boundary of the unit. The Divot and Cochina soils are on the flood plains.

The Divot soils are very deep, well drained, and moderately slowly permeable. Typically, the surface layer is grayish brown silty clay loam in the upper 5 inches and grayish brown silty clay from a depth of 5 to 15 inches. The upper part of the subsoil, from a depth of 15 to 40 inches, is grayish brown clay. The lower part, from a depth of 40 to 64 inches, is light brownish gray and pale brown clay.

The Cochina soils are very deep, moderately well drained, and very slowly permeable. Typically, the surface layer is grayish brown clay about 9 inches thick. The upper part of the subsoil, from a depth of 9 to 24 inches, is grayish brown, saline clay. The lower part, from a depth of 24 to 72 inches, is brown, yellowish brown, and light yellowish brown, saline clay.

The minor soils in this unit consist of about 5 percent Bookout soils, 3 percent Caid soils, and small areas of other soils. The Bookout and Caid soils are on the higher stream terraces.

The major soils are used mainly as rangeland and wildlife habitat. A few areas of the occasionally flooded Divot and Cochina soils are used as cropland. The frequently flooded Divot and Cochina soils are not suited to nonirrigated or irrigated crops, the occasionally flooded Divot soils are well suited, and the occasionally flooded Cochina soils are poorly suited. The hazards of flooding and wind erosion are the main management concerns. The salinity of the Cochina soils is a limitation.

Rangeland productivity is high in areas of the Divot soils and medium in areas of the Cochina soils. When properly managed, areas of native vegetation provide a wide variety of forage for livestock and excellent food and cover for wildlife. These areas are preferred sites for turkey and are heavily used by deer, quail, and dove. The nearby rivers and creeks provide water for wildlife.

This map unit is severely limited as a site for most urban uses because of the hazard of flooding. It is moderately suited or poorly suited to most recreational uses.

12. Cochina

Nearly level, very slowly permeable soils that have a clayey surface layer and a saline, clayey subsoil

This unit makes up 8,270 acres, or about 0.8 percent of the county. It is about 78 percent Cochina soils and 22 percent minor soils.

The landscape consists of broad flood plains along rivers and large creeks. It is dissected by numerous sloughs and braided stream channels. Stream terraces, plains, hills, and ridges are near the boundary of the unit. The Cochina soils are on the flood plains.

The Cochina soils are very deep, moderately well drained, and very slowly permeable. Typically, the surface layer is grayish brown clay about 9 inches thick. The upper part of the subsoil, from a depth of 9 to 24 inches, is grayish brown, saline clay. The lower part, from a depth of 24 to 72 inches, is brown, yellowish brown, and light yellowish brown, saline clay.

The minor soils in this unit consist of about 8 percent Divot soils, 7 percent Bookout soils, 4 percent Maverick soils, 2 percent Moglia soils, 1 percent Dilley soils, and small areas of Cotulla and other soils. The Divot soils are in landscape positions similar to those of the Cochina soils. The Bookout soils are on the higher stream terraces. The Cotulla, Maverick, and Moglia soils are on the higher plains. The Dilley soils are on hills and ridges at the perimeter of the unit.

The Cochina soils are used mainly as rangeland and wildlife habitat. A few areas of the occasionally flooded Cochina soils are used as cropland. The frequently flooded Cochina soils are not suited to nonirrigated or irrigated crops, and the occasionally flooded Cochina soils are poorly suited. The hazard of flooding and the salinity are the main management concerns.

Rangeland productivity is medium. When properly managed, areas of native vegetation provide a wide variety of forage for livestock and excellent food and cover for wildlife. These areas are preferred sites for turkey and deer and are used by quail and dove. The nearby rivers and creeks provide water for wildlife.

This map unit is severely limited as a site for most urban uses because of the hazard of flooding. It is moderately suited or poorly suited to most recreational uses.

Very Deep, Shallow, and Very Shallow, Very Gravelly, Loamy Soils on Uplands

These soils make up 3,720 acres, or about 0.4 percent of the county. The major soils are those in the Hindes and Yologo series. They are on gently undulating to undulating hills and ridges. These soils are well drained. They are moderately slowly permeable and moderately permeable.

These soils generally are poorly suited to most agricultural uses. They are used as rangeland and wildlife habitat.

13. Hindes-Yologo

Gently undulating to undulating, moderately slowly permeable and moderately permeable soils that have a very gravelly, loamy surface layer and an extremely gravelly, clayey or loamy subsoil

This unit makes up 3,720 acres, or about 0.4 percent of the county. It is about 44 percent Hindes soils, 37 percent Yologo soils, and 19 percent minor soils (fig. 6).

The landscape consists of hills and ridges dissected by plains in narrow valleys. The Hindes and Yologo soils are mainly on the hills and ridges.

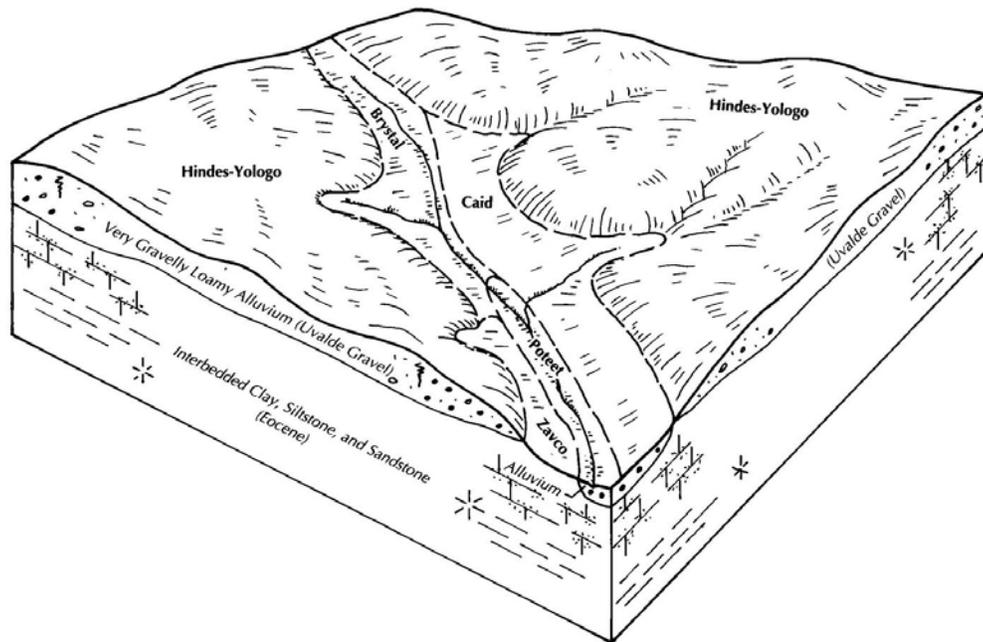


Figure 6.—Typical pattern of soils and underlying material in the Hindes-Yologo general soil map unit.

The Hindes soils are very deep, well drained, and moderately slowly permeable. Typically, the surface layer is dark reddish brown very gravelly sandy clay loam about 7 inches thick. The upper part of the subsoil, from a depth of 7 to 30 inches, is reddish brown extremely gravelly clay. The lower part, from a depth of 30 to 62 inches, is pink, soft caliche that has a texture of gravelly clay loam.

The Yologo soils are shallow and very shallow, well drained, and moderately permeable. Typically, the surface layer is reddish brown very gravelly sandy clay loam about 6 inches thick. The subsoil, from a depth of 6 to 17 inches, is reddish brown extremely gravelly sandy clay loam. The underlying layer, from a depth of 17 to 30 inches, is pink and pinkish white, strongly cemented and weakly cemented caliche.

The minor soils in this unit consist of about 8 percent Caid soils, 4 percent Brystal soils, 2 percent Bookout soils, 2 percent Divot soils, 2 percent Poteet soils, 1 percent Zavco soils, and small areas of other soils. All of the minor soils are lower on the landscape than the major soils. The Brystal and Zavco soils generally are on plains in narrow valleys. The Caid and Bookout soils are on plains in narrow valleys and on stream terraces. The Divot and Poteet soils are on flood plains and in drainageways on uplands.

The major soils are used as rangeland and wildlife habitat. They are not suited to nonirrigated or irrigated crops. A very low available water capacity, a high content of gravel, the depth to a cemented pan, and the hazard of water erosion are the main management concerns.

Rangeland productivity is low. When properly managed, areas of native vegetation produce a variety of grasses, forbs, and browse for livestock. These areas are preferred sites for quail, are good sites for dove, and are used by turkey and deer.

The major soils are poorly suited or moderately suited to most urban uses and are poorly suited to most recreational uses. They are potential sources of caliche and gravel for use in construction.

Detailed Soil Map Units

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

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

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

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

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Duval very fine sandy loam, 1 to 3 percent slopes, is a phase of the Duval series.

Some map units in the survey area are made up of two or more major soils. These map units are called soil complexes.

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

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

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

AGB—Aguilares sandy clay loam, gently undulating. This very deep soil is on smooth plains. Slopes range from 0 to 3 percent. The shape of the slopes is linear or convex. Individual areas are irregular in shape and range from 8 to 100 acres in size.

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

Surface layer:

0 to 9 inches, grayish brown sandy clay loam, nonsaline, moderately alkaline

Subsoil:

9 to 15 inches, light brownish gray clay loam, nonsaline, moderately alkaline

15 to 24 inches, pale brown clay loam, nonsaline, moderately alkaline

24 to 35 inches, pale brown clay loam, very slightly saline, moderately alkaline

Substratum:

35 to 72 inches or more, very pale brown sandy clay loam, moderately saline, moderately alkaline

Important soil properties—

Drainage: well drained

Permeability: moderate

Available water capacity: low

Root zone: very deep

Shrink-swell potential: moderate (the soil shrinks as it dries and swells as it becomes moist)

Surface runoff: medium

Flooding: none

Hazard of water erosion: moderate

Hazard of wind erosion: moderate

The Aguilares soil and similar inclusions make up more than 85 percent of the map unit, and contrasting inclusions make up the rest. The similar inclusions occur as small areas of soils that are like the Aguilares soil but have a dark surface layer or a gravelly surface layer. Also included are small areas of Aguilares soils that have a surface layer of fine sandy loam.

The contrasting inclusions occur as small areas of Brundage, Catarina, Copita, Moglia, Montell, and Tela soils. Copita soils are in landscape positions similar to those of the Aguilares soil. Moglia soils are in the higher positions. Brundage, Catarina, Montell, and Tela soils are in the lower positions.

This map unit was designed primarily for extensive land uses, such as rangeland. Fewer soil examinations were made in areas of this map unit than in areas of map units designed for more intensive uses. Also, the mapped areas and the areas of inclusions in this map unit are generally larger. The map unit purity is adequate for the anticipated land use.

The Aguilares soil is used as rangeland and wildlife habitat. Rangeland productivity is medium. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a wide variety of grasses, forbs, and browse plants for livestock and wildlife. These areas are preferred sites for deer, are good sites for quail, and are used by dove and turkey.

This soil is poorly suited to nonirrigated crops and moderately suited to irrigated crops. The alkaline reaction in the surface layer limits the choice of suitable crops. The main management concerns are the low available water capacity, the hazards of water erosion and wind erosion, and the salinity in the subsoil. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, wind stripcropping, contour or field stripcropping, terraces, diversions, grassed waterways, contour farming, or crop rotations that include high-residue or soil-improving crops may be needed to control erosion, conserve moisture, reduce the salinity, and maintain tilth.

This soil is moderately suited to irrigated pasture. The salinity of the soil can be increased by irrigation. Suitable pasture grasses include kleingrass and buffelgrass.

This soil is moderately suited to most urban uses. Properly designing septic tank absorption fields helps to overcome the restricted permeability. Properly designing building foundations helps to prevent the structural damage caused by shrinking and swelling. Because of low soil strength, suitable base material is needed on sites for local roads and streets.

This soil is well suited to most recreational uses.

The land capability classification is IVe, nonirrigated, and IIe, irrigated. The range site is Gray Loamy Upland.

ARB—Arroyada clay, frequently flooded. This very deep, saline, clayey soil is on flood plains along the Nueces River and its major tributaries. The landscape is characterized by numerous shallow, braided channels and sloughs. Slopes are 0 to 1

percent. They are mainly less than 0.5 percent. The shape of the slopes is linear or concave. Individual areas are elongated or irregularly shaped and range from about 40 to 1,400 acres in size.

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

Surface layer:

- 0 to 12 inches, gray clay, nonsaline, moderately alkaline
- 12 to 24 inches, gray clay, slightly saline, moderately alkaline
- 24 to 50 inches, gray clay, moderately saline, moderately alkaline

Subsoil:

- 50 to 65 inches, light olive gray clay that has pink mottles, moderately saline, moderately alkaline
- 65 to 80 inches or more, light gray clay that has pink and gray mottles, moderately saline, moderately alkaline

Important soil properties—

Drainage: somewhat poorly drained

Permeability: very slow

Available water capacity: low

Root zone: very deep; however, the clayey subsoil restricts the movement of air and water and root development

Shrink-swell potential: very high (the soil shrinks and forms wide, deep cracks as it dries and swells as it becomes moist)

Surface runoff: very slow or ponded (water ponds in microbasins and sloughs after floodwater recedes and after rainstorms)

Seasonal high water table: an apparent water table after periods of heavy rainfall or flooding, 3 to 6 feet below the surface

Flooding: frequent (more often than 50 times in 100 years), usually lasting less than 7 days

Hazard of water erosion: slight; during periods of flooding, however, scouring of bare areas may occur, especially near stream channels

Hazard of wind erosion: moderate

The Arroyada soil and similar inclusions make up more than 85 percent of the map unit, and contrasting inclusions make up the rest. Included in mapping are areas of Arroyada soils that are nonsaline to a depth of more than 20 inches.

The contrasting inclusions occur as small areas of Brundage, Catarina, Chacon, Cochina, Copita, Coquat, Cotulla, Imogene, Moglia, and Montell soils. Also included are small areas of stream channels. Cochina, Coquat, Imogene, and Montell soils are in landscape positions similar to those of the Arroyada soil or are in the slightly higher positions. Brundage, Catarina, Chacon, Copita, Cotulla, and Moglia soils are in the higher positions.

This map unit was designed primarily for extensive land uses, such as rangeland. Fewer soil examinations were made in areas of this map unit than in areas of map units designed for more intensive uses. Also, the mapped areas and the areas of inclusions in this map unit are generally larger. The map unit purity is adequate for the anticipated land use.

The Arroyada soil is used as rangeland and wildlife habitat. Rangeland productivity is very high, but palatability is low most of the year. Gulf cordgrass, the dominant plant, is seldom used by wildlife, except as fawning cover for deer. The soil produces very little brush cover, except along stream channels, and very little food for wildlife. Areas of this soil are used to a limited extent by deer, quail, dove, and turkey. The nearby rivers and creeks provide water for wildlife.

This soil is not suited to cropland. The hazard of flooding and the scouring of bare areas are the main management concerns. Other management concerns are the low available water capacity, the ponding, the salinity in the subsoil, and the hazard of wind erosion.

This soil is poorly suited to irrigated pasture. The salinity, the ponding, and the flooding are the main management concerns. The salinity of the soil can be increased by irrigation. The flooding can destroy irrigation systems. Removing native trees and brush near stream channels may result in severe scouring and streambank erosion during periods of flooding.

The flooding is the main hazard affecting most urban uses. Areas used for these purposes should be protected from flooding and drained. Properly designing septic tank absorption fields helps to overcome the restricted permeability and the water table. Properly designing building foundations and paved roads helps to prevent the structural or road damage caused by shrinking and swelling. Because of the clayey texture, the soil can be worked by earth-moving equipment only within a narrow range in moisture content. Because of low soil strength, suitable base material is needed on sites for local roads and streets.

This soil is poorly suited to most recreational uses. It should not be used as a site for camp areas unless it is protected from flooding. The season, duration, and frequency of flooding should be considered in planning playgrounds and other recreational areas. Because of the very slow permeability and the clayey surface layer, special surfacing material may be needed in areas that are subject to heavy foot traffic during wet periods.

The land capability classification is VIs, nonirrigated. The range site is Lowland.

BkA—Bookout clay loam, 0 to 1 percent slopes. This very deep, nearly level, loamy soil is on smooth plains on stream terraces along the Frio and Nueces Rivers. The shape of the slopes is linear or convex. Individual areas are irregularly shaped or subrounded and range from 8 to several hundred acres in size.

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

Surface layer:

0 to 16 inches, pale brown clay loam, moderately alkaline

Subsoil:

16 to 30 inches, light yellowish brown clay loam, moderately alkaline

30 to 65 inches or more, very pale brown clay loam, moderately alkaline

Important soil properties—

Drainage: well drained

Permeability: moderate

Available water capacity: high

Root zone: very deep

Shrink-swell potential: moderate (the soil shrinks as it dries and swells as it becomes moist)

Surface runoff: slow

Flooding: none

Hazard of water erosion: slight

Hazard of wind erosion: moderate

The Bookout soil and similar inclusions make up 85 percent or more of the map unit, and contrasting inclusions make up the rest. The similar inclusions occur as small areas of soils that are like the Bookout soil but have a dark surface layer or have more than 15 percent sand coarser than very fine sand in the subsoil. Also included are small areas of Bookout soils that have slopes of 1 to 3 percent.

The contrasting inclusions occur as small areas of Brystal, Caid, Chacon, Cochina, Cotulla, and Divot soils. Caid and Chacon soils are in landscape positions similar to those of the Bookout soil. Cochina and Divot soils are in the lower positions. Brystal soils are in the higher positions. Cotulla soils are in landscape positions similar to those of the Bookout soil or are in the higher positions.

The Bookout soil is used mainly as cropland. Some areas are used as rangeland, wildlife habitat, or pasture.

Rangeland productivity is medium. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a wide variety of grasses, forbs, and browse plants for livestock and wildlife. These areas are preferred sites for deer, are good sites for quail, and are used by dove and turkey.

This soil is moderately suited to nonirrigated crops and well suited to irrigated crops. The main crops are corn, forage sorghum, grain sorghum, oats, and wheat. The alkaline reaction in the surface layer limits the choice of suitable crops. The main management concern is the hazard of wind erosion. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, diversions, grassed waterways, or crop rotations that include high-residue or soil-improving crops may be needed to control erosion, conserve moisture, and maintain tilth.

This soil is well suited to irrigated pasture. Suitable pasture grasses include buffelgrass and kleingrass.

This soil is moderately suited to most urban uses. Properly designing septic tank absorption fields helps to overcome the restricted permeability. Properly designing building foundations helps to prevent the structural damage caused by shrinking and swelling. Because of low soil strength, suitable base material is needed on sites for local roads and streets.

This soil is well suited to most recreational uses.

The land capability classification is IIIc, nonirrigated, and I, irrigated. The range site is Clay Loam.

BkB—Bookout clay loam, 1 to 3 percent slopes. This very deep, very gently sloping, loamy soil is on smooth plains on stream terraces along the Frio and Nueces Rivers. The shape of the slopes is convex. Individual areas are irregularly shaped or subrounded and range from 8 to several hundred acres in size.

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

Surface layer:

0 to 15 inches, brown clay loam, moderately alkaline

Subsoil:

15 to 48 inches, light yellowish brown clay loam, moderately alkaline

48 to 60 inches or more, very pale brown clay loam, moderately alkaline

Important soil properties—

Drainage: well drained

Permeability: moderate

Available water capacity: high

Root zone: very deep

Shrink-swell potential: moderate (the soil shrinks as it dries and swells as it becomes moist)

Surface runoff: medium

Flooding: none

Hazard of water erosion: moderate

Hazard of wind erosion: moderate

The Bookout soil and similar inclusions make up 85 percent or more of the map unit, and contrasting inclusions make up the rest. The similar inclusions occur as small areas of soils that are like the Bookout soil but have a dark surface layer or have more than 15 percent sand coarser than very fine sand in the subsoil. Also included are small areas of Bookout soils that have slopes of 0 to 1 or 3 to 5 percent.

The contrasting inclusions occur as small areas of Brystal, Caid, Chacon, Cochina, Cotulla, and Divot soils. Caid and Chacon soils are in landscape positions similar to those of the Bookout soil. Cochina and Divot soils are in the lower positions. Brystal soils are in the higher positions. Cotulla soils are in landscape positions similar to those of the Bookout soil or are in the higher positions.

The Bookout soil is used mainly as cropland. Some areas are used as rangeland, wildlife habitat, or pasture.

Rangeland productivity is medium. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a wide variety of grasses, forbs, and browse plants for livestock and wildlife. These areas are preferred sites for deer, are good sites for quail, and are used by dove and turkey.

This soil is moderately suited to nonirrigated crops and well suited to irrigated crops. The main crops are corn, forage sorghum, grain sorghum, oats, and wheat. The alkaline reaction in the surface layer limits the choice of suitable crops. The main management concerns are the hazards of water erosion and wind erosion. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, contour or field stripcropping, terraces, diversions, grassed waterways, contour farming, or crop rotations that include high-residue or soil-improving crops may be needed to control erosion, conserve moisture, and maintain tilth.

This soil is well suited to irrigated pasture. Suitable pasture grasses include buffelgrass and kleingrass.

This soil is moderately suited to most urban uses. Properly designing septic tank absorption fields helps to overcome the restricted permeability. Properly designing building foundations helps to prevent the structural damage caused by shrinking and swelling. Because of low soil strength, suitable base material is needed on sites for local roads and streets.

This soil is well suited to most recreational uses.

The land capability classification is IIIe, nonirrigated, and IIe, irrigated. The range site is Clay Loam.

BOB—Bookout clay loam, gently undulating. This very deep, loamy soil is on smooth plains on stream terraces along the Frio and Nueces Rivers. Slopes range from 0 to 5 percent. They are mainly less than 2 percent. The shape of the slopes is linear or convex. Individual areas are irregularly shaped or elongated and range from 10 to more than 1,000 acres in size.

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

Surface layer:

0 to 14 inches, brown clay loam, moderately alkaline

Subsoil:

14 to 25 inches, pale brown clay, moderately alkaline

25 to 38 inches, light yellowish brown clay, moderately alkaline

38 to 62 inches or more, very pale brown clay, moderately alkaline

Important soil properties—

Drainage: well drained

Permeability: moderate

Available water capacity: high

Root zone: very deep

Shrink-swell potential: moderate (the soil shrinks as it dries and swells as it becomes moist)

Surface runoff: slow or medium

Flooding: none

Hazard of water erosion: moderate

Hazard of wind erosion: moderate

The Bookout soil and similar inclusions make up 85 percent or more of the map unit, and contrasting inclusions make up the rest. More than 60 percent of the map unit consists of Bookout soil that has slopes of 0 to 1 percent, 20 percent consists of Bookout soil that has slopes of 1 to 3 percent, and 5 percent consists of Bookout soil that has slopes of 3 to 5 percent. The similar inclusions occur as small areas of soils that are like the Bookout soil but have a dark surface layer or have more than 15 percent sand coarser than very fine sand in the subsoil.

The contrasting inclusions occur as small areas of Brystal, Caid, Chacon, Cochina, Cotulla, and Divot soils. Caid and Chacon soils are in landscape positions similar to those of the Bookout soil. Cochina and Divot soils are in the lower positions. Brystal soils are in the higher positions. Cotulla soils are in landscape positions similar to those of the Bookout soil or are in the higher positions.

This map unit was designed primarily for extensive land uses, such as rangeland. Fewer soil examinations were made in areas of this map unit than in areas of map units designed for more intensive uses. Also, the mapped areas and the areas of inclusions in this map unit are generally larger. The map unit purity is adequate for the anticipated land use.

The Bookout soil is used mainly as rangeland and wildlife habitat. Some areas are used as cropland or pasture.

Rangeland productivity is medium. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a wide variety of grasses, forbs, and browse plants for livestock and wildlife. These areas are preferred sites for deer, are good sites for quail, and are used by dove and turkey.

This soil is moderately suited to nonirrigated crops and well suited to irrigated crops. Suitable crops include corn, forage sorghum, grain sorghum, oats, and wheat. The alkaline reaction in the surface layer limits the choice of suitable crops. The main management concerns are the hazards of water erosion and wind erosion. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, contour or field stripcropping, terraces, diversions, grassed waterways, contour farming, or crop rotations that include high-residue or soil-improving crops may be needed to control erosion, conserve moisture, and maintain tilth.

This soil is well suited to irrigated pasture. Suitable pasture grasses include buffelgrass and kleingrass.

This soil is moderately suited to most urban uses. Properly designing septic tank absorption fields helps to overcome the restricted permeability. Properly designing building foundations helps to prevent the structural damage caused by shrinking and swelling. Because of low soil strength, suitable base material is needed on sites for local roads and streets.

This soil is well suited to most recreational uses.

The land capability classification is 11e, nonirrigated, and 12e, irrigated. The range site is Clay Loam.

BrB—Brundage very fine sandy loam, 0 to 2 percent slopes. This very deep, nearly level, saline, loamy soil is on broad, smooth plains on stream terraces. It has a sodic subsoil. Slopes are mainly less than 1 percent. The shape of the slopes is

linear or convex. Individual areas are irregular in shape and range from about 10 to several thousand acres in size.

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

Surface layer:

0 to 2 inches, light brownish gray very fine sandy loam, nonsaline, slightly acid

Subsoil:

2 to 9 inches, dark grayish brown sandy clay loam, very slightly saline, sodic, mildly alkaline

9 to 18 inches, light brownish gray sandy clay loam, moderately saline, sodic, moderately alkaline

18 to 32 inches, pale brown sandy clay loam that has very pale brown mottles, moderately saline, sodic, moderately alkaline

32 to 50 inches, very pale brown sandy clay loam that has yellowish brown mottles, strongly saline, sodic, moderately alkaline

50 to 58 inches, light gray clay loam intermingled with very pale brown clay loam, moderately saline, sodic, mildly alkaline

Substratum:

58 to 80 inches or more, light gray, saline clay loam intermingled with white, fractured, soft shale bedrock, moderately saline, sodic, mildly alkaline

Important soil properties—

Drainage: moderately well drained

Permeability: very slow

Available water capacity: low

Root zone: very deep; however, the subsoil restricts the movement of air and water and root development

Shrink-swell potential: moderate (the soil shrinks as it dries and swells as it becomes moist)

Surface runoff: slow

Flooding: none

Hazard of water erosion: moderate

Hazard of wind erosion: moderate

The Brundage soil and similar inclusions make up more than 85 percent of the map unit, and contrasting inclusions make up the rest. The similar inclusions occur as small areas of soils that are like the Brundage soil but have more clay in the upper part of the subsoil or have a dark surface layer. Also included are small areas of Brundage soils that have a surface layer of loam and small areas of soils on flood plains that are flooded less often than 5 times in 100 years after cyclonic storms.

The contrasting inclusions occur as small areas of Caid, Chacon, Cochina, Coquat, Cotulla, Imogene, Lasalle, Mata, Maverick, Moglia, Monteola, Poteet, and Tiocano soils. Cochina, Coquat, Imogene, Poteet, and Tiocano soils are in the lower positions. The other contrasting soils are in landscape positions similar to those of the Brundage soil or are in the higher positions.

The Brundage soil is used mainly as rangeland and wildlife habitat. Rangeland productivity is low. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a variety of grasses, forbs, and browse plants for livestock and wildlife. These areas are used by deer, quail, dove, and turkey, but they are not preferred sites.

This soil is not suited to nonirrigated crops and is poorly suited to irrigated crops. The salinity and excess sodium in the subsoil limit the choice of suitable crops. The main management concerns are the low available water capacity, the very slow permeability in the subsoil, the hazards of water erosion and wind erosion, and the

salinity in the subsoil. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, wind stripcropping, diversions, grassed waterways, or crop rotations that include high-residue or soil-improving crops may be needed to control erosion, conserve moisture, reduce the salinity, and maintain tilth.

This soil is poorly suited to irrigated pasture. The salinity of the soil can be increased by irrigation.

This soil is moderately suited to most urban uses. The sodium and salinity in the subsoil inhibit the growth of vegetation in areas used for lawns and landscaping. Properly designing septic tank absorption fields helps to overcome the restricted permeability. Properly designing building foundations helps to prevent the structural damage caused by shrinking and swelling. Because of low soil strength, suitable base material is needed on sites for local roads and streets.

This soil is poorly suited to most recreational uses. The sodium and salinity in the subsoil inhibit the growth of vegetation. Applications of water or special surfacing material may be needed during dry periods to prevent excessive dustiness in areas that are subject to heavy foot traffic.

The land capability classification is VI_s, nonirrigated, and III_e, irrigated. The range site is Claypan Prairie.

ByB—Brystal very fine sandy loam, 1 to 3 percent slopes. This very deep, very gently sloping, loamy soil is on broad, smooth plains and on the foot slopes of hills and ridges. The shape of the slopes is convex to concave. Individual areas are irregular in shape and range from 8 to several hundred acres in size.

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

Surface layer:

0 to 14 inches, brown very fine sandy loam, neutral

Subsoil:

14 to 26 inches, light brown sandy clay loam, mildly alkaline

26 to 60 inches or more, reddish yellow sandy clay loam, moderately alkaline

Important soil properties—

Drainage: well drained

Permeability: moderate

Available water capacity: high

Root zone: very deep

Shrink-swell potential: low

Surface runoff: medium

Flooding: none

Hazard of water erosion: moderate

Hazard of wind erosion: moderate

The Brystal soil and similar inclusions make up more than 85 percent of the map unit, and contrasting inclusions make up the rest. The similar inclusions occur as small areas of soils that are like the Brystal soil but have a dark surface layer or a gravelly subsoil. Also included are small areas of Brystal soils that have slopes of 0 to 1 or 3 to 5 percent and small areas of Duval soils. Duval soils have sandstone bedrock at a depth of 40 to 60 inches and have less lime in the subsoil than the Brystal soil.

The contrasting inclusions occur as small areas of Caid, Dilley, Goldfinch, Hinds, Poteet, Tiocano, Webb, Yologo, and Zavco soils. Caid, Webb, and Zavco soils are in landscape positions similar to those of the Brystal soil. Dilley, Goldfinch, Hinds, and Yologo soils are in the higher positions. Poteet and Tiocano soils are in the lower positions.

The Brystal soil is used mainly as cropland. Some areas are used as rangeland, wildlife habitat, or pasture.

Rangeland productivity is medium. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a wide variety of grasses, forbs, and browse plants for livestock and wildlife. These areas are preferred sites for deer, are good sites for quail, and are used by dove and turkey.

This soil is moderately suited to nonirrigated crops and well suited to irrigated crops. It is suitable for a wide variety of nonirrigated and irrigated crops. The main crops are corn, cowpeas, forage sorghum, grain sorghum, oats, peanuts, wheat, potatoes, and watermelons. The main management concerns are the hazards of water erosion and wind erosion. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, wind stripcropping, contour or field stripcropping, terraces, diversions, grassed waterways, contour farming, or crop rotations that include high-residue or soil-improving crops may be needed to control erosion, conserve moisture, and maintain tilth.

This soil is well suited to irrigated pasture. Coastal bermudagrass, kleingrass, buffelgrass, and Wilman lovegrass are suitable pasture grasses.

This soil is well suited to most urban uses. Properly designing septic tank absorption fields helps to overcome the restricted permeability.

This soil is moderately suited to most recreational uses. Applications of water or special surfacing material may be needed during dry periods to prevent excessive dustiness in areas that are subject to heavy foot traffic.

The land capability classification is IIIe, nonirrigated, and IIe, irrigated. The range site is Sandy Loam.

BZB—Brystal very fine sandy loam, gently undulating. This very deep, loamy soil is on broad, smooth plains and the foot slopes of hills and ridges. Slopes range from 0 to 3 percent. The shape of the slopes is convex to concave. Individual areas are irregularly shaped or subrounded and range from 8 to several hundred acres in size.

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

Surface layer:

0 to 9 inches, dark brown very fine sandy loam, neutral

Subsoil:

9 to 25 inches, reddish brown sandy clay loam, mildly alkaline

25 to 38 inches, light brown sandy clay loam, moderately alkaline

38 to 64 inches or more, reddish yellow sandy clay loam that has strong brown mottles, moderately alkaline

Important soil properties—

Drainage: well drained

Permeability: moderate

Available water capacity: high

Root zone: very deep

Shrink-swell potential: low

Surface runoff: slow or medium

Flooding: none

Hazard of water erosion: moderate

Hazard of wind erosion: moderate

The Brystal soil and similar inclusions make up more than 75 percent of the map unit, and contrasting inclusions make up the rest. More than 60 percent of the map

unit consists of Brystal soil that has slopes of 1 to 3 percent, and 15 percent consists of Brystal soil that has slopes of 0 to 1 percent. The similar inclusions occur as small areas of soils that are like the Brystal soil but have a dark surface layer or a gravelly subsoil. Also included are small areas of Brystal soils that have slopes of 3 to 5 percent and small areas of Duval soils. Duval soils have sandstone bedrock at a depth of 40 to 60 inches and have less lime in the subsoil than the Brystal soil.

The contrasting inclusions occur as small areas of Caid, Dilley, Goldfinch, Hinds, Poteet, Tiocano, Webb, Yologo, and Zavco soils. Caid, Webb, and Zavco soils are in landscape positions similar to those of the Brystal soil. Dilley, Goldfinch, Hinds, and Yologo soils are in the higher positions, Poteet and Tiocano soils are in the lower positions.

This map unit was designed primarily for extensive land uses, such as rangeland. Fewer soil examinations were made in areas of this map unit than in areas of map units designed for more intensive uses. Also, the mapped areas and the areas of inclusions in this map unit are generally larger. The map unit purity is adequate for the anticipated land use.

The Brystal soil is used mainly as rangeland and wildlife habitat. Some areas are used as cropland or pasture.

Rangeland productivity is medium. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a wide variety of grasses, forbs, and browse plants for livestock and wildlife. These areas are preferred sites for deer, are good sites for quail, and are used by dove and turkey.

This soil is moderately suited to nonirrigated crops and well suited to irrigated crops. It is suitable for a wide variety of nonirrigated and irrigated crops, including corn, cowpeas, forage sorghum, grain sorghum, oats, peanuts, wheat, potatoes, and watermelons. The main management concerns are the hazards of water erosion and wind erosion. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, wind stripcropping, contour or field stripcropping, terraces, diversions, grassed waterways, contour farming, or crop rotations that include high-residue or soil-improving crops may be needed to control erosion, conserve moisture, and maintain tilth.

This soil is well suited to irrigated pasture. Suitable pasture grasses include coastal bermudagrass, kleingrass, buffelgrass, and Wilman lovegrass.

This soil is well suited to most urban uses. Properly designing septic tank absorption fields helps to overcome the restricted permeability.

This soil is moderately suited to most recreational uses. Applications of water or special surfacing material may be needed during dry periods to prevent excessive dustiness in areas that are subject to heavy foot traffic.

The land capability classification is IIIe, nonirrigated, and Iie, irrigated. The range site is Sandy Loam.

CaA—Caid very fine sandy loam, 0 to 1 percent slopes. This very deep, nearly level, loamy soil is on smooth plains on stream terraces along the Frio and Nueces Rivers and along large creeks. The shape of the slopes is linear. Individual areas are subrounded or irregularly shaped and range from 8 to several hundred acres in size.

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

Surface layer:

0 to 13 inches, dark brown very fine sandy loam, moderately alkaline

Subsoil:

13 to 34 inches, strong brown sandy clay loam, moderately alkaline

34 to 48 inches, reddish yellow clay loam, moderately alkaline

48 to 64 inches, brownish yellow clay loam, moderately alkaline
 64 to 72 inches or more, reddish yellow sandy clay loam, moderately alkaline

Important soil properties—

Drainage: well drained

Permeability: moderate

Available water capacity: high

Root zone: very deep

Shrink-swell potential: moderate (the soil shrinks as it dries and swells as it becomes moist)

Surface runoff: slow

Flooding: none

Hazard of water erosion: slight

Hazard of wind erosion: moderate

The Caid soil and similar inclusions make up more than 85 percent of the map unit, and contrasting inclusions make up the rest. The similar inclusions occur as small areas of soils that are like the Caid soil but are noncalcareous in the surface layer, have a light colored surface layer, or have a dark surface layer that is 7 to 9 inches thick. Also included are Caid soils that have a surface layer of sandy clay loam or have slopes of 1 to 3 percent.

The contrasting inclusions occur as small areas of Bookout, Brystal, Cochina, Cotulla, Chacon, Divot, Duval, Poteet, Tiocano, and Zavco soils. Cochina, Divot, Poteet, and Tiocano soils are in the lower positions, Bookout, Brystal, Chacon, Cotulla, Duval, and Zavco soils are in landscape positions similar to those of the Caid soil or are in the higher positions.

The Caid soil is used mainly as cropland. Some areas are used as rangeland, wildlife habitat, or pasture.

Rangeland productivity is medium. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a wide variety of grasses, forbs, and browse plants for livestock and wildlife. These areas are preferred sites for deer, are good sites for quail, and are used by dove and turkey.

This soil is moderately suited to nonirrigated crops and well suited to irrigated crops. Suitable crops include corn, forage sorghum, grain sorghum, oats, wheat, and cotton. The alkaline reaction in the surface layer limits the choice of suitable crops. The main management concern is the hazard of wind erosion. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, wind stripcropping, diversions, grassed waterways, or crop rotations that include high-residue or soil-improving crops may be needed to control erosion, conserve moisture, and maintain tilth.

This soil is well suited to irrigated pasture. Coastal bermudagrass, kleingrass, and buffelgrass are suitable pasture grasses.

This soil is moderately suited to most urban uses. Properly designing septic tank absorption fields helps to overcome the restricted permeability. Properly designing building foundations helps to prevent the structural damage caused by shrinking and swelling. Because of low soil strength, suitable base material is needed on sites for local roads and streets.

This soil is moderately suited to most recreational uses. Applications of water or special surfacing material may be needed during dry periods to prevent excessive dustiness in areas that are subject to heavy foot traffic.

The land capability classification is IIIc, nonirrigated, and I, irrigated. The range site is Gray Sandy Loam.

CaB—Caid very fine sandy loam, 1 to 3 percent slopes. This very deep, very gently sloping, loamy soil is on smooth plains on stream terraces along the Frio and Nueces Rivers and along large creeks. Slopes are mainly 1 to 2 percent. The shape of the slopes is convex or linear. Individual areas are subrounded or irregularly shaped and range from 8 to several hundred acres in size.

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

Surface layer:

0 to 10 inches, brown very fine sandy loam, moderately alkaline

Subsoil:

10 to 18 inches, brown sandy clay loam, moderately alkaline

18 to 27 inches, light brown sandy clay loam, moderately alkaline

27 to 64 inches or more, reddish yellow sandy clay loam, moderately alkaline

Important soil properties—

Drainage: well drained

Permeability: moderate

Available water capacity: high

Root zone: very deep

Shrink-swell potential: moderate (the soil shrinks as it dries and swells as it becomes moist)

Surface runoff: medium

Flooding: none

Hazard of water erosion: moderate

Hazard of wind erosion: moderate

The Caid soil and similar inclusions make up more than 85 percent of the map unit, and contrasting inclusions make up the rest. The similar inclusions occur as small areas of soils that are like the Caid soil but are noncalcareous in the surface layer, have a light colored surface layer, or have a dark surface layer that is 7 to 9 inches thick. Also included are Caid soils that have a surface layer of sandy clay loam or have slopes of 0 to 1 or 3 to 5 percent.

The contrasting inclusions occur as small areas of Bookout, Brystal, Cochina, Copita, Cotulla, Chacon, Divot, Duval, Poteet, Tiocano, and Zavco soils. Cochina, Divot, Poteet, and Tiocano soils are in the lower positions. Bookout, Brystal, Chacon, Copita, Cotulla, Duval, and Zavco soils are in landscape positions similar to those of the Caid soil or are in the higher positions.

The Caid soil is used mainly as cropland. Some areas are used as rangeland, wildlife habitat, or pasture.

Rangeland productivity is medium. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a wide variety of grasses, forbs, and browse plants for livestock and wildlife. These areas are preferred sites for deer, are good sites for quail, and are used by dove and turkey.

This soil is moderately suited to nonirrigated crops and well suited to irrigated crops. Suitable crops include corn, forage sorghum, grain sorghum, oats, wheat, and cotton. The alkaline reaction in the surface layer limits the choice of suitable crops. The main management concerns are the hazards of water erosion and wind erosion. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, wind stripcropping, contour or field stripcropping, terraces, diversions, grassed waterways, contour farming, or crop rotations that include high-residue or soil improving crops may be needed to control erosion, conserve moisture, and maintain tilth.

This soil is well suited to irrigated pasture. Kleingrass, coastal bermudagrass, and buffelgrass are suitable pasture grasses.

This soil is moderately suited to most urban uses. Properly designing septic tank absorption fields helps to overcome the restricted permeability. Properly designing building foundations helps to prevent the structural damage caused by shrinking and swelling. Because of low soil strength, suitable base material is needed on sites for local roads and streets.

This soil is moderately suited to most recreational uses. Applications of water or special surfacing material may be needed during dry periods to prevent excessive dustiness in areas that are subject to heavy foot traffic.

The land capability classification is IIIe, nonirrigated, and IIe, irrigated. The range site is Gray Sandy Loam.

CBB—Caid very fine sandy loam, gently undulating. This very deep, loamy soil is on smooth plains on stream terraces along the Frio and Nueces Rivers and along large creeks. Slopes range from 1 to 3 percent. The shape of the slopes is convex or linear. Individual areas are subrounded or irregularly shaped and range from 20 to several thousand acres in size.

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

Surface layer:

0 to 8 inches, very dark grayish brown very fine sandy loam, moderately alkaline
8 to 17 inches, dark grayish brown very fine sandy loam, moderately alkaline

Subsoil:

17 to 26 inches, brown sandy clay loam, moderately alkaline
26 to 36 inches, light brown sandy clay loam, moderately alkaline
36 to 64 inches or more, reddish yellow sandy clay loam, moderately alkaline

Important soil properties—

Drainage: well drained

Permeability: moderate

Available water capacity: high

Root zone: very deep

Shrink-swell potential: moderate (the soil shrinks as it dries and swells as it becomes moist)

Surface runoff: slow or medium

Flooding: none

Hazard of water erosion: moderate

Hazard of wind erosion: moderate

The Caid soil and similar inclusions make up more than 75 percent of the map unit, and contrasting inclusions make up the rest. More than 50 percent of the map unit consists of Caid soil that has slopes of 1 to 3 percent, and 25 percent consists of Caid soil that has slopes of 0 to 1 percent. The similar inclusions occur as small areas of soils that are like the Caid soil but are noncalcareous in the surface layer, have a light colored surface layer, or have a dark surface layer that is 7 to 9 inches thick. Also included are Caid soils that have a surface layer of sandy clay loam or have slopes of 3 to 5 percent.

The contrasting inclusions occur as small areas of Bookout, Brystal, Cochina, Copita, Cotulla, Chacon, Divot, Duval, Poteet, Tiocano, and Zavco soils. Cochina, Divot, Poteet, and Tiocano soils are in the lower positions. Bookout, Brystal, Chacon, Copita, Cotulla, Duval, and Zavco soils are in landscape positions similar to those of the Caid soil or are in the higher positions.

This map unit was designed primarily for extensive land uses, such as rangeland. Fewer soil examinations were made in areas of this map unit than in areas of map

units designed for more intensive uses. Also, the mapped areas and the areas of inclusions in this map unit are generally larger. The map unit purity is adequate for the anticipated land use.

The Caid soil is used mainly as rangeland and wildlife habitat. Some areas are used as cropland or pasture.

Rangeland productivity is medium. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a wide variety of grasses, forbs, and browse plants for livestock and wildlife. These areas are preferred sites for deer, are good sites for quail, and are used by dove and turkey.

This soil is moderately suited to nonirrigated crops and well suited to irrigated crops. Suitable crops include corn, forage sorghum, grain sorghum, oats, wheat, and cotton. The alkaline reaction in the surface layer limits the choice of suitable crops. The main management concerns are the hazards of water erosion and wind erosion. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, wind stripcropping, contour or field stripcropping, terraces, diversions, grassed waterways, contour farming, or crop rotations that include high-residue or soil-improving crops may be needed to control erosion, conserve moisture, and maintain tilth.

This soil is well suited to irrigated pasture. Suitable pasture grasses include kleingrass, coastal bermudagrass, and buffelgrass.

This soil is moderately suited to most urban uses. Properly designing septic tank absorption fields helps to overcome the restricted permeability. Properly designing building foundations helps to prevent the structural damage caused by shrinking and swelling. Because of low soil strength, suitable base material is needed on sites for local roads and streets.

This soil is moderately suited to most recreational uses. Applications of water or special surfacing material may be needed during dry periods to prevent excessive dustiness in areas that are subject to heavy foot traffic.

The land capability classification is IIIe, nonirrigated, and IIe, irrigated. The range site is Gray Sandy Loam.

CCA—Catarina clay, nearly level. This very deep, saline, clayey soil is on smooth plains. Slopes range from 0 to 2 percent. The shape of the slopes is linear or concave. Individual areas are subrounded, elongated, or irregularly shaped and range from 7 to 250 acres in size.

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

Surface layer:

0 to 13 inches, light brownish gray clay, very slightly saline, mildly alkaline

Subsoil:

13 to 27 inches, pale brown clay, moderately saline, mildly alkaline

27 to 54 inches, pale brown clay, strongly saline, mildly alkaline

54 to 80 inches, very pale brown clay, moderately saline, mildly alkaline

Important soil properties—

Drainage: moderately well drained

Permeability: very slow

Available water capacity: low

Root zone: very deep; however, the clayey subsoil restricts the movement of air and water and root development

Shrink-swell potential: very high (the soil shrinks and forms wide, deep cracks as it dries and swells as it becomes moist)

Surface runoff: slow or medium

Flooding: none

Hazard of water erosion: moderate

Hazard of wind erosion: moderate

The Catarina soil and similar inclusions make up more than 85 percent of the map unit, and contrasting inclusions make up the rest. The similar inclusions occur as small areas of soils that are like the Catarina soil but have a dark surface layer. Also included are small areas of Catarina soils that are occasionally flooded or have slopes of 2 to 3 percent.

The contrasting inclusions occur as small areas of Brundage, Cotulla, Imogene, Lasalle, Maverick, Moglia, and Viboras soils. Brundage, Cotulla, Lasalle, and Viboras soils are in landscape positions similar to those of the Catarina soil. Maverick and Moglia soils are in the higher positions. Imogene soils are in the lower positions.

This map unit was designed primarily for extensive land uses, such as rangeland. Fewer soil examinations were made in areas of this map unit than in areas of map units designed for more intensive uses. Also, the mapped areas and the areas of inclusions in this map unit are generally larger. The map unit purity is adequate for the anticipated land use.

The Catarina soil is used as rangeland and wildlife habitat. Rangeland productivity is low. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a variety of forage for livestock and wildlife. These areas are used by deer, quail, dove, and turkey, but they are not preferred sites.

This soil is not suited to nonirrigated crops and is poorly suited to irrigated crops. The main management concerns are the low available water capacity, the very slow permeability, the salinity in the subsoil, and the hazards of water erosion and wind erosion. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, contour or field stripcropping, terraces, diversions, grassed waterways, contour farming, or crop rotations that include high-residue or soil-improving crops may be needed to control erosion, conserve moisture, reduce the salinity, and maintain tilth.

This soil is not suited to irrigated pasture. The salinity of the soil can be increased by irrigation.

This soil is poorly suited to most urban uses. Properly designing septic tank absorption fields helps to overcome the restricted permeability. The salinity and excess sodium in the subsoil inhibit the growth of vegetation in areas used for lawns and landscaping. Because of the clayey texture, the soil can be worked by earth-moving equipment only within a narrow range in moisture content. Properly designing building foundations and paved roads helps to prevent the structural or road damage caused by shrinking and swelling. Because of low soil strength, suitable base material is needed on sites for local roads and streets.

This soil is poorly suited to most recreational uses. Because of the very slow permeability and the clayey surface layer, special surfacing material may be needed in areas that are subject to heavy foot traffic during wet periods. The salinity and excess sodium in the subsoil inhibit the growth of vegetation in areas that are subject to heavy foot traffic.

The land capability classification is VIs, nonirrigated, and IVs, irrigated. The range site is Saline Clay.

CdA—Chacon clay loam, 0 to 1 percent slopes. This very deep, loamy soil is on broad, smooth plains. The shape of the slopes is linear or concave. Individual areas are irregularly shaped or subrounded and range from 10 to several hundred acres in size.

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

Surface layer:

0 to 10 inches, dark grayish brown clay loam, nonsaline, moderately alkaline

Subsoil:

10 to 20 inches, grayish brown clay, nonsaline, moderately alkaline

20 to 30 inches, pale brown clay, nonsaline, moderately alkaline

30 to 39 inches, pale brown clay, slightly saline, moderately alkaline

39 to 64 inches or more, light yellowish brown clay, slightly saline, moderately alkaline

Important soil properties—

Drainage: well drained

Permeability: slow

Available water capacity: moderate

Root zone: very deep; however, the clayey subsoil restricts the movement of air and water and root development

Shrink-swell potential: high (the soil shrinks and cracks as it dries and swells as it becomes moist)

Surface runoff: slow

Flooding: none

Hazard of water erosion: slight

Hazard of wind erosion: moderate

The Chacon soil and similar inclusions make up more than 85 percent of the map unit, and contrasting inclusions make up the rest. The similar inclusions occur as small areas of soils that are like the Chacon soil but have a light colored surface layer or have a dark surface layer and subsoil that, combined, are 30 to 40 inches thick. Also included are small areas of Chacon soils that have slopes of 1 to 3 percent.

The contrasting inclusions occur as small areas of Altita, Brundage, Bookout, Brystal, Caid, Charco, Cotulla, Duval, Imogene, Maverick, Moglia, Monteola, Poteet, and Webb soils. Also included are small gullied areas and small areas of stream channels. Altita, Brundage, Bookout, and Charco soils are in landscape positions similar to those of the Chacon soil, and Imogene and Poteet soils are in the lower positions. The other contrasting soils are in the higher positions.

The Chacon soil is used mainly as cropland. Some areas are used as rangeland, wildlife habitat, or pasture.

Rangeland productivity is medium. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a wide variety of grasses, forbs, and browse plants for livestock and wildlife. These areas are preferred sites for deer, are good sites for quail, and are used by dove and turkey.

This soil is poorly suited to nonirrigated crops and well suited to irrigated crops. The main crops are corn, forage sorghum, grain sorghum, oats, and wheat. The main management concerns are the hazard of wind erosion and the salinity in the subsoil. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, diversions, grassed waterways, or crop rotations that include high-residue or soil-improving crops may be needed to control erosion, conserve moisture, reduce the salinity in irrigated areas, and maintain tilth.

This soil is moderately suited to irrigated pasture. The salinity of the soil can be increased by irrigation. Suitable pasture grasses include buffelgrass, blue panicum, improved bermudagrasses, and kleingrass.

This soil is poorly suited to most urban uses. Properly designing septic tank absorption fields helps to overcome the restricted permeability. Properly designing

building foundations helps to prevent the structural damage caused by shrinking and swelling. The clayey subsoil can be worked by earth-moving equipment only within a narrow range in moisture content. Because of low soil strength, suitable base material is needed on sites for local roads and streets.

This soil is well suited to most recreational uses.

The land capability classification is IVe, nonirrigated, and IIs, irrigated. The range site is Clay Loam.

CDB—Chacon clay loam, gently undulating. This very deep, loamy soil is on broad, smooth plains. Slopes range from 0 to 3 percent. The shape of the slopes is convex to concave. Individual areas are irregularly shaped or subrounded and range from 10 to several hundred acres in size.

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

Surface layer:

0 to 11 inches, dark grayish brown clay loam, nonsaline, moderately alkaline

Subsoil:

11 to 18 inches, grayish brown clay, nonsaline, moderately alkaline

18 to 37 inches, pale brown clay, slightly saline, moderately alkaline

37 to 64 inches or more, light yellowish brown clay, slightly saline, moderately alkaline

Important soil properties—

Drainage: well drained

Permeability: slow

Available water capacity: moderate

Root zone: very deep; however, the clayey subsoil restricts the movement of air and water and root development

Shrink-swell potential: high (the soil shrinks and cracks as it dries and swells as it becomes moist)

Surface runoff: slow or medium

Flooding: none

Hazard of water erosion: moderate

Hazard of wind erosion: moderate

The Chacon soil and similar inclusions make up more than 75 percent of the map unit, and contrasting inclusions make up the rest. More than 50 percent of the map unit consists of Chacon soil that has slopes of 1 to 3 percent, and 25 percent consists of Chacon soil that has slopes of 0 to 1 percent. The similar inclusions occur as small areas of soils that are like the Chacon soil but have a light colored surface layer or have a dark surface layer and subsoil that, combined, are 30 to 40 inches thick.

The contrasting inclusions occur as small areas of Altita, Brundage, Bookout, Brystal, Caid, Charco, Cotulla, Duval, Imogene, Maverick, Moglia, Monteola, Poteet, and Webb soils. Also included are small gullied areas and small areas of stream channels. Altita, Brundage, Bookout, and Charco soils are in landscape positions similar to those of the Chacon soil, and Imogene and Poteet soils are in the lower positions. The other contrasting soils are in the higher positions.

This map unit was designed primarily for extensive land uses, such as rangeland. Fewer soil examinations were made in areas of this map unit than in areas of map units designed for more intensive uses. Also, the mapped areas and the areas of inclusions in this map unit are generally larger. The map unit purity is adequate for the anticipated land use.

The Chacon soil is used mainly as rangeland and wildlife habitat. Rangeland productivity is medium. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a wide variety of

grasses, forbs, and browse plants for livestock and wildlife. These areas are preferred sites for deer, are good sites for quail, and are used by dove and turkey.

This soil is poorly suited to nonirrigated crops and moderately suited to irrigated crops. Suitable crops include corn, forage sorghum, grain sorghum, oats, and wheat. The main management concerns are the hazards of wind erosion and water erosion and the salinity in the subsoil. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, contour or field stripcropping, terraces, diversions, grassed waterways, contour farming, or crop rotations that include high-residue or soil-improving crops may be needed to control erosion, conserve moisture, reduce the salinity in irrigated areas, and maintain tilth.

This soil is moderately suited to irrigated pasture. The salinity of the soil can be increased by irrigation. Suitable pasture grasses include buffelgrass, blue panicum, improved bermudagrass, and kleingrass.

This soil is poorly suited to most urban uses. Properly designing septic tank absorption fields helps to overcome the restricted permeability. Properly designing building foundations helps to prevent the structural damage caused by shrinking and swelling. The clayey subsoil can be worked by earth-moving equipment only within a narrow range in moisture content. Because of low soil strength, suitable base material is needed on sites for local roads and streets.

This soil is well suited to most recreational uses.

The land capability classification is IVe, nonirrigated, and IIIe, irrigated. The range site is Clay Loam.

CEB—Charco-Altita complex, nearly level. These very deep, loamy soils are on smooth plains. The Charco soil is in microbasins and the Altita soil on microknolls in a repeating pattern throughout the map unit. Slopes range from 0 to 2 percent. They are mainly less than 1 percent. The shape of the slopes is linear. Individual areas are irregularly shaped or subrounded and range from 20 to several hundred acres in size. The Charco and Altita soils occur as areas so intricately mixed that they could not be mapped separately.

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

Surface layer:

0 to 9 inches, dark gray loam, nonsaline, slightly acid

Subsoil:

9 to 18 inches, very dark gray clay, nonsaline, neutral

18 to 25 inches, dark gray clay loam, very slightly saline, moderately alkaline

25 to 34 inches, grayish brown clay loam, slightly saline, moderately alkaline

34 to 39 inches, grayish brown loam, slightly saline, moderately alkaline

39 to 50 inches, very pale brown clay loam that has yellowish brown mottles, slightly saline, moderately alkaline

50 to 64 inches or more, very pale brown clay loam that has yellowish brown mottles, moderately saline, moderately alkaline

Important properties of the Charco soil—

Drainage: well drained

Permeability: moderately slow

Available water capacity: low

Root zone: very deep; however, the clayey subsoil restricts the movement of air and water and root development

Shrink-swell potential: high (the soil shrinks and cracks as it dries and swells as it becomes moist)

Surface runoff: slow or medium

Flooding: none
Hazard of water erosion: slight
Hazard of wind erosion: slight

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

Surface layer:

0 to 18 inches, grayish brown sandy clay loam, nonsaline, moderately alkaline

Subsoil:

18 to 28 inches, light brownish gray clay loam, nonsaline, moderately alkaline

28 to 38 inches, pale brown clay, slightly saline, moderately alkaline

38 to 50 inches, very pale brown clay loam intermingled with white, soft shale fragments, slightly saline, moderately alkaline

50 to 64 inches or more, very pale brown clay loam intermingled with white, soft shale fragments, moderately saline, moderately alkaline

Important properties of the Altita soil—

Drainage: well drained
Permeability: moderately slow
Available water capacity: low
Root zone: very deep; however, the clayey subsoil restricts the movement of air and water and root development
Shrink-swell potential: high (the soil shrinks and cracks as it dries and swells as it becomes moist)
Surface runoff: slow or medium
Flooding: none
Hazard of water erosion: slight
Hazard of wind erosion: moderate

Based on four transects, the best estimate is that the Charco soil and similar inclusions make up 50 percent of the map unit, the Altita soil and similar inclusions make up 37 percent, and contrasting soils make up 13 percent. There is an 80 percent probability that the true composition of the whole map unit is 46 to 54 percent Charco soil, 34 to 40 percent Altita soil, and 6 to 20 percent contrasting soils.

The similar inclusions occur as small areas of soils that are like the Altita soil but have a dark surface layer and soils that are like the Charco and Altita soils but are more saline in the upper part of the subsoil. Also included are small areas of Charco and Altita soils that have slopes of 2 to 3 percent.

The contrasting inclusions occur as small areas of Brundage, Bookout, Caid, Chacon, Imogene, Mata, Moglia, Monteola, Webb, and Zavco soils. Mata, Moglia, Monteola, Webb, and Zavco soils are in landscape positions similar to those of the Charco and Altita soils or are in the higher positions. The other contrasting soils are in the lower positions.

This map unit was designed primarily for extensive land uses, such as rangeland. Fewer soil examinations were made in areas of this map unit than in areas of map units designed for more intensive uses. Also, the mapped areas and the areas of inclusions in this map unit are generally larger. The map unit purity is adequate for the anticipated land use.

The Charco and Altita soils are used mainly as rangeland and wildlife habitat. Rangeland productivity is medium. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a wide variety of grasses, forbs, and browse plants for livestock and wildlife. These areas are preferred sites for deer, are good sites for quail, and are used by dove and turkey.

These soils are moderately suited to nonirrigated crops and well suited to irrigated crops. The main management concerns are the low available water capacity and the salinity in the subsoil. The alkaline reaction in the surface layer of the Altita soil limits the choice of suitable crops. Suitable crops include forage sorghum, grain sorghum, oats, and wheat. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, diversions, grassed waterways, or crop rotations that include high-residue or soil-improving crops may be needed to control erosion, conserve moisture, reduce the salinity in irrigated areas, and maintain tilth.

These soils are moderately suited to irrigated pasture. The salinity of the soils can be increased by irrigation. Kleingrass and buffelgrass are suitable pasture grasses.

These soils are poorly suited to most urban uses. Properly designing septic tank absorption fields helps to overcome the restricted permeability. Properly designing building foundations and paved roads helps to prevent the structural or road damage caused by shrinking and swelling. The clayey subsoil can be worked by earth-moving equipment only within a narrow range in moisture content. Because of low soil strength, suitable base material is needed on sites for local roads and streets.

The Charco soil is moderately suited to most recreational uses, and the Altita soil is well suited. Applications of water or special surfacing material may be needed during dry periods to prevent excessive dustiness in areas that are subject to heavy foot traffic.

The land capability classification is IIIs, nonirrigated, and IIs, irrigated. The range site is Saline Clay Loam.

Ch—Cochina clay, occasionally flooded. This very deep, clayey soil is on flood plains. The landscape is characterized by numerous shallow, braided channels and sloughs. Slopes are 0 to 1 percent. They are mainly less than 0.5 percent. The shape of the slopes is linear or concave. Individual areas are long and narrow or irregularly shaped and range from 20 to several hundred acres in size.

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

Surface layer:

0 to 8 inches, grayish brown clay, nonsaline, moderately alkaline

Subsoil:

8 to 25 inches, grayish brown clay, very slightly saline, moderately alkaline

25 to 60 inches, pale brown clay, moderately saline, moderately alkaline

Important soil properties—

Drainage: moderately well drained

Permeability: very slow

Available water capacity: moderate

Root zone: very deep; however, the clayey subsoil restricts the movement of air and water and root development

Shrink-swell potential: very high (the soil shrinks and forms wide, deep cracks as it dries and swells as it becomes moist)

Surface runoff: slow

Flooding: occasional (less often than 50 times in 100 years but more often than 5 times in 100 years), usually lasting less than 7 days and having low velocity

Hazard of water erosion: slight; during periods of flooding, however, scouring of bare areas may occur, especially near stream channels

Hazard of wind erosion: moderate

The Cochina soil and similar inclusions make up more than 85 percent of the map unit, and contrasting inclusions make up the rest. Included in mapping are small areas of Cochina soils that are flooded more often than 50 times in 100 years.

The contrasting inclusions occur as small areas of Arroyada, Bookout, Brundage, Caid, Coquat, Cotulla, Divot, Imogene, Lasalle, Maverick, Moglia, Montell, and Tiocano soils. Also included are small areas of stream channels. The Divot, Montell, Imogene, and Tiocano soils are in landscape positions similar to those of the Cochina soil, Bookout, Brundage, Caid, Cotulla, Lasalle, Maverick, and Moglia soils are in the higher positions, Arroyada and Coquat soils are in the lower positions on the flood plain.

The Cochina soil is used mainly as rangeland and wildlife habitat. A few areas are used for pasture.

Rangeland productivity is medium. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a wide variety of forage for livestock and excellent food and cover for wildlife. Where these areas are close to rivers, they are preferred sites for turkey. They are preferred sites for deer and are used by quail and dove.

This soil is poorly suited to cropland. The main management concerns are the hazard of flooding, the very slow permeability, the salinity in the subsoil, and the hazard of wind erosion. Suitable crops include cotton, corn, forage sorghum, grain sorghum, and wheat. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, diversions, grassed waterways, or crop rotations that include high-residue or soil-improving crops may be needed to control erosion, conserve moisture, reduce the salinity, and maintain tilth.

This soil is moderately suited to irrigated pasture. The main management concern is maintaining an adequate plant cover to protect against scouring during periods of flooding. The salinity of the soil can be increased by irrigation. Suitable pasture grasses include kleingrass, blue panicum, Kleberg bluestem, and improved bermudagrasses.

The flooding is the main hazard affecting most urban uses. Areas used for these purposes should be protected from flooding. Properly designing septic tank absorption fields helps to overcome the restricted permeability. Properly designing building foundations and paved roads helps to prevent the structural or road damage caused by shrinking and swelling. Because of the clayey texture, the soil can be worked by earth-moving equipment only within a narrow range in moisture content. Because of low soil strength, suitable base material is needed on sites for local roads and streets.

This soil is moderately suited to most recreational uses. It should not be used as a site for camp areas unless it is protected from flooding. The season, duration, and frequency of flooding should be considered in planning playgrounds and other recreational areas. Because of the very slow permeability and the clayey surface layer, special surfacing material may be needed in areas that are subject to heavy foot traffic during wet periods.

The land capability classification is IVw, nonirrigated and irrigated. The range site is Clayey Bottomland.

Cn—Cochina clay, frequently flooded. This very deep, clayey soil is on flood plains (fig. 7). The landscape is characterized by numerous shallow, braided channels and sloughs. Slopes are 0 to 1 percent. They are mainly less than 0.5 percent. The shape of the slopes is linear or concave. Individual areas are long and narrow or irregularly shaped and range from 20 to several thousand acres in size.

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

Surface layer:

0 to 9 inches, grayish brown clay, nonsaline, mildly alkaline



Figure 7.—An area of Cochina clay, frequently flooded. Mesquite, retama, and spiny aster protrude from the floodwaters of Elm Creek.

Subsoil:

9 to 24 inches, grayish brown clay, very slightly saline, mildly alkaline

24 to 40 inches, brown clay, moderately saline, mildly alkaline

40 to 54 inches, yellowish brown clay, moderately saline, mildly alkaline

54 to 72 inches, light yellowish brown clay, moderately saline, mildly alkaline

Important soil properties—

Drainage: moderately well drained

Permeability: very slow

Available water capacity: moderate

Root zone: very deep; however, the clayey subsoil restricts the movement of air and water and root development

Shrink-swell potential: very high (the soil shrinks and forms wide, deep cracks as it dries and swells as it becomes moist)

Surface runoff: slow

Flooding: frequent (more often than 50 times in 100 years), usually lasting less than 7 days

Hazard of water erosion: slight; during periods of flooding, however, scouring of bare areas may occur, especially near stream channels

Hazard of wind erosion: moderate

The Cochina soil and similar inclusions make up more than 85 percent of the map unit, and contrasting inclusions make up the rest. Included in mapping are small areas of Cochina soils that are flooded less often than 50 times in 100 years.

The contrasting inclusions occur as small areas of Arroyada, Bookout, Brundage, Caid, Coquat, Cotulla, Divot, Imogene, Lasalle, Maverick, Moglia, Montell, and Tiocano soils. Also included are small areas of stream channels and small areas of

water. Divot, Montell, Imogene, and Tiocano soils are in landscape positions similar to those of the Cochina soil. Bookout, Brundage, Caid, Cotulla, Lasalle, Maverick, and Moglia soils are in the higher positions. Arroyada and Coquat soils are in the lower positions on the flood plain.

The Cochina soil is used mainly as rangeland and wildlife habitat. A few small areas are used for pasture.

Rangeland productivity is medium. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a wide variety of forage for livestock and excellent food and cover for wildlife. These areas are preferred sites for turkey and deer and are used by quail and dove. The nearby rivers and creeks provide water for wildlife.

This soil is not suited to cropland. The hazard of flooding and the scouring of bare areas are the main management concerns. Other management concerns include the very slow permeability, the salinity in the subsoil, and the hazard of wind erosion.

This soil is poorly suited to irrigated pasture. The salinity of the soil can be increased by irrigation. The flooding can destroy irrigation systems. Removing native trees and brush near stream channels may result in severe scouring and streambank erosion during periods of flooding.

The flooding is the main hazard affecting most urban uses. Areas used for these purposes should be protected from flooding. Properly designing septic tank absorption fields helps to overcome the restricted permeability. Properly designing building foundations and paved roads helps to prevent the structural or road damage caused by shrinking and swelling. Because of the clayey texture, the soil can be worked by earth-moving equipment only within a narrow range in moisture content. Because of low soil strength, suitable base material is needed on sites for local roads and streets.

This soil is poorly suited to most recreational uses. It should not be used as a site for camp areas unless it is protected from flooding. The season, duration, and frequency of flooding should be considered in planning playgrounds and other recreational areas. Because of the very slow permeability and the clayey surface layer, special surfacing material may be needed in areas that are subject to heavy foot traffic during wet periods.

The land capability classification is Vw, nonirrigated and irrigated. The range site is Clayey Bottomland.

CPB—Copita fine sandy loam, gently undulating. This moderately deep, loamy soil is on smooth plains. Slopes range from 0 to 3 percent. The shape of the slopes is convex. Individual areas are irregular in shape and range from about 20 to 100 acres in size.

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

Surface layer:

0 to 9 inches, brown fine sandy loam, moderately alkaline

Subsoil:

9 to 19 inches, yellowish brown loam, moderately alkaline

19 to 37 inches, light yellowish brown loam, moderately alkaline

Substratum:

37 to 60 inches or more, yellow, fractured, soft sandstone bedrock, moderately alkaline

Important soil properties—

Drainage: well drained

Permeability: moderate above the substratum

Available water capacity: low

Root zone: moderately deep

Shrink-swell potential: low

Surface runoff: medium

Flooding: none

Hazard of water erosion: moderate

Hazard of wind erosion: moderate

The Copita soil and similar inclusions make up more than 85 percent of the map unit, and contrasting inclusions make up the rest. The similar inclusions occur as small areas of Copita soils that have a surface layer of sandy clay loam.

The contrasting inclusions occur as small areas of Brundage, Brystal, Caid, Dilley, Duval, Imogene, and Webb soils. Dilley and Duval soils are in landscape positions similar to those of the Copita soil. The other contrasting soils are in the lower positions.

This map unit was designed primarily for extensive land uses, such as rangeland. Fewer soil examinations were made in areas of this map unit than in areas of map units designed for more intensive uses. Also, the mapped areas and the areas of inclusions in this map unit are generally larger. The map unit purity is adequate for the anticipated land use.

The Copita soil is used as rangeland and wildlife habitat. Rangeland productivity is medium. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a wide variety of grasses, forbs, and browse plants for livestock and wildlife. These areas are preferred sites for deer, are good sites for quail, and are used by dove and turkey.

This soil is not suited to nonirrigated crops but is well suited to irrigated crops. The alkaline reaction in the surface layer limits the choice of suitable crops. The substratum limits the drainage of irrigation water, and a tile drainage system may be needed. The main management concerns are the hazards of water erosion and wind erosion and the low available water capacity. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, wind stripcropping, contour or field stripcropping, terraces, diversions, grassed waterways, contour farming, or crop rotations that include high-residue or soil-improving crops may be needed to control erosion, conserve moisture, and maintain tilth.

This soil is well suited to irrigated pasture. Kleingrass and buffelgrass are suitable pasture grasses.

This soil is moderately suited to most urban uses. Properly designing septic tank absorption fields helps to overcome the depth to bedrock. Droughtiness is a limitation in areas used for lawns and landscaping. The depth to bedrock limits the suitability for shallow excavations and for all kinds of building site development and sanitary facilities.

This soil is moderately suited to most recreational uses. The depth to sandstone bedrock and the low available water capacity inhibit the growth of vegetation in areas that are subject to heavy foot traffic.

The land capability classification is V1e, nonirrigated, and I1e, irrigated. The range site is Gray Sandy Loam.

Cq—Coquat clay, frequently flooded. This very deep, clayey soil is on flood plains along the Nueces River and its major tributaries (fig. 8). The landscape is characterized by numerous shallow, braided channels and sloughs. Slopes are 0 to 1 percent. They are mainly less than 0.5 percent. The shape of the slopes is linear or concave. Individual areas are long and narrow or irregularly shaped and range from 400 to several thousand acres in size.



Figure 8.—Huisache, mesquite, retama, and gulf cordgrass in an area of Coquat clay, frequently flooded, on the flood plain along the Nueces River. The brush canopy is typical for this soil. The flood is a few days after peak stage.

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

Surface layer:

0 to 5 inches, grayish brown clay, nonsaline, moderately alkaline

Subsoil:

5 to 36 inches, light brownish gray clay, nonsaline, moderately alkaline

36 to 52 inches, pale brown clay, slightly saline, moderately alkaline

52 to 65 inches, pale brown clay, moderately saline, moderately alkaline

65 to 74 inches or more, light yellowish brown clay, moderately saline,
moderately alkaline

Important soil properties—

Drainage: somewhat poorly drained

Permeability: very slow

Available water capacity: low

Root zone: very deep; however, the clayey subsoil restricts the movement of air and water and root development

Shrink-swell potential: very high (the soil shrinks and forms wide, deep cracks as it dries and swells as it becomes moist)

Surface runoff: very slow or ponded (water ponds in microbasins and sloughs after floodwater recedes and after rainstorms)

Seasonal high water table: an apparent water table after periods of heavy rainfall or flooding, 3 to 6 feet below the surface

Flooding: frequent (more often than 50 times in 100 years), usually lasting less than 7 days

Hazard of water erosion: slight; during periods of flooding, however, scouring of bare areas may occur, especially near stream channels

Hazard of wind erosion: moderate

The Coquat soil and similar inclusions make up more than 85 percent of the map unit, and contrasting inclusions make up the rest. Included in mapping are areas of Coquat soils that are saline within a depth of 20 inches.

The contrasting inclusions occur as small areas of Arroyada, Bookout, Brundage, Caid, Chacon, Cochina, Cotulla, Divot, Imogene, Lasalle, Moglia, and Montell soils. Also included are small areas of stream channels. Arroyada, Cochina, Divot, and Imogene soils are in landscape positions similar to those of the Coquat soil or are in the slightly higher positions. Bookout, Brundage, Caid, Chacon, Cotulla, Lasalle, Moglia, and Montell soils are in the higher positions.

The Coquat soil is used as rangeland and wildlife habitat. Rangeland productivity is very high, but palatability is low most of the year. Gulf cordgrass, the dominant plant, is seldom used by wildlife, except as fawning cover for deer. The soil produces very little brush cover, except along stream channels, and very little food for wildlife. Areas of this soil are used to a limited extent by deer, quail, dove, and turkey. The nearby rivers and creeks provide water for wildlife.

This soil is not suited to cropland. The hazard of flooding and the scouring of bare areas are the main management concerns. Other management concerns are the low available water capacity, the very slow permeability, the ponding, the salinity in the subsoil, and the hazard of wind erosion.

This soil is poorly suited to irrigated pasture. The salinity, the ponding, and the flooding limit the choice of suitable pasture grasses. The salinity of the soil can be increased by irrigation. The flooding can destroy irrigation systems. Removing native trees and brush near stream channels may result in severe scouring and streambank erosion during periods of flooding.

The flooding is the main hazard affecting most urban uses. Areas used for these purposes should be protected from flooding. Properly designing septic tank absorption fields helps to overcome the restricted permeability and the water table. Properly designing building foundations and paved roads helps to prevent the structural or road damage caused by shrinking and swelling. Because of the clayey texture, the soil can be worked by earth-moving equipment only within a narrow range in moisture content. Because of low soil strength, suitable base material is needed on sites for local roads and streets.

This soil is poorly suited to most recreational uses. It should not be used as a site for camp areas unless it is protected from flooding. The season, duration, and frequency of flooding should be considered in planning playgrounds and other recreational areas. Because of the very slow permeability and the clayey surface layer, special surfacing material may be needed in areas that are subject to heavy foot traffic during wet periods.

The land capability classification is VIs, nonirrigated. The range site is Lowland.

CtA—Cotulla clay, 0 to 1 percent slopes. This very deep, saline, clayey soil is on smooth plains. The shape of the slopes is linear or concave. Individual areas are irregularly shaped or subrounded and range from about 20 to several thousand acres in size.

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

Surface layer:

0 to 5 inches, grayish brown clay, nonsaline, moderately alkaline

5 to 16 inches, grayish brown clay, very slightly saline, moderately alkaline

Subsoil:

16 to 26 inches, brown clay, slightly saline, moderately alkaline

26 to 34 inches, pale brown clay, moderately saline, moderately alkaline

34 to 48 inches, light yellowish brown clay, moderately saline, moderately alkaline

48 to 64 inches or more, light yellowish brown clay, moderately saline, moderately alkaline

Important soil properties—

Drainage: moderately well drained

Permeability: very slow

Available water capacity: low

Root zone: very deep; however, the clayey subsoil restricts the movement of air and water and root development

Shrink-swell potential: very high (the soil shrinks and forms wide, deep cracks as it dries and swells as it becomes moist) *Surface runoff:* slow

Flooding: none

Hazard of water erosion: slight

Hazard of wind erosion: moderate

The Cotulla soil and similar inclusions make up more than 85 percent of the map unit, and contrasting inclusions make up the rest. Included in mapping are small areas of soils that are like the Cotulla soil but are nonsaline to a depth of 20 inches or more. Also included are small areas of Cotulla soils that have slopes of 1 to 3 percent.

The contrasting inclusions occur as small areas of Brundage, Caid, Chacon, Cochina, Imogene, Lasalle, Maverick, Moglia, Montell, and Viboras soils. Brundage, Caid, Lasalle, Montell, and Viboras soils are in landscape positions similar to those of the Cotulla soil. Chacon, Maverick, and Moglia soils are in the higher positions. Cochina and Imogene soils are in the lower positions.

The Cotulla soil is used mainly as cropland. Some areas are used as rangeland, wildlife habitat, or pasture.

Rangeland productivity is medium. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a variety of forage for livestock and wildlife. These areas are used by deer, quail, dove, and turkey, but they are not preferred sites.

This soil is poorly suited to nonirrigated crops and moderately suited to irrigated crops. The main crops are grain sorghum and forage sorghum. The alkaline reaction in the surface layer and the salinity in the subsoil limit the choice of suitable crops. The main management concerns are the low available water capacity, the salinity in the subsoil, the very slow permeability, and the hazard of wind erosion. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, diversions, grassed waterways, or crop rotations that include high-residue or soil-improving crops may be needed to control erosion, conserve moisture, reduce the salinity, and maintain tilth.

This soil is poorly suited to irrigated pasture. Suitable pasture grasses include kleingrass, blue panicum, and improved bermudagrasses. The salinity of the soil can be increased by irrigation.

This soil is poorly suited to most urban uses. Properly designing septic tank absorption fields helps to overcome the restricted permeability. The salinity and excess sodium in the subsoil inhibit the growth of vegetation in areas used for lawns and landscaping. Because of the clayey texture, the soil can be worked by earth-moving equipment only within a narrow range in moisture content. Properly designing building foundations and paved roads helps to prevent the structural or road damage caused by shrinking and swelling. Because of low soil strength, suitable base material is needed on sites for local roads and streets.

This soil is moderately suited to most recreational uses. Because of the very slow permeability and the clayey surface layer, special surfacing material may be needed in areas that are subject to heavy foot traffic during wet periods. The salinity and

excess sodium in the subsoil inhibit the growth of vegetation in areas that are subject to heavy foot traffic.

The land capability classification is IVs, nonirrigated, and IIIs, irrigated. The range site is Saline Clay.

CUA—Cotulla clay, nearly level. This very deep, saline, clayey soil is on smooth plains. Slopes range from 0 to 3 percent. They are mainly less than 1 percent. The shape of the slopes is linear or concave. Individual areas are irregularly shaped or subrounded and range from about 15 to several thousand acres in size.

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

Surface layer:

0 to 7 inches, grayish brown clay, nonsaline, moderately alkaline

7 to 18 inches, grayish brown clay, very slightly saline, moderately alkaline

Subsoil:

18 to 28 inches, light brownish gray clay, slightly saline, moderately alkaline

28 to 34 inches, brown clay, moderately saline, moderately alkaline

34 to 50 inches, pale brown clay, moderately saline, moderately alkaline

50 to 72 inches or more, light yellowish brown clay, moderately saline, moderately alkaline

Important soil properties—

Drainage: moderately well drained

Permeability: very slow

Available water capacity: low

Root zone: very deep; however, the clayey subsoil restricts the movement of air and water and root development

Shrink-swell potential: very high (the soil shrinks and forms wide, deep cracks as it dries and swells as it becomes moist)

Surface runoff: slow or medium

Flooding: none

Hazard of water erosion: moderate

Hazard of wind erosion: moderate

The Cotulla soil and similar inclusions make up more than 80 percent of the map unit, and contrasting inclusions make up the rest. More than 60 percent of the map unit consists of Cotulla soil that has slopes of 0 to 1 percent, and 20 percent consists of Cotulla soil that has slopes of 1 to 3 percent. Included in mapping are small areas of soils that are like the Cotulla soil but are nonsaline to a depth of 20 inches or more.

The contrasting inclusions occur as small areas of Brundage, Caid, Chacon, Cochina, Imogene, Lasalle, Maverick, Moglia, Montell, and Viboras soils. Brundage, Caid, Lasalle, Montell, and Viboras soils are in landscape positions similar to those of the Cotulla soil. Chacon, Maverick, and Moglia soils are in the higher positions. Cochina and Imogene soils are in the lower positions.

This map unit was designed primarily for extensive land uses, such as rangeland. Fewer soil examinations were made in areas of this map unit than in areas of map units designed for more intensive uses. Also, the mapped areas and the areas of inclusions in this map unit are generally larger. The map unit purity is adequate for the anticipated land use.

The Cotulla soil is used mainly as rangeland and wildlife habitat. Some areas are used as cropland or pasture.

Rangeland productivity is medium. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a variety of forage for livestock and wildlife. These areas are used by deer, quail, dove, and turkey, but they are not preferred sites.

This soil is poorly suited to cropland. Suitable crops include grain sorghum, forage sorghum, corn, cotton, oats, and wheat. The alkaline reaction in the surface layer and the salinity in the subsoil limit the choice of suitable crops. The main management concerns are the low available water capacity, the salinity in the subsoil, the very slow permeability, and the hazards of water erosion and wind erosion. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, contour or field stripcropping, terraces, diversions, grassed waterways, contour farming, or crop rotations that include high-residue or soil-improving crops may be needed to control erosion, conserve moisture, reduce the salinity, and maintain tilth.

This soil is poorly suited to irrigated pasture. Suitable pasture grasses include kleingrass, blue panicum, and improved bermudagrasses. The salinity of the soil can be increased by irrigation.

This soil is poorly suited to most urban uses. Properly designing septic tank absorption fields helps to overcome the restricted permeability. The salinity and excess sodium in the subsoil inhibit the growth of vegetation in areas used for lawns and landscaping. Because of the clayey texture, the soil can be worked by earth-moving equipment only within a narrow range in moisture content. Properly designing building foundations and paved roads helps to prevent the structural or road damage caused by shrinking and swelling. Because of low soil strength, suitable base material is needed on sites for local roads and streets.

This soil is moderately suited to most recreational uses. Because of the very slow permeability and the clayey surface layer, special surfacing material may be needed in areas that are subject to heavy foot traffic during wet periods. The salinity and excess sodium in the subsoil inhibit the growth of vegetation in areas that are subject to heavy foot traffic.

The land capability classification is IVe, nonirrigated and irrigated. The range site is Saline Clay.

DLC—Dilley fine sandy loam, gently undulating. This shallow, loamy soil is 10 to 20 inches deep over sandstone bedrock. It is on the summit and shoulder slopes of hills and ridges and on plains. Slopes range from 1 to 5 percent. They are mainly 1 to 3 percent. The shape of the slopes is convex. Individual areas are subrounded or irregularly shaped and range from about 6 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, yellowish red fine sandy loam, slightly acid

Subsoil:

8 to 16 inches, red fine sandy loam, slightly acid

Substratum:

16 to 20 inches, reddish brown, fractured, weakly cemented sandstone bedrock, slightly acid

20 to 36 inches or more, yellowish red, fractured, weakly cemented sandstone bedrock, slightly acid

Important soil properties—

Drainage: well drained

Permeability: moderate above the substratum

Available water capacity: very low

Root zone: shallow

Shrink-swell potential: low

Surface runoff: medium

Flooding: none

Hazard of water erosion: severe
Hazard of wind erosion: moderate

The Dilley soil and similar inclusions make up more than 75 percent of the map unit, and contrasting inclusions make up the rest. The similar inclusions occur as small areas of soils that are like the Dilley soil but have sandstone bedrock at a depth of 7 to 9 or 20 to 30 inches or have slopes of 5 to 8 percent. Also included are small areas of Dilley soils that have a surface layer of gravelly sandy loam or loamy fine sand.

The contrasting inclusions occur as small areas of Brystal, Duval, Goldfinch, Hindes, Webb, and Yologo soils. Also included are small areas of rock outcrop. Goldfinch, Hindes, and Yologo soils and rock outcrop are in landscape positions similar to those of the Dilley soil or are in the higher positions. The Brystal, Duval, and Webb soils are in the lower positions.

This map unit was designed primarily for extensive land uses, such as rangeland. Fewer soil examinations were made in areas of this map unit than in areas of map units designed for more intensive uses. Also, the mapped areas and the areas of inclusions in this map unit are generally larger. The map unit purity is adequate for the anticipated land use.

The Dilley soil is used as rangeland, wildlife habitat, or cropland. Rangeland productivity is low. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a variety of forage for livestock and wildlife. These areas are used by deer, quail, dove, and turkey, but they are not preferred sites.

This soil is not suited to nonirrigated crops and is poorly suited to irrigated crops. The main management concerns are the very low available water capacity, the shallow root zone, and the hazards of water erosion and wind erosion. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, wind stripcropping, contour or field stripcropping, diversions, grassed waterways, contour farming, or crop rotations that include high-residue or soil-improving crops may be needed to control erosion, conserve moisture, and maintain tilth.

This soil is poorly suited to irrigated pasture. Proper grazing use and timely deferment of grazing are needed to maintain a vigorous stand and control water erosion.

This soil is poorly suited to most urban uses. Properly designing septic tank absorption fields helps to overcome the depth to bedrock. Because of the depth to sandstone bedrock, droughtiness is a limitation in areas used for lawns and landscaping. The depth to bedrock limits the suitability for shallow excavations and for all kinds of building site development and sanitary facilities.

This soil is poorly suited to most recreational uses. The depth to bedrock and the very low available water capacity inhibit the growth of vegetation in areas that are subject to heavy foot traffic.

The land capability classification is Vie, nonirrigated, and IVe, irrigated. The range site is Shallow Sandy Loam.

Dm—Divot silty clay loam, occasionally flooded. This very deep, nearly level, loamy soil is on flood plains along the Frio and Nueces Rivers. The shape of the slopes is linear or concave. Slopes range from 0 to 2 percent. They are mainly less than 1 percent. Individual areas are long and narrow and range from about 10 to 3,000 acres in size.

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

Surface layer:

- 0 to 5 inches, grayish brown silty clay loam, moderately alkaline
- 5 to 15 inches, grayish brown silty clay, moderately alkaline

Subsoil:

15 to 40 inches, grayish brown clay, moderately alkaline
 40 to 52 inches, light brownish gray clay, moderately alkaline
 52 to 64 inches or more, pale brown clay, moderately alkaline

Important soil properties—

Drainage: well drained

Permeability: moderately slow

Available water capacity: high

Root zone: very deep

Shrink-swell potential: high (the soil shrinks and cracks as it dries and swells as it becomes moist)

Surface runoff: slow

Flooding: occasional (less often than 50 times in 100 years but more often than 5 times in 100 years), usually lasting less than 2 days

Hazard of water erosion: slight; during periods of flooding, however, scouring of bare areas may occur, especially near stream channels

Hazard of wind erosion: moderate

The Divot soil and similar inclusions make up more than 85 percent of the map unit, and contrasting inclusions make up the rest. The similar inclusions occur as small areas of soils that are like the Divot soil but have a light colored surface layer or have slopes of 2 to 3 percent. Also included are small areas of Divot soils that are flooded more often than 50 times in 100 years.

The contrasting inclusions occur as small areas of Bookout, Caid, Cochina, Poteet, and Tiocano soils. Cochina and Poteet soils are in landscape positions similar to those of the Divot soil. Tiocano soils are in the slightly lower positions. The other contrasting soils are in the higher positions.

The Divot soil is used mainly as rangeland and wildlife habitat. Some areas are used as cropland or pasture.

Rangeland productivity is high. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation provide a wide variety of forage for livestock and excellent food and cover for wildlife. These areas are preferred sites for turkey and are heavily used by deer, quail, and dove. The nearby rivers and creeks provide water for wildlife.

This soil is well suited to cropland. The main crops are forage sorghum, grain sorghum, wheat, and oats. The alkaline reaction in the surface layer limits the choice of suitable crops. Flooding is the main hazard. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, diversions, grassed waterways, or crop rotations that include high-residue or soil-improving crops may be needed to control erosion, conserve moisture, and maintain tilth.

This soil is well suited to irrigated pasture. The main management concern is maintaining an adequate plant cover to protect against scouring during periods of flooding. Suitable pasture grasses include coastal bermudagrass, blue panicum, and kleingrass.

The flooding is the main hazard affecting most urban uses. Areas used for these purposes should be protected from flooding. Properly designing building foundations and paved roads helps to prevent the structural or road damage caused by shrinking and swelling. The clayey subsoil can be worked by earth-moving equipment only within a narrow range in moisture content. Because of low soil strength, suitable base material is needed on sites for local roads and streets.

This soil is moderately suited to most recreational uses. It should not be used as a site for camp areas unless it is protected from flooding. The season, duration, and

frequency of flooding should be considered in planning playgrounds and other recreational areas.

The land capability classification is IIw, nonirrigated and irrigated. The range site is Loamy Bottomland.

Dn—Divot silty clay loam, frequently flooded. This very deep, nearly level, loamy soil is on flood plains along the Frio and Nueces Rivers. Braided channels and sloughs give the land surface an undulating appearance. Slopes range from 0 to 2 percent. They are mainly less than 1 percent. The shape of the slopes is concave or linear. Individual areas are long and narrow and range from several hundred to several thousand acres in size.

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

Surface layer:

0 to 12 inches, dark grayish brown silty clay loam, mildly alkaline

12 to 22 inches, grayish brown silty clay loam, moderately alkaline

Subsoil:

22 to 46 inches, brown silty clay loam, moderately alkaline

46 to 64 inches or more, pale brown silty clay loam, moderately alkaline

Important soil properties—

Drainage: well drained

Permeability: moderately slow

Available water capacity: high

Root zone: very deep

Shrink-swell potential: high (the soil shrinks and cracks as it dries and swells as it becomes moist)

Surface runoff: slow

Flooding: frequent (more often than 50 times in 100 years), usually lasting less than 2 days

Hazard of water erosion: slight; during periods of flooding, however, scouring of bare areas may occur, especially near stream channels

Hazard of wind erosion: moderate

The Divot soil and similar inclusions make up more than 85 percent of the map unit, and contrasting inclusions make up the rest. The similar inclusions occur as small areas of soils that are like the Divot soil but have a light colored surface layer or have slopes of 2 to 3 percent. Also included are small areas of Divot soils that are flooded less often than 50 times in 100 years.

The contrasting inclusions occur as small areas of Bookout, Caid, Cochina, Poteet, and Tiocano soils. Cochina and Poteet soils are in landscape positions similar to those of the Divot soil. Tiocano soils are in the slightly lower positions. The other contrasting soils are in the higher positions.

The Divot soil is used mainly as rangeland and wildlife habitat. Some areas are used as pasture.

Rangeland productivity is high. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation provide a wide variety of forage for livestock and excellent food and cover for wildlife. These areas are preferred sites for turkey and are heavily used by deer, quail, and dove. The nearby rivers and creeks provide water for wildlife.

This soil is not suited to cropland. The hazard of flooding and the scouring of bare areas are the main management concerns.

This soil is poorly suited to irrigated pasture. The flooding can destroy irrigation systems. Removing native trees and brush near stream channels may result in severe scouring and streambank erosion during periods of flooding.

The flooding is the main hazard affecting most urban uses. Areas used for these purposes should be protected from flooding. Properly designing building foundations and paved roads helps to prevent the structural or road damage caused by shrinking and swelling. Because of the content of clay in the subsoil, the soil can be worked by earth-moving equipment only within a narrow range in moisture content. Because of low soil strength, suitable base material is needed on sites for local roads and streets.

This soil is poorly suited to most recreational uses. It should not be used as a site for camp areas unless it is protected from flooding. The season, duration, and frequency of flooding should be considered in planning playgrounds and other recreational areas.

The land capability classification is Vw, nonirrigated. The range site is Loamy Bottomland.

DsC—Duval loamy fine sand, 0 to 5 percent slopes. This deep, nearly level to gently sloping, sandy soil is 40 to 60 inches deep over sandstone bedrock. It is on broad, smooth plains and the foot slopes of hills and ridges. The shape of the slopes is convex to concave. Individual areas are irregular in shape and range from 8 to several thousand acres in size.

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

Surface layer:

0 to 14 inches, reddish brown loamy fine sand, slightly acid

Subsoil:

14 to 20 inches, red sandy clay loam, slightly acid

20 to 30 inches, red sandy clay loam, slightly acid

30 to 46 inches, yellowish red sandy clay loam, neutral

Substratum:

46 to 64 inches or more, reddish yellow, fractured, soft sandstone bedrock

Important soil properties—

Drainage: well drained

Permeability: moderate above the substratum

Available water capacity: low

Root zone: deep

Shrink-swell potential: low

Surface runoff: medium

Flooding: none

Hazard of water erosion: moderate

Hazard of wind erosion: severe

The Duval soil and similar inclusions make up more than 85 percent of the map unit, and contrasting inclusions make up the rest. The similar inclusions occur as small areas of soils that are like the Duval soil but have sandstone bedrock at a depth of 30 to 40 inches or more than 60 inches, have a surface layer of loamy fine sand 20 to 30 inches thick, or have slopes of 5 to 7 percent. Also included are Duval soils that have a surface layer of very fine sandy loam.

The contrasting inclusions occur as small areas of Brystal, Dilley, Goldfinch, Poteet, Tiocano, and Webb soils and a soil that is like the Dilley soil but has sandstone bedrock at a depth of 20 to 30 inches. Also included are some small severely eroded areas and gullied areas. The Brystal and Webb soils are in landscape positions similar to those of the Duval soil. Dilley and Goldfinch soils are in the higher positions on hills and ridges. The Poteet and Tiocano soils are in the lower positions.

The Duval soil is used mainly as cropland. Some areas are used as rangeland, wildlife habitat, or pasture (fig. 9).



Figure 9.—Stocker cattle grazing nonirrigated oats in an area of Duval loamy fine sand, 0 to 5 percent slopes.

Rangeland productivity is medium. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a variety of grasses and forbs for livestock. These areas are preferred sites for quail and dove and are used by turkey. The population of deer generally is lower in the more extensive areas, which have a limited variety of browse plants.

This soil is moderately suited to cropland. It is suitable for a wide variety of nonirrigated and irrigated crops. The main crops are corn, cowpeas, forage sorghum, grain sorghum, mung beans, oats, peanuts, wheat, potatoes, and watermelons. The main management concerns are the hazards of water erosion and wind erosion and the low available water capacity. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, wind stripcropping, contour or field stripcropping, diversions, grassed waterways, contour farming, or crop rotations that include high-residue or soil-improving crops may be needed to control erosion, conserve moisture, and maintain tilth.

This soil is well suited to irrigated pasture. Suitable pasture grasses include coastal bermudagrass, kleingrass, and Wilman lovegrass.

This soil is well suited to most urban uses. Properly designing septic tank absorption fields helps to overcome the depth to bedrock and the restricted permeability.

This soil is moderately suited to most recreational uses. The sandy surface layer inhibits the growth of vegetation in areas used for golf fairways.

The land capability classification is IIIe, nonirrigated and irrigated. The range site is Loamy Sand.

DvA—Duval very fine sandy loam, 0 to 1 percent slopes. This deep, nearly level, loamy soil is 40 to 60 inches deep over sandstone bedrock. It is on broad, smooth plains. The shape of the slopes is linear. Individual areas are irregularly shaped or subrounded and range from 8 to several hundred acres in size.

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

Surface layer:

0 to 15 inches, reddish brown very fine sandy loam, slightly acid

Subsoil:

15 to 19 inches, reddish brown sandy clay loam, slightly acid

19 to 42 inches, red sandy clay loam, slightly acid

42 to 52 inches, yellowish red sandy clay loam, slightly acid

Substratum:

52 to 65 inches or more, yellowish red, fractured, weakly cemented sandstone bedrock

Important soil properties—

Drainage: well drained

Permeability: moderate above the substratum

Available water capacity: moderate

Root zone: deep

Shrink-swell potential: low

Surface runoff: slow

Flooding: none

Hazard of water erosion: slight

Hazard of wind erosion: moderate

The Duval soil and similar inclusions make up more than 85 percent of the map unit, and contrasting inclusions make up the rest. The similar inclusions occur as small areas of soils that are like the Duval soil but have sandstone bedrock at a depth of 30 to 40 inches or more than 60 inches or have a dark surface layer. Also included are small areas of Duval soils that have slopes of 1 to 3 percent or have a surface layer of loamy fine sand.

The contrasting inclusions occur as small areas of Brystal, Dilley, Goldfinch, Poteet, Tiocano, Webb, and Zavco soils. Brystal, Webb, and Zavco soils are in landscape positions similar to those of the Duval soil. Dilley and Goldfinch soils are in the higher positions. Poteet and Tiocano soils are in the lower positions.

The Duval soil is used mainly as cropland. Some areas are used as rangeland, wildlife habitat, or pasture.

Rangeland productivity is medium. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a wide variety of grasses, forbs, and browse plants for livestock and wildlife. These areas are preferred sites for deer, are good sites for quail, and are used by dove and turkey.

This soil is moderately suited to nonirrigated crops and well suited to irrigated crops. It is suitable for a wide variety of nonirrigated and irrigated crops. The main crops are corn, cotton, cowpeas, forage sorghum, grain sorghum, mung beans, oats, peanuts, wheat, cabbage, cantaloupes, onions, potatoes, squash, spinach, and watermelons. The main management concern is the hazard of wind erosion. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, wind stripcropping, diversions, grassed waterways, or crop rotations that include high-residue or soil-improving crops may be needed to control erosion, conserve moisture, and maintain tilth.

This soil is well suited to irrigated pasture. Suitable pasture grasses include buffelgrass, blue panicum, coastal bermudagrass, kleingrass, and Wilman lovegrass.

This soil is well suited to most urban uses. Properly designing septic tank absorption fields helps to overcome the depth to bedrock and the restricted permeability.

This soil is moderately suited to most recreational uses. Applications of water or special surfacing material may be needed during dry periods to prevent excessive dustiness in areas that are subject to heavy foot traffic.

The land capability classification is IIIc, nonirrigated, and I, irrigated. The range site is Sandy Loam.

DvB—Duval very fine sandy loam, 1 to 3 percent slopes. This deep, very gently sloping, loamy soil is 40 to 60 inches deep over sandstone bedrock. It is on broad, smooth plains and the foot slopes of hills and ridges. The shape of the slopes is convex to concave. Individual areas are irregularly shaped or subrounded and range from 8 to several thousand acres in size.

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

Surface layer:

0 to 15 inches, reddish brown very fine sandy loam, slightly acid

Subsoil:

15 to 20 inches, reddish brown sandy clay loam, neutral

20 to 28 inches, red sandy clay loam, neutral

28 to 42 inches, red sandy clay loam, mildly alkaline

Substratum:

42 to 60 inches or more, brownish yellow, fractured, weakly cemented sandstone bedrock, mildly alkaline

Important soil properties—

Drainage: well drained

Permeability: moderate above the substratum

Available water capacity: moderate

Root zone: deep

Shrink-swell potential: low

Surface runoff: medium

Flooding: none

Hazard of water erosion: moderate

Hazard of wind erosion: moderate

The Duval soil and similar inclusions make up more than 85 percent of the map unit, and contrasting inclusions make up the rest. The similar inclusions occur as small areas of soils that are like the Duval soil but have sandstone bedrock at a depth of 30 to 40 inches or more than 60 inches or have a dark surface layer. Also included are small areas of Duval soils that have slopes of 0 to 1 or 3 to 5 percent or have a surface layer of loamy fine sand.

The contrasting inclusions occur as small areas of Brystal, Caid, Dilley, Goldfinch, Hinder, Poteet, Tiocano, Webb, Yologo, and Zavco soils. Also included are some small severely eroded areas and gullied areas. The Brystal, Caid, Webb, and Zavco soils are in landscape positions similar to those of the Duval soil. Dilley, Goldfinch, Hinder, and Yologo soils are in the higher positions. Poteet and Tiocano soils are in the lower positions.

The Duval soil is used mainly as cropland. Some areas are used as rangeland, wildlife habitat, or pasture.

Rangeland productivity is medium. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a wide variety of grasses, forbs, and browse plants for livestock and wildlife. These areas are preferred sites for deer, are good sites for quail, and are used by dove and turkey.

This soil is moderately suited to nonirrigated crops and well suited to irrigated crops. Suitable crops include corn, cotton, cowpeas, forage sorghum, grain sorghum, mung beans, oats, peanuts, wheat, cabbage, cantaloupes, onions, potatoes, squash, spinach, and watermelons. The main management concerns are the hazards of water erosion and wind erosion. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, wind stripcropping, contour or field stripcropping, terraces, diversions, grassed waterways, contour farming, or crop rotations that include high-residue or soil-improving crops may be needed to control erosion, conserve moisture, and maintain tilth.

This soil is well suited to irrigated pasture. Suitable pasture grasses include buffelgrass, blue panicum, coastal bermudagrass, kleingrass, and Wilman lovegrass.

This soil is well suited to most urban uses. Properly designing septic tank absorption fields helps to overcome the depth to bedrock and the restricted permeability.

This soil is moderately suited to most recreational uses. Applications of water or special surfacing material may be needed during dry periods to prevent excessive dustiness in areas that are subject to heavy foot traffic.

The land capability classification is IIIe, nonirrigated, and IIe, irrigated. The range site is Sandy Loam.

DVC—Duval very fine sandy loam, gently undulating. This deep, loamy soil is 40 to 60 inches deep over sandstone bedrock. It is on broad, smooth plains and the foot slopes of hills and ridges. Slopes range from 0 to 3 percent. The shape of the slopes is convex to concave. Individual areas are irregular in shape and range from 20 to several thousand acres in size.

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

Surface layer:

0 to 10 inches, reddish brown very fine sandy loam, neutral

Subsoil:

10 to 18 inches, reddish brown very fine sandy loam, neutral

18 to 26 inches, yellowish red sandy clay loam, mildly alkaline

26 to 48 inches, yellowish red sandy clay loam, moderately alkaline

Substratum:

48 to 60 inches or more, light yellowish brown, fractured, soft sandstone bedrock that has reddish yellow and strong brown strata, moderately alkaline

Important soil properties—

Drainage: well drained

Permeability: moderate above the substratum

Available water capacity: moderate

Root zone: deep

Shrink-swell potential: low

Surface runoff: slow or medium

Flooding: none

Hazard of water erosion: moderate

Hazard of wind erosion: moderate

The Duval soil and similar inclusions make up more than 75 percent of the map unit, and contrasting inclusions make up the rest. The similar inclusions occur as small areas of soils that are like the Duval soil but have sandstone bedrock at a depth of 30 to 40 inches or more than 60 inches or have a dark surface layer. Also included are small areas of Duval soils that have slopes of 3 to 5 percent or have a surface layer of loamy fine sand. About 25 percent of the map unit consists of Duval soil that has slopes of 0 to 1 percent, and 50 percent consists of Duval soil that has slopes of 1 to 3 percent.

The contrasting inclusions occur as small areas of Brystal, Caid, Dilley, Goldfinch, Hindes, Poteet, Tiocano, Webb, Yologo, and Zavco soils. Also included are some small severely eroded areas and gullied areas. The Brystal, Caid, Webb, and Zavco soils are in landscape positions similar to those of the Duval soil. Dilley, Goldfinch, Hindes, and Yologo soils are in the higher positions. Poteet and Tiocano soils are in the lower positions.

This map unit was designed primarily for extensive land uses, such as rangeland. Fewer soil examinations were made in areas of this map unit than in areas of map units designed for more intensive uses. Also, the mapped areas and the areas of inclusions in this map unit are generally larger. The map unit purity is adequate for the anticipated land use.

The Duval soil is used mainly as rangeland and wildlife habitat. Some areas are used as cropland or pasture.

Rangeland productivity is medium. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a wide variety of grasses, forbs, and browse plants for livestock and wildlife. These areas are preferred sites for deer, are good sites for quail, and are used by dove and turkey.

This soil is moderately suited to nonirrigated crops and well suited to irrigated crops. Suitable crops include corn, cotton, cowpeas, forage sorghum, grain sorghum, mung beans, oats, peanuts, wheat, cabbage, cantaloupes, onions, potatoes, squash, spinach, and watermelons. The main management concerns are the hazards of water erosion and wind erosion. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, wind stripcropping, contour or field stripcropping, terraces, diversions, grassed waterways, contour farming, or crop rotations that include high-residue or soil-improving crops may be needed to control erosion, conserve moisture, and maintain tilth.

This soil is well suited to irrigated pasture. Suitable pasture grasses include buffelgrass, blue panicum, coastal bermudagrass, kleingrass, and Wilman lovegrass.

This soil is well suited to most urban uses. Properly designing septic tank absorption fields helps to overcome the depth to bedrock and the restricted permeability.

This soil is moderately suited to most recreational uses. Applications of water or special surfacing material may be needed during dry periods to prevent excessive dustiness in areas that are subject to heavy foot traffic.

The land capability classification is IIIe, nonirrigated, and IIe, irrigated. The range site is Sandy Loam.

GDD—Goldfinch very gravelly sandy loam, undulating. This shallow, very gravelly loamy soil is 10 to 20 inches deep over sandstone bedrock. It is on the summits and shoulder slopes of hills and ridges. Slopes range from 1 to 8 percent. They average about 4 percent. The shape of the slopes is convex. About 10 to 85 percent of the surface is covered with sandstone gravel and cobbles. Individual areas are irregularly shaped or rounded and range from about 15 to 300 acres in size.

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

Surface layer:

0 to 8 inches, reddish brown very gravelly sandy loam, slightly acid

Subsoil:

8 to 14 inches, reddish brown extremely gravelly sandy loam, slightly acid

Substratum:

14 to 30 inches or more, reddish yellow, fractured, soft sandstone bedrock

Important soil properties—

Drainage: well drained

Permeability: moderate above the substratum

Available water capacity: very low

Root zone: shallow

Shrink-swell potential: low

Surface runoff: medium or rapid

Flooding: none

Hazard of water erosion: moderate

Hazard of wind erosion: slight

The Goldfinch soil and similar inclusions make up more than 85 percent of the map unit, and contrasting inclusions make up the rest. The similar inclusions occur as small areas of soils that are like the Goldfinch soil but have less gravel in the surface layer or have sandstone bedrock at a depth of 20 to 30 inches. Also included are small areas of Goldfinch soils that have a surface layer of very cobbly sandy loam or extremely gravelly sandy loam.

The contrasting inclusions occur as small areas of Dilley and Duval soils. Also in this unit are small scattered areas of rock outcrop, soils that are like Dilley soils but have sandstone bedrock at a depth of 7 to 9 inches, and small areas that are covered with large stones. Dilley soils are in landscape positions similar to those of the Goldfinch soil or are in the slightly lower positions. Duval soils are in the lower positions.

This map unit was designed primarily for extensive land uses, such as rangeland. Fewer soil examinations were made in areas of this map unit than in areas of map units designed for more intensive uses. Also, the mapped areas and the areas of inclusions in this map unit are generally larger. The map unit purity is adequate for the anticipated land use.

The Goldfinch soil is used as rangeland and wildlife habitat. Rangeland productivity is low. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a variety of grasses, forbs, and browse for livestock. These are preferred sites for quail, are good sites for dove, and are used by turkey and deer.

This soil is not suited to cropland. The main management concerns are the very gravelly surface layer, the shallow root zone, the very low available water capacity, and the hazard of water erosion.

This soil is not suited to irrigated pasture. Because of the very gravelly surface layer, the very low available water capacity, and the hazard of water erosion, establishing or maintaining pasture grasses is impractical.

This soil is poorly suited to most urban uses. Properly designing septic tank absorption fields helps to overcome the depth to bedrock. Because of the shallow root zone, droughtiness is a limitation in areas used for lawns and landscaping. Because of the very gravelly surface layer, additions of topsoil may be needed in these areas. The depth to bedrock limits the suitability for shallow excavations and for all kinds of building site development and sanitary facilities.

This soil is poorly suited to most recreational uses. The depth to sandstone bedrock and the very low available water capacity inhibit the growth of vegetation in areas that are subject to heavy foot traffic. Because of the high content of gravel and the slope, special surfacing material or additions of topsoil may be needed in these areas. Additions of topsoil may be needed in areas used for golf fairways.

The land capability classification is Vlls, nonirrigated and irrigated. The range site is Gravelly Ridge.

HYD—Hindes-Yologo complex, undulating. These very gravelly, loamy soils are on hills and ridges. The Hindes soil is very deep. The Yologo soil is shallow or very shallow. It is 7 to 20 inches deep over cemented caliche. Slopes range from 1 to 8 percent. The shape of the slopes is convex. Individual areas are subrounded or irregularly shaped and range from 8 to several hundred acres in size. The Hindes and Yologo soils occur as areas so intricately mixed that they could not be mapped separately.

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

Surface layer:

0 to 7 inches, dark reddish brown very gravelly sandy clay loam, neutral

Subsoil:

7 to 30 inches, reddish brown extremely gravelly clay, neutral

30 to 62 inches or more, pink, soft caliche that has a texture of gravelly clay loam, moderately alkaline

Important properties of the Hindes soil—

Drainage: well drained

Permeability: moderately slow

Available water capacity: very low

Root zone: very deep

Shrink-swell potential: low

Surface runoff: medium

Flooding: none

Hazard of water erosion: moderate

Hazard of wind erosion: slight

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

Surface layer:

0 to 6 inches, reddish brown very gravelly sandy clay loam, slightly acid

Subsoil:

6 to 17 inches, reddish brown extremely gravelly sandy clay loam, neutral

Underlying layers:

17 to 20 inches, pinkish white, strongly cemented caliche, moderately alkaline

20 to 30 inches or more, pinkish white, weakly cemented caliche, moderately alkaline

Important properties of the Yologo soil—

Drainage: well drained

Permeability: moderate above the underlying layers

Available water capacity: very low

Root zone: very shallow or shallow

Shrink-swell potential: low

Surface runoff: medium

Flooding: none

Hazard of water erosion: moderate

Hazard of wind erosion: slight

Based on four transects, the best estimate is that the Hindes soil and similar inclusions make up 53 percent of the map unit, the Yologo soil and similar inclusions make up 45 percent, and contrasting soils make up 2 percent. There is an 80 percent probability that the true composition of the whole map unit is 50 to 56 percent Hindes soil, 42 to 48 percent Yologo soil, and 0 to 8 percent contrasting soils.

The similar inclusions occur as small areas of soils that are like the Yologo soil but have cemented caliche at a depth of 20 to 30 inches and soils that are like the Hindes and Yologo soils but have less gravel in the surface layer or have a light colored surface layer. Also included are small areas of soils that are like the Hindes soil but have slopes of 12 to 15 percent, small areas of soils that are like the Yologo soil but have slopes of 8 to 12 percent, and small areas of Hindes soils that have slopes of 8 to 12 percent.

The contrasting inclusions occur as small areas of Brystal, Caid, Dilley, Duval, Goldfinch, Bookout, Webb, and Zavco soils. Also included are small areas of caliche and gravel pits. Dilley and Goldfinch soils are in landscape positions similar to those of the Hindes and Yologo soils or are in the slightly lower positions. The other contrasting soils are in the lower positions.

This map unit was designed primarily for extensive land uses, such as rangeland. Fewer soil examinations were made in areas of this map unit than in areas of map units designed for more intensive uses. Also, the mapped areas and the areas of inclusions in this map unit are generally larger. The map unit purity is adequate for the anticipated land use.

The Hindes and Yologo soils are used as rangeland and wildlife habitat. They are a potential source of caliche and gravel for use in construction.

Rangeland productivity is low. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a variety of grasses, forbs, and browse for livestock. These are preferred sites for quail, are good sites for dove, and are used by turkey and deer.

These soils are not suited to cropland. The main management concerns are the very gravelly surface layer, the very low or low available water capacity, and the hazard of water erosion.

These soils are not suited to irrigated pasture. Because of the very gravelly surface layer, the very low available water capacity, and the hazard of water erosion, establishing or maintaining pasture grasses is impractical.

The Hindes soil is moderately suited to most urban uses, and the Yologo soil is poorly suited. Properly designing septic tank absorption fields helps to overcome the restricted permeability in the Hindes soil and the depth to a cemented pan in the Yologo soil. Because of the very gravelly surface layer in both soils, additions of topsoil may be needed in areas used for lawns and landscaping. Because of the shallow root zone and the high content of gravel, droughtiness is a limitation in areas where the Yologo soil is used for lawns and landscaping. The depth to cemented caliche in the Yologo soil limits the suitability for shallow excavations and for all kinds of building site development and sanitary facilities.

These soils are poorly suited to most recreational uses. The shallow root zone in the Yologo soil and the very low available water capacity in both soils inhibit the growth of vegetation in areas that are subject to heavy foot traffic. Because of the high content of gravel, additions of topsoil may be needed in areas used for golf fairways.

The land capability classification is VIIc, nonirrigated. The range site is Gravelly Ridge.

Im—Imogene very fine sandy loam, occasionally flooded. This very deep, nearly level, loamy soil is on low stream terraces and flood plains along creeks. It has a sodic subsoil. Slopes range from 0 to 2 percent and average about 0.5 percent. The shape of the slopes is linear or concave. Individual areas are long and narrow and range from 60 to more than 1,000 acres in size.

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

Surface layer:

0 to 4 inches, grayish brown very fine sandy loam, nonsaline, neutral

Subsoil:

4 to 11 inches, grayish brown sandy clay loam, very slightly saline, sodic, moderately alkaline

11 to 22 inches, light gray sandy clay loam, moderately saline, sodic, moderately alkaline

22 to 48 inches, light gray sandy clay loam that has dark brown mottles, strongly saline, sodic, moderately alkaline

48 to 64 inches, light gray loam that has dark brown mottles, strongly saline, sodic, mildly alkaline

Substratum:

64 to 80 inches or more, white loam that has dark brown mottles, moderately saline, sodic, neutral

Important soil properties—

Drainage: moderately well drained

Permeability: very slow

Available water capacity: low

Root zone: very deep; however, the sodic subsoil restricts the movement of air and water and root development

Shrink-swell potential: moderate (the soil shrinks as it dries and swells as it becomes moist)

Surface runoff: slow

Flooding: occasional (less often than 50 times in 100 years but more often than 5 times in 100 years), usually lasting less than 2 days and having low velocity

Hazard of water erosion: moderate; during periods of flooding, scouring of bare areas may occur, especially near stream channels

Hazard of wind erosion: moderate

The Imogene soil and similar inclusions make up more than 85 percent of the map unit, and contrasting inclusions make up the rest. The similar inclusions occur as small areas of soils that are like the Imogene soil but have more clay in the upper part of the subsoil. Also included are small areas of Imogene soils that have a surface layer of loam.

The contrasting inclusions occur as small areas of Brundage, Caid, Chacon, Cochina, Coquat, Cotulla, Lasalle, Mata, Maverick, Moglia, Monteola, Poteet, and Tiocano soils. Also included are small areas of stream channels. Cochina, Coquat, Poteet, and Tiocano soils are in landscape positions similar to those of the Imogene soil or are in the slightly lower positions. The other contrasting soils are in the higher positions.

The Imogene soil is used as rangeland and wildlife habitat. Rangeland productivity is medium. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a wide variety of

grasses, forbs, and browse plants for livestock and wildlife. These areas are preferred sites for deer, are good sites for quail, and are used by dove and turkey.

This soil is poorly suited to nonirrigated crops and moderately suited to irrigated crops. The salinity and excess sodium in the subsoil limit the choice of suitable crops. The main management concerns are the low available water capacity, the hazards of water erosion and wind erosion, the very slow permeability, the hazard of flooding, and the salinity in the subsoil. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, wind stripcropping, diversions, grassed waterways, or crop rotations that include high-residue or soil-improving crops may be needed to control erosion, conserve moisture, reduce the salinity, and maintain tilth.

This soil is poorly suited to irrigated pasture. The salinity of the soil can be increased by irrigation. The main management concern is maintaining an adequate plant cover to protect against scouring during periods of flooding.

The flooding is the main hazard affecting most urban uses. Areas used for these purposes should be protected from flooding. The salinity and excess sodium in the subsoil result in droughtiness and thus inhibit the growth of vegetation in areas used for landscaping. Properly designing building foundations helps to prevent the structural damage caused by shrinking and swelling. Because of low soil strength, suitable base material is needed on sites for local roads and streets.

This soil is poorly suited to most recreational uses. It should not be used as a site for camp areas unless it is protected from flooding. The season, duration, and frequency of flooding should be considered in planning playgrounds and other recreational areas. Because of the very slow permeability, special surfacing material may be needed in areas that are subject to heavy foot traffic during wet periods. The salinity and excess sodium in the subsoil inhibit the growth of vegetation. As a result, special surfacing material may be needed in areas that are subject to heavy foot traffic.

The land capability classification is IVs, nonirrigated, and IIIs, irrigated. The range site is Tight Sandy Loam.

LaA—Lasalle clay, 0 to 1 percent slopes. This very deep, saline, clayey soil is on smooth plains. The shape of the slopes is linear or convex. Individual areas are irregularly shaped or subrounded and range from about 20 to 250 acres in size.

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

Surface layer:

0 to 6 inches, reddish brown clay, nonsaline, moderately alkaline

6 to 26 inches, light reddish brown clay, slightly saline, moderately alkaline

Subsoil:

26 to 60 inches or more, light reddish brown clay, moderately saline, moderately alkaline

Important soil properties—

Drainage: moderately well drained

Permeability: very slow

Available water capacity: low

Root zone: very deep; however, the clayey subsoil restricts the movement of air and water and root development

Shrink-swell potential: very high (the soil shrinks and forms wide, deep cracks as it dries and swells as it becomes moist)

Surface runoff: slow

Flooding: none

Hazard of water erosion: slight

Hazard of wind erosion: moderate

The Lasalle soil and similar inclusions make up more than 85 percent of the map unit, and contrasting inclusions make up the rest. Included in mapping are small areas of soils that are like the Lasalle soil but are nonsaline to a depth of 20 inches or more. Also included are small areas of Lasalle soils that have slopes of 1 to 3 percent.

The contrasting inclusions occur as small areas of Brundage, Cotulla, Imogene, Maverick, Moglia, Montell, and Viboras soils. Brundage, Cotulla, Montell, and Viboras soils are in landscape positions similar to those of the Lasalle soil. Maverick and Moglia soils are in the higher positions. Imogene soils are in the lower positions.

The Lasalle soil is used mainly as cropland. Some areas are used as rangeland, wildlife habitat, or pasture.

Rangeland productivity is medium. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a variety of forage for livestock and wildlife. These areas are used by deer, quail, dove, and turkey, but they are not preferred sites.

This soil is poorly suited to nonirrigated crops and moderately suited to irrigated crops. The main crops are grain sorghum and forage sorghum. The alkaline reaction in the surface layer and the salinity in the subsoil limit the choice of suitable crops. The main management concerns are the low available water capacity, the salinity in the subsoil, the very slow permeability, and the hazard of wind erosion. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, diversions, grassed waterways, or crop rotations that include high-residue or soil-improving crops may be needed to control erosion, conserve moisture, reduce the salinity, and maintain tilth.

This soil is poorly suited to irrigated pasture. Suitable pasture grasses include kleingrass, blue panicum, and improved bermudagrasses. The salinity of the soil can be increased by irrigation.

This soil is poorly suited to most urban uses. Properly designing septic tank absorption fields helps to overcome the restricted permeability. The salinity and excess sodium in the subsoil inhibit the growth of vegetation in areas used for lawns and landscaping. Because of the clayey texture, the soil can be worked by earth-moving equipment only within a narrow range in moisture content. Properly designing building foundations and paved roads helps to prevent the structural or road damage caused by shrinking and swelling. Because of low soil strength, suitable base material is needed on sites for local roads and streets.

This soil is moderately suited to most recreational uses. Because of the very slow permeability and the clayey surface layer, special surfacing material may be needed in areas that are subject to heavy foot traffic during wet periods. The salinity and excess sodium in the subsoil inhibit the growth of vegetation in areas that are subject to heavy foot traffic.

The land capability classification is IVs, nonirrigated, and IIIs, irrigated. The range site is Saline Clay.

LAB—Lasalle clay, gently undulating. This very deep, saline, clayey soil is on smooth plains. Slopes range from 0 to 3 percent. The shape of the slopes is linear or concave. Individual areas are irregular in shape and range from about 20 to 2,000 acres in size.

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

Surface layer:

0 to 5 inches, brown clay, nonsaline, moderately alkaline

5 to 24 inches, brown clay, slightly saline, moderately alkaline

Subsoil:

24 to 58 inches, light reddish brown clay, moderately saline, moderately alkaline

58 to 72 inches or more, reddish brown clay, moderately saline, moderately alkaline

Important soil properties—

Drainage: moderately well drained

Permeability: very slow

Available water capacity: low

Root zone: very deep; however, the clayey subsoil restricts the movement of air and water and root development

Shrink-swell potential: very high (the soil shrinks and forms wide, deep cracks as it dries and swells as it becomes moist)

Surface runoff: slow or medium

Flooding: none

Hazard of water erosion: moderate

Hazard of wind erosion: moderate

The Lasalle soil and similar inclusions make up more than 80 percent of the map unit, and contrasting inclusions make up the rest. More than 35 percent of the map unit consists of Lasalle soil that has slopes of 0 to 1 percent, and 45 percent consists of Lasalle soil that has slopes of 1 to 3 percent. Included in mapping are small areas of soils that are like the Lasalle soil but are nonsaline to a depth of 20 inches or more.

The contrasting inclusions occur as small areas of Brundage, Cotulla, Imogene, Maverick, Moglia, Montell, and Viboras soils. Brundage, Cotulla, Montell, and Viboras soils are in landscape positions similar to those of the Lasalle soil. Maverick and Moglia soils are in the higher positions. Imogene soils are in the lower positions.

This map unit was designed primarily for extensive land uses, such as rangeland. Fewer soil examinations were made in areas of this map unit than in areas of map units designed for more intensive uses. Also, the mapped areas and the areas of inclusions in this map unit are generally larger. The map unit purity is adequate for the anticipated land use.

The Lasalle soil is used mainly as rangeland and wildlife habitat. Some areas are used as cropland.

Rangeland productivity is medium. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a variety of forage for livestock and wildlife. These areas are used by deer, quail, dove, and turkey, but they are not preferred sites.

This soil is poorly suited to cropland. Suitable crops include grain sorghum, forage sorghum, corn, cotton, oats, and wheat. The alkaline reaction in the surface layer and the salinity in the subsoil limit the choice of suitable crops. The main management concerns are the low available water capacity, the salinity in the subsoil, the very slow permeability, and the hazards of water erosion and wind erosion. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, contour or field stripcropping, terraces, diversions, grassed waterways, contour farming, or crop rotations that include high-residue or soil-improving crops may be needed to control erosion, conserve moisture, reduce the salinity, and maintain tilth.

This soil is poorly suited to irrigated pasture. Suitable pasture grasses include kleingrass, blue panicum, and improved bermudagrasses. The salinity of the soil can be increased by irrigation.

This soil is poorly suited to most urban uses. Properly designing septic tank absorption fields helps to overcome the restricted permeability. The salinity and excess sodium in the subsoil inhibit the growth of vegetation in areas used for lawns and landscaping. Because of the clayey texture, the soil can be worked by earth-moving equipment only within a narrow range in moisture content. Properly designing

building foundations and paved roads helps to prevent the structural or road damage caused by shrinking and swelling. Because of low soil strength, suitable base material is needed on sites for local roads and streets.

This soil is moderately suited to most recreational uses. Because of the very slow permeability and the clayey surface layer, special surfacing material may be needed in areas that are subject to heavy foot traffic during wet periods. The salinity and excess sodium in the subsoil inhibit the growth of vegetation in areas that are subject to heavy foot traffic.

The land capability classification is IVe, nonirrigated and irrigated. The range site is Saline Clay.

MAC—Mata gravelly sandy clay loam, gently undulating. This deep, gravelly loamy soil is on smooth plains high on the landscape. Slopes range from 0 to 5 percent. The shape of the slopes is convex or linear. Individual areas are irregular in shape and range from 20 to several thousand acres in size.

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

Surface layer:

0 to 7 inches, pale brown gravelly sandy clay loam, nonsaline, mildly alkaline

Subsoil:

7 to 16 inches, pale brown very gravelly clay loam, nonsaline, mildly alkaline

16 to 25 inches, light yellowish brown extremely gravelly clay loam, slightly saline, mildly alkaline

25 to 42 inches, very pale brown fine sandy loam, moderately saline, moderately alkaline

42 to 54 inches, very pale brown gravelly sandy loam, moderately saline, moderately alkaline

Substratum:

54 to 72 inches or more, white, fractured, soft shale intermingled with clay, moderately saline, moderately alkaline

Important soil properties—

Drainage: well drained

Permeability: moderate above the substratum

Available water capacity: low

Root zone: deep

Shrink-swell potential: low

Surface runoff: medium

Flooding: none

Hazard of water erosion: moderate

Hazard of wind erosion: slight

The Mata soil and similar inclusions make up more than 75 percent of the map unit, and contrasting inclusions make up the rest. The similar inclusions occur as small areas of soils that are like the Mata soil but have a dark surface layer. Also included are areas of Mata soils that have a surface layer of clay loam, gravelly clay loam, or sandy clay loam.

The contrasting inclusions occur as small areas of Altita, Brundage, Charco, Chacon, Cochina, Cotulla, Imogene, Lasalle, Moglia, Maverick, and Montell soils. Altita, Chacon, Charco, and Moglia soils are in landscape positions similar to those of the Mata soil or are in the slightly lower positions. The other contrasting soils are in the lower positions.

This map unit was designed primarily for extensive land uses, such as rangeland. Fewer soil examinations were made in areas of this map unit than in areas of map

units designed for more intensive uses. Also, the mapped areas and the areas of inclusions in this map unit are generally larger. The map unit purity is adequate for the anticipated land use.

The Mata soil is used as rangeland and wildlife habitat. Rangeland productivity is low. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a wide variety of grasses, forbs, and browse plants for livestock and wildlife. These areas are preferred sites for deer, are good sites for quail, and are used by dove and turkey.

This soil is not suited to cropland. The main management concerns are the salinity in the subsoil, the low available water capacity, and the hazard of water erosion.

This soil is moderately suited to irrigated pasture. The salinity of the soil can be increased by irrigation.

This soil is moderately suited to most urban uses. Properly designing septic tank absorption fields helps to overcome the restricted permeability and the depth to soft shale bedrock. The low available water capacity inhibits the growth of vegetation in areas used for lawns and landscaping.

This soil is moderately suited to most recreational uses. Because of the gravelly surface layer, special surfacing material or additions of topsoil may be needed in areas that are subject to heavy foot traffic. The low available water capacity inhibits the growth of vegetation in these areas.

The land capability classification is VIs, nonirrigated. The range site is Saline Clay Loam.

MCC—Maverick clay, gently undulating. This moderately deep, saline, clayey soil is on smooth plains. Slopes range from 1 to 5 percent. The shape of the slopes is convex or linear. Individual areas are irregular in shape and range from 20 to several thousand acres in size.

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

Surface layer:

0 to 8 inches, grayish brown clay, slightly saline, moderately alkaline

Subsoil:

8 to 16 inches, light brownish gray clay, moderately saline, moderately alkaline

16 to 28 inches, pale brown clay, moderately saline, moderately alkaline

Substratum:

28 to 60 inches or more, light gray, fractured, soft shale bedrock that has pale yellow mottles, moderately saline, moderately alkaline

Important soil properties—

Drainage: well drained

Permeability: slow above the substratum

Available water capacity: very low

Root zone: moderately deep; however, the clayey subsoil restricts the movement of air and water and root development

Shrink-swell potential: high (the soil shrinks as it dries and swells as it becomes moist)

Surface runoff: rapid

Flooding: none

Hazard of water erosion: severe

Hazard of wind erosion: moderate

The Maverick soil and similar inclusions make up more than 75 percent of the map unit, and contrasting inclusions make up the rest. The similar inclusions occur as

small areas of soils that are like the Maverick soil but have soft shale bedrock at a depth of 15 to 20 or 40 to 45 inches. Also included are small areas of Maverick soils that have a surface layer of clay loam, gravelly clay loam, or gravelly clay or that have slopes of 5 to 8 percent.

The contrasting inclusions in this map unit include small areas of Brundage, Catarina, Copita, Cotulla, Imogene, Lasalle, Moglia, Montell, and Viboras soils. Copita and Viboras soils are in landscape positions similar to those of the Maverick soil or are in the slightly lower positions, and Moglia soils are in the higher positions. The other contrasting soils are in the lower positions.

This map unit was designed primarily for extensive land uses, such as rangeland. Fewer soil examinations were made in areas of this map unit than in areas of map units designed for more intensive uses. Also, the mapped areas and the areas of inclusions in this map unit are generally larger. The map unit purity is adequate for the anticipated land use.

The Maverick soil is used as rangeland and wildlife habitat. Rangeland productivity is low. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a variety of forage for livestock and wildlife. These areas are used by deer, quail, dove, and turkey, but they are not preferred sites.

This soil is not suited to nonirrigated crops and is poorly suited to irrigated crops. The alkaline reaction in the surface layer and the salinity in the subsoil limit the choice of suitable crops. The main management concerns are the very low available water capacity, the hazards of water erosion and wind erosion, the slow permeability, and the salinity in the subsoil. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, vegetative windstrips, wind stripcropping, contour or field stripcropping, terraces, diversions, grassed waterways, contour farming, reduced tillage, or crop rotations that include high-residue or soil-improving crops may be needed to control erosion, conserve moisture, reduce the salinity, and maintain tilth.

This soil is not suited to irrigated pasture. The salinity of the soil can be increased by irrigation.

This soil is poorly suited to most urban uses. Properly designing septic tank absorption fields helps to overcome the restricted permeability and the depth to soft shale bedrock. The salinity inhibits the growth of vegetation in areas used for lawns and landscaping. Because of the clayey texture, the soil can be worked by earth-moving equipment only within a narrow range in moisture content. Properly designing building foundations and paved roads helps to prevent the structural or road damage caused by shrinking and swelling. Because of low soil strength, suitable base material is needed on sites for local roads and streets.

This soil is moderately suited to most recreational uses. Because of the very slow permeability and the clayey surface layer, special surfacing material may be needed in areas that are subject to heavy foot traffic during wet periods. The salinity inhibits the growth of vegetation in areas that are subject to heavy foot traffic.

The land capability classification is V1e, nonirrigated, and IVe, irrigated. The range site is Rolling Hardland.

MGC—Moglia clay loam, gently undulating. This very deep, loamy soil is on smooth plains high on the landscape. Slopes range from 0 to 3 percent. The shape of the slopes is convex or linear. Individual areas are irregular in shape and range from 8 to several hundred acres in size.

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

Surface layer:

0 to 12 inches, grayish brown clay loam, nonsaline, mildly alkaline

Subsoil:

- 12 to 20 inches, very pale brown clay loam, nonsaline, mildly alkaline
- 20 to 32 inches, very pale brown clay loam, moderately saline, mildly alkaline
- 32 to 64 inches, very pale brown clay loam, moderately saline, moderately alkaline
- 64 to 72 inches or more, very pale brown clay loam, moderately saline, moderately alkaline

Important soil properties—

Drainage: well drained*Permeability:* moderately slow*Available water capacity:* low*Root zone:* very deep; however, the subsoil restricts the movement of air and water and root development*Shrink-swell potential:* moderate (the soil shrinks as it dries and swells as it becomes moist)*Surface runoff:* medium*Flooding:* none*Hazard of water erosion:* moderate*Hazard of wind erosion:* moderate

The Moglia soil and similar inclusions make up more than 75 percent of the map unit, and contrasting inclusions make up the rest. The similar inclusions occur as small areas of soils that are like the Moglia soil but have a dark surface layer. Also included are small areas of Moglia soils that have a surface layer of sandy clay loam or have slopes of 3 to 5 percent.

The contrasting inclusions occur as small areas of Aguilares, Altita, Brundage, Brystal, Charco, Chacon, Cochina, Cotulla, Imogene, Lasalle, Mata, Maverick, Montell, and Monteola soils. Aguilares, Altita, Chacon, Charco, and Mata soils are in landscape positions similar to those of the Moglia soil. The other contrasting soils are in the lower positions.

This map unit was designed primarily for extensive land uses, such as rangeland. Fewer soil examinations were made in areas of this map unit than in areas of map units designed for more intensive uses. Also, the mapped areas and the areas of inclusions in this map unit are generally larger. The map unit purity is adequate for the anticipated land use.

The Moglia soil is used as rangeland and wildlife habitat. Rangeland productivity is medium. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a wide variety of grasses, forbs, and browse plants for livestock and wildlife. These areas are preferred sites for deer, are good sites for quail, and are used by dove and turkey.

This soil is not suited to nonirrigated crops and is poorly suited to irrigated crops. The alkaline reaction in the surface layer limits the choice of suitable crops. The main management concerns are the low available water capacity, the hazards of water erosion and wind erosion, and the salinity in the subsoil. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, wind stripcropping, contour or field stripcropping, terraces, diversions, grassed waterways, contour farming, or crop rotations that include high-residue or soil-improving crops may be needed to control erosion, conserve moisture, reduce the salinity, and maintain tilth.

This soil is moderately suited to irrigated pasture. The salinity of the soil can be increased by irrigation.

This soil is poorly suited to most urban uses.

Properly designing septic tank absorption fields helps to overcome the restricted permeability. Properly designing building foundations helps to prevent the structural

damage caused by shrinking and swelling. Because of low soil strength, suitable base material is needed on sites for local roads and streets.

This soil is moderately suited to most recreational uses. The salinity inhibits the growth of vegetation in areas used for golf fairways.

The land capability classification is V1e, nonirrigated, and 11e, irrigated. The range site is Saline Clay Loam.

MNA—Montell clay, saline, nearly level. This very deep, saline, clayey soil is on smooth plains on stream terraces. Slopes range from 0 to 2 percent. The shape of the slopes is linear or concave. Individual areas are elongated or irregularly shaped and range from 8 to 200 acres in size.

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

Surface layer:

0 to 12 inches, gray clay, nonsaline, moderately alkaline

Subsoil:

12 to 28 inches, gray clay, moderately saline, moderately alkaline

28 to 38 inches, pale brown clay, moderately saline, moderately alkaline

38 to 60 inches or more, pale brown clay, moderately saline, moderately alkaline

Important soil properties—

Drainage: moderately well drained

Permeability: very slow

Available water capacity: low

Root zone: very deep; however, the clayey subsoil restricts the movement of air and water and root development

Shrink-swell potential: very high (the soil shrinks and forms wide, deep cracks as it dries and swells as it becomes moist)

Surface runoff: slow

Flooding: none

Hazard of water erosion: slight

Hazard of wind erosion: moderate

The Montell soil and similar inclusions make up more than 85 percent of the map unit, and contrasting inclusions make up the rest. The similar inclusions occur as small areas of Montell soils that are occasionally flooded or that are nonsaline to a depth of 20 inches or more.

The contrasting inclusions occur as small areas of Aguilares, Brundage, Catarina, Cotulla, Imogene, Maverick, Moglia, and Viboras soils. Brundage, Catarina, Cotulla, and Viboras soils are in landscape positions similar to those of the Montell soil. Aguilares, Maverick, and Moglia soils are in the higher positions. Imogene soils are in the lower positions.

This map unit was designed primarily for extensive land uses, such as rangeland. Fewer soil examinations were made in areas of this map unit than in areas of map units designed for more intensive uses. Also, the mapped areas and the areas of inclusions in this map unit are generally larger. The map unit purity is adequate for the anticipated land use.

The Montell soil is used as rangeland and wildlife habitat. Rangeland productivity is medium. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a variety of forage for livestock and wildlife. These areas are used by deer, quail, dove, and turkey, but they are not preferred sites.

This soil is not suited to cropland. The main management concerns are the low available water capacity, the very slow permeability, the salinity in the subsoil, and the hazard of wind erosion.

This soil is poorly suited to irrigated pasture. The salinity of the soil can be increased by irrigation.

This soil is poorly suited to most urban uses. Properly designing septic tank absorption fields helps to overcome the restricted permeability. The salinity and excess sodium in the subsoil inhibit the growth of vegetation in areas used for lawns and landscaping. Properly designing building foundations and paved roads helps to prevent the structural or road damage caused by shrinking and swelling. Because of the clayey texture, the soil can be worked by earth-moving equipment only within a narrow range in moisture content. Because of low soil strength, suitable base material is needed on sites for local roads and streets.

This soil is moderately suited to most recreational uses. Because of the very slow permeability and the clayey surface layer, special surfacing material may be needed in areas that are subject to heavy foot traffic during wet periods. The salinity and excess sodium inhibit the growth of vegetation in areas that are subject to heavy foot traffic.

The land capability classification is VIs, nonirrigated. The range site is Clay Flat.

Mn—Montell clay, saline, occasionally flooded. This very deep, saline, clayey soil is on smooth plains. Slopes are 0 to 1 percent. They are mainly less than 0.5 percent. The shape of the slopes is linear or concave. Individual areas are elongated or irregularly shaped and range from 6 to 200 acres in size.

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

Surface layer:

0 to 12 inches, gray clay, nonsaline, moderately alkaline

Subsoil:

12 to 30 inches, gray clay, slightly saline, moderately alkaline

30 to 44 inches, light gray clay, moderately saline, moderately alkaline

44 to 70 inches or more, light brownish gray clay, moderately saline, moderately alkaline

Important soil properties—

Drainage: moderately well drained

Permeability: very slow

Available water capacity: low

Root zone: very deep; however, the clayey subsoil restricts the movement of air and water and root development

Shrink-swell potential: very high (the soil shrinks and forms wide, deep cracks as it dries and swells as it becomes moist)

Surface runoff: slow

Flooding: occasional (less often than 50 times in 100 years but more often than 5 times in 100 years), usually lasting less than 2 days and having low velocity

Hazard of water erosion: slight; during periods of flooding, however, scouring of bare areas may occur, especially near stream channels

Hazard of wind erosion: moderate

The Montell soil and similar inclusions make up more than 85 percent of the map unit, and contrasting inclusions make up the rest. Included in mapping are small areas of Montell soils that are nonsaline to a depth of 20 inches or more.

The contrasting inclusions occur as small areas of Aguilares, Arroyada, Brundage, Catarina, Cochina, Coquat, Cotulla, Imogene, Moglia, and Viboras soils. Cochina and Imogene soils are in landscape positions similar to those of the Montell soil. Aguilares, Brundage, Catarina, Cotulla, Moglia, and Viboras soils are in the higher positions. Arroyada and Coquat soils are in the lower positions on the flood plain.

The Montell soil is used as rangeland and wildlife habitat. Rangeland productivity is medium. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a variety of forage for livestock and wildlife. These areas are used by deer, quail, dove, and turkey, but they are not preferred sites.

This soil is not suited to cropland. The main management concerns are the low available water capacity, the hazard of flooding, the very slow permeability, the salinity in the subsoil, and the hazard of wind erosion.

This soil is poorly suited to irrigated pasture. The main management concern is maintaining an adequate plant cover to protect against scouring during periods of flooding. The salinity of the soil can be increased by irrigation.

The flooding is the main hazard affecting most urban uses. Areas used for these purposes should be protected from flooding. Properly designing septic tank absorption fields helps to overcome the restricted permeability. The salinity and excess sodium in the subsoil limit the growth of vegetation in areas used for lawns and landscaping. Properly designing building foundations and paved roads helps to prevent the structural or road damage caused by shrinking and swelling. Because of the clayey texture, the soil can be worked by earth-moving equipment only within a narrow range in moisture content. Because of low soil strength, suitable base material is needed on sites for local roads and streets.

This soil is moderately suited to most recreational uses. It should not be used as a site for camp areas unless it is protected from flooding. The season, duration, and frequency of flooding should be considered in planning playgrounds and other recreational areas. Because of the very slow permeability and the clayey surface layer, special surfacing material may be needed in areas that are subject to heavy foot traffic during wet periods. The salinity and excess sodium in the subsoil inhibit the growth of vegetation in areas that are subject to heavy foot traffic.

The land capability classification is VIs, nonirrigated and irrigated. The range site is Clay Flat.

MTC—Monteola clay, saline, gently undulating. This very deep, saline, clayey soil is on smooth plains. Slopes range from 0 to 3 percent. They are mainly less than 2 percent. The shape of the slopes is convex or linear. Individual areas are subrounded, elongated, or irregularly shaped and range from 20 to several hundred acres in size.

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

Surface layer:

0 to 15 inches, dark gray clay, nonsaline, mildly alkaline

Subsoil:

15 to 24 inches, dark gray clay, slightly saline, mildly alkaline

24 to 37 inches, dark grayish brown clay, moderately saline, mildly alkaline

37 to 57 inches, light yellowish brown clay, moderately saline, mildly alkaline

57 to 62 inches, brownish yellow clay, moderately saline, mildly alkaline

Important soil properties—

Drainage: moderately well drained

Permeability: very slow

Available water capacity: low

Root zone: very deep; however, the clayey subsoil restricts the movement of air and water and root development

Shrink-swell potential: very high (the soil shrinks and forms wide, deep cracks as it dries and swells as it becomes moist)

Surface runoff: slow or medium

Flooding: none

Hazard of water erosion: moderate

Hazard of wind erosion: moderate

The Monteola soil and similar inclusions make up more than 85 percent of the map unit, and contrasting inclusions make up the rest. The similar inclusions occur as small areas of soils that are like the Monteola soil but have a light colored surface layer. Also included are small areas of Monteola soils that have a surface layer of gravelly clay or have slopes of 3 to 5 percent.

The contrasting inclusions occur as small areas of Altita, Brundage, Chacon, Charco, Imogene, Moglia, and Zavco soils. Altita, Brundage, and Charco soils are in landscape positions similar to those of the Monteola soil. Chacon, Moglia, and Zavco soils are in the higher positions. Imogene soils are in the lower positions.

This map unit was designed primarily for extensive land uses, such as rangeland. Fewer soil examinations were made in areas of this map unit than in areas of map units designed for more intensive uses. Also, the mapped areas and the areas of inclusions in this map unit are generally larger. The map unit purity is adequate for the anticipated land use.

The Monteola soil is used as rangeland and wildlife habitat. Rangeland productivity is medium. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a variety of forage for livestock and wildlife. These areas are used by deer, quail, dove, and turkey, but they are not preferred sites.

This soil is poorly suited to cropland. Suitable crops include grain sorghum, oats, and wheat. The alkaline reaction in the surface layer and the salinity in the subsoil limit the choice of suitable crops. The main management concerns are the low available water capacity, the salinity in the subsoil, the very slow permeability, and the hazards of water erosion and wind erosion. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, contour or field stripcropping, terraces, diversions, grassed waterways, contour farming, or crop rotations that include high-residue or soil-improving crops may be needed to control erosion, conserve moisture, reduce the salinity, and maintain tilth.

This soil is poorly suited to irrigated pasture. The salinity of the soil can be increased by irrigation.

This soil is poorly suited to most urban uses. Properly designing septic tank absorption fields helps to overcome the restricted permeability. The salinity in the subsoil inhibits the growth of vegetation in areas used for lawns and landscaping. Because of the clayey texture, the soil can be worked by earth-moving equipment only within a narrow range in moisture content. Properly designing building foundations and paved roads helps to prevent the structural or road damage caused by shrinking and swelling. Because of low soil strength, suitable base material is needed on sites for local roads and streets.

This soil is moderately suited to most recreational uses. Because of the very slow permeability and the clayey surface layer, special surfacing material may be needed in areas that are subject to heavy foot traffic during wet periods. The salinity inhibits the growth of vegetation in areas that are subject to heavy foot traffic.

The land capability classification is IVe, nonirrigated and irrigated. The range site is Saline Clay.

Pt—Poteet very fine sandy loam, occasionally flooded. This very deep, nearly level, loamy soil is in narrow drainageways on uplands. Slopes are 0 to 1 percent. The shape of the slopes is concave or linear. Individual areas are long and narrow and range from about 20 to several hundred acres in size.

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

Surface layer:

0 to 22 inches, reddish brown very fine sandy loam, neutral

Subsoil:

22 to 28 inches, reddish brown sandy clay loam that has yellowish red and brown mottles, slightly acid

28 to 34 inches, reddish brown sandy clay loam that has red and dark brown mottles, slightly acid

34 to 48 inches, yellowish red sandy clay that has red and dark brown mottles, slightly acid

48 to 64 inches or more, reddish yellow sandy clay loam that has yellowish red and dark brown mottles, neutral

Important soil properties—

Drainage: moderately well drained

Permeability: slow

Available water capacity: high

Root zone: very deep; however, the clayey subsoil restricts the movement of air and water and root development

Shrink-swell potential: moderate (the soil shrinks as it dries and swells as it becomes moist)

Surface runoff: slow

Flooding: occasional (less often than 50 times in 100 years but more often than 5 times in 100 years), usually lasting less than 2 days and having low velocity

Hazard of water erosion: slight; during periods of flooding, however, scouring of bare areas may occur, especially near stream channels

Hazard of wind erosion: moderate

The Poteet soil and similar inclusions make up more than 85 percent of the map unit, and contrasting inclusions make up the rest. The similar inclusions occur as small areas of soils that are like the Poteet soil but have 4 to 12 inches of loamy overwash or have a dark surface layer and subsoil that, combined, are more than 40 inches thick. Also included are small areas of Poteet soils that are flooded more often than 50 times in 100 years. They generally are adjacent to stream channels.

The contrasting inclusions occur as small areas of Brystal, Chacon, Cochina, Duval, Imogene, Tiocano, Webb, and Zavco soils. Also included are small areas of stream channels. Cochina and Imogene soils are in landscape positions similar to those of the Poteet soil or are in the lower positions, and Tiocano soils are in the lower positions. The other contrasting soils are in the higher positions.

The Poteet soil is used mainly as rangeland and wildlife habitat. Some areas are used as cropland or pasture.

Rangeland productivity is high. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation provide a wide variety of forage for livestock and excellent food and cover for wildlife. These areas are preferred sites for turkey and are heavily used by deer, quail, and dove.

This soil is well suited to cropland. It is suitable for a wide variety of nonirrigated and irrigated crops. Suitable crops include corn, cotton, cowpeas, forage sorghum, grain sorghum, mung beans, oats, peanuts, wheat, cabbage, cantaloupes, onions, potatoes, squash, spinach, and watermelons. The main management concerns are the hazard of flooding and the hazard of wind erosion. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, wind stripcropping, diversions, grassed waterways, or crop rotations that include high-residue or soil-improving crops may be needed to control erosion, conserve moisture, and maintain tilth.

This soil is well suited to irrigated pasture. Suitable pasture grasses include buffelgrass, blue panicum, coastal bermudagrass, and kleingrass. The main management concern is maintaining an adequate plant cover to protect against scouring during periods of flooding.

The flooding is the main hazard affecting most urban uses. Areas used for these purposes should be protected from flooding. Properly designing septic tank absorption fields helps to overcome the restricted permeability.

This soil is moderately suited to most recreational uses. It should not be used as a site for camp areas unless it is protected from flooding. The season, duration, and frequency of flooding should be considered in planning playgrounds and other recreational areas.

The land capability classification is IIw, nonirrigated and irrigated. The range site is Ramadero.

Ta—Tela sandy clay loam, frequently flooded. This very deep, nearly level, loamy soil is in narrow drainageways on uplands. The shape of the slopes is concave or linear. Slopes are 0 to 1 percent. Individual areas are long and narrow and range from about 15 to 200 acres in size.

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

Surface layer:

0 to 13 inches, dark grayish brown sandy clay loam, mildly alkaline

Subsoil:

13 to 18 inches, grayish brown sandy clay loam, mildly alkaline

18 to 39 inches, grayish brown sandy clay loam, moderately alkaline

39 to 46 inches, light brownish gray sandy clay loam, moderately alkaline

Substratum:

46 to 63 inches or more, light brownish gray loam, moderately alkaline

Important soil properties—

Drainage: well drained

Permeability: moderate

Available water capacity: high

Root zone: very deep

Shrink-swell potential: low

Surface runoff: slow

Flooding: frequent (more often than 50 times in 100 years), usually lasting less than 2 days

Hazard of water erosion: slight; during periods of flooding, however, scouring of bare areas may occur, especially near stream channels

Hazard of wind erosion: slight

The Tela soil and similar inclusions make up more than 75 percent of the map unit, and contrasting inclusions make up the rest. The similar inclusions occur as small areas of soils that are like the Tela soil but have a dark surface layer that is more than 20 inches thick. Also included are small areas of Tela soils that are flooded less often than 50 times in 100 years.

The contrasting inclusions occur as small areas of Brystal, Duval, Imogene, Poteet, Tiocano, Webb, and Zavco soils. Also included are small areas of stream channels. Imogene and Poteet soils are in landscape positions similar to those of the Tela soil or are in the slightly higher positions, and Tiocano soils are in the lower positions. The other contrasting soils are in the higher positions.

The Tela soil is used as rangeland and wildlife habitat. Rangeland productivity is high. Under a grazing system that includes proper grazing use and timely deferment

of grazing, areas of native vegetation provide a wide variety of forage for livestock and excellent food and cover for wildlife. These areas are preferred sites for turkey and are heavily used by deer, quail, and dove.

This soil is not suited to cropland. The hazard of flooding and the scouring of bare areas are the main management concerns.

This soil is poorly suited to irrigated pasture. The flooding can destroy irrigation systems. Removing native trees and brush near stream channels may result in severe scouring and streambank erosion during periods of flooding.

The flooding is the main hazard affecting most urban uses. Areas used for these purposes should be protected from flooding.

This soil is poorly suited to most recreational uses. It should not be used as a site for camp areas unless it is protected from flooding. The season, duration, and frequency of flooding should be considered in planning playgrounds and other recreational areas.

The land capability classification is Vw, nonirrigated. The range site is Ramadero.

Tc—Tiocano clay. This very deep, clayey soil is in depressions and playas. Slopes are less than 1 percent. The shape of the slopes is concave. Individual areas are rounded in shape and range from 3 to 30 acres in size.

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

Surface layer:

0 to 5 inches, dark gray clay, neutral

Subsoil:

5 to 34 inches, dark gray clay, mildly alkaline

34 to 40 inches, grayish brown clay, mildly alkaline

40 to 50 inches, light brownish gray clay, mildly alkaline

50 to 64 inches or more, pale brown clay, mildly alkaline

Important soil properties—

Drainage: somewhat poorly drained

Permeability: very slow

Available water capacity: moderate

Root zone: very deep; however, the clayey subsoil restricts the movement of air and water and root development

Shrink-swell potential: very high (the soil shrinks and forms wide, deep cracks as it dries and swells as it becomes moist)

Surface runoff: ponded

Seasonal high water table: a perched water table after periods of heavy rainfall, 6 feet below the surface to 2 feet above

Flooding: none

Hazard of water erosion: slight

Hazard of wind erosion: moderate

The Tiocano soil and similar inclusions make up more than 85 percent of the map unit, and contrasting inclusions make up the rest. The similar inclusions occur as small areas of soils that are like the Tiocano soil but have 6 to 12 inches of loamy overwash or have a high percentage of exchangeable sodium near the surface.

The contrasting inclusions occur as small areas of Brystal, Caid, Divot, Duval, Imogene, Montell, Poteet, Webb, and Zavco soils. They are in the slightly higher positions, mainly on the perimeter of the mapped areas.

The Tiocano soil is used mainly as rangeland and wildlife habitat (fig. 10).

Rangeland productivity is high. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation provide a wide variety of forage for livestock and excellent food and cover for wildlife. These

areas are preferred sites for turkey and are heavily used by deer, quail, and dove. When ponded, these areas are used by migrating waterfowl as rest areas.

This soil is not suited to cropland. The main management concerns are the perched water table and the ponding.

This soil is moderately suited to irrigated pasture. Coastal bermudagrass is the main pasture grass.

The ponding and the perched water table severely limit the suitability for all kinds of building site development and sanitary facilities. Areas used for these purposes should be protected from ponding. Properly designing building foundations and paved roads helps to prevent the structural or road damage caused by shrinking and swelling. Because of the clayey texture, the soil can be worked by earth-moving equipment only within a narrow range in moisture content. Because of low soil strength, suitable base material is needed on sites for local roads and streets.

This soil is poorly suited to most recreational uses. All recreational areas should be protected from ponding. Because of the clayey surface layer, special surfacing material or a drainage system may be needed in areas that are subject to heavy foot traffic during wet periods.

The land capability classification is VIw, nonirrigated and irrigated. The range site is Lakebed.



Figure 10.—Retama, mesquite, twisted acacia, sedges, and lilies in an area of Tiocono clay that has water ponded on the surface.

VBB—Viboras clay, gently undulating. This moderately deep, saline, clayey soil is on smooth plains. Slopes range from 0 to 3 percent. The shape of the slopes is convex or linear. Individual areas are irregular in shape and range from 20 to several hundred acres in size.

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

Surface layer:

0 to 8 inches, reddish brown clay, nonsaline, moderately alkaline

Subsoil:

8 to 34 inches, reddish brown clay, moderately saline, moderately alkaline

34 to 38 inches, light reddish brown clay, moderately saline, moderately alkaline

Substratum:

38 to 60 inches or more, weak, red, soft shale bedrock intermingled with light reddish brown clay, moderately saline, moderately alkaline

Important soil properties—

Drainage: moderately well drained

Permeability: very slow

Available water capacity: very low

Root zone: moderately deep; however, the clayey subsoil restricts the movement of air and water and root development

Shrink-swell potential: high (the soil shrinks and cracks as it dries and swells as it becomes moist)

Surface runoff: medium

Flooding: none

Hazard of water erosion: severe

Hazard of wind erosion: moderate

The Viboras soil and similar inclusions make up more than 80 percent of the map unit. and contrasting inclusions make up the rest. The similar inclusions occur as small areas of soils that are like the Viboras soil but have soft shale bedrock at a depth of 40 to 45 inches.

The contrasting inclusions occur as small areas of Catarina, Cotulla, Imogene, Lasalle, Maverick, Moglia, and Montell soils. Maverick soils are in landscape positions similar to those of the Viboras soil or are in the slightly higher positions. Moglia soils are in the higher positions. Catarina, Cotulla, Imogene, Lasalle, and Montell soils are in the lower positions.

This map unit was designed primarily for extensive land uses, such as rangeland. Fewer soil examinations were made in areas of this map unit than in areas of map units designed for more intensive uses. Also, the mapped areas and the areas of inclusions in this map unit are generally larger. The map unit purity is adequate for the anticipated land use.

The Viboras soil is used as rangeland and wildlife habitat. Rangeland productivity is low. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a variety of forage for livestock and wildlife. These areas are used by deer, quail, dove, and turkey, but they are not preferred sites.

This soil is not suited to cropland. The main management concerns are the very low available water capacity, the very slow permeability, the salinity in the subsoil, and the hazards of water erosion and wind erosion.

This soil is not suited to irrigated pasture. The salinity of the soil can be increased by irrigation.

This soil is poorly suited to most urban uses. Properly designing septic tank absorption fields helps to overcome the restricted permeability and the depth to soft shale bedrock. The salinity and excess sodium in the subsoil inhibit the growth of vegetation in areas used for lawns and landscaping. Because of the clayey texture, the soil can be worked by earth-moving equipment only within a narrow range in moisture content. Properly designing building foundations and paved roads helps to

prevent the structural or road damage caused by shrinking and swelling. Because of low soil strength, suitable base material is needed on sites for local roads and streets.

This soil is poorly suited to most recreational uses. Because of the very slow permeability and the clayey surface layer, special surfacing material may be needed in areas that are subject to heavy foot traffic during wet periods. The salinity and excess sodium in the subsoil inhibit the growth of vegetation in areas that are subject to heavy foot traffic.

The land capability classification is VII_s, nonirrigated. The range site is Saline Clay.

WbA—Webb very fine sandy loam, 0 to 1 percent slopes. This very deep, nearly level, loamy soil is on broad, smooth plains. The shape of the slopes is linear. Individual areas are elongated or irregular in shape and range from 8 to several hundred acres in size.

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

Surface layer:

0 to 10 inches, reddish brown very fine sandy loam, slightly acid

Subsoil:

10 to 22 inches, red sandy clay loam, slightly acid

22 to 34 inches, red sandy clay, mildly alkaline

34 to 48 inches, brown sandy clay loam, moderately alkaline

48 to 60 inches or more, pale brown sandy clay loam, moderately alkaline

Important soil properties—

Drainage: well drained

Permeability: moderately slow

Available water capacity: moderate

Root zone: very deep; however, the clayey subsoil restricts the movement of air and water and root development

Shrink-swell potential: moderate (the soil shrinks as it dries and swells as it becomes moist)

Surface runoff: slow

Flooding: none

Hazard of water erosion: slight

Hazard of wind erosion: moderate

The Webb soil and similar inclusions make up more than 85 percent of the map unit, and contrasting inclusions make up the rest. The similar inclusions occur as small areas of soils that are like the Webb soil but have sandstone bedrock at a depth of 50 to 60 inches, a gravelly surface layer, a gravelly subsoil, or a dark surface layer. Also included are small areas of Webb soils that have slopes of 1 to 3 percent.

The contrasting inclusions occur as small areas of Brystal, Caid, Duval, Imogene, Poteet, Tiocano, and Zavco soils. Brystal, Caid, Duval, and Zavco soils are in landscape positions similar to those of the Webb soil. Imogene, Poteet, and Tiocano soils are in the lower positions.

The Webb soil is used mainly as cropland. Some areas are used as rangeland, wildlife habitat, or pasture.

Rangeland productivity is medium. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a wide variety of grasses, forbs, and browse plants for livestock and wildlife. These areas are preferred sites for deer, are good sites for quail, and are used by dove and turkey.

This soil is moderately suited to nonirrigated crops and well suited to irrigated crops. It is suitable for a wide variety of nonirrigated and irrigated crops. The main crops are corn, cotton, cowpeas, forage sorghum, grain sorghum, mung beans, oats, peanuts, wheat, cabbage, cantaloupes, onions, potatoes, squash, spinach, and watermelons. The main management concern is the hazard of wind erosion. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, wind stripcropping, diversions, grassed waterways, or crop rotations that include high-residue or soil-improving crops may be needed to control erosion, conserve moisture, and maintain tilth.

This soil is well suited to irrigated pasture. Suitable pasture grasses include buffelgrass, blue panicum, coastal bermudagrass, kleingrass, and Wilman lovegrass.

This soil is moderately suited to most urban uses. Properly designing septic tank absorption fields helps to overcome the restricted permeability. Properly designing building foundations helps to prevent the structural damage caused by shrinking and swelling. The clayey subsoil can be worked by earth-moving equipment only within a narrow range in moisture content. Because of low soil strength, suitable base material is needed on sites for local roads and streets.

This soil is moderately suited to most recreational uses. Applications of water or special surfacing material may be needed during dry periods to prevent excessive dustiness in areas that are subject to heavy foot traffic.

The land capability classification is IIIc, nonirrigated, and I, irrigated. The range site is Tight Sandy Loam.

WbB—Webb very fine sandy loam, 1 to 3 percent slopes. This very deep, very gently sloping, loamy soil is on broad, smooth plains and the foot slopes of hills and ridges. The shape of the slopes is convex to concave. Slopes are mainly 0 to 2 percent. Individual areas are irregular in shape and range from 8 to several hundred acres in size.

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

Surface layer:

0 to 10 inches, reddish brown very fine sandy loam, slightly acid

Subsoil:

10 to 20 inches, reddish brown sandy clay, neutral

20 to 28 inches, yellowish red sandy clay, neutral

28 to 40 inches, reddish yellow sandy clay loam, moderately alkaline

40 to 49 inches, reddish yellow sandy clay loam, moderately alkaline

49 to 60 inches or more, reddish yellow sandy clay loam, moderately alkaline

Important soil properties—

Drainage: well drained

Permeability: moderately slow

Available water capacity: moderate

Root zone: very deep; however, the clayey subsoil restricts the movement of air and water and root development

Shrink-swell potential: moderate (the soil shrinks as it dries and swells as it becomes moist)

Surface runoff: medium

Flooding: none

Hazard of water erosion: moderate

Hazard of wind erosion: moderate

The Webb soil and similar inclusions make up more than 85 percent of the map unit, and contrasting inclusions make up the rest. The similar inclusions occur as small areas of soils that are like the Webb soil but have sandstone bedrock at a depth of 50

to 60 inches, a gravelly surface layer, a gravelly subsoil, or a dark surface layer. Also included are small areas of Webb soils that have slopes of 0 to 1 or 3 to 5 percent.

The contrasting inclusions occur as small areas of Brystal, Caid, Dilley, Duval, Hindes, Imogene, Poteet, Tiocano, Yologo, and Zavco soils. Also included are some small severely eroded areas and gullied areas. Brystal, Card, Duval, and Zavco soils are in landscape positions similar to those of the Webb soil. Poteet, Imogene, and Tiocano soils are in the lower positions. Dilley, Hindes, and Yologo soils are in the higher positions.

The Webb soil is used mainly as cropland. Some areas are used as rangeland, wildlife habitat, or pasture.

Rangeland productivity is medium. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a wide variety of grasses, forbs, and browse plants for livestock and wildlife. These areas are preferred sites for deer, are good sites for quail, and are used by dove and turkey.

This soil is moderately suited to nonirrigated crops and well suited to irrigated crops. It is suitable for a wide variety of nonirrigated and irrigated crops. The main crops are corn, cotton, cowpeas, forage sorghum, grain sorghum, mung beans, oats, peanuts, wheat, cabbage, cantaloupes, onions, potatoes, squash, spinach, and watermelons. The main management concerns are the hazards of water erosion and wind erosion. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, wind stripcropping, contour or field stripcropping, terraces, diversions, grassed waterways, contour farming, or crop rotations that include high-residue or soil-improving crops may be needed to control erosion, conserve moisture, and maintain tilth.

This soil is well suited to irrigated pasture. Suitable pasture grasses include buffelgrass, blue panicum, coastal bermudagrass, kleingrass, and Wilman lovegrass.

This soil is moderately suited to most urban uses. Properly designing septic tank absorption fields helps to overcome the restricted permeability. Properly designing building foundations helps to prevent the structural damage caused by shrinking and swelling. The clayey subsoil can be worked by earth-moving equipment only within a narrow range in moisture content. Because of low soil strength, suitable base material is needed on sites for local roads and streets.

This soil is moderately suited to most recreational uses. Applications of water or special surfacing material may be needed during dry periods to prevent excessive dustiness in areas that are subject to heavy foot traffic.

The land capability classification is IIIe, nonirrigated, and IIe, irrigated. The range site is Tight Sandy Loam.

WCB—Webb very fine sandy loam, gently undulating. This very deep, loamy soil is on broad, smooth plains and the foot slopes of hills and ridges. Slopes range from 0 to 3 percent, but are mainly 0 to 2 percent. The shape of the slopes is convex to concave. Individual areas are irregular in shape and range from 10 to several hundred acres in size.

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

Surface layer:

- 0 to 9 inches, reddish brown very fine sandy loam, slightly acid
- 9 to 14 inches, reddish brown very fine sandy loam, slightly acid

Subsoil:

- 14 to 28 inches, reddish brown sandy clay, slightly acid
- 28 to 34 inches, yellowish red sandy clay loam, moderately alkaline
- 34 to 46 inches, reddish yellow sandy clay loam, moderately alkaline
- 46 to 64 inches or more, yellow sandy clay loam, moderately alkaline

Important soil properties—

Drainage: well drained

Permeability: moderately slow

Available water capacity: moderate

Root zone: very deep; however, the clayey subsoil restricts the movement of air and water and root development

Shrink-swell potential: moderate (the soil shrinks as it dries and swells as it becomes moist)

Surface runoff: medium

Flooding: none

Hazard of water erosion: moderate

Hazard of wind erosion: moderate

The Webb soil and similar inclusions make up more than 75 percent of the map unit, and contrasting inclusions make up the rest. The similar inclusions occur as small areas of soils that are like the Webb soil but have sandstone bedrock at a depth of 50 to 60 inches, a gravelly surface layer, a gravelly subsoil, or a dark surface layer. Also included are small areas of Webb soils that have slopes of 3 to 5 percent.

The contrasting inclusions occur as small areas of Brystal, Caid, Dilley, Duval, Hindes, Imogene, Poteet, Tiocano, Yologo, and Zavco soils. Also included are some small severely eroded areas and gullied areas. Brystal, Caid, Duval, and Zavco soils are in landscape positions similar to those of the Webb soil. Poteet, Imogene, and Tiocano soils are in the lower positions. Dilley, Hindes, and Yologo soils are in the higher positions.

This map unit was designed primarily for extensive land uses, such as rangeland. Fewer soil examinations were made in areas of this map unit than in areas of map units designed for more intensive uses. Also, the mapped areas and the areas of inclusions in this map unit are generally larger. The map unit purity is adequate for the anticipated land use.

The Webb soil is used mainly as rangeland and wildlife habitat. Some areas are used as cropland or pasture.

Rangeland productivity is medium. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a wide variety of grasses, forbs, and browse plants for livestock and wildlife. These areas are preferred sites for deer, are good sites for quail, and are used by dove and turkey.

This soil is moderately suited to nonirrigated crops and well suited to irrigated crops. Suitable crops include corn, cotton, cowpeas, forage sorghum, grain sorghum, mung beans, oats, peanuts, wheat, cabbage, cantaloupes, onions, potatoes, squash, spinach, and watermelons. The main management concerns are the hazards of water erosion and wind erosion. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, wind stripcropping, contour or field stripcropping, terraces, diversions, grassed waterways, contour farming, or crop rotations that include high-residue or soil-improving crops may be needed to control erosion, conserve moisture, and maintain tilth.

This soil is well suited to irrigated pasture. Suitable pasture grasses include buffelgrass, blue panicum, coastal bermudagrass, kleingrass, and Wilman lovegrass.

This soil is moderately suited to most urban uses. Properly designing septic tank absorption fields helps to overcome the restricted permeability. Properly designing building foundations helps to prevent the structural damage caused by shrinking and swelling. The clayey subsoil can be worked by earth-moving equipment only within a narrow range in moisture content. Because of low soil strength, suitable base material is needed on sites for local roads and streets.

This soil is moderately suited to most recreational uses. Applications of water or special surfacing material may be needed during dry periods to prevent excessive dustiness in areas that are subject to heavy foot traffic.

The land capability classification is IIIe, nonirrigated, and IIe, irrigated. The range site is Tight Sandy Loam.

ZVB—Zavco sandy clay loam, gently undulating. This very deep, loamy soil is on broad, smooth plains and the foot slopes of hills and ridges. Slopes range from 0 to 3 percent, but are mainly 0 to 2 percent. The shape of the slopes is convex to concave. Individual areas are irregular in shape and range from 20 to several hundred 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 sandy clay loam, slightly acid
9 to 15 inches, reddish brown sandy clay loam, slightly acid

Subsoil:

15 to 22 inches, reddish brown sandy clay, mildly alkaline
22 to 28 inches, yellowish red sandy clay, moderately alkaline
28 to 64 inches, reddish yellow sandy clay loam, moderately alkaline

Important soil properties—

Drainage: well drained

Permeability: moderately slow

Available water capacity: moderate

Root zone: very deep; however, the clayey subsoil restricts the movement of air and water and root development

Shrink-swell potential: moderate (the soil shrinks as it dries and swells as it becomes moist)

Surface runoff: medium

Flooding: none

Hazard of water erosion: slight

Hazard of wind erosion: moderate

The Zavco soil and similar inclusions make up more than 75 percent of the map unit, and contrasting inclusions make up the rest. The similar inclusions occur as small areas of soils that are like the Zavco soil but have a light colored surface layer, sandstone bedrock at a depth of 50 to 60 inches, or a dark surface layer and subsoil that, combined, are 20 to 30 inches thick. Also included are small areas of Zavco soils that have slopes of 3 to 5 percent or have a gravelly surface layer.

The contrasting inclusions occur as small areas of Altita, Brystal, Caid, Charco, Duval, Hindes, Imogene, Monteola, Poteet, Tiocano, Webb, and Yologo soils. Also included are small gullied areas and small areas of stream channels. Altita, Charco, Monteola, and Webb soils are in landscape positions similar to those of the Zavco soil, and Imogene, Poteet, and Tiocano soils are in the lower positions. The other contrasting soils are in the higher positions.

This map unit was designed primarily for extensive land uses, such as rangeland. Fewer soil examinations were made in areas of this map unit than in areas of map units designed for more intensive uses. Also, the mapped areas and the areas of inclusions in this map unit are generally larger. The map unit purity is adequate for the anticipated land use.

The Zavco soil is used mainly as rangeland and wildlife habitat. Rangeland productivity is medium. Under a grazing system that includes proper grazing use and timely deferment of grazing, areas of native vegetation produce a wide variety of

grasses, forbs, and browse plants for livestock and wildlife. These areas are preferred sites for deer, are good sites for quail, and are used by dove and turkey.

This soil is moderately suited to nonirrigated crops and well suited to irrigated crops. Suitable crops include corn, cowpeas, forage sorghum, grain sorghum, oats, wheat, cabbage, potatoes, and other vegetables. The main management concern is the hazard of wind erosion. Crop residue management, timely seedbed preparation, conservation tillage, cover crops, contour or field stripcropping, terraces, diversions, grassed waterways, contour farming, or crop rotations that include high-residue or soil-improving crops may be needed to control erosion, conserve moisture, and maintain tilth.

This soil is well suited to irrigated pasture. Suitable pasture grasses include buffelgrass, blue panicum, coastal bermudagrass, kleingrass, and Wilman lovegrass.

This soil is moderately suited to most urban uses. Properly designing septic tank absorption fields helps to overcome the restricted permeability. Properly designing building foundations helps to prevent the structural damage caused by shrinking and swelling. The clayey subsoil can be worked by earth-moving equipment only within a narrow range in moisture content. Because of low soil strength, suitable base material is needed on sites for local roads and streets.

This soil is well suited to most recreational uses.

The land capability classification is IIIe, nonirrigated, and IIe, irrigated. The range site is Clay Loam.

Prime Farmland

In this section, prime farmland is defined and the soils in La Salle County that are considered prime farmland are listed.

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

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

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

Prime farmland soils usually receive an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The acidity or alkalinity level of the soils is acceptable. The soils have few or no rocks and are permeable to water and air. They are not excessively erodible or

saturated with water for long periods and are not frequently flooded during the growing season. The slope ranges mainly from 0 to 5 percent.

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

Soils that have an inadequate supply of moisture qualify as prime farmland only if irrigated. If applicable, the need for irrigation is indicated in parentheses after the map unit name in table 5. Onsite evaluation is necessary to determine if an irrigation system has been installed.

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 for predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other 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 that is in harmony with nature.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

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

About 75,000 acres in La Salle County, or about 8 percent of the land area, is used for crops, pasture, or orchards.

Management of Cropland

About 70,000 acres in the county is cropland. About 14,000 to 15,000 acres is irrigated each year. The rest of the cropland is nonirrigated.

The major nonirrigated crops are grain sorghum, forage sorghum, wheat, oats, corn, cowpeas, watermelons, and cantaloupes. The major irrigated crops are peanuts, corn, cotton, grain sorghum, wheat, and forage sorghum and watermelons, potatoes, cabbage, and other truck crops. Peanuts are the most important of the cash crops grown in irrigated areas. In most fields they are rotated with other irrigated crops or with dryland crops.

Irrigation water is drawn from wells in the Carrizo Sand Aquifer and from the Nueces and Rio Rivers. Both surface and sprinkler irrigation systems are used. Most of the surface systems are on the nearly level terraces along the rivers.

Sprinkler systems throughout the county include center-pivot systems, lateral move systems, and hand lines. Center-pivot systems are the most common (fig. 11). Low-pressure linear systems are advantageous because of energy efficiency, the ability to irrigate rectangular fields, and the uniform application of water across the fields. Hand lines are very labor intensive.



Figure 11.—Irrigated corn in an area of Duval very fine sandy loam, 1 to 3 percent slopes.

Irrigation water management is important because of the high cost of pumping water and the need to conserve the water in the Carrizo Sand Aquifer and the Nueces and Frio Rivers. Irrigation water should be applied at the proper times and in the amounts required by the crop. The timing of irrigation can be determined by the feel and appearance method; by moisture monitoring devices, such as gypsum blocks and tensiometers; and by the moisture accounting method. Crop needs for various growth stages can be determined from consumptive use curves.

Irrigation water should be distributed evenly to all parts of the field. Annual or biennial evaluations of surface and sprinkler irrigation systems are recommended in order to locate inefficiencies in distribution. Where surface systems are used, land

leveling, land grading, shortening of irrigation runs, surge irrigation systems, and cutback head irrigation systems can increase the efficiency of water distribution. Replacing worn nozzles can increase the efficiency of sprinkler systems. Also, operating the systems at the pressures recommended by manufacturers or distributors can ensure a high degree of efficiency.

In all areas of cropland, soil and water conservation are important management concerns. Crop residue management and other measures, such as furrow diking, contour stripcropping, field stripcropping, wind stripcropping, cover cropping, contour farming, and terracing, help to control wind erosion and water erosion, conserve moisture, and maintain or improve tilth. Measures that conserve moisture generally result in higher crop yields.

Crop residue management includes crop residue use, delayed seedbed preparation, and conservation tillage. Leaving crop residue on the surface helps to protect the soil against wind erosion; minimizes soil crusting and the detachment of soil particles and thus helps to control runoff and water erosion; reduces the rate at which soil moisture evaporates; improves tilth in the surface layer; and minimizes compaction by farm machinery.

Tillage should be sufficient to prepare a good seedbed and to control weeds without damaging the structure of the soil. Heavy traffic on the soil, especially during wet periods, can cause the formation of a compaction pan by destroying soil structure. Compaction reduces soil porosity and restricts root growth into and through the compacted layer. It limits the ability of the root system of a crop to take up moisture and nutrients. It also increases the amount of moisture and nutrients lost through runoff and erosion. Deep chiseling and controlled traffic patterns can minimize compaction. Roughening the surface through emergency tillage helps to control wind erosion.

Properly applied fertilizer is needed on all cultivated soils. Soil analysis and knowledge of the history of fertilizer application on a field can help in making accurate estimates of the kind and amount of nutrients needed to produce a specific yield. An annual soil analysis can detect a buildup or depletion of required nutrients for each crop. Also, plant analyses can be used to determine nutrient deficiencies in a growing crop.

Management of Pasture and Hayland

Pasture and hayland make up about 5,000 acres in the county. Most of the acreage is irrigated.

Management of pasture and hayland includes selecting plants that are suited to the soil, applying fertilizer, managing grazing heights for maximum productivity, rotating pastures, and controlling weeds and brush. Efficient water management is important in areas where pasture or hayland is irrigated.

Many highly productive grasses are suitable for improved pasture. The most widely used grasses are buffelgrass, kleingrass, improved bermudagrass, blue panicum, and Wilman lovegrass. Improved bermudagrasses are the most widely grown grasses in areas of irrigated pasture. Kleingrass and buffelgrass are grown on a small acreage of irrigated pasture.

Applying fertilizer or planting soil-improving, leguminous crops is essential for economical forage production in areas of irrigated pasture and hay. In areas of nonirrigated pasture, fertilizer should be applied when the moisture supply is adequate. All fertilizer should be applied according to the results of soil or plant analysis.

Rotating pastures for proper grazing use is an important management practice. Timely rotation allows for the maximum production of improved grasses. Weeds can be controlled by mowing, by prescribed burning, or by applying approved herbicides.

Management of Orchards

About 20 acres in the county is used for orchards. Apples, grapes, and pecans are the major orchard crops. A number of soils in the county are well suited to irrigated orchard crops. Most of the soils used for irrigated row crops are suited to orchard crops.

The management measures needed in orchards are similar to those needed in areas of other irrigated crops. They include proper tillage, management of crop residue, use of cover crops, applications of fertilizer, timely disease and insect control, weed control, and management of irrigation water.

Yields per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The 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 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for use as cropland (11). 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 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 Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode, but they have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production. No soils in La Salle County are in class VIII.

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

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

The capability classification of each map unit is given in the section "Detailed Soil Map Units" and in table 6.

Rangeland

Kenneth D. Sparks and Mike Black, area range conservationists, Soil Conservation Service, helped prepare this section.

Rangeland occurs as areas where the native vegetation consists of a wide variety of grasses, grasslike plants, forbs, shrubs, and trees. The vegetation is generally suitable for grazing by livestock and is in sufficient amounts to justify such use. Rangeland, or native grassland, receives no regular or frequent cultural treatment. The composition and production of the plant community are determined by the soil, climate, topography, overstory canopy, fire, and grazing management.

About 887,000 acres in La Salle County, or 91 percent of the land area, is rangeland. The original vegetation grew dominantly on an open grassland. It consisted of mid and short grasses interspersed with woody shrubs and some trees. The relatively abundant woody shrubs were suppressed by periodic fires, some of which were started by lightning and others by the Indian inhabitants of the area.

The vegetative community on the rangeland in the county has changed drastically during the past 150 years. The major factors in the change are widely fluctuating climatic conditions; continuous, heavy grazing by livestock; and the elimination of controlled burning. Woody plants have increased in abundance on much of the rangeland. The more productive grasses and forbs have been grazed out in some areas and replaced by a mixture of short grasses and annual forbs.

Most of the ranches in the county are cow-calf enterprises. Some are stocker calf and yearling enterprises; however, and some ranchers supplement their cow herds with stockers. These ranchers have greater flexibility in adjusting livestock numbers during periods of drought and moisture stress.

In many areas the forage provided by native grassland is supplemented by improved grasses and by grazing crops produced on cropland. Buffelgrass, kleingrass, improved bermudagrass, blue panicum, and Kleberg bluestem are common improved pasture grasses. Small grain and forage sorghums are the most common grazing crops produced on cropland.

Forage production in areas of rangeland occurs primarily during two distinct growth periods. Approximately 60 percent of the annual growth occurs in April, May, and June, when spring rains and moderate temperatures are most favorable to the growth of warm-season plants. A secondary growth period usually occurs in September and October, when fall rains and gradually cooling temperatures are common.

Droughts of varying lengths are frequent in this county. Short periods of drought normally occur during midsummer. Droughts that last for several months also occur.

Different soils vary in their capacity to produce plants for grazing animals. Soils that produce about the same kinds, amounts, and proportions of forage plants make up a range site. The climax vegetation on a range site is the stabilized plant community that the site is capable of producing. It reproduces itself and changes very little so long as the environment remains unchanged. It consists of the plants that were growing on the site when the region was first settled. The most productive combination of native forage plants on a range site is generally the climax vegetation.

Three kinds of plants can be identified on a site that has deteriorated because of grazing pressure. These are decreaseers, increaseers, and invaders.

Decreaseers are plants in the climax vegetation that tend to decrease in relative amounts under close, continuous grazing. They generally are the most productive perennial grasses and forbs and the most palatable to livestock.

Increaseers are plants in the climax vegetation that increase in abundance as the extent of the more desirable decreaseer plants is reduced by close, continuous grazing. They are generally less palatable to livestock than decreaseers. If overgrazing continues for long periods, these plants also decrease in abundance.

Invaders are plants that normally cannot compete with plants in the climax plant community for moisture, nutrients, and light. After the extent of the climax vegetation has been reduced, they invade and grow along with the increaseers. As the increaseers begin to decrease, the invaders tend to dominate the site.

Range condition is judged according to standards that apply to the particular range site. Four range condition classes are used to indicate the degree of departure from the potential, or climax, vegetation brought about by grazing or other factors. The classes show the present condition of the native vegetation on a range site in relation to the climax plant community for that site. A range is in excellent condition if 76 to 100 percent of the vegetation is the same kind as that in the climax stand, in good condition if the percentage is 51 to 75, in fair condition if the percentage is 26 to 50, and in poor condition if the percentage is 25 or less.

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

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

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, or proportion of range plants. The relationship between soils

and vegetation was ascertained 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, but it does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, average, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In an 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.

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

A primary objective of range management is keeping the range in excellent or good condition and thus conserving water, improving yields, and the protecting the soils. The main management concern is recognizing important changes that occur in the kinds of plants on a range site. These changes take place gradually and can be misinterpreted or overlooked. Plant growth that occurs because of heavy rainfall can lead to the conclusion that the range is in good condition when the plant community actually has a large percentage of annual plants and the long-term trend is toward lower production. On the other hand, some rangeland that has been closely grazed for short periods may have a degraded appearance that temporarily conceals its quality and ability to recover.

Following years of prolonged overuse, seed sources of desirable vegetation may be eliminated. Under these conditions, the vegetation must be reestablished before management can be effective. The condition of the range can be improved by controlling brush, range seeding, fencing, developing water sources, or using other mechanical treatment to revitalize stands of native plants. Thereafter, deferred grazing, proper grazing use, and a planned grazing system can help to maintain or improve the range.

Good management generally results in the optimum production of vegetation, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

The 18 range sites in the county are Clay Flat, Clay Loam, Clayey Bottomland, Claypan Prairie, Gravelly Ridge, Gray Loamy Upland, Gray Sandy Loam, Lakebed, Loamy Bottomland, Loamy Sand, Lowland, Ramadero, Rolling Hardland, Saline Clay, Saline Clay Loam, Sandy Loam, Shallow Sandy Loam, and Tight Sandy Loam.

Clay Flat range site

The Montell soils in map units MNA and Mn are in this range site.

The potential plant community is that of an open grassland. The composition, by weight, is about 95 percent grasses, 5 percent forbs, and a few woody plants.

The dominant plants consist of 25 percent pink pappusgrass and plains bristlegrass; 20 percent curlymesquite and tobosa; 10 percent alkali sacaton; 10 percent twoflower trichloris and pinhole bluestem; 10 percent Arizona cottontop and lovegrass tridens; 10 percent vine-mesquite, buffalograss, white tridens, and big sacaton; 5 percent fall witchgrass, slim tridens, perennial threeawn, whorled dropseed, and Texas bristlegrass; 5 percent forbs, such as bundleflower, orange zexmenia, bush sunflower, Texas varilla, and some annual forbs; and 5 percent woody plants, such as mesquite, guayacan, spiny hackberry, whitebrush, fourwing saltbush, lotebush, amargosa, pricklypear, tasajillo, huisache, screwbean, and twisted acacia.

Such plants as twoflower trichloris, Arizona cottontop, alkali sacaton, and the more palatable perennial forbs decrease in abundance under continuous, heavy grazing by livestock. They are replaced initially by pink pappusgrass and plains bristlegrass and later by buffalograss, curlymesquite, and woody plants. If overgrazing continues, the woody plants native to the site continue to increase in abundance and whitebrush, cacti, and other brush species invade. The woody plants dominate an understory of such plants as curlymesquite, red grama, Halls panicum, whorled dropseed, perennial threeawn, Texas grama, and forbs, including bitterweed, annual broomweed, and coneflower.

Clay Loam range site

The Bookout, Chacon, and Zavco soils in map units BkA, BkB, BOB, CdA, CDB, and ZVB are in this range site.

The potential plant community is that of an open grassland with some scattered mesquite trees and woody shrubs. The composition, by weight, is 90 percent grasses, 5 percent forbs, and 5 percent woody plants (fig. 12).



Figure 12.—An area of Zavco sandy clay loam, gently undulating, in the Clay Loam range site. The vegetation includes mesquite, blackbrush, whitebrush, fourflower trichloris, pink pappusgrass, and plains bristlegrass. The range condition in this area is good.

The dominant plants consist of 40 percent plains lovegrass, fourflower trichloris, Arizona cottontop, pinhole bluestem, and plains bristlegrass; 20 percent buffalograss and curlymesquite; 15 percent pink pappusgrass; 15 percent Texas winter-grass,

lovegrass tridens, white tridens, and perennial threeawn; 5 percent forbs, such as bush sunflower, orange zexmenia, and bundleflower; and 5 percent woody plants, such as mesquite, condalia, spiny hackberry, guayacan, and cacti.

Plains lovegrass, fourflower trichloris, and plains bristlegrass are preferred by livestock and thus are grazed out under continuous, heavy grazing. They are replaced initially by woody plants, such as mesquite, blackbrush, and whitebrush, and by grasses, such as curlymesquite. If overgrazing continues, the site is dominated by a wide array of woody plants and by an understory of short grasses, such as red grama, perennial threeawn, curlymesquite, and Halls panicum.

Clayey Bottomland range site

The Cochina soils in map units Ch and Cn are in this range site.

The potential plant community is that of an open savanna. It has a mixture of trees, shrubs, grasses, and forbs. The composition, by weight, is about 80 percent grasses, 10 percent forbs, and 10 woody plants.

The dominant plants consist of 30 percent southwestern bristlegrass, plains bristlegrass, fourflower trichloris, big cenchrus, and big sacaton; 25 percent plains bristlegrass, pink pappusgrass, vine-mesquite, and white tridens; 15 percent buffalograss and curlymesquite; 10 percent Virginia wildrye, Texas winter-grass, and sedges; 10 percent forbs, such as bundleflower, sensitive briar, and ruellia; and 10 percent trees and woody vines, such as live oak, elm, hackberry, anaqua, greenbriar, clematis, spiny aster, and mesquite.

The taller grasses, such as southwestern bristlegrass, fourflower trichloris, and big cenchrus, decrease in abundance under continuous, heavy grazing by livestock. They are replaced initially by such plants as buffalograss and sedges and by woody plants. If overgrazing continues, the site may be dominated by such plants as retama, spiny aster, bitter sneezeweed, prairie coneflower, and annual weeds and grasses.

Claypan Prairie range site

The Brundage soil in map unit BrB is in this range site.

The potential plant community consists of mid and short grasses interspersed with a few woody plants. The composition, by weight, is about 95 percent grasses, 5 percent forbs, and a trace amount of woody plants (fig. 13).



Figure 13.—An area of Brundage very fine sandy loam, 0 to 2 percent slopes, in the Claypan Prairie range site. The vegetation includes mesquite, pricklypear, leatherstem, goldenweed, red grama, and perennial threeawn. The range condition in this area is poor. The area has 50 percent bare ground.

The dominant plants consist of 35 percent Arizona cottontop, pink pappusgrass, vine-mesquite, and pinhole bluestem; 20 percent hooded windmillgrass, fall witchgrass, lovegrass tridens, plains lovegrass, Texas winter-grass, slim tridens, and white tridens; 15 percent plains bristlegrass; 15 percent buffalograss and curlymesquite; 10 percent fourflower trichloris; and 5 percent forbs, such as bundleflower, bush sunflower, sensitive briar, and ruellia.

Such plants as plains bristlegrass and fourflower trichloris are preferred by livestock and thus are grazed out under continuous, heavy grazing. They are replaced initially by such plants as curlymesquite, buffalograss, hooded windmillgrass, and fall witchgrass and by invading woody plants, such as mesquite, spiny hackberry, amargosa, goldenweed, cacti, and condalia. If overgrazing continues, the woody plants continue to invade and increase in abundance along with an understory of short grasses, such as red grama, whorled dropseed, Halls panicum, tumble windmillgrass, and perennial threeawn.

Gravelly Ridge range site

The Goldfinch, Hindes, and Yologo soils in map units GDD and HYD are in this range site.

The potential plant community is that of an open grassland. It is interspersed with a variety of scattered woody shrubs and perennial forbs. The composition, by weight, is about 85 percent grasses, 5 percent forbs, and 10 percent woody plants.

The dominant plants consist of 60 percent tanglehead, green sprangletop, pinhole bluestem, plains bristlegrass, plains lovegrass, twoflower trichloris, Arizona cottontop, lovegrass tridens, sideoats grama, Nealley grama, and pink pappusgrass; 20 percent reverchon panicum, fall witchgrass, slim tridens, hooded windmillgrass, hairy grama, and perennial threeawn; 5 percent buffalograss and curlymesquite; 5 percent forbs, such as bush sunflower, orange zexmenia, menodora, and bundleflower; and 10 percent woody plants, such as guajillo, blackbrush, range ratany, false mesquite, vine ephedra, guayacan, desert yaupon, littleleaf sumac, Texas colubrina, feather dalea, and cenizo.

Green sprangletop, plains lovegrass, pinhole bluestem, plains bristlegrass, and bush sunflower are preferred by livestock and thus are grazed out under continuous, heavy grazing by livestock. They are replaced initially by such plants as fall witchgrass, slim tridens, and panicum and by woody shrubs. If overgrazing continues, the site is dominated by woody plants, such as blackbrush, guajillo, littleleaf sumac, shrubby blue sage, and cenizo, and by an understory of short grasses, such as red grama, hairy tridens, perennial threeawn, Halls panicum, and annual forbs and grasses.

Gray Loamy Upland range site

The Aguilares soil in map unit AGB is in this range site.

The potential plant community is that of a partly open grassland. It is interspersed with scattered woody plants. The composition, by weight, is about 90 percent grasses, 5 percent forbs, and 5 percent woody plants.

The dominant plants consist of 35 percent twoflower trichloris and fourflower trichloris; 25 percent plains bristlegrass, pink pappusgrass, and silver bluestem; 15 percent Arizona cottontop and lovegrass tridens; 5 percent hooded windmillgrass and sand dropseed; 5 percent buffalograss and curlymesquite; 5 percent slim tridens, perennial threeawn, fall witchgrass, and Texas bristlegrass; 5 percent forbs, such as bundleflower, western ragweed, dalea, bush sunflower, orange zexmenia, and some annual forbs; and 5 percent woody plants, such as guajillo, blackbrush, mesquite, huisache, lotebush, spiny bumelia, granjeno, colima, coyotillo, guayacan, pricklypear, tasajillo, vine ephedra, narrowleaf forestiera, cenizo, and paloverde.

Twoflower trichloris, fourflower trichloris, Arizona cottontop, lovegrass tridens, and many palatable perennial forbs increase in abundance under continuous, heavy grazing by livestock. They are replaced initially by such plants as plains bristlegrass, pink pappusgrass, and silver bluestem and by woody plants. If overgrazing continues, the woody plants, such as guajillo, blackbrush, pricklypear, mesquite, and other climax brush species, may form a dense canopy over a sparse cover of such plants as Texas bristlegrass, perennial threeawn, Halls panicum, red grama, many unpalatable perennial forbs, and annual forbs. Goldenweed commonly invades under these conditions.

Gray Sandy Loam range site

The Caid and Copita soils in map units CaA, CaB, CBB, and CPB are in this range site.

The potential plant community is that of an open grassland. It is interspersed with scattered woody plants. The composition, by weight, is about 90 percent grasses, 5 percent forbs, and 5 percent woody plants.

The dominant plants consist of 40 percent tanglehead, fourflower trichloris, lovegrass tridens, Arizona cottontop, pinhole bluestem, and pink pappusgrass; 25 percent fall witchgrass, vine-mesquite, buffalograss, and curlymesquite; 20 percent plains bristlegrass; 5 percent perennial threeawn and slim tridens; 5 percent forbs, such as bundleflower, bush sunflower, and orange zexmenia; and 5 percent woody plants, such as mesquite, blackbrush, vine ephedra, guayacan, desert yaupon, cacti, kidneywood, and Texas colubrina.

Tanglehead, fourflower trichloris, pinhole bluestem, and plains bristlegrass decrease in abundance under continuous, heavy grazing by livestock. They are replaced initially by such plants as hooded windmillgrass, curlymesquite, and perennial threeawn and by woody plants. If overgrazing continues, woody plants may form a dense canopy over a sparse cover of such plants as perennial threeawn, Halls panicum, western ragweed, croton, tumblegrass, red grama, sandbur, and annual weeds and grasses.

Lakebed range site

The Tiocano soil in map unit Tc is in this range site.

The potential plant community is that of an open grassland that has varying degrees of wetness. The composition, by weight, is about 95 percent grasses and 5 percent forbs.

The dominant plants consist of 55 percent hartweg paspalum, white tridens, switchgrass, and vine-mesquite; 20 percent buffalograss and curlymesquite; 20 percent knotroot bristlegrass, filly panicum, sedges, and rushes; and 5 percent forbs, such as ruellia, bundleflower, frog-fruit, and annuals.

Switchgrass, white tridens, hartweg paspalum, and vine-mesquite decrease in abundance under continuous, heavy grazing by livestock. They are replaced initially by sedges, rushes, buffalograss, bermudagrass, and knotroot bristlegrass. Retama and mesquite also invade. If overgrazing continues, the site is dominated by such plants as retama and mesquite and by an understory of sedges, rushes, common bermudagrass, smallhead sneezeweed, and annual forbs.

Loamy Bottomland range site

The Divot soils in map units Dm and Dn are in this range site.

The potential plant community is a mixture of trees, shrubs, grasses, and forbs. The composition, by weight, is about 80 percent grasses, 5 percent forbs, and 15 percent woody plants. It varies, depending on the frequency and amount of overflow and the position on the landscape.

The dominant plants consist of 40 percent fourflower trichloris, southwestern bristlegrass, big cenchrus, big sacaton, and switchgrass; 15 percent white tridens, vine-mesquite, and pink pappusgrass; 15 percent buffalograss, plains bristlegrass,

and sedges; 10 percent Texas winter-grass and Virginia wildrye; 5 percent forbs, such as bundleflower, ruellia, and sensitive briar; and 15 percent woody plants, such as hackberry, pecan, elm, willow, live oak, and mesquite.

The taller grasses, such as fourflower trichloris, switchgrass, big cenchrus, southwestern bristlegrass, and big sacaton, decrease in abundance under continuous, heavy grazing by livestock. They are replaced initially by such plants as sedges, buffalograss, hooded windmillgrass, and fall witchgrass and by a wide variety of woody plants. If overgrazing continues, the woody plants, such as mesquite, spiny hackberry, whitebrush, and huisache, continue to invade and increase in abundance and dominate an understory of such plants as sedges, red threeawn, Halls panicum, filly panicum, bermudagrass, tumble windmillgrass, and annual grasses and forbs.

Loamy Sand range site

The Duval soil in map unit DsC is in this range site.

The potential plant community is that of an open grassland. It is interspersed with a few mesquite trees. The composition, by weight, is about 90 percent grasses, 5 percent forbs, and 5 percent woody plants (fig. 14).

The dominant plants consist of 45 percent seacoast bluestem, tanglehead, and trichloris; 25 percent pinhole bluestem, Arizona cottontop, and plains bristlegrass; 15 percent fall witchgrass, hooded windmillgrass, hairy grama, and fringleaf paspalum; 5 percent perennial threeawn and balsamscale; 5 percent forbs, such as Engelmann daisy, bush sunflower, western indigo, sensitive briar, and sida; and 5 percent woody plants, such as mesquite, hackberry, Texas colubrina, spiny hackberry, wolfberry, pricklypear, and tasajillo.

The taller grasses, such as seacoast bluestem, tanglehead, and trichloris, decrease in abundance under continuous, heavy grazing by livestock. They are replaced initially by such plants as hooded windmillgrass and fall witchgrass and by woody plants. If overgrazing continues, the woody plants continue to invade and increase in abundance along with such plants as red lovegrass, fringed signalgrass, perennial threeawn, hairy grama, sandbur, beebalm, and annual forbs and grasses.



Figure 14.—An area of Duval loamy fine sand, 0 to 5 percent slopes, in the Loamy Sand range site. The vegetation includes mesquite, hog-plum, bluewood condalia, broomweed, threeawn, hairy grama, and hooded windmillgrass.

Lowland range site

The Arroyada and Coquat soils in map units ARB and Cq are in this range site.

The potential plant community is that of an open grassland and has little or no brush canopy.

The dominant plants consist of 85 percent gulf cordgrass; 5 percent big sacaton; 5 percent hartweg paspalum, white tridens, and silver bluestem; 5 percent vine-mesquite, buffalograss, curlymesquite, and shoregrass; a few forbs; and a few woody plants, such as mesquite, retama, spiny aster, and screwbean.

Gulf cordgrass is normally quite unpalatable to cattle and thus does not decrease much in abundance under continuous, heavy grazing by livestock. In most areas this range site is associated with other range sites that support more palatable forage. Consequently, this site is seldom grazed.

If the gulf cordgrass is burned in the fall or winter, the young and tender regrowth is palatable to cattle and wildlife. If the site is subject to annual burning and to heavy grazing by livestock, the gulf cordgrass and the other climax grasses decrease in abundance and are replaced by unpalatable salt-tolerant perennial and annual forbs, woody plants, and grasses, including whorled dropseed. If this occurs, cattle tend not to graze the site and gulf cordgrass becomes reestablished.

Ramadero range site

The Poteet and Tela soils in map units Pt and Ta are in this range site.

The potential plant community is that of a partly open riparian savannah. Periodic range fires kept the brush canopy open. The potential plant community has an understory of productive grasses and a moderate canopy of trees and tall brush. The composition, by weight, is about 90 percent grasses, 5 percent forbs, and 5 percent woody plants.

The dominant plants consist of 35 percent twoflower trichloris and fourflower trichloris; 20 percent plains bristlegrass and pink pappusgrass; 10 percent southwestern bristlegrass and cane bluestem; 5 percent Arizona cottontop; 5 percent lovegrass tridens and big cenchrus; 5 percent curlymesquite and buffalograss; 5 percent vine-mesquite; 5 percent hooded windmillgrass; 5 percent forbs, such as Engelmann daisy, bush sunflower, orange zexmenia, bundleflower, ruellia, dayflower, and annual forbs; and 5 percent woody plants, such as mesquite, hackberry, spiny hackberry, spiny bumelia, coyotillo, whitebrush, bluewood condalia, kidneywood, pricklypear, guayacan, tasajillo, Texas persimmon, and ephedra.

Twoflower trichloris, fourflower trichloris, Arizona cottontop, southwestern bristlegrass, cane bluestem, lovegrass tridens, big cenchrus, and the most palatable forbs are grazed out under continuous, heavy grazing by livestock. They are replaced initially by such plants as plains bristlegrass, pink pappusgrass, curlymesquite, buffalograss, hooded windmillgrass, and the less palatable forbs and brush. If overgrazing continues, the understory consists mainly of Halls panicum, Texas bristlegrass, whorled dropseed, perennial threeawns, tumblegrass, unpalatable perennial forbs, and annual forbs. A dense, impenetrable thicket of mesquite, whitebrush, and other climax brush species forms in overgrazed areas that are not subject to periodic range fires.

Rolling Hardland range site

The Maverick soil in map unit MCC is in this range site.

The potential plant community is that of an open grassland. It is interspersed with scattered low brush. The composition, by weight, is about 90 percent grasses, 5 percent forbs, and 5 percent woody plants.

The dominant plants consist of 45 percent fourflower trichloris, lovegrass tridens, pinhole bluestem, pink pappusgrass, and plains lovegrass; 15 percent plains bristlegrass and Arizona cottontop; 15 percent curlymesquite and buffalograss; 15

percent fall witchgrass, hooded windmillgrass, perennial threeawn, bristle panicum, and Texas bristlegrass; 5 percent forbs, such as bush sunflower, bundleflower, and orange zexmenia; and 5 percent woody plants, such as guayacan, kidneywood, guajillo, blackbrush, mesquite, allthorn, and amargosa.

Fourflower trichloris, plains lovegrass, bush sunflower, and pinhole bluestem decrease in abundance under continuous, heavy grazing by livestock. They are replaced initially by woody plants and grasses, such as fall witchgrass, perennial threeawn, and curlymesquite. If overgrazing continues, woody plants generally form a dense canopy over a sparse cover of red grama, whorled dropseed, Texas grama, Halls panicum, Texas varilla, and threeawn.

Saline Clay range site

The Catarina, Cotulla, Lasalle, Monteola, and Viboras soils in map units CCA, CtA, CUA, LaA, LAB, MTC, and VBB are in this range site.

The potential plant community consists of mid and short grasses interspersed with a few woody plants. The composition, by weight, is about 90 percent grasses, 5 percent forbs, and 5 percent woody plants.

The dominant plants consist of 25 percent twoflower trichloris, fourflower trichloris, and alkali sacaton; 20 percent white tridens, vine-mesquite, and pink pappusgrass; 15 percent buffalograss and curlymesquite; 10 percent pinhole bluestem and Arizona cottontop; 10 percent plains bristlegrass; 10 percent whorled dropseed, Halls panicum, and perennial threeawn; 5 percent forbs, such as bundleflower, screwbean, and ruellia; and 5 percent woody plants, such as fourwing saltbush, armed saltbush, spiny hackberry, mesquite, guayacan, condalia, cacti, and desert yaupon.

Trichloris, vine-mesquite, and Arizona cottontop are grazed out under continuous, heavy grazing by livestock. They are replaced initially by such plants as curlymesquite and Halls panicum and by woody plants. If overgrazing continues, woody plants continue to invade and increase in abundance along with such plants as whorled dropseed, red grama, Mediterranean lovegrass, and gummy lovegrass.

Saline Clay Loam range site

The Altita, Charco, Mata, and Moglia soils in map units CEB, MAC, and MGC are in this range site.

The potential plant community consists of mid and short grasses interspersed with scattered blackbrush and other woody shrubs. The composition, by weight, is about 90 percent grasses, 5 percent forbs, and 5 percent woody plants (fig. 15).

The dominant plants consist of 35 percent white tridens, vine-mesquite, and pink pappusgrass; 15 percent twoflower trichloris and fourflower trichloris; 15 percent plains bristlegrass, Arizona cottontop, and bristle panicum; 15 percent buffalograss and curlymesquite; 10 percent tall witchgrass, Halls panicum, and perennial threeawn; 5 percent forbs, such as bundleflower, bush sunflower, and orange zexmenia; and 5 percent woody plants, such as guajillo, blackbrush, spiny hackberry, mesquite, guayacan, condalia, cacti, and desert yaupon.

Trichloris, vine-mesquite, and bush sunflower are grazed out under continuous, heavy grazing by livestock. They are replaced initially by such plants as curlymesquite and Halls panicum and by woody plants. If overgrazing continues, woody plants continue to invade and increase in abundance and blackbrush and other brush species, broomweed, and goldenweed form a dense canopy.



Figure 15.—An area of Mata gravelly sandy clay loam, gently undulating, in the Saline Clay Loam range site. The vegetation includes blackbrush, guajillo, condalia, broomweed, goldenweed, red grama, slim tridens, and threeawn. The gravel mulch on the surface helps protect the soil from water erosion and wind erosion.

Sandy Loam range site

The Brystal and Duval soils in map units ByB, BZB, DvA, DvB, and DVC are in this range site.

The potential plant community is that of an open grassland. It is dominated by mid grasses and some forbs and woody plants. The composition, by weight, is about 90 percent grasses, 5 percent woody plants, and 5 percent forbs.

The dominant plants consist of 50 percent pinhole bluestem, plains bristlegrass, hooded windmillgrass, pink pappusgrass, and plains lovegrass; 25 percent tanglehead, twoflower trichloris, and fourflower trichloris; 15 percent slim tridens, reverchon panicum, bristle panicum, lovegrass tridens, perennial threeawn, fall witchgrass, hairy grama, and fringleaf paspalum; 5 percent forbs, such as Engelmann daisy, sensitive briar, and bundleflower; and 5 percent woody plants, such as condalia, kidneywood, blackbrush, vine ephedra, desert yaupon, spiny hackberry, guayacan, mesquite, and pricklypear.

The taller grasses, such as fourflower trichloris and tanglehead, and the more palatable forbs, such as Engelmann daisy, decrease in abundance under continuous heavy grazing by livestock. They are replaced initially by such grasses as hooded windmillgrass, perennial threeawn, and fall witchgrass and by woody plants, which increase rapidly in abundance. If overgrazing continues, a wide variety of woody plants continues to invade and increases in abundance along with an understory of such plants as perennial threeawn, red grama, red lovegrass, Hails panicum, hooded windmillgrass, sandbur, other annual grasses, and forbs.

Shallow Sandy Loam range site

The Dilley soil in map unit DLC is in this range site.

The potential plant community is that of an open grassland. It is interspersed with a few scattered woody plants and a wide variety of forbs. The composition, by weight, is about 85 percent grasses, 10 percent forbs, and 5 percent woody plants.

The dominant plants consist of 45 percent tanglehead, plains bristlegrass, silver bluestem, and Arizona cottontop; 20 percent hooded windmillgrass, pink pappusgrass, slender grama, and perennial threeawn; 20 percent fall witchgrass, slim tridens, and sand dropseed; 10 percent forbs, such as menodora, dalea, bundleflower, bush sunflower, orange zexmenia, and sensitive briar; and 5 percent woody plants, such as guajillo, blackbrush, range ratany, kidneywood, vine ephedra, spiny hackberry, desert yaupon, condalia, and cacti.

Tanglehead, bush sunflower, plains bristlegrass, silver bluestem, and Arizona cottontop decrease in abundance under continuous, heavy grazing by livestock. They are replaced initially by such plants as perennial threeawn, hooded windmillgrass, hairy grama, and fall witchgrass and by a wide variety of woody plants. If overgrazing continues, the site is dominated by a wide variety of woody plants, such as blackbrush, leatherstem, shrubby blue sage, spiny hackberry, Texas colubrina, and cacti, and by an understory of such plants as slender grama, red grama, perennial threeawn, gummy lovegrass, and annual grasses and forbs.

Tight Sandy Loam range site

The Imogene and Webb soils in map units Im, WbA, WbB, and WCB are in this range site.

The potential plant community is that of an open grassland. It is interspersed with scattered woody plants and some forbs. The composition, by weight, is about 90 percent grasses, 5 percent woody plants, and 5 percent forbs.

The dominant plants consist of 40 percent fourflower trichloris, pinhole bluestem, tanglehead, Arizona cottontop, and pink pappusgrass; 20 percent hooded windmillgrass, slender grama, fringleaf paspalum, and perennial threeawn; 15 percent plains bristlegrass and plains lovegrass; 15 percent buffalograss and curlymesquite; 5 percent forbs, such as bush sunflower, Engelmann daisy, orange zexmenia, and bundleflower; and 5 percent woody plants, such as kidneywood, vine ephedra, spiny bumelia, mesquite, condalia, spiny hackberry, and cacti.

The taller grasses, such as fourflower trichloris, pinhole bluestem, tanglehead, and plains lovegrass, decrease in abundance under continuous, heavy grazing by livestock. They are replaced initially by such plants as hooded windmillgrass and curlymesquite and by woody plants. If overgrazing continues, the woody plants native to the site and such plants as twisted acacia, whitebrush, and goldenweed form a moderately dense canopy and the understory consists of such plants as lantana, broomweed, croton, red grama, Texas grama, perennial threeawn, and fringed signalgrass.

Recreation

In table 8, the soils of the survey area are rated according to the limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public 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 8, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have gentle slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes, stones, or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

By Jerry Turrentine, area biologist, Soil Conservation Service.

Wildlife is an important resource in La Salle County. Most of the land that supports wildlife is leased for hunting or is used by the landowners for hunting. Because of good management of wildlife habitat, many wildlife species are increasing in number.

The improvement of habitat for game species has been given special emphasis in the county. The major game species include white-tailed deer, javelina, bobwhite quail, scaled quail, white-winged dove, mourning dove, and turkey. In some locations feral hogs are numerous and hunted. Fox, raccoon, badger, skunk, opossum, nutria, armadillo, cottontail rabbit, jackrabbit, squirrel, bats, and numerous rodents also inhabit the county. The common predators are coyote and bobcat. A few mountain lions inhabit the county.

Intensive management of deer herds to produce quality bucks is fairly common. Many ranches have high fences to help control the number of deer.

Many ponds in the county are stocked with channel catfish, black bass, and sunfish. Fishing is fair in the Nueces and Frio Rivers (fig. 16). Water areas are widely used by animals and birds and provide habitat for amphibians. Several species of reptiles, including a small number of alligators, inhabit the county. The diamondback rattlesnake is the best known reptile in the county.



Figure 16.—Recreational fishing below Holland Reservoir on the Nueces River.

Migrating waterfowl use the water areas and cropland in the county as resting sites and feeding areas. They include white-fronted geese; widgeon, pintail, gadwall, teal, and ring-necked ducks; and sandhill cranes. Other birds in the county include water-associated species, vultures, and numerous species of songbirds. Many raptors, such as the white-tailed kite, sharp-shinned hawk, marsh hawk, red-tailed hawk, and Harris hawk, inhabit the county or migrate through it.

The successful management of wildlife requires the proper combination of food, cover, and water. A lack of any one of these elements, an unfavorable balance among them, or an inadequate distribution of them can eliminate or severely limit a desired kind of wildlife in an area. Information about soils is helpful in creating, improving, or maintaining suitable food, cover, and water for wildlife.

Most wildlife habitat is created or managed by planting suitable vegetation, by increasing the extent of existing vegetation or improving its quality, or by a combination of these measures. The influence that most soils have on plants is known or can be reliably inferred from a knowledge of the soil characteristics. Soil

information also is useful in selecting sites for creating or improving water areas for wildlife habitat.

Proper management of wildlife habitat is important. Areas of corn and grain sorghum provide food for dove and quail. Small grain can provide food for geese, sandhill cranes, and deer if suitable cover is nearby. Leaving crop residue on the surface can provide forage for numerous species of wildlife. Small areas of unharvested grain can provide food and cover. Properly managed waterways can provide cover for small mammals and birds. Additional cover can be provided by leaving brush in fence rows. Disking field borders can greatly improve the food supply available in pastures. Brush in pastured areas provides food and cover. Kleingrass and blue panicum provide seed for birds.

Proper management of habitat for rangeland wildlife includes several rangeland improvement practices. Controlled grazing, planned grazing systems, and deferred grazing can increase the amount of forage available to wildlife. A good vegetative cover can provide cover for quail and turkey and fawning areas for deer. If allowed to mature, many grasses can provide seed for dove, quail, and turkey. Brush management is important. If brush is cleared in strips or other patterns, a diversity of food sources for various species of wildlife is created. Other measures that can improve the habitat include disking, planting food plots, range seeding, and establishing water facilities.

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in range management; 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 ratings are based mainly on soil characteristics and closely related natural factors of the environment. They do not take into account the present use of the soils or distribution of wildlife and people; therefore, onsite inspection is necessary when selecting a site for development of wildlife 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 grain sorghum.

Grasses and legumes are 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 buffelgrass, kleingrass, blue panicum, sorghum alnum, clover, and vetch.

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 native panicums, bristlegass, native sunflowers, Engelmann daisy, western ragweed, tephrosia, and wooly tidestromia.

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 spiny hackberry, guayacan, kidneywood, guajillo, blackbrush, Texas colubrina, mesquite, spiny bumelia, and pricklypear cactus.

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, and sedges.

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

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, clearings, 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 quail, dove, cottontail, jackrabbit, and sandhill crane.

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, and nutria.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include deer, turkey, quail, javelina, raccoon, and coyote.

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 kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the "Glossary."

Building Site Development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and 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. Depth to a high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of

excavation and construction. Landscaping and grading that require cuts and fills of more than 5 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, depth to a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost-action potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, depth to a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 11 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for 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 60 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, depth to a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons

generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, depth to a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage 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 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, depth to a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench 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 final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good*, *fair*, or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help 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 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

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

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

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal 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 releases a variety of plant nutrients as it decomposes.

Water Management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas 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 drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

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; and susceptibility to flooding. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

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 or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed (13). During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 17.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help 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 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under 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 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 17.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and plasticity index (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index generally are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

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

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of movement of water through the soil when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems 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 in each major soil layer is stated in inches of water per inch of soil. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, more than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion. Losses are expressed in tons per acre per year. These estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur over a sustained period without affecting crop productivity. The rate is expressed in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility to wind erosion. Soils are grouped according to the following distinctions:

1. Coarse sands, sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to reestablish.
2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.
3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.
- 4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.
4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.
5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.
6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control wind erosion are used.
7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control wind erosion are used.
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 15, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter 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 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

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

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

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

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

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

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

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as *none*, *rare*, *occasional*, or *frequent*. *None* means that flooding is not probable. *Rare* means that flooding is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year). *Occasional* means that flooding occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year). *Frequent* means that flooding occurs often under normal weather conditions (the chance of flooding is more than 50 percent in any year). Duration is expressed as *very brief* (less than 2 days), *brief* (2 to 7 days), and *long* (more than 7 days). 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 the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is highest. A water table that is seasonally high for less than 1 month is not indicated in table 16.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

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 specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

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.

Engineering Index Test Data

Table 17 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. Most of 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 423 (ASTM), D 2217 (ASTM); Liquid limit—I 89 (AASHTO), D 4318 (ASTM); Plasticity index—T 90 (AASHTO), D 4318 (ASTM); Specific gravity—T 100 (AASHTO), D 653 (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 (12). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or on laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. 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 climate, 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; 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 development, 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 is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Aridic* identifies the subgroup that has a soil moisture regime bordering the aridic regime. An example is Aridic 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 class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine, montmorillonitic, hyperthermic Aridic Paleustalfs.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. There can be some variation in the texture of the surface layer or of the substratum within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" (10). Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" (12). Unless otherwise stated, matrix 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."

Aguilares Series

The Aguilares series consists of very deep, well drained, loamy soils on uplands. These soils formed in loamy sediments. Slopes range from 0 to 3 percent.

Typical pedon of Aguilares sandy clay loam, gently undulating; from the intersection of U.S. Highway 81 and Texas Highway 97 in Cotulla, 0.8 mile east on Texas Highway 97, about 20 miles southeast on Farm Road 624, about 5.25 miles south on county road to locked gate, 9.25 miles south and east on ranch road, 1.8 miles east along fence line, and 4.6 miles east in an area of rangeland:

A—0 to 9 inches; grayish brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to weak fine

- subangular blocky and granular; slightly hard, friable; a hard, friable surface crust in the upper 1.0 inch; many very fine and fine roots; common fine and medium tubular pores; few snail shell fragments; about 9 percent calcium carbonate equivalent; nonsaline; strongly effervescent; moderately alkaline; clear smooth boundary.
- Bk1—9 to 15 inches; light brownish gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) moist; weak coarse prismatic structure parting to weak fine and medium subangular blocky; slightly hard, friable; common very fine and medium roots; few fine and medium tubular pores; few fine, irregular threads and soft masses of calcium carbonate; about 15 percent calcium carbonate equivalent; nonsaline; violently effervescent; moderately alkaline; clear wavy boundary.
- Bk2—15 to 24 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; weak coarse prismatic structure parting to weak fine subangular blocky; slightly hard, friable; few very fine roots; few fine tubular pores; about 5 percent, by volume, fine, irregular threads and soft masses of calcium carbonate; few faint coatings of calcium carbonate on faces of peds; about 20 percent calcium carbonate equivalent; nonsaline; violently effervescent; moderately alkaline; clear wavy boundary.
- Bk3—24 to 35 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; weak fine subangular blocky structure; slightly hard, friable; few very fine roots; few fine tubular pores; about 10 percent, by volume, fine, irregular threads and fine and medium, irregular soft masses of calcium carbonate; few faint coatings of calcium carbonate on faces of peds; about 35 percent calcium carbonate equivalent; very slightly saline; violently effervescent; moderately alkaline; clear wavy boundary.
- Cknz1—35 to 47 inches; very pale brown (10YR 7/3) sandy clay loam, pale brown (10YR 6/3) moist; massive; slightly hard, friable; few very fine and fine roots; about 10 percent, by volume, fine, irregular threads and fine and medium, irregular soft masses of calcium carbonate; about 31 percent calcium carbonate equivalent; exchangeable sodium percentage of 18; moderately saline; violently effervescent; moderately alkaline; gradual wavy boundary.
- Cknz2—47 to 58 inches; very pale brown (10YR 8/3) sandy clay loam, very pale brown (10YR 7/3) moist; massive; slightly hard, friable; about 15 percent, by volume, light gray (5Y 7/2), soft sandstone fragments that slake in water; few very fine and fine roots; about 5 percent, by volume, fine, irregular threads and fine and medium, irregular soft masses of calcium carbonate; about 26 percent calcium carbonate equivalent; exchangeable sodium percentage of 25; moderately saline; violently effervescent; moderately alkaline; clear wavy boundary.
- Ckyz—58 to 72 inches; very pale brown (10YR 8/3) sandy clay loam, very pale brown (10YR 7/3) moist; massive; slightly hard, friable; about 30 percent, by volume, light gray (5Y 7/2), soft sandstone fragments that slake in water; few very fine roots; about 3 percent, by volume, fine, irregular threads and fine and medium, irregular soft masses of calcium carbonate; about 17 percent calcium carbonate equivalent; exchangeable sodium percentage of 22; about 10 percent, by volume, fine and medium, irregular soft masses and clusters of gypsum crystals and other salts; moderately saline; violently effervescent; moderately alkaline.

The thickness of the solum ranges from 30 to 50 inches. By weighted average, the content of total clay in the 10- to 40-inch control section is 25 to 40 percent and the content of silicate clay is 18 to 30 percent. By weighted average, the calcium

carbonate equivalent in the control section is 10 to 25 percent. The depth to a calcic horizon is 10 to 35 inches. The calcium carbonate equivalent in the calcic horizon is 15 to 35 percent, of which 5 to 15 percent is in visible secondary forms. The content of visible accumulations of gypsum and other salts ranges from 0 to 20 percent, by volume, below a depth of 40 inches. Salinity is less than 4 millimhos per centimeter in the upper 30 inches of the solum and 4 to 16 millimhos per centimeter below a depth of 30 inches. The exchangeable sodium percentage is 10 to 30 below a depth of 30 inches.

The A horizon is light brownish gray, grayish brown, dark grayish brown, pale brown, or brown. Where it has value of less than 3.5 when moist, it is less than 7 inches thick. It is calcareous or noncalcareous. It is calcareous in all areas where the upper 7 inches is mixed. The content of total clay is 18 to 30 percent. This horizon is 5 to 12 inches thick.

The Bk horizon is light brownish gray, light gray, very pale brown, pale brown, brown, grayish brown, yellowish brown, or light yellowish brown. It is sandy clay loam or clay loam. The content of total clay is 20 to 39 percent. The content of carbonate clay is 1 to 20 percent.

The C horizon is very pale brown, pale brown, light yellowish brown, light brown, or pink. It is fine sandy loam, sandy clay loam, or clay loam. The content of total clay is 10 to 40 percent. The content of soft or weakly cemented sandstone fragments ranges from 0 to 35 percent, by volume, below a depth of 40 inches. The soft sandstone fragments slake in water. Some pedons have fractured, soft sandstone bedrock below a depth of 40 inches.

Altita Series

The Altita series consists of very deep, well drained, loamy soils on uplands. These soils formed in loamy alluvium over residuum. Slopes range from 0 to 2 percent.

Typical pedon of Altita sandy clay loam, in an area of Charco-Altita complex, nearly level; from the intersection of U.S. Highway 81 and Texas Highway 97 in Cotulla, 5.8 miles east on Texas Highway 97, about 1.6 miles southeast on ranch road, and 170 feet northeast in an area of rangeland:

- A—0 to 18 inches; grayish brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; moderate fine and medium subangular blocky structure; very hard, firm; few very fine and fine roots; few fine tubular pores; about 7 percent calcium carbonate equivalent; nonsaline; strongly effervescent; moderately alkaline; gradual smooth boundary.
- Btk—18 to 28 inches; light brownish gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) moist; moderate fine and medium angular blocky structure; very hard, firm; few very fine roots; few fine tubular pores; common faint clay films on faces of peds; few fine, irregular threads of calcium carbonate; about 9 percent calcium carbonate equivalent; nonsaline; violently effervescent; moderately alkaline; gradual wavy boundary.
- Btyz—28 to 38 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; weak fine and medium subangular blocky structure; very hard, very firm; few very fine roots; few faint clay films on faces of peds; common fine and medium, irregular soft masses and crystals of gypsum and other salts; common distinct coatings of gypsum crystals on faces of peds; about 7 percent calcium carbonate equivalent; slightly saline; violently effervescent; moderately alkaline; gradual wavy boundary.
- Byz1—38 to 50 inches; very pale brown (10YR 7/3) clay loam, pale brown (10YR 6/3) moist; few fine distinct grayish brown (10YR 5/2) vertical streaks in the upper part; weak fine and medium subangular blocky structure; hard,

firm; about 20 percent, by volume, white (5Y 8/2), soft shale fragments that slake in water; few fine and medium, rounded, yellow (10YR 7/6), weakly cemented nodules; about 30 percent, by volume, fine to coarse, irregular soft masses and crystals of gypsum and other salts; about 5 percent calcium carbonate equivalent; slightly saline; strongly effervescent; moderately alkaline; gradual wavy boundary.

Byz2—50 to 64 inches; very pale brown (10YR 8/4) clay loam, light yellowish brown (10YR 6/4) moist; weak fine and medium subangular blocky structure; hard, firm; about 20 percent, by volume, white (5Y 8/2), soft shale fragments that slake in water; few fine and medium, rounded, yellow (10YR 7/6), weakly cemented nodules; about 30 percent, by volume, fine to coarse, irregular soft masses and clusters of gypsum crystals and other salts; about 3 percent calcium carbonate equivalent; moderately saline; slightly effervescent; moderately alkaline.

The thickness of the solum ranges from 36 to more than 60 inches. Salinity is 0.2 to 2.0 millimhos per centimeter in the A horizon, 1 to 4 millimhos per centimeter in the Btk horizon, and 4 to 12 millimhos per centimeter in the lower part of the Btyz horizon and in the Cyz horizon. COLE is 0.07 to 0.09 in the upper 20 inches of the Bt horizon. The soils are mildly alkaline or moderately alkaline throughout.

The A horizon is grayish brown, brown, or light brownish gray. Where it has value of less than 3.5 when moist, it is less than 7 inches thick. In some pedons the upper 2 to 8 inches is noncalcareous.

The Btk and Btyz horizons are light brownish gray, pale brown, or light yellowish brown. They are clay loam or clay. They have few or common soft masses and clusters of gypsum crystals and other salts.

The Byz horizon is pale brown, very pale brown, or light yellowish brown. It is clay or clay loam that has few to many soft shale fragments that slake in water. It has common or many soft masses and clusters of gypsum crystals and other salts. The C horizon, if it occurs, is similar to Byz horizon but has higher value.

Arroyada Series

The Arroyada series consists of very deep, somewhat poorly drained, saline, clayey soils on flood plains. These soils formed in saline, calcareous, clayey alluvium. Slopes are 0 to 1 percent. They are mainly less than 0.5 percent.

Typical pedon of Arroyada clay, frequently flooded; from the intersection of U.S. Highway 81 and Texas Highway 97 in Cotulla, 0.8 mile east on Texas Highway 97, about 20 miles southeast on Farm Road 624, about 5.25 miles south on county road to locked gate, 9.25 miles south and east on ranch road, 1.8 miles east along fence line, 1.3 miles north along fence line, and 50 feet west in an area of rangeland:

Ag—0 to 12 inches; gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; moderate very coarse prismatic structure parting to strong fine and medium angular blocky; very hard, very firm, very sticky and very plastic; many very fine, fine, and medium roots; common fine pores; few medium, rounded, strongly cemented nodules of calcium carbonate; nonsaline; strongly effervescent; moderately alkaline; clear wavy boundary.

Anzg—12 to 24 inches; gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; moderate very coarse prismatic structure parting to strong fine and medium angular blocky; extremely hard, very firm, very sticky and very plastic; common very fine and fine roots; common intersecting slickensides; common medium, rounded, strongly cemented nodules of calcium carbonate; slightly saline; strongly effervescent; moderately alkaline; gradual wavy boundary.

Anzg/Bnzc—24 to 50 inches; gray (10YR 5/1) clay (Anzg), dark gray (10YR 4/1) moist; common fine distinct streaks of gray (10YR 6/1) clay (Bnzc), gray (10YR 5/1) moist; moderate very coarse prismatic structure parting to strong fine and medium angular blocky; extremely hard, very firm, very sticky and very plastic; common very fine and fine roots; few fine tubular pores; common intersecting slickensides; common medium, rounded, strongly cemented nodules of calcium carbonate; moderately saline; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bnzc/Anzg—50 to 65 inches; light olive gray (5Y 6/2) clay (Bnzc), olive gray (5Y 5/2) moist; common coarse distinct pink (7.5YR 7/4) mottles, mainly in the lower part; common fine distinct streaks of gray (10YR 5/1) clay (Anzg), dark gray (10YR 4/1) moist; weak very coarse prismatic structure parting to moderate fine and medium angular blocky; extremely hard, very firm, very sticky and very plastic; common very fine and fine roots; common intersecting slickensides; moderately saline; strongly effervescent; moderately alkaline; clear wavy boundary.

Bnzc—65 to 80 inches; light gray (5Y 6/1) clay, gray (5Y 5/1) moist; many coarse distinct pink (7.5YR 7/4) mottles; weak very coarse prismatic structure parting to moderate fine and medium angular blocky; extremely hard, very firm, very sticky and very plastic; common very fine and fine roots; common medium, irregular clusters of gypsum crystals; moderately saline; strongly effervescent; moderately alkaline.

The thickness of the solum ranges from 60 to more than 80 inches. The microknolls are 8 to 12 inches higher than the microbasins. The amplitude of the boundary between the A/B and B/A horizons is about 5 to 17 inches. The depth to intersecting slickensides is 12 to 30 inches. Salinity is 0 to 4 millimhos per centimeter in the upper 10 inches and 4 to 20 millimhos per centimeter below a depth of 20 inches. The exchangeable sodium percentage is 15 or more within 30 inches of the surface and increases with increasing depth. The content of total clay is 45 to 60 percent. The soils have cracks 0.4 inch to 3.0 inches wide at the surface when dry. The cracks extend to a depth of more than 20 inches. The soils are mildly alkaline or moderately alkaline throughout.

The A and A/B horizons are dark gray or gray. The A/B horizon has common or many streaks that are the same color as the B horizon.

The B/A and B horizons are gray, light olive gray, light gray, pale brown, or very pale brown. They have common or many streaks that are the same color as the A horizon.

The C horizon is slightly altered alluvial clay. In some areas it is intermingled with soft shale fragments that slake in water. It is the same color as the B horizon or is lighter colored.

Bookout Series

The Bookout series consists of very deep, well drained, loamy soils on stream terraces. These soils formed in calcareous, loamy and clayey alluvium. Slopes range from 0 to 5 percent.

Typical pedon of Bookout clay loam, 0 to 1 percent slopes; from the intersection of U.S. Highway 81 and Texas Highway 97 in Cotulla, 0.8 mile east on Texas Highway 97 to Farm Road 624, about 9.4 miles southeast on Farm Road 624, about 1.7 miles southeast on county road to a 90-degree curve in the road, 0.75 mile southwest on county road, and 100 feet northwest in an area of cropland:

Ap—0 to 6 inches; pale brown (10YR 6/3) clay loam, dark brown (10YR 4/3) moist; weak fine subangular blocky structure; hard, friable; many very fine

and fine roots; few fine tubular pores; few snail shell fragments; strongly effervescent; moderately alkaline; abrupt smooth boundary.

A—6 to 16 inches; pale brown (10YR 6/3) clay loam, dark brown (10YR 4/3) moist; moderate fine and medium subangular blocky structure; hard, friable; many very fine and fine roots; few fine tubular pores; few snail shell fragments; violently effervescent; moderately alkaline; gradual smooth boundary.

Bk1—16 to 30 inches; light yellowish brown (10YR 6/4) clay loam, yellowish brown (10YR 5/4) moist; moderate fine and medium subangular blocky structure; hard, friable; few very fine roots; few fine tubular pores; few snail shell fragments; few fine, irregular threads of calcium carbonate; violently effervescent; moderately alkaline; gradual wavy boundary.

Bk2—30 to 44 inches; very pale brown (10YR 7/4) clay loam, light yellowish brown (10YR 6/4) moist; weak fine and medium subangular blocky structure; hard, friable; few very fine roots; few fine tubular pores; few snail shell fragments; common fine, irregular threads and medium, irregular soft masses of calcium carbonate; violently effervescent; moderately alkaline; gradual wavy boundary.

Bk3—44 to 65 inches; very pale brown (10YR 7/4) clay loam, light yellowish brown (10YR 6/4) moist; weak fine and medium subangular blocky structure; hard, friable; few very fine roots; few fine tubular pores; few snail shell fragments; common fine, irregular threads and medium, irregular soft masses of calcium carbonate and few medium, strongly cemented nodules of calcium carbonate; violently effervescent; moderately alkaline.

The thickness of the solum ranges from 60 to more than 80 inches. By weighted average, the calcium carbonate equivalent in the 10- to 40-inch control section is 20 to 40 percent. By weighted average, the content of total clay in the control section is 32 to 50 percent and the content of silicate clay is 18 to 35 percent. The soils are mildly alkaline or moderately alkaline throughout.

The A horizon is grayish brown, brown, light brownish gray, pale brown, or very pale brown. It is 9 to 20 inches thick.

The Bk1 horizon is light brownish gray, pale brown very pale brown, yellowish brown, light yellowish brown, or light brown. It is clay loam, silty clay loam, or clay. It has few or common visible accumulations of calcium carbonate.

The Bk2 and Bk3 horizons are pale brown, very pale brown, light brown, light yellowish brown, or pink. They have common or many visible accumulations of calcium carbonate occurring as threads, soft masses, and nodules.

Brundage Series

The Brundage series consists of very deep, moderately well drained, saline, loamy soils that have a sodic subsoil (fig. 17). These soils are on stream terraces. They formed in saline, loamy alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Brundage very fine sandy loam, 0 to 2 percent slopes; from the intersection of U.S. Highway 81 and Texas Highway 97 in Cotulla, 1.7 miles south on U.S. Highway 81 to Interstate Highway 35, about 9.7 miles south on Interstate Highway 35 to its intersection with Farm Road 133 in Artesia Wells, 0.7 mile south on east frontage road of Interstate Highway 35 to county road, 6.3 miles east on county road, 2.8 miles south on ranch road to ranch gate, 0.9 mile south on airstrip, 0.65 mile west on ranch road to old bridge over creek, 0.1 mile north on ranch road, and 400 feet east in an area of rangeland:

A—0 to 2 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure;

weak fine platy surface crust about 0.2 inch thick; slightly hard, very friable; common very fine and fine roots; few fine tubular pores; nonsaline; slightly acid; abrupt smooth boundary.

Bt—2 to 9 inches; dark grayish brown (10YR 4/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; moderate coarse columnar structure parting to moderate fine and medium angular blocky; light gray (10YR 7/2) caps on the tops of columns; extremely hard, firm; common very fine and fine roots, mainly along faces of peds; few fine tubular pores; common faint clay films on faces of peds; very slightly saline; noneffervescent; mildly alkaline; clear wavy boundary.

Btnz1—9 to 18 inches; light brownish gray (10YR 6/2) sandy clay loam, grayish brown (10YR 5/2) moist; few fine distinct dark grayish brown (10YR 4/2) vertical streaks; weak coarse columnar structure parting to weak fine and medium subangular blocky; very hard, firm; few very fine roots; few fine tubular pores; few faint clay films on vertical faces of peds; few fine, regular threads and soft masses of calcium carbonate; few fine, irregular soft masses and clusters of gypsum crystals and other salts; moderately saline; violently effervescent; moderately alkaline; gradual wavy boundary.



Figure 17.—Profile of a Brundage very fine sandy loam. A natric horizon is at a depth of about 5 inches. The scale is marked in decimeters and feet.

- Bt_{nz}2—18 to 32 inches; pale brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) moist; common fine distinct very pale brown (10YR 7/3) mottles; weak fine and medium subangular blocky structure; hard, friable; few very fine roots; few fine tubular pores; few faint clay films on vertical faces of peds; few fine, irregular soft masses of calcium carbonate; few fine, irregular soft masses and clusters of gypsum crystals and other salts; moderately saline; violently effervescent; moderately alkaline; gradual wavy boundary.
- BC_{nz}—32 to 50 inches; very pale brown (10YR 7/3) sandy clay loam, pale brown (10YR 6/3) moist; few fine distinct yellowish brown (10YR 5/6) mottles; weak fine and medium subangular blocky structure; hard, friable; few fine and medium, irregular soft masses of calcium carbonate; few fine, irregular soft masses and clusters of gypsum crystals and other salts; strongly saline; violently effervescent; moderately alkaline; clear irregular boundary.
- 2C/BC_{nz}—50 to 58 inches; about 55 percent, by volume, light gray (2.5Y 7/2) clay loam (C), light brownish gray (2.5Y 6/2) moist; massive; very hard, firm; few fine distinct yellowish brown (10YR 5/6) mottles; moderately saline; noneffervescent; mildly alkaline; very pale brown (10YR 7/3) clay loam (BC_{nz}), pale brown (10YR 6/3) moist; weak fine subangular blocky structure; very hard, firm; few fine and medium, irregular soft masses of calcium carbonate; common fine soft masses and clusters of gypsum crystals and other salts; moderately saline; slightly effervescent; mildly alkaline; gradual irregular boundary.
- 2C_{nz}/Cr—58 to 80 inches; about 55 percent, by volume, light gray (2.5Y 7/2) clay loam (C_{nz}), light brownish gray (2.5Y 6/2) moist; common medium and coarse distinct yellowish brown (10YR 5/6) mottles; massive; hard, friable; few fine and medium, irregular soft masses of calcium carbonate; few fine soft masses and clusters of gypsum crystals and other salts; noneffervescent matrix; moderately saline; mildly alkaline; white (2.5Y 8/2), fractured, soft shale bedrock (Cr) that slakes in water, light gray (2.5Y 7/2) moist; massive; extremely hard, friable; moderately saline; noneffervescent; mildly alkaline.

The thickness of the solum ranges from 50 to more than 80 inches. Salinity is less than 4 millimhos per centimeter in the A horizon, 4 to 16 millimhos per centimeter in the upper part of the Bt horizon, and 8 to 20 millimhos per centimeter in the lower part of the profile. The depth to visible accumulations of calcium carbonate is 6 to 22 inches. The exchangeable sodium percentage is 15 or more in some part of the upper 16 inches of the Bt horizon.

The A horizon is dark grayish brown, brown, light brownish gray, light yellowish brown, yellowish brown, dark yellowish brown, or light gray. It is 1 to 12 inches thick. It is medium acid to neutral.

The Bt horizon is dark grayish brown, brown, light brownish gray, yellowish brown, light yellowish brown, very pale brown, pale brown, grayish brown, or light gray. The upper part of this horizon typically is darker than the A horizon. The Bt horizon is clay loam or sandy clay loam. Visible accumulations of calcium carbonate, gypsum, and other salts make up 0 to 5 percent of the volume. The content of total clay ranges from 22 to 35 percent. The Bt horizon is slightly acid to mildly alkaline, and the Bt_{nz} horizon is mildly alkaline or moderately alkaline.

The BC horizon has colors higher in value than the Bt horizon. It is sandy clay loam or clay loam. Visible accumulations of calcium carbonate, gypsum, and other salts make up as much as 20 percent of the volume.

The 2C horizon or the 2Cr layer is sandy clay loam or clay loam, or it is sandy clay loam or clay loam intermingled with fractured, soft shale or siltstone that slakes in water. Visible accumulations of calcium carbonate, gypsum, and other salts make up as much as 20 percent of the volume.

Brystal Series

The Brystal series consists of very deep, well drained, loamy soils on uplands. These soils formed in loamy sediments. Slopes range from 0 to 3 percent.

Typical pedon of Brystal very fine sandy loam, gently undulating; from the intersection of U.S. Highway 81 and Texas Highway 97 in Cotulla, 5.8 miles east on Texas Highway 97 to ranch entrance, 0.25 mile south on ranch road, and 100 feet west in an area of rangeland:

- A—0 to 9 inches; dark brown (7.5YR 4/4) very fine sandy loam, dark brown (7.5YR 3/4) moist; weak fine subangular blocky structure; thin surface crust; slightly hard, very friable; common very fine and fine roots; few fine tubular pores; neutral; clear smooth boundary.
- Bt—9 to 18 inches; reddish brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; weak medium prismatic structure parting to weak fine and medium subangular blocky; hard, friable; common very fine and fine roots; few fine tubular pores; few faint clay films on faces of peds; few fine, rounded, weakly cemented nodules of calcium carbonate; noneffervescent matrix; mildly alkaline; gradual smooth boundary.
- Btk1—18 to 25 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; weak medium prismatic structure parting to moderate fine and medium subangular blocky; hard, friable; few very fine roots; few fine tubular pores; few faint clay films on faces of peds and in pores; few fine, irregular threads and rounded, weakly cemented nodules of calcium carbonate; violently effervescent; mildly alkaline; gradual wavy boundary.
- Btk2—25 to 38 inches; light brown (7.5YR 6/4) sandy clay loam, brown (7.5YR 5/4) moist; weak medium prismatic structure parting to weak fine and medium subangular blocky; hard, friable; few very fine roots; few fine tubular pores; few faint clay films on faces of peds and in pores; few fine, irregular threads and fine and medium, irregular nodules of calcium carbonate; violently effervescent; moderately alkaline; gradual wavy boundary.
- Btk3—38 to 64 inches; reddish yellow (7.5YR 7/6) sandy clay loam, reddish yellow (7.5YR 6/6) moist; common fine distinct strong brown (7.5YR 5/6) mottles; weak fine and medium subangular blocky structure; hard, friable; few very fine roots; few fine tubular pores; few faint clay films on vertical faces of peds and in pores; about 20 percent, by volume, fine to coarse, rounded and irregular soft masses of calcium carbonate; violently effervescent; moderately alkaline.

The thickness of the solum ranges from 60 to more than 80 inches. The depth to a prominent accumulation of soft, powdery calcium carbonate ranges from about 20 to 35 inches.

The A horizon is dark brown, brown, or reddish brown. It is neutral or mildly alkaline. It is 6 to 15 inches thick.

The Bt horizon is reddish brown, yellowish red, brown, light brown, strong brown, reddish yellow, light reddish brown, or red. It is very fine sandy loam, fine sandy loam, or sandy clay loam. The content of total clay is 18 to 32 percent. Some pedons have as much as 15 percent, by volume, ironstone and siliceous gravel. This horizon is neutral to moderately alkaline.

The Btk horizon is reddish brown, reddish yellow, yellowish red, light yellowish brown, light brown, strong brown, or red. In some pedons it has reddish or brownish mottles in the lower part. Visible accumulations of calcium carbonate in the form of threads, soft masses, or nodules make up 1 to 25 percent of the volume. This horizon is very fine sandy loam, fine sandy loam, or sandy clay loam. It is mildly alkaline or moderately alkaline.

Some pedons have a Cr layer of weakly cemented sandstone bedrock or soft sandstone bedrock below a depth of 60 inches.

Caid Series

The Caid series consists of very deep, well drained, calcareous, loamy soils on stream terraces. These soils formed in calcareous, loamy alluvium. Slopes range from 0 to 3 percent.

Typical pedon of Caid very fine sandy loam, gently undulating; from the intersection of U.S. Highway 81 and Texas Highway 97 in Cotulla, 15.0 miles east on Texas Highway 97 to Los Angeles, 1.0 mile north on Farm Road 469, about 7.7 miles east on county road, and 50 feet north of fence in an area of rangeland:

- A1—0 to 8 inches; very dark grayish brown (10YR 3/2) very fine sandy loam, very dark brown (10YR 2/2) moist; weak fine and medium subangular blocky structure; slightly hard, very friable; thin surface crust; many very fine roots; common fine tubular pores; few snail shell fragments; few fine, irregular threads and fine, rounded, weakly cemented nodules of calcium carbonate; about 5 percent calcium carbonate equivalent; slightly effervescent; moderately alkaline; gradual smooth boundary.
- A2—8 to 17 inches; dark grayish brown (10YR 4/2) very fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; slightly hard, very friable; many very fine roots; common fine tubular pores; few snail shell fragments; few fine, irregular threads and fine, rounded, weakly cemented nodules of calcium carbonate; about 5 percent calcium carbonate equivalent; violently effervescent; moderately alkaline; gradual smooth boundary.
- Btk1—17 to 26 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; moderate fine and medium subangular blocky structure; hard, friable; common very fine roots; common fine tubular pores; few faint clay films on faces of peds; few fine, irregular threads and fine, rounded, weakly cemented nodules of calcium carbonate; about 9 percent calcium carbonate equivalent; violently effervescent; moderately alkaline; gradual wavy boundary.
- Btk2—26 to 36 inches; light brown (7.5YR 6/4) sandy clay loam, brown (7.5YR 5/4) moist; moderate fine and medium subangular blocky structure; hard, friable; few very fine roots; few fine tubular pores; few faint clay films on faces of peds; few fine, irregular threads and soft masses and fine and medium, rounded, weakly cemented nodules of calcium carbonate; about 11 percent calcium carbonate equivalent; violently effervescent; moderately alkaline; gradual wavy boundary.
- Btk3—36 to 52 inches; reddish yellow (7.5YR 7/6) sandy clay loam, strong brown (7.5YR 5/6) moist; moderate fine and medium subangular blocky structure; hard, friable; few very fine roots; few fine tubular pores; few faint clay films on vertical faces of peds; about 20 percent, by volume, fine to coarse, irregular soft masses and weakly to strongly cemented nodules of calcium carbonate; about 24 percent calcium carbonate equivalent; violently effervescent; moderately alkaline; gradual wavy boundary.

Btk4—52 to 64 inches; reddish yellow (7.5YR 7/6) sandy clay loam, reddish yellow (7.5YR 6/6) moist; moderate fine and medium subangular blocky structure; hard, friable; few very fine roots; few fine tubular pores; few faint clay films on vertical faces of peds; about 15 percent, by volume, fine to coarse, irregular soft masses and weakly cemented or strongly cemented nodules of calcium carbonate; about 22 percent calcium carbonate equivalent; violently effervescent; moderately alkaline.

The thickness of the solum ranges from 60 to more than 80 inches. The depth to a prominent zone of calcium carbonate accumulation is 25 to 40 inches. The soils are calcareous throughout and are mildly alkaline or moderately alkaline.

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

The Btk horizon is reddish brown, grayish brown, strong brown, brown, yellowish brown, pale brown, very pale brown, light brown, dark yellowish brown, dark brown, pink, yellowish red, reddish yellow, light yellowish brown, or brownish yellow. The redder colors are mainly in the lower part of the horizon. This horizon is clay loam or sandy clay loam. By weighted average, the content of total clay in the upper 20 inches of the Btk horizon is 24 to 35 percent. The upper part of this horizon has few threads, soft masses, or nodules of calcium carbonate. The content of these carbonates ranges to as much as 30 percent, by volume, in the lower part of the horizon.

Some pedons have a Cr layer of weakly cemented sandstone or soft sandstone or shale bedrock below a depth of 60 inches.

Catarina Series

The Catarina series consists of very deep, moderately well drained, saline, clayey soils on uplands. These soils formed in saline, calcareous, clayey sediments. Slopes range from 0 to 2 percent.

Typical pedon of Catarina clay, nearly level; from the intersection of U.S. Highway 81 and Texas Highway 97 in Cotulla, 0.8 mile east on Texas Highway 97, about 20 miles southeast on Farm Road 624, about 5.25 miles south on county road to locked gate, 9.25 miles south and east on ranch road, 1.8 miles east along fence line, and 0.8 mile east in an area of rangeland:

Ay—0 to 13 inches; light brownish gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) moist; weak coarse subangular blocky structure parting to moderate medium angular blocky; extremely hard, firm, sticky and plastic; common very fine and medium roots; common very fine and fine tubular pores; few wormcasts; few siliceous pebbles; few fine, irregular threads and few faint coatings of gypsum on faces of cracks; very slightly saline; strongly effervescent; mildly alkaline; gradual wavy boundary.

Bnyz1—13 to 27 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; weak coarse subangular blocky structure parting to moderate fine and medium angular blocky; extremely hard, very firm, sticky and plastic; common very fine and fine roots; common very fine and fine tubular pores; common intersecting slickensides; few fine, irregular threads and soft masses of crystals of calcium carbonate, gypsum, and other salts; moderately saline; strongly effervescent; mildly alkaline; diffuse wavy boundary.

Bnyz2—27 to 54 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; common fine faint yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure parting to moderate fine and medium angular blocky; extremely hard, very firm, sticky and plastic; few very fine roots; few fine tubular pores; common intersecting slickensides; common fine,

irregular threads and medium, irregular soft masses of crystals of calcium carbonate, gypsum, and other salts; strongly saline; strongly effervescent; mildly alkaline; gradual wavy boundary.

Bnyz3—54 to 80 inches; very pale brown (10YR 7/4) clay, light yellowish brown (10YR 6/4) moist; weak medium subangular blocky structure; extremely hard, very firm, sticky and plastic; few very fine roots in the upper part; few fine, irregular threads and medium, irregular soft masses of crystals of calcium carbonate, gypsum, and other salts; moderately saline; strongly effervescent; mildly alkaline.

The thickness of the solum ranges from 40 to more than 80 inches. The amplitude of the boundary between the A and B horizons is about 2 to 10 inches. COLE is 0.09 to 0.16. The depth to intersecting slickensides is 12 to 30 inches. Salinity is 1 to 8 millimhos per centimeter in the A horizon and 4 to 20 millimhos per centimeter in the B horizon. The exchangeable sodium percentage is 15 or more in the upper 30 inches of the solum. The soils have cracks 0.4 inch to 2 inches wide at the surface when dry. The cracks extend to a depth of 20 inches or more. The soils are mildly alkaline or moderately alkaline throughout.

The A horizon is grayish brown, light brownish gray, brown, pale brown, olive gray, light olive gray, olive, pale olive, yellowish brown, or light yellowish brown. In some pedons the upper 1 to 3 inches is silty clay loam or silty clay. The content of total clay in the A horizon is 35 to 55 percent.

The B horizon is grayish brown, light brownish gray, pale brown, very pale brown, olive gray, light olive brown, light olive gray, olive, olive yellow, pale olive, pale yellow, or light yellowish brown. It is clay or silty clay. It has few or common threads and clusters of crystals of calcium carbonate, gypsum, and other salts. The content of total clay is 40 to 55 percent.

Some pedons have a C horizon at a depth of 40 to 80 inches. This horizon is clay or clay intermingled with soft shale fragments. It has colors similar to those of the B horizon. It has few to many threads and clusters of salt crystals.

Chacon Series

The Chacon series consists of very deep, well drained, calcareous, loamy soils on stream terraces. These soils formed in calcareous, loamy and clayey sediments. Slopes range from 0 to 3 percent.

Typical pedon of Chacon clay loam, gently undulating; from the intersection of U.S. Highway 81 and Texas Highway 97 in Cotulla, 15.0 miles east on Texas Highway 97 to Los Angeles, 1.0 mile north on Farm Road 469, about 3.4 miles east on county road, and 200 feet north of fence in an area of rangeland:

A—0 to 11 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; hard, friable; many very fine roots; few fine tubular pores; few snail shell fragments; few fine, irregular threads and fine, rounded, weakly cemented nodules of calcium carbonate; nonsaline; strongly effervescent; moderately alkaline; clear smooth boundary.

Bt—11 to 18 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate fine and medium angular blocky structure; very hard, firm; common very fine roots; few fine tubular pores; common faint clay films on faces of peds; common distinct stress surfaces on faces of peds; few snail shell fragments; few fine, irregular threads and fine, rounded, weakly cemented nodules of calcium carbonate; nonsaline; violently effervescent; moderately alkaline; gradual wavy boundary.

Btz—18 to 28 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; moderate fine and medium angular blocky structure; very hard, firm; few

very fine roots; few fine tubular pores; common faint clay films on faces of peds; few distinct stress surfaces on faces of peds; few fine, irregular threads and fine, rounded, weakly cemented nodules of calcium carbonate; slightly saline; violently effervescent; moderately alkaline; gradual wavy boundary.

Btkz—28 to 37 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; few fine distinct grayish brown (10YR 5/2) vertical streaks; moderate fine and medium angular blocky structure; very hard, firm; few very fine roots; few faint clay films on faces of peds; few fine and medium, rounded, weakly cemented nodules of calcium carbonate; slightly saline; violently effervescent; moderately alkaline; diffuse wavy boundary.

BCyz1—37 to 48 inches; light yellowish brown (10YR 6/4) clay, yellowish brown (10YR 5/4) moist; few fine distinct grayish brown (10YR 5/2) vertical streaks; weak fine and medium subangular blocky structure; very hard, firm; few fine and medium, irregular soft masses and clusters of gypsum crystals and other salts; slightly saline; violently effervescent; moderately alkaline; diffuse wavy boundary.

BCyz2—48 to 64 inches; light yellowish brown (10YR 6/4) clay, yellowish brown (10YR 5/4) moist; few fine distinct grayish brown (10YR 5/2) vertical streaks; weak fine and medium subangular blocky structure; very hard, firm; few fine and medium, irregular soft masses and clusters of gypsum crystals and other salts; slightly saline; violently effervescent; moderately alkaline.

The thickness of the solum ranges from 60 to more than 80 inches. The mollic epipedon is 10 to 30 inches thick. Salinity is 0.2 to 4 millimhos per centimeter in the A horizon and as much as 4 to 16 millimhos per centimeter in the BCyz horizon. COLE is 0.07 to 0.10 in the upper 50 inches. The soils have cracks 0.4 to 1.0 inch wide at the surface when dry. The cracks extend to a depth of 20 inches or more.

The A horizon is dark grayish brown, gray, grayish brown, very dark gray, or very dark grayish brown. It is 10 to 18 inches thick.

The Bt horizon is dark gray, grayish brown, light brownish gray, or pale brown. The darker colors are in the upper part of the Bt horizon. This horizon is clay loam, sandy clay, or clay. The content of total clay is 35 to 50 percent.

The BCyz horizon is light brownish gray, pale brown, light yellowish brown, yellowish brown, or pale yellow. It is clay loam, sandy clay, or clay. The content of total clay is 35 to 50 percent. Visible accumulations of gypsum and other salts make up as much as 20 percent of the volume.

Charco Series

The Charco series consists of very deep, well drained, loamy soils on uplands. These soils formed in loamy alluvium over residuum. Slopes range from 0 to 2 percent.

Typical pedon of Charco loam, in an area of Charco-Altita complex, nearly level; from the intersection of U.S. Highway 81 and Texas Highway 97 in Cotulla, 5.8 miles east on Texas Highway 97, about 1.6 miles southeast on ranch road, and 150 feet northeast in an area of rangeland:

A—0 to 9 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; moderate fine and medium subangular blocky structure; hard, friable; common very fine and fine roots; few fine tubular pores; nonsaline; slightly acid; clear smooth boundary.

Bt1—9 to 18 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate fine and medium angular blocky structure; extremely hard, very firm; common very fine roots, mainly along faces of peds; few fine tubular

- pores; common faint clay films on faces of peds; few distinct stress surfaces on faces of peds; nonsaline; neutral; gradual wavy boundary.
- Bt2—18 to 25 inches; dark gray (10YR 4/1) clay loam, very dark gray (10YR 3/1) moist; moderate fine and medium angular blocky structure; very hard, firm; common very fine roots, mainly along faces of peds; few fine tubular pores; few faint clay films on faces of peds; few fine, rounded, weakly cemented nodules of calcium carbonate; about 12 percent calcium carbonate equivalent; very slightly saline; violently effervescent; moderately alkaline; gradual wavy boundary.
- Btyz1—25 to 34 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; weak fine and medium subangular blocky structure; very hard, firm; few very fine roots; few faint clay films on faces of peds; few fine, irregular threads and soft masses of calcium carbonate; few fine and medium, irregular soft masses and clusters of gypsum crystals and other salts; about 11 percent calcium carbonate equivalent; slightly saline; violently effervescent; moderately alkaline; gradual wavy boundary.
- Btyz2—34 to 39 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak fine and medium subangular blocky structure; hard, firm; few very fine roots; few faint clay films on faces of peds; few fine, irregular threads and soft masses of calcium carbonate; common fine and medium, irregular soft masses and clusters of gypsum crystals and other salts; common distinct coatings of gypsum crystals on faces of peds; about 8 percent calcium carbonate equivalent; slightly saline; violently effervescent; moderately alkaline; abrupt wavy boundary.
- Byz1—39 to 50 inches; very pale brown (10YR 7/3) clay loam, pale brown (10YR 6/3) moist; common fine and medium distinct yellowish brown (10YR 5/6) mottles; few fine distinct grayish brown (10YR 5/2) vertical streaks; weak fine and medium subangular blocky structure; hard, firm; about 25 percent, by volume, fine to coarse, irregular soft masses and clusters of gypsum crystals and other salts; about 8 percent calcium carbonate equivalent; slightly saline; violently effervescent; moderately alkaline; diffuse wavy boundary.
- Byz2—50 to 64 inches; very pale brown (10YR 7/3) clay loam, pale brown (10YR 6/3) moist; common fine and medium distinct yellowish brown (10YR 5/6) mottles; few fine distinct grayish brown (10YR 5/2) vertical streaks in the upper part; weak fine and medium subangular blocky structure; hard, firm; few white (5Y 8/2), weakly cemented soft shale fragments that slake in water; few fine and medium, rounded, yellow (10YR 7/6), weakly cemented nodules; about 25 percent, by volume, fine to coarse, irregular soft masses and clusters of gypsum crystals and other salts; about 7 percent calcium carbonate equivalent; moderately saline; strongly effervescent; moderately alkaline.

The thickness of the solum ranges from 40 to more than 60 inches. Salinity is 0.2 to 2.0 millimhos per centimeter in the A horizon, 1 to 4 millimhos per centimeter in the upper part of the Bt horizon, and 4 to 12 millimhos per centimeter in the lower part of the Bt horizon and in the C horizon. COLE is 0.07 to 0.09 in the upper 20 inches of the Bt horizon.

The A horizon generally is dark gray, very dark gray, gray, or dark grayish brown. It is 6 to 20 inches thick. It is slightly acid or neutral. The boundary between the A and Bt horizons is abrupt or clear and has an absolute clay increase of 20 to 30 percent in the upper part of the Bt horizon.

The Bt horizon is dark gray, very dark gray, gray, dark grayish brown grayish brown, brown, or pale brown. It is clay or clay loam in the upper part. It is neutral to moderately alkaline.

The Btyz horizon is gray, grayish brown, light brownish gray, or pale brown. It is loam, clay loam, or sandy clay loam. It has few or common soft masses and clusters of gypsum crystals and other salts. It is mildly alkaline or moderately alkaline.

The Byz horizon is pale brown, very pale brown, or light yellowish brown. It is clay loam, clay, or sandy clay loam intermingled with soft shale fragments that slake in water. It has common or many soft accumulations of calcium carbonate, calcium sulfate, and other salts. It has few or common vertical streaks that are the same color as the Bt horizon. It is mildly alkaline or moderately alkaline. The C horizon, if it occurs, is similar to the Byz horizon but has higher value.

Cochina Series

The Cochina series consists of very deep, moderately well drained, clayey soils on flood plains. These soils formed in saline, calcareous, clayey alluvium. Slopes are 0 to 1 percent.

Typical pedon of Cochina clay, frequently flooded; from the intersection of U.S. Highway 81 and Texas Highway 97 in Cotulla, 15.0 miles east on Texas Highway 97 to Los Angeles, 5.7 miles east on Texas Highway 97, and 300 feet south of fence in an area of rangeland:

- A—0 to 9 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky and angular blocky structure; extremely hard, very firm, very sticky and very plastic; few very fine and fine roots; few snail shell fragments; nonsaline; violently effervescent; mildly alkaline; gradual wavy boundary.
- BAw—9 to 24 inches; grayish brown (10YR 5/2) clay, dark brown (10YR 4/3) moist; moderate medium angular blocky structure; extremely hard, very firm, very sticky and very plastic; few very fine and fine roots; few snail shell fragments; few slickensides in the lower part; very slightly saline; violently effervescent; mildly alkaline; diffuse wavy boundary.
- Bz—24 to 40 inches; brown (10YR 5/3) clay, brown (10YR 5/3) moist; common fine faint grayish brown (10YR 5/2) streaks; moderate medium angular blocky structure; extremely hard, very firm, very sticky and very plastic; few very fine and fine roots; common intersecting slickensides; moderately saline; violently effervescent; mildly alkaline; diffuse wavy boundary.
- Byz1—40 to 54 inches; yellowish brown (10YR 5/4) clay, yellowish brown (10YR 5/4) moist; common fine faint grayish brown (10YR 5/2) streaks; weak fine and medium angular blocky structure; extremely hard, very firm, very sticky and very plastic; few very fine and fine roots; few slickensides; few snail shell fragments; few fine, irregular threads and clusters of gypsum crystals and other salts; moderately saline; violently effervescent; mildly alkaline; diffuse wavy boundary.
- Byz2—54 to 72 inches; light yellowish brown (10YR 6/4) clay, yellowish brown (10YR 5/4) moist; weak fine and medium angular blocky structure; extremely hard, very firm, very sticky and very plastic; few very fine and fine roots; few slickensides; few fine, irregular threads and clusters of gypsum crystals and other salts; moderately saline; violently effervescent; mildly alkaline.

The thickness of the solum ranges from 60 to more than 80 inches. Salinity is 0 to 4 millimhos per centimeter in the A and BA horizons, about 2 to 16 millimhos per centimeter in the upper part of the B horizon, and 4 to 16 millimhos per centimeter in

the lower part of the B horizon. The content of total clay in the 10 to 40-inch control section is 60 to 80 percent. The soils have cracks 0.4 inch to 3.0 inches wide at the surface when dry. The cracks extend to a depth of 20 inches or more. The soils are mildly alkaline or moderately alkaline throughout.

The A and BA horizons are grayish brown, light brownish gray, light yellowish brown, or light olive brown. The A horizon is 4 to 12 inches thick.

The B horizon is light brownish gray, brown, yellowish brown, pale brown, very pale brown, or light yellowish brown. It has few or common streaks that are the same color as the A horizon.

Copita Series

The Copita series consists of moderately deep, well drained, loamy soils on uplands. These soils formed in loamy residuum over sandstone bedrock. Slopes range from 0 to 3 percent.

Typical pedon of Copita fine sandy loam, gently undulating; from the intersection of U.S. Highway 81 and Texas Highway 97 in Cotulla, 0.8 mile east on Texas Highway 97 to Farm Road 624, about 20 miles southeast on Farm Road 624, about 5.25 miles south on county road to ranch entrance, 7.85 miles south on ranch road to fence line, 1.0 mile east along fence line to a gate, and 40 feet south of fence line in an area of rangeland:

- A—0 to 9 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak fine and medium subangular blocky structure; slightly hard, very friable; many very fine and fine roots; common fine and medium tubular and vesicular pores; few fine, irregular threads and soft masses of calcium carbonate; few snail shell fragments; about 6 percent calcium carbonate equivalent; strongly effervescent; moderately alkaline; clear smooth boundary.
- Bk1—9 to 19 inches; yellowish brown (10YR 5/4) loam, dark yellowish brown (10YR 4/4) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, friable; common very fine and fine roots; common fine tubular and few medium vesicular pores; common fine, irregular threads and soft masses of calcium carbonate; about 10 percent calcium carbonate equivalent; violently effervescent; moderately alkaline; clear wavy boundary.
- Bk2—19 to 37 inches; light yellowish brown (10YR 6/4) loam, yellowish brown (10YR 5/4) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, friable; few very fine and fine roots; few fine tubular pores; about 5 percent, by volume, fine, irregular threads and medium to coarse, irregular and rounded soft masses of calcium carbonate; about 16 percent calcium carbonate equivalent; violently effervescent; moderately alkaline; clear wavy boundary.
- Crk—37 to 60 inches; yellow (10YR 7/6), fractured, soft sandstone bedrock that slakes in water, brownish yellow (10YR 6/6) moist; massive; hard, friable; few pores and cracks in the upper part filled with light yellowish brown (10YR 6/4) loam; about 2 percent, by volume, fine, irregular threads and soft masses of calcium carbonate; about 9 percent calcium carbonate equivalent; violently effervescent; moderately alkaline.

The depth to sandstone bedrock is 20 to 40 inches. The calcium carbonate equivalent is 1 to 10 percent in the A horizon and 10 to 35 percent in the B horizon. Salinity is 0 to 4 millimhos per centimeter in the A horizon and 2 to 8 millimhos per centimeter in the B horizon.

The A horizon is brown, light brown, pale brown, grayish brown, light brownish gray, or yellowish brown. It is 5 to 16 inches thick.

The Bk horizon is brown, pale brown, light brown, very pale brown, pale yellow, yellowish brown, or light yellowish brown. It is sandy clay loam, fine sandy loam, or loam. The content of total clay is 18 to 35 percent.

The Cr layer is soft sandstone bedrock that slakes in water, weakly cemented sandstone bedrock, or sandstone interbedded with soft siltstone or soft shale bedrock. When moist the Cr layer can be dug with a spade. Some pedons have masses and strata of strongly cemented sandstone.

Coquat Series

The Coquat series consists of very deep, somewhat poorly drained, clayey soils on flood plains. These soils formed in saline, calcareous, clayey alluvium. Slopes are 0 to 1 percent.

Typical pedon of Coquat clay, frequently flooded; from the intersection of U.S. Highway 81 and Texas Highway 97 in Cotulla, 0.8 mile east on Texas Highway 97 to Farm Road 624, about 20 miles southeast on Farm Road 624, about 2.75 miles south on county road, 1.55 miles east to locked gate at ranch headquarters, 13 miles east through gate on ranch road to highline, 75 feet south along road under highline, and 18 feet east in an area of rangeland:

- A—0 to 5 inches; grayish brown (10YR 5/2) clay, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to weak fine angular blocky; very hard, very firm, very sticky and very plastic; common very fine and fine roots; few snail shell fragments; nonsaline; strongly effervescent; moderately alkaline; gradual wavy boundary.
- Bkn—5 to 36 inches; light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; common fine faint vertical streaks of grayish brown (10YR 5/2) clay; weak medium subangular blocky structure parting to moderate fine angular blocky; extremely hard, very firm, very sticky and very plastic; common very fine and fine roots; few fine, rounded, strongly cemented nodules of calcium carbonate; few intersecting slickensides in the lower part; nonsaline; exchangeable sodium percentage of 20; strongly effervescent; moderately alkaline; diffuse wavy boundary.
- Bknz1—36 to 52 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; few fine faint grayish brown (10YR 5/2) vertical streaks; weak medium subangular blocky structure parting to moderate fine angular blocky; extremely hard, very firm, very sticky and very plastic; common very fine and fine roots; few slickensides; few fine, rounded, strongly cemented nodules of calcium carbonate; few fine, rounded, weakly cemented, black ferromanganese nodules; slightly saline; exchangeable sodium percentage of 30; strongly effervescent; moderately alkaline; diffuse wavy boundary.
- Bknz2—52 to 65 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; few fine and medium faint yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) mottles; few fine faint brown (10YR 5/3) vertical streaks; weak medium subangular blocky structure parting to moderate fine angular blocky; extremely hard, very firm, very sticky and very plastic; few very fine and fine roots; few slickensides; few snail shell fragments; few fine, rounded, strongly cemented nodules of calcium carbonate; moderately saline; exchangeable sodium percentage of 35; strongly effervescent; moderately alkaline; diffuse wavy boundary.
- BCknz—65 to 74 inches; light yellowish brown (10YR 6/4) clay, yellowish brown (10YR 5/4) moist; few fine and medium faint yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) mottles; few fine faint brown (10YR 5/3) vertical streaks; weak medium subangular blocky structure parting to

weak fine angular blocky; extremely hard, very firm, very sticky and very plastic; few very fine and fine roots; few fine, rounded, strongly cemented nodules of calcium carbonate; few fine, rounded clusters of gypsum crystals and other salts; moderately saline; exchangeable sodium percentage of 35; strongly effervescent; moderately alkaline.

The thickness of the solum ranges from 60 to more than 80 inches. The microknolls are 2 to 12 inches higher than the microbasins. Salinity is 0.2 to 4 millimhos per centimeter in the upper 30 inches and about 4 to 16 millimhos per centimeter below a depth of 30 inches. The exchangeable sodium percentage is 15 or more within 30 inches of the surface and increases with increasing depth. The content of total clay is 45 to 60 percent. The soils have cracks 0.4 inch to 3.0 inches wide at the surface when dry. The cracks extend to a depth of 20 inches or more. The soils are mildly alkaline or moderately alkaline throughout.

The A horizon is dark gray, gray, grayish brown, light brownish gray, or pale brown. It is 4 to 10 inches thick. Where it is dark gray or gray, it is less than 8 inches thick.

The B horizon is grayish brown, light brownish gray, pale brown, or very pale brown. It has common or many streaks that are the same color as the A horizon.

The BC and C horizons, if they occur, are light brownish gray, pale brown, or very pale brown. They have fine or medium, faint or distinct, brownish, grayish, or yellowish mottles.

Cotulla Series

The Cotulla series consists of very deep, moderately well drained, saline, clayey soils on uplands. These soils formed in saline, calcareous, clayey sediments. Slopes range from 0 to 3 percent.

Typical pedon of Cotulla clay, nearly level; from the intersection of Texas Highway 97 and U.S. Highway 81 in Cotulla, 0.8 mile east on Texas Highway 97 to Farm Road 624, about 13.3 miles southeast on Farm Road 624, about 1.2 miles north on Farm Road 469, about 250 feet west along south end of cultivated field, and 100 feet south in an area of rangeland:

- A—0 to 7 inches; grayish brown (10YR 5/2) clay, grayish brown (10YR 5/2) moist; moderate fine and medium subangular blocky structure; very hard, firm; common very fine and fine roots; few snail shell fragments; thin surface crust; about 9 percent calcium carbonate equivalent; nonsaline; strongly effervescent; moderately alkaline; clear smooth boundary.
- AB—7 to 18 inches; grayish brown (10YR 5/2) clay, grayish brown (10YR 5/2) moist; moderate fine and medium angular blocky structure; extremely hard, very firm; few very fine and fine roots; few snail shell fragments; about 10 percent calcium carbonate equivalent; very slightly saline; exchangeable sodium percentage of 13; strongly effervescent; moderately alkaline; gradual wavy boundary.
- BAnz—18 to 28 inches; light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; moderate fine and medium angular blocky structure; extremely hard, very firm; few very fine and fine roots; few intersecting slickensides; few snail shell fragments; about 8 percent calcium carbonate equivalent; slightly saline; exchangeable sodium percentage of 22; strongly effervescent; moderately alkaline; gradual wavy boundary.
- Bnyz1—28 to 34 inches; brown (10YR 5/3) clay, brown (10YR 5/3) moist; common fine distinct grayish brown (10YR 5/2) streaks; moderate fine and medium angular blocky structure; extremely hard, very firm; few very fine and fine roots; few intersecting slickensides; few fine, irregular threads of gypsum and other salts; about 10 percent calcium carbonate

equivalent; moderately saline; exchangeable sodium percentage of 27; strongly effervescent; moderately alkaline; diffuse wavy boundary.

Bnyz2—34 to 50 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; common fine distinct grayish brown (10YR 5/2) streaks; weak fine and medium angular blocky structure; very hard, very firm; few very fine and fine roots; few intersecting slickensides; common fine, irregular threads and clusters of gypsum crystals and other salts; about 9 percent calcium carbonate equivalent; moderately saline; strongly effervescent; moderately alkaline; diffuse wavy boundary.

Bnyz3—50 to 72 inches; light yellowish brown (10YR 6/4) clay, light yellowish brown (10YR 6/4) moist; weak fine and medium angular blocky structure; very hard, very firm; few very fine roots; common fine, irregular threads and clusters of gypsum crystals and other salts; about 8 percent calcium carbonate equivalent; moderately saline; strongly effervescent; moderately alkaline.

The thickness of the solum ranges from 50 to more than 80 inches. Salinity is 0.5 to 4 millimhos per centimeter in the A and AB horizons and 4 to 16 millimhos per centimeter in the BA and B horizons. The exchangeable sodium percentage is 15 or more in the upper 30 inches of the solum and increases within creasing depth. The content of total clay is 40 to 60 percent. The soils are mildly alkaline or moderately alkaline throughout.

The A and AB horizons are grayish brown, light brownish gray, brown, pale brown, light olive brown, or light yellowish brown.

The BAnz and Bnyz horizons have the same colors as those of the A horizon or have slightly higher value or chroma. They have few or common threads and clusters of salt crystals. The B horizon has few to many streaks that have the same colors as those of the A and AB horizons. In some pedons it has a few siliceous pebbles.

The C horizon, if it occurs, is clay, clay intermingled with soft shale fragments, or soft shale bedrock. In some pedons the soft shale bedrock is interbedded with sandstone bedrock. This horizon has few to many threads and clusters of salt crystals.

Dilley Series

The Dilley series consists of shallow, well drained, loamy soils on uplands. These soils formed in loamy residuum over sandstone bedrock. Slopes range from 1 to 5 percent.

Typical pedon of Dilley fine sandy loam, gently undulating; from the intersection of U.S. Highway 81 and Farm Road 468 in Cotulla, 2.2 miles northwest on Farm Road 468, about 0.7 mile north on Farm Road 469, and 100 feet west of fence in an area of rangeland:

A—0 to 8 inches; yellowish red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; slightly hard, very friable; common fine roots; slightly acid; gradual smooth boundary.

Bt—8 to 16 inches; red (2.5YR 4/6) fine sandy loam, dark red (2.5YR 3/6) moist; weak medium prismatic structure parting to weak fine subangular blocky; hard, friable; common fine roots; few fine tubular pores; common faint clay bridges between sand grains; slightly acid; abrupt wavy boundary.

Cr1—16 to 20 inches; reddish brown (5YR 4/3), fractured, weakly cemented sandstone bedrock that can be dug with a spade when moist, interbedded with masses of fractured, strongly cemented, sandy ironstone; massive; more than 4 inches of horizontal spacing between cracks, which are filled with red (2.5YR 4/6) fine sandy loam; few very fine and fine roots in cracks; slightly acid; abrupt wavy boundary.

Cr2—20 to 36 inches; yellowish red (5YR 5/6), fractured, weakly cemented sandstone bedrock that can be dug with a spade when moist; more than 4 inches of horizontal spacing between cracks, which are filled with red (2.5YR 4/6) fine sandy loam; few very fine roots in cracks; slightly acid.

The depth to sandstone bedrock is 10 to 20 inches (fig. 18). The soils are slightly acid to mildly alkaline. The A horizon is reddish brown, yellowish red, brown, or dark brown. It is 4 to 12 inches thick. The content of coarse fragments ranges from 0 to 15 percent, by volume. The fragments are sandstone or siliceous gravel and cobbles.

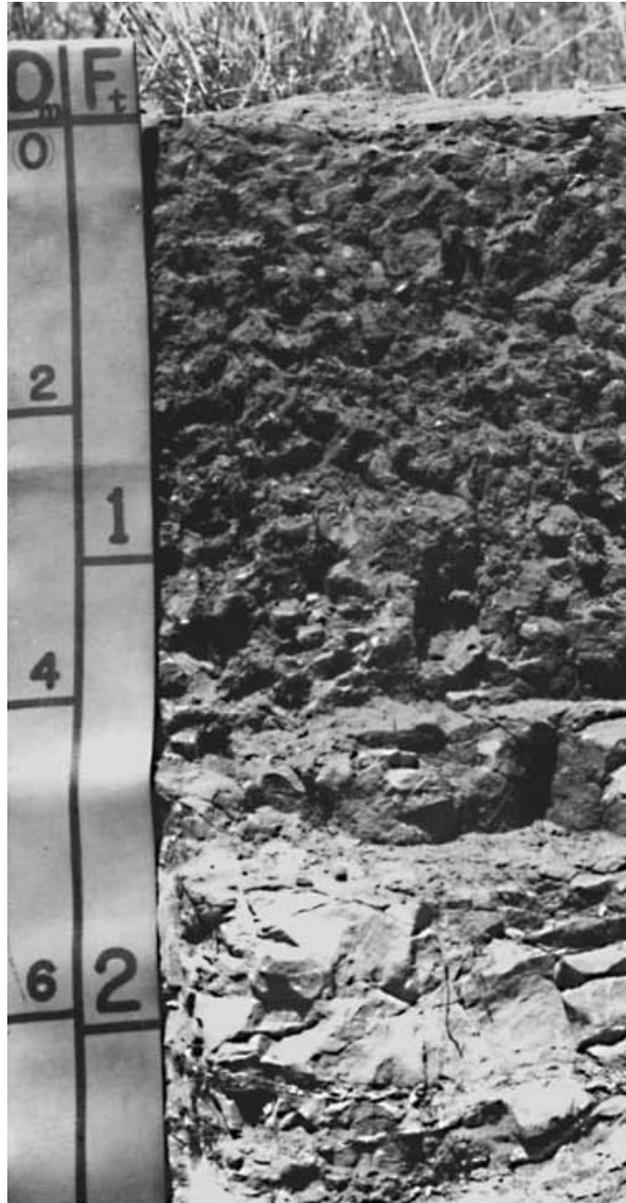


Figure 18.—Profile of a Dilley fine sandy loam. Sandstone bedrock is below a depth of 16 inches. The scale is marked in decimeters and feet.

The Bt horizon is red, reddish brown, yellowish red, reddish yellow, or brown. It is 4 to 14 inches thick. It is fine sandy loam, sandy clay loam, gravelly sandy clay loam, or gravelly sandy loam. The content of total clay ranges from 12 to 25 percent. The content of sandstone fragments or siliceous gravel and cobbles ranges from 0 to 30 percent, by volume.

The Cr layer is weakly cemented sandstone bedrock or soft sandstone bedrock that slakes in water. When moist the Cr layer can be dug with a spade. Some pedons have strata and masses of ironstone or strongly cemented sandstone bedrock or have fractured sandstone bedrock that has thin coatings of calcium carbonate on faces of cracks. In some pedons the Cr layer is interbedded with unconsolidated loamy material.

Divot Series

The Divot series consists of very deep, well drained, loamy soils on flood plains. These soils formed in calcareous, loamy and clayey alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Divot silty clay loam, occasionally flooded; from the intersection of Texas Highway 97 and U.S. Highway 81 in Cotulla, 20 miles east on Texas Highway 97 to ranch headquarters on north side of highway, 0.85 mile north-northeast through cropland, 0.25 mile north along fence line, 0.5 mile east-northeast to gap in fence corner, 0.5 mile east along fence line, and 100 feet south in an area of cropland:

- Ap—0 to 5 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium subangular blocky structure; hard, friable; common very fine roots; many fine tubular pores; common wormcasts; few snail shell fragments; about 25 percent calcium carbonate equivalent; violently effervescent; moderately alkaline; abrupt smooth boundary.
- A—5 to 15 inches; grayish brown (10YR 5/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; very hard, firm; common very fine roots; many fine tubular pores; common wormcasts; few snail shell fragments; about 28 percent calcium carbonate equivalent; violently effervescent; moderately alkaline; gradual smooth boundary.
- BAw—15 to 26 inches; grayish brown (10YR 5/2) clay, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; very hard, firm; few very fine roots; few snail shell fragments; about 31 percent calcium carbonate equivalent; violently effervescent; moderately alkaline; gradual smooth boundary.
- BAk—26 to 40 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate fine and medium subangular blocky structure; very hard, firm; few very fine roots; few fine tubular pores; few snail shell fragments; few distinct stress surfaces on faces of peds; few fine, irregular threads of calcium carbonate; about 32 percent calcium carbonate equivalent; violently effervescent; moderately alkaline; diffuse wavy boundary.
- Bk1—40 to 52 inches; light brownish gray (10YR 6/2) clay, dark grayish brown (10YR 4/2) moist; common fine distinct grayish brown (10YR 5/2) streaks; moderate fine and medium subangular blocky structure; very hard, firm; few very fine roots; few fine pores; few snail shell fragments; few distinct stress surfaces on faces of peds; few fine, irregular threads of calcium carbonate; about 33 percent calcium carbonate equivalent; violently effervescent; moderately alkaline; diffuse wavy boundary.

Bk2—52 to 64 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; weak fine and medium subangular blocky structure; hard, firm; few very fine roots; few snail shell fragments; few fine, irregular threads of calcium carbonate; about 33 percent calcium carbonate equivalent; violently effervescent; moderately alkaline.

The thickness of the solum ranges from 60 to more than 80 inches. The mollic epipedon is 20 to 40 inches thick. By weighted average, the calcium carbonate equivalent in the 10- to 40-inch control section is 25 to 40 percent. COLE is 0.07 to 0.12. The soils have cracks 0.4 to 1 inch wide at the surface when dry. The cracks extend to a depth of 20 inches or more. By weighted average, the content of total clay in the 10- to 40-inch control section is 35 to 55 percent and the content of silicate clay is 35 to 45 percent. The soils are mildly alkaline or moderately alkaline throughout.

The A horizon is very dark grayish brown, dark grayish brown, dark brown, or grayish brown. It is silty clay loam or silty clay.

The BA and B horizons are grayish brown, light brownish gray, pale brown, brown, very pale brown, light yellowish brown, or yellowish brown. They are clay, silty clay, silty clay loam, or clay loam. Visible accumulations of calcium carbonate make up 1 to 10 percent of the total volume of the horizons. They make up 5 percent or more of the volume below a depth of 40 inches.

Duval Series

The Duval series consists of deep, well drained, loamy and sandy soils on uplands. These soils formed in loamy residuum from interbedded sandstone and siltstone, over sandstone bedrock (fig. 19). Slopes range from 0 to 5 percent.

Typical pedon of Duval very fine sandy loam, gently undulating; from the intersection of U.S. Highway 81 and Farm Road 468 in Cotulla, 2.2 miles northwest on Farm Road 468, about 6.7 miles northwest on Farm Road 469 to Woodward, 2.8 miles northwest of Woodward on county road, 5.2 miles northeast on county road, and 100 feet north in a cleared area of rangeland:

A—0 to 10 inches; reddish brown (5YR 4/4) very fine sandy loam, dark reddish brown (5YR 3/4) moist; weak fine and medium subangular blocky structure; slightly hard, very friable; few very fine roots; few fine and medium tubular pores; neutral; clear smooth boundary.

Bt1—10 to 18 inches; reddish brown (5YR 4/4) very fine sandy loam, dark reddish brown (5YR 3/4) moist; weak medium prismatic structure parting to weak fine and medium subangular blocky; slightly hard, friable; few very fine roots; few fine tubular pores; few faint clay films on faces of prisms and in pores; common faint clay bridges between sand grains; neutral; gradual wavy boundary.

Bt2—18 to 26 inches; yellowish red (5YR 4/6) sandy clay loam, yellowish red (5YR 3/6) moist; weak medium prismatic structure parting to weak fine and medium subangular blocky; hard, friable; few very fine roots; common fine tubular and vesicular pores; few faint clay films on faces of prisms and in pores; common faint clay bridges between sand grains; mildly alkaline; gradual wavy boundary.

Bt3—26 to 38 inches; yellowish red (5YR 4/6) sandy clay loam, yellowish red (5YR 3/6) moist; weak medium prismatic structure parting to weak fine and medium subangular blocky; hard, very friable; few very fine roots; common fine tubular and vesicular pores; few faint clay films on faces of prisms and in pores; common faint clay bridges between sand grains; moderately alkaline; gradual wavy boundary.

Bk—38 to 48 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; slightly hard, very friable; few very fine roots; few fine tubular pores; about 20 percent, by volume, yellowish red (5YR 5/6), soft sandstone fragments that slake in water; few fine, irregular threads and few fine, rounded, weakly cemented nodules of calcium carbonate; strongly effervescent; moderately alkaline; abrupt wavy boundary.

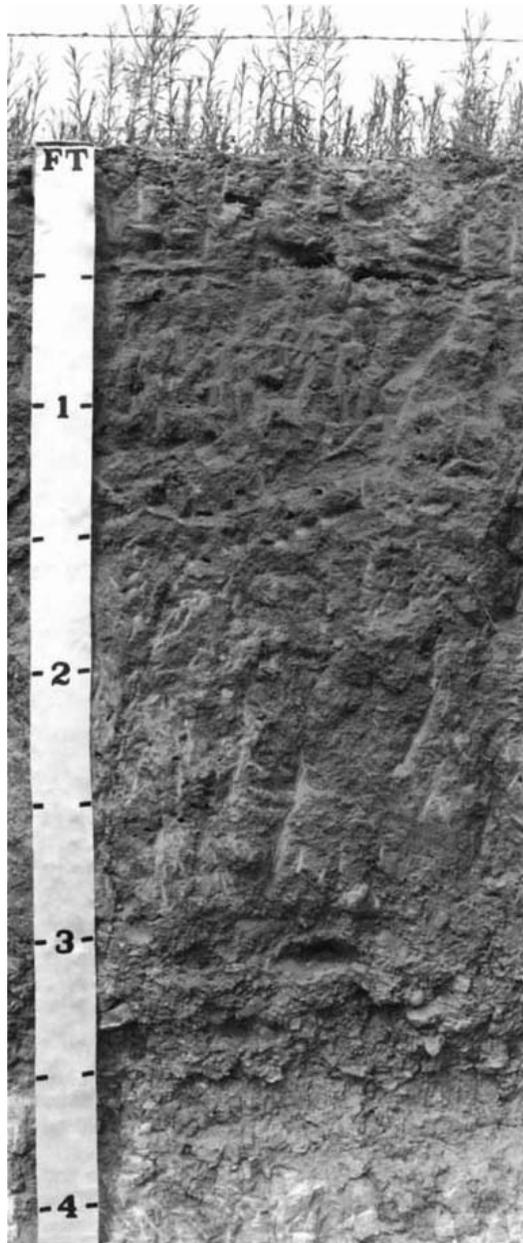


Figure 19.—Profile of a Duval loamy fine sandy. A Bt horizon begins at a depth of about 15 inches. Sandstone bedrock is at a depth of 43 to 48 inches. The scale is marked in feet.

Crk—48 to 60 inches; light yellowish brown (10YR 6/4), fractured, soft sandstone bedrock that slakes in water, dark yellowish brown (10YR 4/4) moist; common strata and masses of reddish yellow (7.5YR 6/6) and strong brown (7.5YR 5/6), soft sandstone bedrock that slakes in water; massive; hard, friable; about 10 percent, by volume, medium to very coarse, weakly cemented nodules of calcium carbonate and few fine, irregular threads and soft masses of calcium carbonate; violently effervescent; moderately alkaline.

The depth to sandstone bedrock is 40 to 60 inches. The depth to an accumulation of calcium carbonate is more than 35 inches. By weighted average, the content of total clay in the control section is 18 to 30 percent.

The A horizon is brown, reddish brown, light brown, or yellowish red. It is 8 to 20 inches thick. It is very fine sandy loam or loamy fine sand. It is slightly acid or neutral.

The Bt horizon is red, reddish brown, yellowish red, brown, strong brown, or reddish yellow. It is sandy clay loam, fine sandy loam, or very fine sandy loam. It is slightly acid to moderately alkaline.

The Bk horizon has colors that are 1 or 2 units higher in value and chroma than those of the Bt horizon. It is slightly acid to moderately alkaline.

Most pedons have a Cr layer. This layer is soft sandstone bedrock that slakes in water, or it is weakly cemented sandstone bedrock. Some pedons have a Cr/C layer, which is sandstone bedrock interbedded with reddish to yellowish sandy clay loam, very fine sandy loam, fine sandy loam, or soft siltstone. Some Cr layers have strata and masses of strongly cemented sandstone or ironstone.

Goldfinch Series

The Goldfinch series consists of shallow, well drained, very gravelly, loamy soils on uplands. These soils formed in very gravelly loamy residuum from sandstone over sandstone bedrock (fig. 20). Slopes range from 1 to 8 percent.

Typical pedon of Goldfinch very gravelly sandy loam, undulating; from the intersection of U.S. Highway 81 and Farm Road 468 in Cotulla, 3.5 miles northwest on Farm Road 468, about 0.4 mile south on county road, 0.15 mile west to house, and 0.1 mile northwest of house in an area of rangeland:

A—0 to 8 inches; reddish brown (5YR 4/4) very gravelly sandy loam, dark reddish brown (5YR 3/4) moist; weak fine subangular blocky and granular structure; slightly hard, very friable; common very fine and fine roots; about 55 percent, by volume, coarse fragments of strongly cemented sandstone and a few coarse fragments of strongly cemented sandy ironstone; fragments are mainly gravel mixed with some cobbles; slightly acid; clear wavy boundary.

Bt—8 to 14 inches; reddish brown (5YR 5/4) extremely gravelly sandy loam, reddish brown (5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, very friable; few very fine and fine roots; few faint clay films on peds and on coarse fragments; few faint clay bridges between sand grains; about 70 percent, by volume, coarse fragments of strongly cemented sandstone and a few coarse fragments of strongly cemented sandy ironstone; fragments are mainly gravel mixed with some cobbles; slightly acid; abrupt wavy boundary.



Figure 20.—Profile of a Goldfinch very gravelly sandy loam. The A horizon is 5 to 6 inches thick. Fractured sandstone bedrock is at a depth of 10 to 19 inches. The scale is marked in feet.

Cr—14 to 30 inches; reddish yellow (7.5YR 6/6), fractured, soft sandstone bedrock that slakes in water, strong brown (7.5YR 5/6) moist; massive; hard, friable; many strata of brownish and yellowish, soft sandstone bedrock interbedded with masses and strata of fractured, weakly cemented or strongly cemented ironstone and sandstone; more than 4 inches of horizontal spacing between cracks; few very fine and fine roots in cracks; slightly acid.

The depth to sandstone bedrock is 10 to 20 inches. The cover of gravel and cobbles on the surface is 10 to 85 percent. The soils are medium acid to mildly alkaline.

The A horizon is reddish brown or yellowish red. It is 3 to 10 inches thick. The content of coarse fragments, mainly sandstone and sandy ironstone, ranges from 35 to 70 percent, by volume. The content of gravel ranges from 15 to 55 percent, and the content of cobbles ranges from 0 to 30 percent. Some pedons have as much as 2 percent stones.

The Bt horizon is reddish brown, yellowish red, red, or reddish yellow. The content of coarse fragments, mainly sandstone and sandy ironstone, ranges from 35 to 75 percent, by volume. The content of gravel ranges from 25 to 60 percent, and the content of cobbles ranges from 0 to 25 percent. Some pedons have as much as 2 percent stones. This horizon is extremely gravelly sandy loam, very cobbly sandy loam, very gravelly sandy loam, extremely gravelly sandy clay loam, very cobbly sandy clay loam, or very gravelly sandy clay loam.

The Cr layer is weakly cemented sandstone bedrock or soft sandstone bedrock that slakes in water. In some pedons it is interbedded with unconsolidated loamy materials. Cracks in the sandstone bedrock are at horizontal intervals of 4 inches or more. In some pedons the upper part of the Cr layer has an accumulation of calcium carbonate. When moist the Cr layer can be dug with a spade. It commonly has masses and strata of weakly cemented or strongly cemented sandstone or ironstone.

Hindes Series

The Hindes series consists of very deep, well drained, very gravelly loamy soils on uplands. These soils formed in calcareous, very gravelly, loamy alluvium. Slopes range from 1 to 8 percent.

Typical pedon of Hindes very gravelly sandy clay loam, in an area of Hindes-Yologo complex, undulating; from the intersection of U.S. Highway 81 and Texas Highway 97 in Cotulla, 15 miles east on Texas Highway 97 to Los Angeles, 1.0 mile north on Farm Road 469, about 4.15 miles east on county road, 0.75 mile northwest through farm gate, 2.25 miles north on ranch road by windmill, 0.75 mile northwest to old ranch house, 0.6 mile west down lane, 0.5 mile northeast along fence line, 0.2 mile north-northeast along fence line, 0.2 mile west along sendero, and 20 feet north in an area of rangeland:

- A—0 to 7 inches; dark reddish brown (5YR 3/3) very gravelly sandy clay loam, dark reddish brown (5YR 2.5/2) moist; moderate very fine and fine subangular blocky structure; hard, friable; many very fine and fine roots; about 45 percent, by volume, rounded chert pebbles, mainly 0.5 inch to 2 inches in diameter; neutral; clear wavy boundary.
- Bt1—7 to 16 inches; reddish brown (5YR 4/3) extremely gravelly clay, dark reddish brown (5YR 3/3) moist; moderate very fine and fine angular blocky and granular structure; very hard, firm; common very fine roots; common distinct clay films on faces of peds and coarse fragments; about 65 percent, by volume, rounded chert pebbles, mainly 0.5 inch to 2 inches in diameter; neutral; gradual wavy boundary.
- Bt2—16 to 30 inches; reddish brown (2.5YR 4/4) extremely gravelly clay, dark reddish brown (2.5YR 3/4) moist; moderate very fine and fine angular blocky and granular structure; very hard, firm; common very fine roots; common distinct clay films on faces of peds and coarse fragments; about 65 percent, by volume, rounded chert pebbles, mainly 0.5 inch to 2 inches in diameter; neutral; abrupt wavy boundary.
- Bk—30 to 62 inches; pink (7.5YR 7/4), soft caliche that has a texture of gravelly clay loam and is weakly cemented and fractured in the upper 0.5 inch, light brown (7.5YR 6/4) moist; common fine distinct white (5YR 8/1) and brown (7.5YR 5/4) mottles; weak fine subangular blocky structure; very hard, friable; about 20 percent, by volume, rounded chert pebbles; violently effervescent; moderately alkaline.

The solum is more than 60 inches thick. The mollic epipedon is 7 to 20 inches thick.

The A horizon is very dark grayish brown, dark grayish brown, dark reddish brown, reddish brown, dark brown, or brown. It is 4 to 16 inches thick. It is gravelly or very gravelly and is sandy clay loam, loam, or clay loam in the fine-earth fraction. The content of siliceous pebbles and cobbles ranges from 5 to 50 percent, by volume. This horizon is slightly acid to mildly alkaline.

The Bt horizon is dark reddish brown, reddish brown, brown, or dark brown. The content of siliceous gravel ranges from 35 to 75 percent, by volume. This horizon is very gravelly clay, very gravelly clay loam, extremely gravelly clay, or extremely gravelly clay loam. It is slightly acid to mildly alkaline.

The Bk horizon is caliche that has a texture of loam, clay loam, gravelly loam, or gravelly clay loam. It is weakly consolidated to weakly cemented and fractured in the upper part. The horizontal cracks in the upper part are less than 4 inches apart. Some pedons have a 2Bk horizon, which has soft sandstone fragments.

Imogene Series

The Imogene series consists of very deep, moderately well drained, saline, loamy soils that have a sodic subsoil. These soils are on low stream terraces and on flood plains. They formed in saline, loamy alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Imogene very fine sandy loam, occasionally flooded; from the intersection of U.S. Highway 81 and Texas Highway 97 in Cotulla, 1.7 miles south on U.S. Highway 81 to Interstate Highway 35, about 9.7 miles south on Interstate Highway 35 to its intersection with Farm Road 133 in Artesia Wells, 0.7 mile south on east frontage road of Interstate Highway 35 to county road, 6.3 miles east on county road, 2.8 miles south on ranch road to ranch gate, 0.9 mile south on airstrip, 0.65 mile west on ranch road, and 150 feet north and 75 feet west of old bridge over creek in an area of rangeland:

- A—0 to 4 inches; grayish brown (10YR 5/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure; weak fine platy surface crust about 0.5 inch thick; slightly hard, very friable; common very fine and fine roots; few fine tubular pores; nonsaline; neutral; abrupt smooth boundary.
- Btn—4 to 11 inches; grayish brown (10YR 5/2) sandy clay loam, very dark grayish brown (10YR 3/2) moist; moderate coarse columnar structure parting to moderate fine and medium angular blocky; light brownish gray (10YR 6/2) caps on the tops of columns; extremely hard, very firm; common very fine roots, mainly along faces of peds; few fine tubular pores; common distinct clay films on faces of peds; very slightly saline; noneffervescent; moderately alkaline; clear wavy boundary.
- Btnz1—11 to 22 inches; light gray (10YR 7/2) sandy clay loam, light brownish gray (10YR 6/2) moist; few fine distinct light brownish gray (10YR 6/2) vertical streaks; weak coarse columnar structure parting to weak fine and medium subangular blocky; very hard, firm; few very fine roots; few fine tubular pores; few faint clay films on vertical faces of peds; about 2 percent, by volume, fine, irregular threads and fine and medium, rounded soft masses of calcium carbonate; moderately saline; slightly effervescent; moderately alkaline; gradual wavy boundary.
- Btnz2—22 to 48 inches; light gray (10YR 7/2) sandy clay loam, light gray (10YR 7/2) moist; few fine distinct dark brown (7.5YR 3/4) mottles; weak fine and medium subangular blocky structure; hard, friable; few very fine roots; few faint clay films on vertical faces of peds; few fine, irregular soft masses of calcium carbonate; strongly saline; slightly effervescent; moderately alkaline; diffuse wavy boundary.
- BCnyz—48 to 64 inches; light gray (10YR 7/2) loam, light gray (10YR 7/2) moist; few fine distinct dark brown (7.5YR 3/4) mottles that surround few fine black (N 2/0) weakly cemented ferromanganese nodules; weak fine and medium subangular blocky structure; hard, friable; few very fine roots; few fine and medium, irregular soft masses of calcium carbonate; few fine, irregular soft masses and clusters of gypsum crystals and other salts; strongly saline; noneffervescent matrix; mildly alkaline; gradual wavy boundary.
- Cyz—64 to 80 inches; white (2.5Y 8/2) loam, light gray (2.5Y 7/2) moist; few fine and medium distinct dark brown (7.5YR 3/4) mottles that surround few

fine and medium black (N 2/0) weakly cemented ferromanganese nodules; weak fine and medium subangular blocky structure; very hard, friable; few fine soft masses and clusters of gypsum crystals and other salts; moderately saline; noneffervescent matrix; neutral.

The thickness of the solum ranges from 38 to more than 60 inches. Salinity is less than 4 millimhos per centimeter in the A horizon. It increases as depth increases. It is 4 to 20 millimhos per centimeter in some part of the upper 40 inches of the solum and below that depth. The exchangeable sodium percentage is 15 or more in some part of the upper 16 inches of the Bt horizon.

The A horizon is grayish brown, brown, light brownish gray, dark brown, dark grayish brown, pale brown, or dark yellowish brown. It is 3 to 12 inches thick. The upper 7 inches has moist value of 3 or less after mixing. This horizon is slightly acid to mildly alkaline.

The upper part of the Bt horizon is dark brown, very dark gray, very dark grayish brown, brown, or grayish brown. The lower part is brown, light yellowish brown, light brownish gray, pale brown, light gray, or very pale brown. The Bt horizon is clay loam, sandy clay loam, or sandy clay. The content of total clay ranges from 20 to 40 percent. It is highest in the upper 20 inches. By weighted average, the content of total clay in the control section ranges from 20 to 35 percent. The Bt horizon is neutral to moderately alkaline.

The BC horizon is light gray, gray, grayish brown, light brownish gray, brown, pale brown, or very pale brown. Visible accumulations of calcium carbonate, gypsum, and other salts make up as much as 5 percent of the volume. This horizon is neutral to moderately alkaline. It is sandy clay loam, clay loam, or loam.

The C horizon has colors similar to those of the BC horizon or has higher value. It is sandy clay loam, clay loam, or loam. Visible accumulations of calcium carbonate, gypsum, and other salts make up as much as 20 percent of the volume.

Lasalle Series

The Lasalle series consists of very deep, moderately well drained, saline, clayey soils on uplands. These soils formed in saline, calcareous, clayey sediments. Slopes range from 0 to 3 percent.

Typical pedon of Lasalle clay, gently undulating; from the intersection of Texas Highway 97 and U.S. Highway 81 in Cotulla, 0.8 mile east on Texas Highway 97 to Farm Road 624, about 18.6 miles southeast on Farm Road 624, about 0.2 mile west on Hillge Ranch headquarters road, and 150 feet north of fence in an area of rangeland:

- A—0 to 5 inches; brown (7.5YR 5/2) clay, dark brown (7.5YR 4/2) moist; moderate fine and medium angular blocky structure; very hard, very firm; many very fine and fine roots; few snail shell fragments; nonsaline; strongly effervescent; moderately alkaline; clear smooth boundary.
- ABnz—5 to 24 inches; brown (7.5YR 5/2) clay, dark brown (7.5YR 4/2) moist; moderate fine and medium angular blocky structure; extremely hard, very firm; common very fine and fine roots; few snail shell fragments; slightly saline; exchangeable sodium percentage of 20; strongly effervescent; moderately alkaline; gradual wavy boundary.
- Bnyz1—24 to 42 inches; light reddish brown (5YR 6/3) clay, reddish brown (5YR 5/3) moist; common fine faint brown (7.5YR 5/2) streaks; moderate fine and medium angular blocky structure; extremely hard, very firm; few very fine and fine roots; few intersecting slickensides; few snail shell fragments; few fine, irregular threads of gypsum and other salts; moderately saline; strongly effervescent; moderately alkaline; diffuse wavy boundary.

- Bnyz2—42 to 58 inches; light reddish brown (5YR 6/3) clay, reddish brown (5YR 5/3) moist; common fine faint brown (7.5YR 5/2) streaks; moderate fine and medium angular blocky structure; extremely hard, very firm; few very fine roots; few intersecting slickensides; few fine, irregular threads and medium, irregular clusters of gypsum crystals and other salts; moderately saline; strongly effervescent; moderately alkaline; diffuse wavy boundary.
- BCnyz—58 to 72 inches; reddish brown (5YR 5/3) clay, reddish brown (5YR 5/3) moist; weak fine and medium angular blocky structure; extremely hard, very firm; few intersecting slickensides; few fine, irregular threads and medium, irregular clusters of gypsum crystals and other salts; moderately saline; strongly effervescent; moderately alkaline.

The thickness of the solum ranges from 40 to more than 80 inches. Salinity is 0 to 4 millimhos per centimeter in the A horizon, 2 to 12 millimhos per centimeter in the AB horizon, and 8 to 16 millimhos per centimeter in the B and BC horizons. The exchangeable sodium percentage is 15 or more in some part of the upper 30 inches of the solum and increases with increasing depth. The content of total clay is 40 to 60 percent.

The A and AB horizons are grayish brown, brown, dark brown, reddish brown, or light reddish brown.

The B and BC horizons are pinkish gray, light brown, light reddish brown, reddish brown, or reddish gray. They have few or common threads and clusters of salt crystals. The B horizon has few to many streaks that have the same colors as those of the A and AB horizons.

The C horizon, if it occurs, is clay, clay intermingled with soft shale fragments, or clay intermingled with soft shale bedrock. The soft shale slakes in water. In some pedons the soft shale bedrock is interbedded with sandstone. This horizon has few to many threads and clusters of salt crystals.

Mata Series

The Mata series consists of deep, well drained, gravelly, loamy soils on uplands. These soils formed in saline, calcareous, gravelly, loamy alluvium over residuum. Slopes range from 0 to 5 percent.

Typical pedon of Mata gravelly sandy clay loam, gently undulating; from the intersection of Texas Highway 97 and U.S. Highway 81 in Cotulla, 0.8 mile east on Texas Highway 97 to Farm Road 624, about 20.8 miles southeast on Farm Road 624, and 50 feet north of fence in an area of rangeland:

- A—0 to 7 inches; pale brown (10YR 6/3) gravelly sandy clay loam, dark brown (10YR 4/3) moist; weak fine and medium subangular blocky structure; hard, friable; common very fine and fine roots; few fine, irregular threads and fine, rounded soft masses of calcium carbonate; about 8 percent calcium carbonate equivalent; about 20 percent, by volume, rounded siliceous pebbles, mainly 0.25 inch to 2.0 inches in diameter; nonsaline; strongly effervescent; mildly alkaline; clear smooth boundary.
- Bk—7 to 16 inches; pale brown (10YR 6/3) very gravelly clay loam, brown (10YR 5/3) moist; weak fine subangular blocky structure; hard, friable; few very fine roots; few fine, irregular threads and fine, rounded, weakly cemented nodules of calcium carbonate; about 21 percent calcium carbonate equivalent; about 60 percent, by volume, rounded siliceous pebbles with common prominent coatings of calcium carbonate; nonsaline; violently effervescent; mildly alkaline; gradual wavy boundary.
- Bkz1—16 to 25 inches; light yellowish brown (10YR 6/4) extremely gravelly clay loam, yellowish brown (10YR 5/4) moist; weak fine subangular blocky structure; hard, friable; few very fine roots; few fine, irregular threads and

fine, rounded, weakly cemented nodules of calcium carbonate; about 22 percent calcium carbonate equivalent; about 65 percent, by volume, rounded siliceous pebbles with few distinct coatings of calcium carbonate; slightly saline; violently effervescent; mildly alkaline; clear wavy boundary.

Bkz2—25 to 42 inches; very pale brown (10YR 7/4) fine sandy loam, light yellowish brown (10YR 6/4) moist; weak fine subangular blocky structure; slightly hard, friable; few very fine roots; about 20 percent, by volume, fine, irregular threads and fine to coarse, rounded soft masses of calcium carbonate; about 28 percent calcium carbonate equivalent; about 10 percent, by volume, rounded siliceous pebbles with few distinct coatings of calcium carbonate; moderately saline; violently effervescent; moderately alkaline; gradual wavy boundary.

Bkz3—42 to 54 inches; very pale brown (10YR 7/4) gravelly sandy loam, light yellowish brown (10YR 6/4) moist; weak fine subangular blocky structure; slightly hard, friable; few very fine roots; about 30 percent, by volume, fine, irregular threads and fine to coarse, rounded soft masses of calcium carbonate; about 32 percent calcium carbonate equivalent; about 15 percent, by volume, rounded siliceous pebbles with few distinct coatings of calcium carbonate; few soft shale fragments in the lower part; moderately saline; violently effervescent; moderately alkaline; abrupt wavy boundary.

2Cryz—54 to 72 inches; white (5Y 8/2), fractured, soft shale bedrock that slakes in water, light gray (5Y 7/2) moist; few fine faint yellow mottles; massive; very hard, friable; common fine and medium, irregular soft masses of gypsum crystals and other salts; moderately saline; violently effervescent; moderately alkaline.

The depth to soft shale bedrock is 40 to 60 inches. Salinity is 0.4 to 1.0 millimhos per centimeter in the A horizon and the upper part of the Bk horizon and 4 to 16 millimhos per centimeter in the Bkz and 2Cryz horizons. By weighted average, the calcium carbonate equivalent of the 10- to 40-inch control section is 12 to 35 percent. The depth to a calcic horizon is 5 to 39 inches. The content of coarse fragments in the control section averages 35 to 60 percent, by volume. The soils are mildly alkaline or moderately alkaline throughout.

The A horizon is light brownish gray, grayish brown, pale brown, brown, dark brown, or reddish brown. It is gravelly sandy clay loam or gravelly clay loam.

The Bk and Bkz horizons are very pale brown, pale brown, light yellowish brown, grayish brown, light brownish gray, light brown, brown, or pink. They have few to as much as 35 percent, by volume, threads, soft masses, and nodules of calcium carbonate. The content of coarse fragments ranges from 0 to 75 percent, by volume, in individual horizons. The fine-earth fraction is clay loam, sandy clay loam, fine sandy loam, sandy loam, or loam.

The 2Cryz horizon is white, light gray, pale yellow, or weak red. It is soft shale bedrock or soft shale bedrock intermingled with clay or clay loam. It has few to many threads, soft masses, and clusters of salt crystals.

Maverick Series

The Maverick series consists of moderately deep, well drained, saline, clayey soils on uplands. These soils formed in saline, calcareous, clayey residuum. Slopes range from 1 to 5 percent.

Typical pedon of Maverick clay, gently undulating; from the intersection of Texas Highway 97 and U.S. Highway 81 in Cotulla, 15 miles east on Texas Highway 97 to

Los Angeles, 6.6 miles further east on Texas Highway 97, about 0.55 mile south on ranch road, 130 feet west on ranch road, and 50 feet south in an area of rangeland:

- A—0 to 8 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate fine and medium angular blocky structure; weak fine platy surface crust; very hard, firm, very sticky and very plastic; common very fine and fine roots; few fine and medium tubular pores; few snail shell fragments; slightly saline; strongly effervescent; moderately alkaline; clear wavy boundary.
- Bz—8 to 16 inches; light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; few fine faint grayish brown (10YR 5/2) vertical streaks; moderate fine and medium angular blocky structure; extremely hard, very firm, very sticky and very plastic; common very fine and fine roots; few fine tubular and medium vesicular pores; few siliceous pebbles; moderately saline; strongly effervescent; moderately alkaline; gradual wavy boundary.
- Byz—16 to 28 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; moderate fine and medium angular blocky structure; extremely hard, very firm, very sticky and very plastic; common fine, irregular threads and clusters of gypsum crystals and other salts; few soft shale fragments; moderately saline; strongly effervescent; moderately alkaline; abrupt wavy boundary.
- Cryz—28 to 60 inches; light gray (5Y 7/2), fractured, soft shale bedrock that slakes in water, light olive gray (5Y 6/2) moist; common fine and medium distinct pale yellow (2.5Y 7/4) mottles; massive; very hard, firm; less than 4 inches of horizontal spacing between cracks; common fine and medium, irregular clusters of gypsum crystals and other salts; moderately saline; strongly effervescent; moderately alkaline.

The depth to soft shale bedrock is 20 to 40 inches. Salinity is about 0 to 5 millimhos per centimeter in the A horizon, 4 to 16 millimhos per centimeter in the B horizon, and 8 to 16 millimhos per centimeter in the Cr layer. The soils are mildly alkaline or moderately alkaline throughout.

The A horizon is grayish brown, light brownish gray, olive gray, light olive gray, pale brown, brown, light yellowish brown, yellowish brown, light olive brown, or pale olive. It is 4 to 10 inches thick.

The B horizon is very pale brown, yellowish brown, light brownish gray, pale brown, light olive gray, light gray, light olive brown, light yellowish brown, pale yellow, or pale olive. It is clay or clay loam. Visible accumulations of gypsum, calcium carbonate, and other salts make up as much as 20 percent of the volume. The calcium carbonate equivalent generally is less than 15 percent but is more than 15 percent where the horizon is less than 6 inches thick.

The Cr layer is soft shale bedrock or soft shale bedrock intermingled with clay or clay loam. The soft shale slakes in water. The horizon has few to many clusters of gypsum crystals and other salts. In some pedons the shale is interbedded with sandstone bedrock.

Moglia Series

The Moglia series consists of very deep, well drained, loamy soils on uplands. These soils formed in saline, calcareous, loamy alluvium. Slopes range from 0 to 3 percent.

Typical pedon of Moglia clay loam, gently undulating; from the intersection of Texas Highway 97 and U.S. Highway 81 in Cotulla, 0.8 mile east on Texas Highway 97 to Farm Road 624, about 1.3 miles southeast on Farm Road 624, about 3.0 miles east on county road to a cattle guard at ranch entrance, 2.0 miles east on ranch road

to another cattle guard, 0.4 mile east on ranch road to oil field road, 1.6 miles southeast on oil field road to a windmill, 0.2 mile north of windmill, and 150 feet east in an area of rangeland:

- A—0 to 12 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; hard, friable; common very fine and fine roots; common fine tubular pores; few fine, irregular threads and fine, rounded soft masses of calcium carbonate; about 6 percent calcium carbonate equivalent; nonsaline; strongly effervescent; mildly alkaline; clear wavy boundary.
- Bk—12 to 20 inches; very pale brown (10YR 7/3) clay loam, brown (10YR 5/3) moist; moderate medium subangular blocky structure; hard, friable; few very fine roots; few fine tubular pores; few fine, irregular threads and soft masses of calcium carbonate; about 16 percent calcium carbonate equivalent; nonsaline; violently effervescent; mildly alkaline; clear wavy boundary.
- Bknz—20 to 32 inches; very pale brown (10YR 7/4) clay loam, yellowish brown (10YR 5/4) moist; moderate medium subangular blocky structure; hard, friable; few very fine roots; few fine tubular pores; few fine, irregular threads and soft masses of calcium carbonate; about 19 percent calcium carbonate equivalent; moderately saline; violently effervescent; mildly alkaline; clear wavy boundary.
- Bkyz1—32 to 64 inches; very pale brown (10YR 7/4) clay loam, yellowish brown (10YR 5/4) moist; weak fine subangular blocky structure; hard, friable; few very fine roots; few fine, irregular threads and fine and medium, irregular soft masses of calcium carbonate; few fine, irregular clusters of gypsum crystals and other salts; common faint coatings of gypsum crystals on faces of peds; about 13 percent calcium carbonate equivalent; moderately saline; violently effervescent; moderately alkaline; clear wavy boundary.
- 2Bkyz2—64 to 72 inches; very pale brown (10YR 7/4) clay loam, light yellowish brown (10YR 6/4) moist; weak fine subangular blocky structure; hard, friable; common fine to coarse, irregular clusters of gypsum crystals and other salts; few fine, irregular threads and soft masses of calcium carbonate; about 13 percent calcium carbonate equivalent; moderately saline; violently effervescent; moderately alkaline.

The solum is more than 60 inches thick. By weighted average, the calcium carbonate equivalent of the 10- to 40-inch control section is 10 to 20 percent. By weighted average, the content of total clay in the control section is 25 to 42 percent and the content of silicate clay is 20 to 35 percent. A calcic horizon is at a depth of 5 to 39 inches, and it has a calcium carbonate equivalent 5 to 15 percent more than that of the C horizon. The content of visible accumulations of gypsum and other salts ranges from 0 to 25 percent, by volume, below a depth of 40 inches. Salinity is 0.4 to 2 millimhos per centimeter in the surface layer. It increases to between 4 and more than 16 millimhos per centimeter between the bottom of the surface layer and a depth of 25 inches. The exchangeable sodium percentage is 15 or more in some horizon within 25 inches of the surface. The content of siliceous pebbles ranges from 0 to about 10 percent, by volume. The pebbles are concentrated in the upper part of the pedon. The soils are mildly alkaline or moderately alkaline throughout.

The A horizon is light brownish gray, light yellowish brown, grayish brown, brownish gray, or brown.

The Bk horizon is very pale brown, pale brown, brown, light yellowish brown, light brownish gray, or light brown. It is clay loam or clay.

The Bknz, Bkyz, and 2Bkyz horizons are light brownish gray, light brown, pink, pale brown, light yellowish brown, light brownish gray, or very pale brown. The Bknz and Bkyz horizons are loam or clay loam. The 2B horizon is clay intermingled with soft shale fragments, clay, or clay loam. It has few to many threads and clusters of salt crystals.

Montell Series

The Montell series consists of very deep, moderately well drained, saline, clayey soils on stream terraces. These soils formed in saline, calcareous, clayey, old alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Montell clay, saline, occasionally flooded; from the intersection of U.S. Highway 81 and Texas Highway 97 in Cotulla, 0.8 mile east on Texas Highway 97 to Farm Road 624, about 20 miles southeast on Farm Road 624, about 5.25 miles south on county road to ranch entrance, 9.6 miles southeast on ranch road, and 50 feet southwest in an area of rangeland:

- A—0 to 12 inches; gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; strong fine and medium angular blocky structure; extremely hard, very firm, very sticky and very plastic; common very fine and fine roots; common fine tubular pores; common fine and medium, rounded nodules of calcium carbonate; strongly effervescent; moderately alkaline; gradual wavy boundary.
- BA_{nz}—12 to 30 inches; gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; strong medium and coarse angular blocky structure; extremely hard, very firm, very sticky and very plastic; common very fine and fine roots; few fine tubular pores; common intersecting slickensides in the lower part; common distinct stress surfaces on faces of peds; common fine and medium, rounded nodules of calcium carbonate; slightly saline; strongly effervescent; moderately alkaline; gradual wavy boundary.
- B_{nz}1—30 to 44 inches; light gray (10YR 6/1) clay, gray (10YR 5/1) moist; common fine distinct gray (10YR 5/1) vertical streaks; strong medium and coarse angular blocky structure; extremely hard, firm, very sticky and very plastic; few very fine and fine roots; few fine tubular pores; common intersecting slickensides; common distinct stress surfaces on faces of peds; common fine and medium, rounded nodules of calcium carbonate; moderately saline; strongly effervescent; moderately alkaline; gradual wavy boundary.
- B_{nz}2—44 to 70 inches; light brownish gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) moist; common fine distinct gray (10YR 5/1) streaks; moderate fine and medium angular blocky structure; extremely hard, firm, very sticky and very plastic; few very fine roots; common distinct stress surfaces on faces of peds; few fine and medium, rounded nodules of calcium carbonate; moderately saline; calcareous; strongly effervescent; moderately alkaline.

The solum is more than 60 inches thick. The depth to intersecting slickensides is 20 to 30 inches. The soils have cracks 0.4 inch to 2.0 inches wide at the surface when dry. The cracks extend to a depth of 20 inches or more and taper with increasing depth. The exchangeable sodium percentage is 15 or more in some part of the upper 30 inches of the solum. Gilgai microrelief in areas that have never been plowed consists of microknolls that are 5 to 12 feet in diameter and 3 to 12 inches higher than microbasins. The amplitude of the boundary between the BA and B horizons is about 4 to 17 inches. Salinity is 0.4 to 4 millimhos per centimeter in the A horizon and 2 to more than 16 millimhos per centimeter in the B and C horizons. The

content of total clay is 40 to 60 percent. The soils are mildly alkaline or moderately alkaline throughout.

The A and BA horizons are gray or dark gray. Where the A horizon has value of less than 3.5, it is less than 12 inches thick.

The B horizon is grayish brown, light brownish gray, light gray, pale brown, brown, or light yellowish brown. It has common or many streaks that are the same color as the A and BA horizons.

Monteola Series

The Monteola series consists of very deep, moderately well drained, saline, clayey soils on uplands. These soils formed in saline, calcareous, clayey sediments. Slopes range from 0 to 3 percent.

Typical pedon of Monteola clay, saline, gently undulating; from the intersection of U.S. Highway 81 and Texas Highway 97 in Cotulla, 27.2 miles east on Texas Highway 97 to Fowlerton, 11.6 miles north on Texas Highway 97 to Farm Road 1582, about 2.4 miles west on Farm Road 1582, and 50 feet north of fence in an area of rangeland:

- A—0 to 15 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate medium and coarse angular blocky structure; extremely hard, very firm; common very fine roots; few fine tubular pores; slightly effervescent; mildly alkaline; clear wavy boundary.
- BAkz1—15 to 24 inches; dark gray (10YR 4/1) clay, black (10YR 2/1) moist; moderate medium and coarse angular blocky structure; extremely hard, very firm; common very fine roots; few fine tubular pores; common intersecting slickensides; common distinct stress surfaces on faces of peds; few fine, rounded nodules and fine, irregular soft masses of calcium carbonate; slightly saline; slightly effervescent; mildly alkaline; diffuse wavy boundary.
- BAkz2—24 to 37 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate medium and coarse angular blocky structure; extremely hard, very firm; few very fine roots; few fine tubular pores; common intersecting slickensides; few fine, rounded nodules and medium, irregular soft masses of calcium carbonate; moderately saline; strongly effervescent; mildly alkaline; diffuse wavy boundary.
- Byz—37 to 57 inches; light yellowish brown (10YR 6/4) clay, yellowish brown (10YR 5/4) moist; common fine distinct dark gray (10YR 4/1) streaks; weak fine and medium subangular blocky structure; extremely hard, very firm; few very fine roots; common fine and medium soft masses and clusters of gypsum crystals and other salts; moderately saline; strongly effervescent; mildly alkaline; diffuse wavy boundary.
- BCyz—57 to 62 inches; brownish yellow (10YR 6/6) clay, yellowish brown (10YR 5/6) moist; few fine distinct yellowish brown (10YR 5/4) mottles; weak fine subangular blocky structure; extremely hard, very firm; few very fine roots; common fine and medium, irregular soft masses and clusters of gypsum crystals and other salts; few fine soft shale fragments that slake in water; moderately saline; slightly effervescent; mildly alkaline.

The solum is more than 60 inches thick. It is thinnest on the microknolls and thickest in the microbasins. Salinity is 0 to 4 millimhos per centimeter in the A horizon. It increases with depth to as much as 8 to 16 millimhos per centimeter below that layer. By weighted average, the content of total clay in the 10- to 40-inch control section is 40 to 60 percent. The soils have cracks 0.4 inch to 2 inches wide at the surface when dry. The cracks extend to a depth of more than 20 inches. The soils are mildly alkaline or moderately alkaline throughout.

The A horizon and the upper part of the BA horizon are very dark gray or dark gray in the upper 12 to 30 inches in more than half of the pedon. The soil matrix may be noneffervescent or effervescent in the A and BA horizons. The amplitude of the boundary between the BA and B horizons ranges from 5 to about 14 inches. The content of rounded siliceous gravel ranges from 0 to 15 percent, by volume, in the A and AB horizons.

The B horizon and the lower part of the BA horizon are dark grayish brown, grayish brown, brown, pale brown, dark brown, gray, or light yellowish brown. The B horizon has few or common streaks that are the same color as the A or AB horizon. Visible accumulations of calcium carbonate, gypsum, and other salts make up as much as 10 percent of the volume. This horizon has few or common streaks that are the same color as the A or AB horizon.

The BC and C horizons are brownish yellow, light gray, light yellowish brown, or light brownish gray. Visible accumulations of calcium carbonate, gypsum, and other salts are few or common.

Poteet Series

The Poteet series consists of very deep, moderately well drained, loamy soils along drainageways on uplands. These soils formed in loamy alluvium. Slopes are 0 to 1 percent.

Typical pedon of Poteet very fine sandy loam, occasionally flooded; from the intersection of U.S. Highway 81 and Texas Highway 97 in Cotulla, 1.7 miles south on U.S. Highway 81 to Interstate Highway 35, about 9.7 miles south on Interstate Highway 35 to its intersection with Farm Road 133 in Artesia Wells, 1.55 miles north on west frontage road of Interstate Highway 35, and 100 feet west in a low spot between road and railroad tracks, in an area of rangeland:

- A—0 to 22 inches; reddish brown (5YR 4/3) very fine sandy loam, dark reddish brown (5YR 3/3) moist; weak fine subangular blocky structure; slightly hard, very friable; common very fine and fine roots; few fine tubular pores; neutral; clear smooth boundary.
- Bt1—22 to 28 inches; reddish brown (5YR 4/4) sandy clay loam, reddish brown (5YR 4/4) moist; few fine faint yellowish red (5YR 4/6) and brown (7.5YR 5/4) mottles; moderate fine and medium angular blocky structure; very hard, firm; few very fine roots; common distinct clay films on faces of peds; few distinct very dark grayish brown (10YR 3/2) coatings on faces of peds; slightly acid; gradual wavy boundary.
- Bt2—28 to 34 inches; reddish brown (5YR 4/4) sandy clay loam, reddish brown (5YR 4/4) moist; common fine distinct red (2.5YR 4/6) and dark brown (7.5YR 4/2) mottles; moderate fine and medium angular blocky structure; very hard, firm; few very fine roots; common distinct clay films on faces of peds; few distinct very dark grayish brown (10YR 3/2) coatings on faces of peds; slightly acid; gradual wavy boundary.
- Bt3—34 to 48 inches; yellowish red (5YR 4/6) sandy clay, yellowish red (5YR 4/6) moist; few fine distinct red (2.5YR 4/6) and dark brown (7.5YR 4/2) mottles; moderate fine and medium angular blocky structure; very hard, firm; few very fine roots; few faint clay films on faces of peds; slightly acid; gradual wavy boundary.
- Bt4—48 to 64 inches; reddish yellow (7.5YR 6/6) sandy clay loam, strong brown (7.5YR 5/6) moist; few fine distinct yellowish red (5YR 5/6) and dark brown (7.5YR 4/4) mottles; weak fine and medium subangular blocky structure; very hard, firm; few very fine roots; few faint clay films on faces of peds; neutral.

The thickness of the solum ranges from 60 to more than 80 inches. The mollic epipedon is 20 to 40 inches thick. Visible accumulations of calcium carbonate are below a depth of 36 inches.

The A horizon is very dark grayish brown, dark grayish brown, brown, dark brown, dark reddish brown, or reddish brown. It is neutral or mildly alkaline. It is 14 to 36 inches thick.

The upper part of the Bt horizon is brown, dark brown, reddish brown, dark reddish brown, very dark grayish brown, dark grayish brown, grayish brown, or yellowish brown. It has few to many, faint to prominent mottles in shades of red, brown, yellow, or gray. It is sandy clay loam, clay loam, or sandy clay. By weighted average, the content of total clay in the upper 20 inches of the Bt horizon is 23 to 35 percent. Reaction is slightly acid to mildly alkaline.

The lower part of the Bt horizon is grayish brown, brown, strong brown, light reddish brown, brownish yellow, yellowish brown, light yellowish brown, reddish yellow, or yellowish red. It has few to many, faint to prominent mottles in shades of red, brown, yellow, and gray. It is sandy clay loam, clay loam, or fine sandy loam. Visible accumulations of calcium carbonate make up 0 to 5 percent of the volume. Reaction is neutral to moderately alkaline.

Tela Series

The Tela series consists of very deep, well drained, loamy soils along drainageways on uplands. These soils formed in loamy alluvium. Slopes are 0 to 1 percent.

Typical pedon of Tela sandy clay loam, frequently flooded; from the intersection of U.S. Highway 81 and Texas Highway 97 in Cotulla, 1.7 miles south on U.S. Highway 81 to Interstate Highway 35, about 26.5 miles south on Interstate Highway 35 to Encinal, 2.2 miles west on Texas Highway 44, and 400 feet south of fence in an area of rangeland:

- A—0 to 13 inches; dark grayish brown (10YR 4/2) sandy clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; hard, friable; common very fine roots; mildly alkaline; gradual wavy boundary.
- Bt—13 to 18 inches; grayish brown (10YR 5/2) sandy clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium angular blocky structure; hard, firm; few very fine roots; few faint clay films on vertical faces of peds; mildly alkaline; gradual irregular boundary.
- Btk—18 to 39 inches; grayish brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; moderate medium angular blocky structure; hard, firm; few fine roots; few faint clay films on vertical faces of peds; few fine, irregular threads of calcium carbonate; very slightly effervescent; moderately alkaline; gradual wavy boundary.
- Bck1—39 to 46 inches; light brownish gray (10YR 6/2) sandy clay loam, grayish brown (10YR 5/2) moist; moderate medium subangular blocky structure; hard, friable; few fine, irregular threads and soft masses of calcium carbonate; strongly effervescent; moderately alkaline; gradual wavy boundary.
- Bck2—46 to 63 inches; light brownish gray (10YR 6/2) loam, grayish brown (10YR 5/2) moist; massive; hard, friable; about 15 percent, by volume, fine to coarse, rounded soft masses and strongly cemented concretions of calcium carbonate; violently effervescent; moderately alkaline.

The solum is more than 60 inches thick. The depth to a visible accumulation of calcium carbonate is 12 to 34 inches. The solum is neutral or mildly alkaline in the upper part and mildly alkaline or moderately alkaline in the lower part.

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

The Bt and Btk horizons are brown, dark brown, dark grayish brown, pale brown, grayish brown, or light brownish gray. They are sandy clay loam or clay loam. The content of total clay in the upper 20 inches of these horizons is 18 to 35 percent. The Bt horizon is neutral or mildly alkaline.

The BCk horizon is pale brown, light brownish gray, or very pale brown. It is clay loam, sandy clay loam, or loam.

Tiocano Series

The Tiocano series consists of very deep, somewhat poorly drained, clayey soils on playas. These soils formed in lacustrine clays. Slopes are 0 to 1 percent.

Typical pedon of Tiocano clay; from intersection of Missouri Pacific Railroad and the west frontage road to Interstate Highway 35 in Gardendale, 2.2 miles south on frontage road, and 100 feet west of fence in an area of rangeland:

- A—0 to 5 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate fine and medium angular blocky structure; extremely hard, very firm; common very fine and fine roots; common fine tubular pores; few distinct yellowish red (5YR 5/6) clay and sand coatings on faces of peds and in pores; noneffervescent; neutral; gradual wavy boundary.
- BA—5 to 34 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate medium and coarse angular blocky structure; extremely hard, very firm; common very fine and fine roots; common fine tubular pores; common intersecting slickensides; common distinct stress surfaces on faces of peds; very few distinct yellowish red (5YR 5/6) clay and sand coatings on faces of peds and in pores in the upper part; noneffervescent; mildly alkaline; diffuse wavy boundary.
- Bw1—34 to 40 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; many fine and medium distinct gray (10YR 5/1) streaks; moderate fine and medium angular blocky structure; extremely hard, very firm; few very fine and fine roots; common intersecting slickensides; common distinct stress surfaces on faces of peds; very slightly effervescent; mildly alkaline; gradual wavy boundary.
- Bw2—40 to 50 inches; light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; common fine and medium distinct gray (10YR 5/1) streaks; weak fine and medium angular blocky structure; extremely hard, very firm; few distinct stress surfaces on faces of peds; very slightly effervescent; mildly alkaline; gradual wavy boundary.
- BC—50 to 64 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; weak fine and medium subangular blocky structure; extremely hard, very firm; very slightly effervescent; mildly alkaline.

The solum is more than 60 inches thick. The soils have cracks 0.4 inch to 4 inches wide at the surface when dry. The cracks extend to a depth of 30 inches or more. The content of total clay is 40 to 60 percent in the 10- to 40-inch control section. The amplitude of the boundary between the BA and Bw horizons from the microknolls to the microbasins is 14 to 50 inches. The soils are neutral to moderately alkaline throughout.

The A and BA horizons are gray, dark gray, or very dark gray and range from 20 to 44 inches in thickness. Some pedons have as much as 6 inches of loamy overwash on the surface. The overwash is fine sandy loam to clay loam and brown to very dark grayish brown.

The Bw horizon is gray, grayish brown, light brownish gray, pale brown, or brown and has streaks that have the same colors as the A and BA horizons.

The BC horizon is slightly lighter in color than the Bw horizon. It is grayish, brownish, or yellowish.

Viboras Series

The Viboras series consists of moderately deep, moderately well drained, saline, clayey soils on uplands. These soils formed in saline, calcareous, clayey residuum derived from interbedded siltstone and shale bedrock. Slopes range from 0 to 3 percent.

Typical pedon of Viboras clay, gently undulating; from the intersection of U.S. Highway 81 and Texas Highway 97 in Cotulla, 1.7 miles south on U.S. Highway 81 to Interstate Highway 35, about 26.5 miles south on Interstate Highway 35, about 3.3 miles east on Texas Highway 44, about 5.0 miles east on county road to ranch entrance, 0.2 mile south along fence line, 0.4 mile west on ranch road, 0.2 mile south on ranch road, and 50 feet east in an area of rangeland:

- A—0 to 8 inches; reddish brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; moderate medium angular blocky structure; very hard, firm, very sticky and very plastic; many very fine and fine roots; common fine and medium tubular pores; few snail shell fragments; nonsaline; violently effervescent; moderately alkaline; clear wavy boundary.
- Bnyz1—8 to 21 inches; light reddish brown (5YR 6/4) clay, reddish brown (5YR 5/4) moist; common fine distinct reddish brown (5YR 5/4) streaks; strong coarse angular blocky structure; extremely hard, very firm, very sticky and very plastic; common very fine and fine roots; few fine tubular pores; common distinct stress surfaces on faces of peds; few fine, irregular threads and clusters of gypsum crystals and other salts; moderately saline; violently effervescent; moderately alkaline; clear wavy boundary.
- Bnyz2—21 to 34 inches; reddish brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; strong coarse angular blocky structure; extremely hard, very firm, very sticky and very plastic; few very fine and fine roots; few fine, irregular threads, soft masses, and clusters of gypsum crystals and other salts; few faint coatings of gypsum crystals on faces of peds; moderately saline; violently effervescent; moderately alkaline; gradual wavy boundary.
- Bnyz3—34 to 38 inches; light reddish brown (2.5YR 6/4) clay, reddish brown (2.5YR 5/4) moist; moderate coarse angular blocky structure; extremely hard, very firm, very sticky and very plastic; few weak red (10R 5/2) noneffervescent soft shale fragments that slake in water; few very fine roots; common fine, irregular threads and clusters of gypsum crystals and other salts; few faint coatings of gypsum crystals on faces of peds; moderately saline; strongly effervescent; moderately alkaline; clear wavy boundary.
- Cryz—38 to 60 inches; weak red (10YR 5/2), fractured, soft shale bedrock, dusky red (10YR 3/2) moist; massive; very hard, firm; about 90 percent, by volume, soft shale bedrock that slakes in water intermingled with light reddish brown (2.5YR 6/4) clay, reddish brown (2.5YR 5/4) moist; massive; hard, firm; less than 4 inches of horizontal spacing between cracks; common fine to coarse, irregular clusters of gypsum crystals and other salts, mainly in the upper part; moderately saline; violently effervescent; moderately alkaline.

The thickness of the solum, or the depth to soft shale or siltstone bedrock, ranges from 20 to 40 inches. The soils have cracks 0.4 to 1.0 inch wide at the surface when dry. The cracks extend to a depth of 20 inches or more. Salinity is about 1 to 8 millimhos per centimeter in the A horizon. It increases with depth to between 4 and 35 millimhos per

centimeter in the B and Cr horizons. The exchangeable sodium percentage is 15 or more in some part of the upper 20 inches of the solum and increases with increasing depth. The calcium carbonate equivalent in the control section is 5 to 25 percent. The content of total clay is 40 to 60 percent. The solum is mildly alkaline or moderately alkaline in the upper part and moderately alkaline in the lower part.

The A horizon is dark brown, reddish brown, reddish gray, or brown. It is 1 to 9 inches thick.

The B horizon is reddish brown, brown, light reddish brown, pinkish gray, or reddish gray. The upper part of the B horizon has common or many streaks that are the same color as the A horizon. Visible threads, soft masses, and clusters of gypsum crystals and other salts make up 0 to 5 percent of the volume. In some pedons the B horizon has common or many fragments of shale or siltstone.

The Cr layer is soft siltstone or soft shale bedrock or is soft siltstone or soft shale bedrock intermingled with clay, clay loam, or silty clay loam. The soft bedrock slakes in water. It has colors similar to or redder than those of the B horizon. The horizon has few or common clusters of gypsum crystals and other salts. It is underlain by interbedded soft siltstone and shale. In some pedons the shale is interbedded with sandstone bedrock.

Webb Series

The Webb series consists of very deep, well drained, loamy soils on uplands. These soils formed in loamy and clayey residuum (fig. 21). Slopes range from 0 to 3 percent.

Typical pedon of Webb very fine sandy loam, gently undulating; from the intersection of U.S. Highway 81 and Texas Highway 97 in Cotulla, 5.5 miles north on U.S. Highway 81 and Interstate Highway 35 to junction of railroad tracks and county road at Gardendale, 0.1 mile east on county road, 0.15 mile north on county road, 1.4 miles east on county road, and 75 feet north of fence line in an area of rangeland:

- A1—0 to 9 inches; reddish brown (5YR 4/3) very fine sandy loam, dark reddish brown (5YR 3/3) moist; weak fine and medium subangular blocky structure; slightly hard, very friable; many very fine and fine roots; few fine tubular and vesicular pores; slightly acid; clear smooth boundary.
- A2—9 to 14 inches; reddish brown (5YR 4/4) very fine sandy loam, dark reddish brown (5YR 3/4) moist; weak fine and medium subangular blocky structure; hard, friable; common very fine roots; few fine tubular pores; slightly acid; clear smooth boundary.
- Bt—14 to 28 inches; reddish brown (5YR 4/4) sandy clay, dark reddish brown (5YR 3/4) moist; moderate fine and medium angular blocky structure; very hard, very firm; few very fine roots, mainly along faces of peds; many distinct clay films on faces of peds; slightly acid; gradual wavy boundary.
- Btk1—28 to 34 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; moderate fine and medium subangular blocky structure; hard, firm; few very fine roots; few fine tubular pores; few distinct clay films on faces of peds; few fine, irregular threads and soft masses and fine, rounded nodules of calcium carbonate; strongly effervescent; moderately alkaline; gradual wavy boundary.
- Btk2—34 to 46 inches; reddish yellow (5YR 6/6) sandy clay loam, yellowish red (5YR 5/6) moist; weak fine and medium subangular blocky structure; hard, friable; few very fine roots; few fine tubular pores; few faint clay films on vertical faces of peds; common fine, irregular threads and soft masses and fine and medium, rounded, weakly cemented nodules of calcium carbonate; strongly effervescent moderately alkaline; clear wavy boundary.

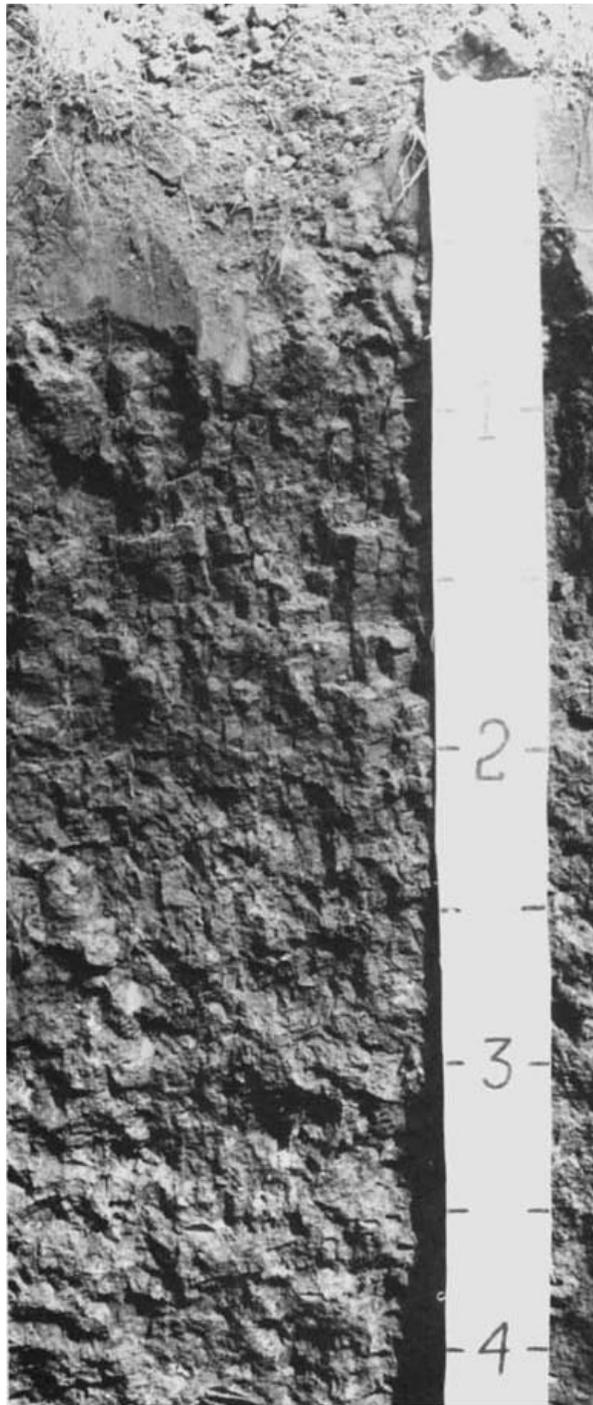


Figure 21.—Profile of a Webb very fine sandy loam. The A horizon is 10 inches thick. The scale is marked in feet.

BCkc—46 to 64 inches; yellow (10YR 7/6) sandy clay loam, brownish yellow (10YR 6/6) moist; weak fine and medium subangular blocky structure; hard, firm; few fine tubular pores; few faint clay films on vertical faces of peds; about 15 percent, by volume, fine, irregular threads, medium and coarse, irregular soft masses, and fine and medium, rounded, weakly

cemented nodules of calcium carbonate; few fine, rounded, black ferromanganese nodules; violently effervescent; moderately alkaline.

The thickness of the solum ranges from 60 to more than 80 inches. Salinity is 0 to 2 millimhos per centimeter in the Bt and Btk horizons and 0 to 8 millimhos per centimeter below those horizons.

The A horizon is reddish brown, yellowish red, or brown. It is 7 to 20 inches thick. It is medium acid to neutral. Some pedons have a BA horizon of sandy clay loam between the A and Bt horizons. The boundary between the A and Bt horizons is abrupt or clear.

The Bt and Btk horizons are red, reddish brown, reddish yellow, yellowish red, brown, or strong brown. The colors that have the higher chroma are in the lower part. These horizons are sandy clay, clay, or clay loam in the upper part and sandy clay loam, very fine sandy loam, or fine sandy loam in the lower part. By weighted average, the content of total clay in the upper 20 inches of the Bt horizon is 35 to 45 percent. The Bt and Btk horizons are slightly acid to moderately alkaline.

The BCkc horizon is similar in color to the Btk horizon or has higher value and chroma. It is sandy clay loam, very fine sandy loam, or fine sandy loam. It is mildly alkaline or moderately alkaline.

The Cr layer, if it occurs, is white, reddish, yellowish, or brownish, soft or weakly cemented sandstone bedrock that slakes or crushes to fine sandy loam, very fine sandy loam, or sandy clay loam.

Yologo Series

The Yologo series consists of very shallow and shallow, well drained, very gravelly, loamy soils on uplands (fig. 22). These soils formed in calcareous, very gravelly, loamy alluvium, Slopes range from 1 to 8 percent.

Typical pedon of Yologo very gravelly sandy clay loam, in an area of Hindes-Yologo complex, undulating; from the intersection of U.S. Highway 81 and Texas Highway 97 in Cotulla, 15.0 miles east on Texas Highway 97 to Los Angeles, 1.0 mile north on Farm Road 469, about 4.15 miles east on county road, 0.75 mile northwest through farm gate, 2.25 miles north on ranch road by windmill, 0.15 mile northwest to old ranch house, 0.6 mile west down lane, 0.5 mile northeast along fence line, 0.2 mile north-northeast along fence line, 0.4 mile west along sendero, 200 feet northwest along another sendero, and 20 feet south in an area of rangeland:

- A—0 to 6 inches; reddish brown (5YR 4/3) very gravelly sandy clay loam, dark reddish brown (5YR 3/2) moist; weak fine subangular blocky structure; hard, friable; many very fine and fine roots; few fine tubular pores; about 50 percent, by volume, rounded chert pebbles, mainly 0.5 inch to 2 inches in diameter; slightly acid; clear smooth boundary.
- Bt—6 to 17 inches; reddish brown (5YR 4/3) extremely gravelly sandy clay loam, dark reddish brown (5YR 3/3) moist; moderate fine subangular blocky and granular structure; very hard, firm; common very fine and fine roots; few fine tubular pores; common distinct clay films on faces of peds and coarse fragments; about 65 percent, by volume, rounded chert pebbles and cobbles, mainly less than 3 inches in diameter; neutral; abrupt wavy boundary.
- Bkm—17 to 20 inches; pinkish white (7.5YR 8/2), fractured, strongly cemented caliche that is laminar in the upper part; massive; few fine distinct brown (7.5YR 5/4) streaks; strongly effervescent; moderately alkaline; clear wavy boundary.
- Bk—20 to 30 inches; pinkish white (7.5YR 8/2), fractured, weakly cemented, loamy caliche; massive; few chert pebbles; violently effervescent; moderately alkaline.



Figure 22.—Profile of Yologo very gravelly sandy clay loam in an area of Hindes-Yologo complex, undulating. A petrocalcic horizon of strongly cemented caliche begins at a depth of 9 to 12 inches. The mark on the scale is at a depth of 6 inches.

The depth to a petrocalcic horizon is 7 to 20 inches. The soils are slightly acid to mildly alkaline above the petrocalcic horizon.

The A horizon is dark grayish brown, brown, or reddish brown. It is 2 to 14 inches thick. It is gravelly loam, very gravelly loam, gravelly sandy clay loam, or very gravelly sandy clay loam. The content of siliceous gravel ranges from 15 to 60 percent, by volume.

The Bt horizon is dark brown or reddish brown. The content of siliceous gravel ranges from 35 to 80 percent, by volume. This horizon is very gravelly clay loam, extremely gravelly clay loam, very gravelly sandy clay loam, or extremely gravelly sandy clay loam. The content of total clay is 20 to 35 percent.

The Bkm horizon is 0.25 inch to 6 inches thick. In some pedons the Bk horizon has weathered limestone gravel in the lower part.

Zavco Series

The Zavco series consists of very deep, well drained, loamy soils on uplands. These soils formed in calcareous, loamy residuum derived from interbedded sandstone and siltstone bedrock. Slopes range from 0 to 3 percent.

Typical pedon of Zavco sandy clay loam, gently undulating; from the intersection of U.S. Highway 81 and Texas Highway 97 in Cotulla, 0.8 mile east on Texas Highway 97 to Farm Road 624, about 1.3 miles southeast on Farm Road 624, about

3.0 miles east on county road to cattle guard at ranch entrance, 0.45 mile east on ranch road, and 100 feet south in an area of rangeland:

- A—0 to 9 inches; very dark grayish brown (10YR 3/2) sandy clay loam, very dark brown (10YR 2/2) moist; slightly lighter in color in the top inch; weak fine and medium subangular blocky structure; hard, friable; many very fine and fine roots; few fine tubular pores; slightly acid; clear smooth boundary.
- AB—9 to 15 inches; reddish brown (5YR 4/3) sandy clay loam, dark reddish brown (5YR 3/3) moist; moderate fine and medium subangular blocky structure; hard, friable; common very fine roots; few fine tubular pores and common medium vesicular pores; few distinct very dark gray (5YR 3/1) organic coatings on faces of peds; slightly acid; gradual smooth boundary.
- Bt—15 to 22 inches; reddish brown (5YR 4/4) sandy clay, dark reddish brown (5YR 3/4) moist; moderate fine and medium angular blocky structure; very hard, very firm; few very fine roots; few fine tubular and medium vesicular pores; common distinct clay films on faces of peds; few distinct very dark gray (5YR 3/1) organic coatings on faces of peds; mildly alkaline; gradual wavy boundary.
- Btk1—22 to 28 inches; yellowish red (5YR 5/6) sandy clay, yellowish red (5YR 5/6) moist; moderate fine and medium angular blocky structure; very hard, very firm; few very fine roots; few fine tubular pores; few faint clay films on faces of peds; few distinct very dark gray (5YR 3/1) organic coatings on faces of peds; few fine, irregular threads and soft masses of calcium carbonate; violently effervescent; moderately alkaline; clear wavy boundary.
- Btk2—28 to 40 inches; reddish yellow (5YR 6/6) sandy clay loam, yellowish red (5YR 5/6) moist; weak fine and medium subangular blocky structure; hard, friable; few very fine roots; few fine tubular pores; few faint clay films on faces of peds; about 5 percent, by volume, fine and medium, irregular threads and soft masses and medium, rounded, weakly cemented nodules of calcium carbonate; few medium very dark gray (5YR 3/1) krotovinas; violently effervescent; moderately alkaline; diffuse wavy boundary.
- BCK1—40 to 48 inches; reddish yellow (5YR 6/6) sandy clay loam, yellowish red (5YR 5/6) moist; weak fine and medium subangular blocky structure; hard, friable; about 10 percent, by volume, fine and medium, irregular threads and soft masses and medium and coarse, rounded, strongly cemented nodules of calcium carbonate; few soft sandstone fragments; violently effervescent; moderately alkaline; clear wavy boundary.
- BCK2—48 to 64 inches; reddish yellow (7.5YR 6/6) sandy clay loam, strong brown (7.5YR 5/6) moist; weak fine and medium subangular blocky structure; hard, friable; few fine, irregular soft masses of calcium carbonate; common light gray (10YR 7/2), soft sandstone fragments that slake in water; noneffervescent matrix; moderately alkaline.

The thickness of the solum ranges from 50 to more than 80 inches. The depth to visible accumulations of calcium carbonate is 10 to 28 inches. The mollic epipedon is 10 to 20 inches thick.

The A and AB horizons are very dark grayish brown, dark brown, brown, dark reddish brown, dark reddish gray, dark grayish brown, or reddish brown. The combined thickness of the A and AB horizons is 10 to 20 inches. The A and AB horizons are slightly acid to mildly alkaline.

The Bt and Btk horizons are brown, reddish brown, strong brown, or yellowish red. They are sandy clay, clay loam, or sandy clay loam. The content of total clay is 35 to 45 percent. These horizons are neutral to moderately alkaline.

The BCk horizon is brown, strong brown, yellowish red, light yellowish brown, yellowish brown, brownish yellow, light brown, pink, or reddish yellow. It is sandy clay loam or clay loam. Visible accumulations of calcium carbonate make up as much as 30 percent of the volume. Salinity is 0 to 8 millimhos per centimeter in the lower part of the horizon. This horizon is mildly alkaline or moderately alkaline.

The Cr layer, if it occurs, is soft or weakly cemented sandstone or siltstone bedrock that slakes or crushes to sandy clay loam or clay loam. The bedrock is below a depth of 60 inches. Salinity is 0 to 8 millimhos per centimeter.

Formation of the Soils

In this section the factors of soil formation are related to the soils in La Salle County. Also, soil horizons and surface geology are described.

Factors of Soil Formation

Soil forms through the action and interaction of five major factors. These factors are climate, living organisms, relief, time, and parent material. The kind of soil that forms in a given area is determined by these factors, although isolating the effect of any one factor is difficult in some areas.

Climate

La Salle County has a subhumid climate characterized by mild, dry winters and hot summers. Low rainfall, a high evaporation rate, temperature, and wind are some of the climatic factors that influence soil formation in the county.

Because the pattern of rainfall varies, the soils in the county are alternately wet and dry. Clayey soils, such as Cochina, Cotulla, and Tiocano soils, crack when they dry. Animals, rainfall, and wind deposit surface soil in the cracks. During periods of rainfall, water fills the cracks, wetting the soil thoroughly. As it becomes wet, the soil swells and the cracks close. Because of this shrinking and swelling, the surface of the soil rises and falls and the soil is mixed. This mixing has been termed "self swallowing" (8). These processes result in deep soil development and gilgai microrelief.

Water moving through the soil can carry clay particles downward in suspension from the surface layer. The clay particles are deposited in the subsoil as the water flow ceases. As the clay accumulates, permeability is restricted. The restricted permeability, in turn, accelerates the deposition of clay. Duval, Webb, and Zavco soils have accumulations of clay in the subsoil.

Minerals are leached by rainfall from the upper layers and deposited in the lower layers. As a result, Brystal, Caid, Webb, Zavco, and many other soils have a layer in which calcium carbonate has accumulated. Cotulla, Lasalle, Imogene, and Viboras soils are examples of soils that have an accumulation of soluble salts in the subsoil. Poteet and other soils have an accumulation of ferromanganese oxide compounds in the lower part of the subsoil.

The accumulation of organic matter is affected by temperature and moisture. Low rainfall and high temperatures limit plant growth and the accumulation of organic matter. Soils on flood plains and in depressions have more moisture than the soils on the surrounding upland soils. As a result, the amount of vegetation and the content of organic matter are higher. In areas where there is more vegetation, temperatures near the surface of the soil are lower and the rate of decomposition of organic matter is slower.

Wind has affected the formation of soils in the county. Many of the sandy soils that have been used as cropland have gained or lost soil material because of past wind erosion. Duval loamy fine sand is an example. Small sand dunes are along fences and accumulations of soil material are in swales throughout areas of this soil.

Living Organisms

Plants, animals, earthworms, insects, and micro-organisms are important factors in the formation of soils. They affect the amount of organic matter and nitrogen in the soil and can affect the gains or losses in plant nutrients and changes in soil structure and porosity.

Vegetation, predominantly grasses and brush, has played a major role in soil formation in La Salle County. Decayed plant roots add organic matter to the soils and leave channels and pores that provide passageways for the intake of air and water. Deep-rooting brush plants bring nutrients from the subsoil to the surface.

Earthworms, insects, and burrowing animals mix the soil material and create channels for the downward movement of air and water and the penetration of plant roots. Actinomycetes, bacteria, and fungi aid in the formation of humus by breaking down primary forms of organic matter and releasing plant nutrients. As a result, they improve soil tilth and fertility.

Human activities have greatly affected the soils in La Salle County. In the past some of the rangeland in the county was overstocked with livestock and native wildlife and thus was overgrazed. In the overgrazed areas, the better grasses, brush, and forbs decreased in abundance and were replaced with the less desirable grasses, brush, and forbs. Overgrazing by livestock and other animals increases the extent of bare areas and soil compaction and thus increases the runoff rate and the hazard of soil erosion.

Farming has resulted in accelerated water erosion and wind erosion in many areas. Compaction of the soil by farm equipment has restricted the movement of air and water and the penetration of plant roots in many of the soils used as cropland.

Relief

Relief, or topography, affects soil formation through its influence on drainage, erosion, and plant cover. If other factors of soil formation are equal, the degree of profile development in a soil depends on the amount of water that enters the soil.

Generally, Cotulla and other nearly level soils absorb more rainfall, have a greater degree of profile development, are less susceptible to water erosion, and have a lower runoff rate than Maverick and other gently undulating soils. The steeper soils may erode away nearly as fast as they form. On nearly level slopes, which are more stable than the steeper slopes, the rate of soil formation generally exceeds soil loss caused by erosion and a deeper soil profile develops.

Time

The characteristics of a soil are determined mainly by the length of time that the soil-forming factors have been active. Hundreds to thousands of years are usually required for the formation of well defined, genetic horizons. Genetically, the soils in La Salle County range from very young to old. Differences in the ages of the soils are evident in their profiles.

Divot soils are young. They formed in altered alluvial sediments on recent flood plains.

The older soils in the county generally are nearly level or gently undulating and are on stable uplands that are actually ancient stream terraces. Yologo soils are old. Calcium carbonate was leached from the upper part of these soils and accumulated as a layer of cemented caliche. Also, clay was translocated from the surface layer to the subsoil.

Parent Material

Parent material is the unconsolidated organic and inorganic material in which a soil forms. The type of parent material determines the physical and chemical limits of the soil. For example, the surface layer of the Duval soil is very fine sandy loam and that of the Dilley soil is fine sandy loam. The parent material for these soils weathered from sandstone. The surface layer of the Maverick and Viboras soils is clay. The parent material for these soils weathered from soft shale bedrock.

Bookout, Caid, and Divot soils formed in calcareous alluvium along the Frio and Nueces Rivers. The alluvium contained calcium carbonate. All of these soils are calcareous throughout.

Soil Horizons

The soil-forming factors produce a succession of layers, or horizons, in the soil profile. The horizons differ in one or more properties, such as thickness, color, texture, structure, consistence, porosity, and reaction.

Most profiles have three major horizons. These are the A, B, and C horizons. Several processes are involved in the formation of these horizons. In La Salle County the main processes are the leaching of calcium carbonate and other salts and bases, the accumulation of organic matter, and the formation and translocation of silicate clay minerals. In most of the soils, more than one of these processes have been active in the development of the horizons.

The A horizon is the surface layer. It is the horizon that has the maximum accumulation of organic matter. The soils in La Salle County range from low to high in organic matter content. Various dissolved or suspended materials, such as calcium carbonate, organic matter, salt, iron, and clay, may have been leached out of the A horizon into the B horizon.

The B horizon lies directly below the A horizon. It is the horizon that has the maximum accumulation of dissolved or suspended materials, or it is an altered horizon that has distinct structure. The Bk horizon is a layer that has an accumulation of carbonates, commonly calcium carbonate. Bookout soils have a Bk horizon. The Bt horizon has a significant accumulation of silicate clay. Brystal and Duval soils have a Bt horizon. Subsoil layers that have a distinct structure and little evidence of accumulation of dissolved or suspended materials are designated as Bw horizons. Divot soils have a Bw horizon.

The C horizon is little affected by soil-forming processes. It consists mainly of unconsolidated sediments or weathered or soft bedrock that can be dug with a spade when moist. Mata soils have a C horizon. The Cr layer is weathered or soft bedrock, such as soft shale, soft siltstone, soft sandstone, or weakly cemented bedrock. Dilley and Duval soils have a Cr layer.

Some young soils do not have a B horizon, and some shallow soils that formed directly over bedrock do not have a C horizon.

Surface Geology

In this section the major geological formations that crop out in La Salle County are described in relation to the uppermost sediments that affect soil characterization. Absolute relationships between geologic outcrops and the soils they underlie, however, are not possible because of displacement and mixing of surface sediments since exposure of the outcrop. The geologic names and locations generally follow the latest geological maps of the region (14).

All of the geological formations that crop out in the county are from the Cenozoic Era. Sediments deposited during the Tertiary Period consist of Eocene deposits, which are as old as 54 million years. Sediments deposited during the Quaternary Period consist of Pleistocene and Holocene deposits, which are as old as 2 million

years (5). Uvalde Gravel was deposited between the late Pliocene Epoch (Tertiary Period) and the early Pleistocene Epoch (Quaternary Period) and thus may range in age from 1 to 10 million years (3,5).

The major geological formations are described in order of age from the oldest to youngest in the following paragraphs.

The Cook Mountain Formation crops out in the northeastern quadrant of the county, east of the Frio River (14). Its strata are distinguished from overlying and underlying formations because of a rich abundance of large marine fossils (9). The sediments of the Cook Mountain Formation show evidence of much variation in deposition. During periods of deposition, water levels changed from very shallow to deep and back to shallow. Deposition occurred in both exposed and inundated areas (9). The Cook Mountain Formation (9) is made up of sandstone and clay. The sandstone is calcareous, very fine grained, and gray to yellowish brown. It has some glauconite. The clay is silty, brown to brownish gray or gray, and high in content of gypsum. The formation is 200 to 350 feet thick (14).

The Cook Mountain Formation underlies areas of the Duval-Brystal-Webb, Webb-Zavco-Poteet, and Caid-Bookout general soil map units in the northeast corner of the county. The area of the formation mapped on stream terraces northeast of the Frio River underlies part of the Caid-Bookout map unit (14).

The Laredo Formation crops out mainly in the northwestern half of the county and west of the Frio River. It is distinguished from the adjacent Cook Mountain Formation by thicker sandstone strata (14). In most ways, its formation was very similar to that of the Cook Mountain Formation. The Laredo Formation is dominantly made up of very fine grained or fine grained, red and brown sandstone. It has some clay, which weathers to orange-yellow. It is 600 to 700 feet thick (14).

The Laredo Formation underlies the Duval-Brystal-Webb and Duval general soil map units and some areas of the Webb-Zavco-Poteet and Caid-Bookout general soil map units. The latest geological maps of the county indicate that the Laredo Formation underlies an area of the Caid-Bookout general soil map unit on stream terraces southeast of the Frio River. This mapping is probably an error. The area is probably underlain by fluvial terrace deposits.

The Yegua Formation crops out in the southeastern half of the county (14). It is essentially a piedmont, coastal alluvial fan built up by the coalescing of stream levees and deltas. It is made up of gray to red clay, sandy clay, and thin beds of sandstone (9). It is 400 to 1,050 feet thick (14).

The Yegua Formation underlies the Cotulla-Brundage-Moglia, Maverick, Brundage-Imogene-Monteola, and Montell-Moglia-Viboras general soil map units and some areas of the Duval-Brystal-Webb and Webb-Zavco-Poteet general soil map units. The areas mapped as the Yegua Formation that underlie the Duval-Brystal-Webb and Webb-Zavco-Poteet general soil map units on upland plains may be outliers of the Laredo Formation.

The Jackson Group crops out in the southeast corner of the county on both sides of the Nueces River (14). It consists mainly of clay, sandy clay, sandstone, and volcanic ash. Areas of clay commonly are bentonitic and grade laterally into ashy sandstone. Opalized and silicified wood are common. The origin of these strata is a series of marine, brackish water, near shore and continental deposits (9). The group is 750 to 850 feet thick (14).

The Jackson Group underlies the Aguilares-Montell general soil map unit and some areas of the Cotulla-Brundage-Moglia and Montell-Moglia-Viboras general soil map units.

Uvalde Gravel consists of discontinuous deposits in the northeastern quadrant of the county near the Frio River (14). It is distinguished from the underlying sediments by a large percentage of gravel. It was deposited on exposed strata of various ages by ancient rivers. Because of erosion-resistant qualities, these gravel beds are now in

areas of topographic highs rather than in river valleys (3). According to one source, Uvalde Gravel deposits are made up almost entirely of siliceous cobbles and pebbles derived from Lower Cretaceous Formations (9). A more recent study of the pebbles indicates that the headwaters of all the drainage from the Southern Rocky Mountains were captured by the Pecos River of the Pleistocene Epoch (3). This river removed the sediments of the Ogallala Formation from an area approximately 510 miles wide and 300 miles long. All of this sandy and gravelly material must have been carried to the Gulf of Mexico or deposited along the way. The coarsest textured material was deposited in upland river valleys. These gravelly valley deposits resisted erosion and persist today as hills. It is possible that the Uvalde Gravel deposits in La Salle County were derived from a combination of sources. The deposits are made up of well rounded siliceous and limestone pebbles and cobbles and some silicified, or petrified, wood. A thick accumulation of calcium carbonate underlies the surface gravel in many areas. The gravel is 1 to 30 feet thick (14).

Uvalde Gravel underlies the Hindes-Yologo general soil map unit. It is an important source of gravel and caliche used locally as road building and foundation material.

Fluviatile terrace deposits are mainly on terraces along the major rivers and creeks in the county (14). They are distinguished from the adjacent formations by a level, benchlike topography and a lack of consolidation. They were laid down unconformably on strata of various ages by streams during the Pleistocene Epoch. The deposits are made up of clay, sand, silt, and gravel (14). They are probably less than 100 feet thick. The thickness varies.

The Fluviatile terrace deposits underlie the Caid-Bookout general soil map unit and some areas of the Duval-Brystal-Webb, Cotulla-Brundage-Moglia, and Coquat-Cochina general soil map units.

Alluvial deposits are in and adjacent to the major rivers and creeks and many of the smaller creeks, depressions, alluvial plains, and drainageways. Alluvium is distinguished from the adjacent formations by its location on the bottom of river or stream valleys and by a generally level topography. It was deposited during the flooding of past and present streams. The sediments are made up of clay, silt, sand, and gravel. The source of the sediments includes strata from as far away as the Edward's Plateau. These deposits are probably less than 100 feet thick. The thickness varies.

Alluvium underlies the Coquat-Cochina, Divot-Cochina, and Cochina general soil map units, and some areas of all other map units in the county, except the Hindes-Yologo map unit.

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Glossary

- Aggregate, soil.** Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.
- 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 gravel, sand, silt, clay, and various mixtures of these, deposited by running water.
- Area reclaim** (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.
- Association, soil.** A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.
- Available water capacity (available moisture capacity).** The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:
- | | |
|-----------------|--------------|
| Very low | 0 to 3 |
| Low | 3 to 6 |
| Moderate | 6 to 9 |
| High | 9 to 12 |
| Very high | more than 12 |
- Bedrock.** The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.
- Bottom land.** The normal flood plain of a stream, subject to flooding.
- 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 or soft, thick beds just beneath the solum, or it is exposed at the surface by erosion. Some layers are laminar and indurated or strongly cemented. Fragments of caliche may be gravel, cobbles, or stones in the soil or on the surface.
- Cemented.** Material in an air-dry test specimen that does not slake after being immersed in water for one hour. Cemented soil material has a brittle, hard consistence caused by some cementing agent other than clay. Calcium carbonate, silica, or oxides or salts of iron and aluminum are common cementing materials.
- Chiseling.** Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.
- Clay.** As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.
- Clay film.** A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. 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 vegetation.** The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.
- Coarse fragments.** If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.
- Cobblestone (or cobble).** A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.
- Coefficient of linear extensibility (COLE).** The ratio of the difference between the moist length and the dry length of a clod to its dry length.
- 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 in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.
- Concretions.** Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.
- Conservation tillage.** A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.
- Consistence, soil.** The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:
Loose.—Noncoherent when dry or moist; does not hold together in a mass.
Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.
Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.
Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.
Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.
Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.
Soft.—When dry, breaks into powder or individual grains under very slight pressure.
Cemented.—Hard; little affected by moistening.
- Contour stripcropping.** Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.
- Control section.** The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.
- Cover crop.** A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.
- Cutbanks cave** (in tables). The walls of excavations tend to cave in or slough.
- Decreasers.** The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.
- Deferred grazing.** Postponing grazing or resting grazing land for a prescribed period.
- Depth to rock** (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

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.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the

building up of such landscape features as flood plains and coastal plains.

Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, such as fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Excess salt (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 most plants.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast intake (in tables). The movement of water into the soil is rapid.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the oven-dry 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*.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant that is not a grass or a sedge.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gilgai. Commonly, a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of clayey soils that shrink and swell considerably with changes in moisture content.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 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 (geology). Water filling all the unblocked pores of the material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Hill. A natural elevation of the land surface, rising prominently above the surrounding lower lands and having a well defined outline; generally considered to be less than 300 meters from base to summit.

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 at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is, in part, a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as accumulation of clay, sesquioxides, humus, or a combination of these; prismatic or blocky structure; redder or browner colors than those in the A horizon; or a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Consolidated rock (unweathered bedrock) beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

- Illuviation.** The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.
- Impervious soil.** A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.
- Increasesers.** Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasesers commonly are the shorter plants and the plants that are less palatable to livestock.
- 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.
- Invaders.** On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.
- Irrigation.** Application of water to soils to assist in production of crops. Methods of irrigation are:
- Border.*—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.
 - Drip (or trickle).*—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.
 - Furrow.*—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.
 - Sprinkler.*—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.
- Large stones** (in tables). Rock fragments 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.
- Low strength.** The soil is not strong enough to support loads.
- Mineral soil.** Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.
- Minimum tillage.** Only the tillage essential to crop production and prevention of soil damage.
- Morphology, soil.** The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.
- Mottling, soil.** Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few*, *common*, and *many*; size—*fine*, *medium*, and *coarse*; and contrast—*faint distinct*, and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of 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.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

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.

Pebble. See Gravel.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move through the profile. Permeability is measured as the number of inches per hour that water moves through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Subsurface tunnels or pipelike cavities are formed by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Playa. The usually dry, nearly level lake plain that occupies the lowest parts of closed depressions. Temporary flooding occurs primarily in response to precipitation and runoff. Playa deposits are fine grained and may or may not be characterized by a high water table and saline conditions.

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.

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.

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 climax vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range 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 pH values in this soil survey were determined by the 1:1 water method unless otherwise indicated. The degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Ridge. A long, narrow elevation of the land surface. It generally is sharp crested and forms an extended upland between valleys.

Rill. A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Rippable bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 drawbar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders. Rock fragments do not break down after shaking overnight in a weak solution of sodium hexametaphosphate. They influence moisture storage, infiltration, runoff, and land use; protect fine particles from washing and blowing; and reduce the volume of soil material that roots can penetrate and that provides nutrients to plants.

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.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Sediment. Solid, clastic material, both mineral and organic, that is in suspension, is being transported, or has been moved from its site of origin by water, wind, ice, or mass wasting and has come to rest on the earth's surface either above or below sea level.

Seepage (in tables). The movement of water through the soil adversely affects the specified use.

Sendero. A path, track, road, or way cut through the brush to allow travel across a range on horseback or by automobile.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Side slope. The erosional slope on the side of a ridge or broad divide that leads down to a drainage way or valley floor. A side slope may include one or more geomorphic components of a hill slope as well as nose slopes and head slopes.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

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 $\text{Ca}^{++} + \text{Mg}^{++}$. The degrees of sodicity and their respective ratios are:

Slight	less than 13:1
Moderate	13-30:1
Strong	more than 30:1

Soft rock fragments. Fragments that have rock structure but that break down in sodium hexametaphosphate after shaking overnight. Examples are fragments of some shales and sandstones that lack the hardness and durability of rock fragments. See Rock fragments.

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 substratum. 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, thickness of the line may be one fragment or more. It generally overlies material that weathered in place, and it 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.

Stratified. Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Stream terrace. One of a series of platforms in a stream valley, flanking and more or less parallel to the stream channel, originally formed near the level of the stream, and representing the dissected remnants of an abandoned flood plain, streambed, or valley floor produced during a former stage of erosion or deposition.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which 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. Breaking up a compact subsoil by pulling a special chisel through the soil.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the E horizon. Generally refers to a leached horizon lighter in color and lower in organic matter content than the overlying surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Summit. The top of a hill, mountain, or rolling plain.

Surface layer. Technically, the A horizon in mineral soils. Generally refers to the uppermost mineral layer of soil. Includes the Ap horizon or "plow layer."

Terrace. An embankment, or ridge, constructed on the contour or at a slight angle to the contour across sloping soils. The terrace intercepts surface runoff, so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material that is too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Too arid (in tables). The soil is dry most of the time, and vegetation is difficult to establish.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, such as zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited in stream valleys by heavily loaded streams.

Weathering. All physical and chemical changes produced by atmospheric agents in rocks or other deposits at or near the earth's surface. These changes result in disintegration and decomposition of the material.

Wilting point (or permanent wilting point). The moisture content of soil, on an oven-dry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

The tables in this soil survey contain information that affects land use planning in this survey area. More current data tables may be available from the Web Soil Survey at the Tabular Data tab.

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