SOIL SURVEY OF

Eastland County, Texas

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

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all who need the information, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in the period 1965–71. Soil names and descriptions were approved in 1972. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1971. This survey was made cooperatively by the Soil Conservation Service and the Texas Agricultural Experiment Station. It is part of the technical assistance furnished to the Upper Leon and Palo Pinto Soil and Water Conservation Districts.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms and ranches; in selecting sites for roads, ponds, buildings, and other structures; and in determining the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Eastland County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside, and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page number of the capability unit and the range site in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those that have a moderate limitation can be colored yellow, and those that have a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units and the range sites.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Wildlife."

Ranchers and others can find, under "Range," groupings of the soils according to their suitability for range, and also the names of many of the plants that grow on each range site.

Community planners and others can read about soil properties that affect the choice of sites for dwellings and industrial buildings and for recreation areas in the sections "Engineering Uses of the Soils" and "Use of the Soils for Recreational Development."

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers in Eastland County will be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given at the beginning of the publication.

Cover: **A good cover of native grasses on Thurber clay loam, 0 to 1 percent slopes, in foreground. Exray stony soils in background.**

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SOIL SURVEY OF EASTLAND COUNTY, TEXAS

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE TEXAS AGRICULTURAL EXPERIMENT STATION

EASTLAND COUNTY is in the central part of Texas (fig. 1). The county has a total area of 612,480 acres, which includes 3,456 acres of water. It is gently rolling and sandy in the southern part and hilly and broken in the northern and east-central parts. Elevation ranges from 1,250 to 1,750 feet. Average rainfall is 27.35 inches. The county is drained by the Brazos River Watershed on the north and by the Leon River and the Sabanno River on the south.

Most of the county is in range. Some areas have been seeded to introduced range grasses. The acreage of improved pasture, mainly Coastal bermudagrass and weeping lovegrass, continues to increase. Many idle fields and areas of brushland have been planted to these grasses.

Beef cattle are the main kind of livestock, but many mohair goats are produced in areas where landowners are controlling shinnery brush. White-tailed deer are abundant, especially in the northern and eastern parts of the county.

In 1960, about 30 percent of the county was cultivated. Of this cultivated area, about 28,000 acres was farmed to peanuts, which are well suited to the sandy soils of the county. The rest of the cultivated land was farmed to grain sorghum or forage crops for grazing.

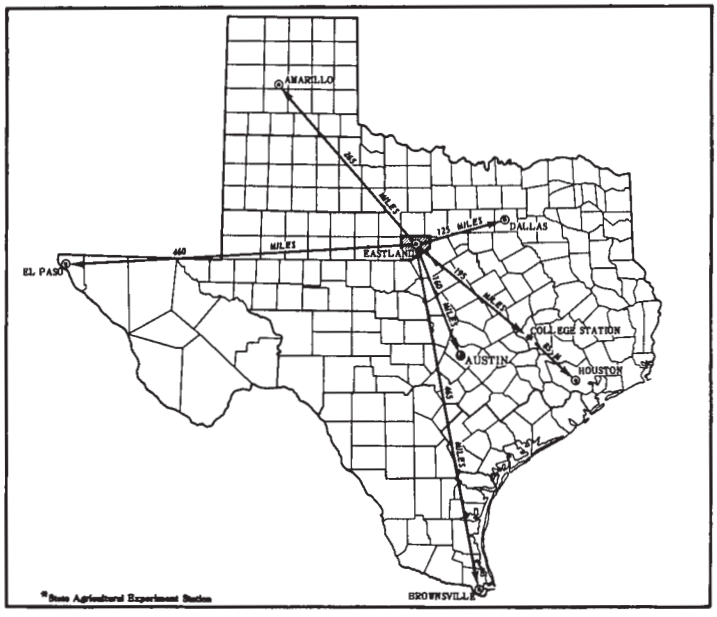

Figure 1.—Location of Eastland County in Texas.

Eastland County was created on February 1, 1858, and was organized on December 2, 1873. The county was named in honor of William M. Eastland.

During the oil boom, the population of the county reached a peak of 58,505 in 1920, but it has declined steadily. In 1960 the population was 19,526. A railroad and an interstate highway cross the county from east to west. Other U.S. and State highways link all parts of the county.

Eastland, the county seat, is located midway between Cisco and Ranger. Several other small farm communities are in the county. High school education is available in each of the towns in Eastland County, and junior colleges are in Ranger and Cisco.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Eastland County, where they are located, and how they can be used. The soil scientists went into the county knowing they would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Chaney and Nimrod, for example, are the names of two soil series.

All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Pedernales fine sandy loam, 1 to 3 percent slopes, is one of several phases within the Pedernales series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Two such kinds of mapping units are shown on the soil map of Eastland County: soil complexes and undifferentiated groups.

A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. Generally, the name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Exray-Bonti complex, 1 to 8 percent slopes, is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. Exray stony soils, hilly, is an example.

While a soil survey is in progress, samples of soil are taken as needed for laboratory measurements and for engineering tests. Laboratory data from the same kind of soil in other places are also assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kind of soil. Yields under defined management are estimated for all the soils.

Soil scientists observe how soils behave when used as a growing place for native and cultivated plants, and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this to the slow permeability of the soil or its high water table. They see that streets, road pavements, and foundations for houses are cracked on a named kind of soil, and they relate this failure to the high shrink-swell potential of the soil material. Thus, they use observation and knowledge of soil properties, together with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Eastland County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is useful as a general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The soil associations in Eastland County are discussed in this section. The associations have been grouped into three general kinds of landscapes for broad interpretative purposes. Each of the broad groups and their included soil associations are described in the following paragraphs. The terms for texture used in the title for several of the associations apply to the texture of the surface layer. For example, in the title of association 1, the word "sandy", refers to the texture of the surface layer.

Deep Sandy and Loamy Soils

The soils in this group are used mostly for crops or pasture, for which they are well suited. Peanuts and grain sorghum are the main crops. Soil blowing is a hazard in cultivated areas. Native vegetation is dominantly post oak savanna.

1. *Chaney association*

Gently sloping to sloping, deep, sandy soils over sandy clay and sandy clay loam interbedded with weakly cemented sandstone

This association is on broad uplands that are dissected by numerous drainageways and streams. It makes up about 37 percent of the county. It is about 65 percent Chaney soils. The remaining 35 percent is minor soils.

Chaney soils have a surface layer of pale-brown, slightly acid loamy sand about 12 inches thick. The next layer is

mottled, yellowish-red, medium acid sandy clay about 8 inches thick. Below this is mottled, light-gray sandy clay 28 inches thick. The underlying material to a depth of 60 inches is massive sandy clay loam interbedded with weakly cemented sandstone.

Minor in this association are Bunyan, Demona, Elandco, Hassee, Nimrod, Patilo, and Pedernales soils. Bunyan and Elandco soils are on the flood plains of the streams that drain this association. Demona, Nimrod, and Patilo soils are in slightly higher areas. Hassee soils are in low depressional areas. Pedernales soils are on low knolls.

This association is suited to large-scale farming. Cultivated areas are farmed to crops common to the area. Many fields of improved pasture are interspersed among the cultivated fields. The remaining acreage is used as native range. Soil blowing is a hazard in cultivated areas. Quail, dove, deer, and turkey are the most important kinds of wildlife. Many farm ponds and lakes in this association provide opportunities for fishing and duck hunting.

2. *Pedernales-Cisco association*

Gently sloping to sloping, deep, loamy and sandy soils over limy sandy clay loam and fine sandy loam

This association is mostly on broad eroded uplands. It makes up about 8 percent of the county. Pedernales soils make up about 53 percent of the association, Cisco soils about 21 percent, and minor soils the remaining 26 percent.

Pedernales soils are gently sloping to sloping. They have a surface layer of brown, slightly acid fine sandy loam about 6 inches thick. The next layer is slightly acid or neutral sandy clay about 34 inches thick. It is reddish brown in the upper part and yellowish red in the lower part. The underlying material to a depth of 60 inches is pink, limy sandy clay loam.

Cisco soils are mostly in broad shallow valleys that have weakly defined drainageways. They have a surface layer of brown, neutral loamy fine sand about 10 inches thick. The next layer is yellowish-red, slightly acid sandy clay loam about 20 inches thick. Below this is 20 inches of reddish-yellow, neutral sandy clay loam that has faint brownish mottles. The underlying material to a depth of 70 inches is light brownish-gray, calcareous fine sandy loam.

Minor in this association are Bunyan, Chaney, Elandco, May, and Menard soils. Bunyan and Elandco soils are on flood plains of streams that drain this association. Chaney soils are on lower side slopes. May soils are in shallow valleys near drainageways, and Menard soils are on slight ridges.

This association is used mostly for crops, but some areas are in native range. Native vegetation is dominantly tall and mid grasses. Soil blowing is a hazard in cultivated areas. In sloping areas erosion is also a hazard. Quail and dove are the main kinds of wildlife that inhabit this association.

3. *Patilo association*

Nearly level to gently sloping, deep, sandy soils over sandy clay loam

This association is in broad areas that have weakly defined drainageways. These soils are in intricate patterns. Surfaces are slightly undulating, and slopes are mixed concave and convex. This association makes up about 3 percent of the county. It is about 71 percent Patilo soils and 29 percent minor soils.

Patilo soils have a surface layer of brown, neutral fine sand about 6 inches thick and a subsurface layer of very pale brown, slightly acid fine sand about 40 inches thick. Below this is about 10 inches of brownish-yellow, strongly acid sandy clay loam that has red and light brownish-gray mottles. The next layer is reddish-yellow, strongly acid sandy clay loam that extends to a depth of 62 inches.

Minor in the association are Demona and Nimrod soils. Demona soils are on slight ridges and knolls. Nimrod soils are in areas similar to areas of Patilo soils.

About 30 percent of this association is cultivated, and the rest is in native range, improved pasture, or woodland. Soil blowing is a hazard in cultivated areas. Peanuts are the main crop. A few fields are irrigated, and many areas are in improved pasture. Quail, dove, turkey, and deer are the most important kinds of wildlife. Most of this association can be reached by paved or graded roads.

Very Shallow to Deep Loamy and Clayey Soils

The soils in this group are mainly stony and shallow. They are used mostly as range. Vegetation is dominantly mid and tall grasses interspersed with post oak trees and motts of live oak trees.

4. *Exray-Bonti-Owens association*

Gently sloping to sloping and hilly, very shallow to moderately deep, loamy to clayey soils over sandstone and shale

This association is on sandstone ridges and along the slopes that lead to many of the major streams. It is dissected by numerous streams. It makes up about 23 percent of the county. Exray stony soils make up about 23 percent of this association, Bonti soils about 16 percent, Owens soils about 14 percent, and minor soils the remaining 47 percent.

Exray stony soils are on ridgetops and hillsides. They have a surface layer of slightly acid fine sandy loam about 7 inches thick. It is dark brown in the upper 3 inches and yellowish brown in the lower 4 inches. Sandstone fragments 1 foot to 4 feet in diameter cover 1 to 20 percent of the surface. The next layer is red, medium acid clay about 11 inches thick. The underlying material is strongly cemented sandstone bedrock.

Bonti soils are gently sloping and are on ridgetops and foot slopes. They have a surface layer of fine sandy loam about 6 inches thick. It is brown in the upper 4 inches and grayish brown in the lower 2 inches. The next layer is yellowish-red, medium acid sandy clay about 20 inches thick. The underlying material is strongly cemented sandstone.

Owens soils are on side slopes and low knolls. They have a surface layer of light olive-brown, calcareous clay about 5 inches thick. The next layer is light yellowish-brown clay about 13 inches thick. The underlying material is light olive-brown shaly clay to a depth of about 36 inches.

Minor in this association are Bolar, Bunyan, Chaney, Cisco, Deleon, Demona, Elandco, Hensley, Lindy, Menard, Nimrod, Patilo, Tarrant, Thurber, and Truce soils. Bolar, Hensley, Lindy, Menard, Tarrant, and Thurber soils are on ridgetops and in shallow valleys.

Bunyan, Deleon, and Elandco soils are on flood plains of streams that drain this association. Chaney, Cisco, Demona, Nimrod, and Patilo soils are in sandy fringe areas. Truce soils are on ridgetops and foot slopes.

This association is used mostly as range or wildlife habitat, for which it is well suited. Some of the steeper stony areas are not easily accessible to cattle. Few areas are suitable for cultivation. The native vegetation is a cover of trees and an understory of tall, mid, and short grasses. Many ranchers add to their income by leasing land for hunting.

5. *Hensley-Lindy association*

Gently sloping, shallow and moderately deep, loamy soils over limestone

This association is on narrow ridgetops and broad uplands. It makes up about 10 percent of the county. It is about 34 percent Hensley soils, and 23 percent Lindy soils. The remaining 43 percent is minor soils.

Hensley soils have a surface layer of reddish-brown, slightly acid loam about 4 inches thick. Flat limestone fragments, 6 to 30 inches across the long axis, occupy about 5 percent of the surface and about 2 percent of the surface layer and subsoil. The next layer is a dark reddish-brown, neutral clay 12 inches thick. The underlying material is hard limestone bedrock.

Lindy soils are on broad uplands. They have a surface layer of brown, neutral loam about 6 inches thick. The next layer is a red, neutral clay about 22 inches thick. The underlying material is strongly cemented limestone.

Minor in this association are Leeray, Thurber, Deleon, Tarrant, and Elandco soils. Leeray and Thurber soils are mostly on the slightly lower elevations. Tarrant soils are on scarps between Hensley soils and soils on the lower slopes. Elandco and Deleon soils are on the flood plains of streams draining this association

Most of this association is used as range. A few areas of Lindy and Hensley soils are cultivated. Deer are abundant in most of this association.

6. *Tarrant-Bolar association*

Gently sloping to sloping and hilly, very shallow to moderately deep, clayey and loamy soils over limestone

This association is on broad ridgetops, hillsides, and foot slopes. It makes up about 7 percent of the county. It is about 42 percent Tarrant soils and about 17 percent Bolar soils. The remaining 41 percent is minor soils.

Tarrant soils are gently sloping to sloping and hilly and are on limestone ridges. They have a surface layer of very dark grayish brown, calcareous clay about 10 inches thick. It is about 25 to 70 percent, by volume, limestone fragments, and 3 to 60 percent of the surface is covered by limestone fragments that are 3 to 15 inches across the long axis. The underlying material is platy limestone bedrock.

Bolar soils are gently sloping and are on broad ridgetops and foot slopes. They have a surface layer of dark grayish-brown, calcareous clay loam about 12 inches thick. The next layer is light yellowish-brown, calcareous clay loam about 26 inches thick. The underlying material is hard limestone interbedded with limy clayey marl.

Minor in the association are Cisco, Elandco, Hensley, and Owens soils. Cisco soils are in lower lying timbered areas below the Tarrant soils. Elandco soils are on flood plains of streams that drain this association. Hensley soils are on gently sloping ridgetops, and Owens soils are on hillsides and small knolls.

This association is used mostly as range. A few areas of Bolar soils are cultivated. Deer are abundant in most areas, and many ranchers add to their income by selling hunting leases. Wild turkey frequently inhabit areas along streams.

7. *Brackett-Lamar association*

Gently sloping to moderately steep, shallow to deep, loamy soils over limestone or limy loam

This association is on benched hills and foot slopes. It makes up about 2 percent of the county. Brackett soils make up about 38 percent of this association, Lamar soils about 27 percent, and minor soils the remaining 35 percent.

Brackett soils are gently sloping to moderately steep and are on benched hills. They have a surface layer of light brownish-gray, calcareous loam about 6 inches thick. The next layer is light-gray loam about 10 inches thick. The underlying material is white limy loam interbedded with soft limestone and sandstone.

Lamar soils are gently sloping to sloping and are on foot slopes. They have a surface layer of brown, calcareous loam about 15 inches thick. The next layer is light yellowish-brown, calcareous loam about 30 inches thick. The underlying material is brownish-yellow loam to a depth of 60 inches.

Minor in this association are Bunyan, Cisco, Menard, and Pedernales soils. Bunyan soils are on flood plains of streams that drain this association. Cisco, Menard, and Pedernales soils are in lower lying areas.

This association is used mostly as range. A few small areas are used for crops. Erosion is a hazard. Native vegetation is dominantly tall and mid grasses and a few trees. Deer, quail, and dove are abundant.

Deep Loamy and Clayey Soils

The soils in this group are used mostly as range. Vegetation is mainly mid and short grasses and mesquite trees.

8. *Truce-Thurber-Leeray association*

Nearly level to gently sloping, deep, loamy and clayey soils over limy clay or shale

This association is on ridges and in adjacent broad, shallow valleys. The shallow valleys receive extra water as runoff from adjacent higher slopes. This association makes up about 10 percent of the county. It is about 42 percent Truce soils, 22 percent Thurber soils, and 17 percent Leeray soils. The remaining 19 percent is minor soils.

Truce soils are mostly in areas at high elevations. They have a surface layer of yellowish-brown, slightly acid fine sandy loam about 5 inches thick. The next layer is clay that reaches to a depth of 46 inches. It is reddish brown in the upper 15 inches, brown in the next 14 inches, and light olive brown in the lower 12 inches. The underlying material is olive and gray brittle shale.

Thurber soils are nearly level to gently sloping and are in broad areas. They have a surface layer of dark grayish-brown, neutral clay loam about 5 inches thick. The next layer is clay that extends to a depth of 48 inches. It is

very dark grayish brown and neutral in the upper 17 inches and dark grayish-brown and calcareous in the lower 26 inches. The underlying material to a depth of 70 inches is very pale brown, calcareous shaly clay.

Leeray soils are nearly level to gently sloping and are in broad areas. They have a surface layer of calcareous clay about 18 inches thick. It is dark grayish brown in the upper part and very dark grayish brown in the lower part. The next layer is dark-brown, calcareous clay about 36 inches thick. Below this is brown limy clay to a depth of 64 inches.

Minor in this association are Bonti, Bunyan, Elandco, Exray, Lindy, and Owens soils. Bonti, Exray, and Owens soils are on ridges and foot slopes. Bunyan and Elandco soils are on flood plains of streams that drain this association. Lindy soils are gently sloping and are in broad areas that are slightly higher in elevation than those of Leeray and Thurber soils.

This association is used mostly as range. Several large areas of Leeray and Thurber soils are farmed to crops common to the area. Erosion is a hazard in most cultivated areas. Quail, dove, and deer are the main kinds of wildlife that inhabit this association.

Descriptions of the Soils

This section describes the soil series and mapping units in Eastland County. Each soil series is described in detail, and then, briefly, each mapping unit in that series. Unless it is specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of each series description is the soil profile; that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. The profile described in the series is representative for mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, the differences are stated in the description of the mapping unit, or they are differences that are apparent in the name of the mapping unit. Soil colors in this section are expressed both in words and in Munsell color notations and are for dry soil unless otherwise stated.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit and range site in which the mapping unit has been placed. The page for the description of each capability unit and range site can be learned by referring to the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary at the back of this survey, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual.[1]

[1] United States Department of Agriculture. Soil Survey Manual. U.S. Dept. Agric. Handbook 18, 503 pp., illus., 1951. [Supplement issued in May 1962]

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Acres	Percent	Soil	Acres	Percent
Bolar clay loam, 1 to 3 percent slopes	7, 760	1. 3	Leeray clay, 1 to 3 percent slopes	15, 990	2. 6
Bonti fine sandy loam, 1 to 3 percent slopes	15, 510	2. 5	Lindy loam, 1 to 3 percent slopes	16, 500	2. 7
Brackett stony loam, 1 to 8 percent slopes	2, 570	. 4	May fine sandy loam, 0 to 1 percent slopes	1, 050	. 2
Brackett complex, 8 to 20 percent slopes	2, 110	. 3	May fine sandy loam, 1 to 3 percent slopes	1, 710	. 3
Bunyan fine sandy loam	6, 700	1.	Menard fine sandy loam, 1 to 3 percent slopes	2, 470	. 4
Bunyan soils, frequently flooded	6, 120	1. 0	Menard fine sandy loam, 3 to 5 percent slopes	900	. 1
Chaney loamy sand, 1 to 5 percent slopes	98, 110	16. 0	Nimrod fine sand, 0 to 5 percent slopes	18, 100	3. 0
Chaney loamy sand, 1 to 5 percent slopes, eroded	26, 970	4. 4	Owens clay, 1 to 3 percent slopes	10, 060	1. 6
Chaney stony loamy sand, 1 to 8 percent slopes	32, 070	5. 2	Owens stony soils, hilly	26, 410	4. 3
Chaney soils, 2 to 6 percent slopes, severely eroded	1, 400	. 2	Patilo fine sand, 0 to 3 percent slopes	18, 980	3. 1
Cisco loamy fine sand, 1 to 5 percent slopes	6, 750	1. 1	Pedernales loamy fine sand, 1 to 5 percent slopes	13, 210	2. 2
Cisco fine sandy loam, 1 to 3 percent slopes	7, 190	1. 2	Pedernales fine sandy loam, 1 to 3 percent slopes	16, 380	2. 7
Cisco fine sandy loam, 3 to 5 percent slopes	1, 290	. 2	Pedernales fine sandy loam, 3 to 5 percent slopes	2, 800	. 5
Cisco fine sandy loam, 1 to 5 percent slopes, eroded	1, 040	. 2	Pedernales fine sandy loam, 1 to 5 percent slopes, eroded	9, 990	1. 6
Deleon clay, frequently flooded	4, 770	. 8	Pedernales soils, 2 to 8 percent slopes, severely eroded	1, 280	. 2
Demona loamy sand, 0 to 5 percent slopes	47, 600	7. 8	Tarrant stony clay, 1 to 8 percent slopes	16, 950	2. 8
Elandco silty clay loam	13, 120	2. 1	Tarrant stony soils, hilly	10, 070	1. 6
Elandco silty clay loam, frequently flooded	5, 530	. 9	Thurber clay loam, 0 to 1 percent slopes	3, 280	. 5
Exray-Bonti complex, 1 to 8 percent slopes	30, 910	5. 0	Thurber clay loam, 1 to 3 percent slopes	13, 180	2. 2
Exray stony soils, hilly	14, 340	2. 3	Truce fine sandy loam, 1 to 3 percent slopes	18, 920	3. 1
Hassee loam, 0 to 1 percent slopes	2, 380	. 4	Truce fine sandy loam, 3 to 5 percent slopes	1, 354	. 2
Hassee loam, 1 to 2 percent slopes	8, 240	1. 3	Truce fine sandy loam, 1 to 5 percent slopes, eroded	15, 130	2. 5
Hensley loam, 1 to 3 percent slopes	3, 550	. 6	Water	3, 456	. 7
Hensley stony loam, 1 to 5 percent slopes	23, 060	3. 8			
Lamar loam, 2 to 5 percent slopes	2, 130	. 3			
Lamar loam, 5 to 8 percent slopes	200	. 2			
Leeray clay, 0 to 1 percent slopes	1, 890	. 3	Total area	612, 480	100. 0

Bolar Series

The Bolar series consists of moderately deep, gently sloping, loamy soils on uplands. These soils formed in interbedded limestone and marl.

In a representative profile the surface layer is dark grayish-brown, calcareous clay loam about 12 inches thick. The next layer is about 26 inches of light yellowish-brown, calcareous clay loam that has many fine concretions and masses of calcium carbonate and a few limestone fragments. The underlying material is fractured hard limestone bedrock interbedded with clayey marl.

Bolar soils are well drained. Permeability is moderate, and available water capacity is medium.

These soils are used mostly as range. A few areas are in crops.

Representative profile of Bolar clay loam, 1 to 3 percent slopes, 13 miles north of Cisco on U.S. Highway 380 to a gas pumping plant, then 0.9 mile southeast on the highway and 60 feet east of the highway, in a cultivated field:

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate, fine, subangular blocky and granular structure; very hard, very firm but crumbly; common fine roots; few fine concretions of calcium carbonate; calcareous; moderately alkaline; clear, smooth boundary.

A1—6 to 12 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate, fine, blocky and granular structure; very hard, very firm; few fine concretions of calcium carbonate; few limestone fragments; calcareous; moderately alkaline; gradual, smooth boundary.

B2ca—12 to 38 inches, light yellowish-brown (10YR 6/4) clay loam, yellowish brown (10YR 5/4) moist; moderate, fine and very fine, subangular blocky structure; hard, very firm, friable; numerous fine concretions and masses of calcium carbonate; few limestone fragments; 64 percent calcium carbonate equivalent; calcareous; moderately alkaline; abrupt, wavy boundary.

R—38 to 40 inches, fractured hard limestone interbedded with clayey marl.

The solum ranges from 20 to 40 inches in thickness. The soil is 40 to 75 percent calcium carbonate between depths of 10 and 40 inches. Noncarbonate clay is between depths of 10 and 40 inches. Limestone fragments and gravel and stones of strongly cemented or indurated calcium carbonate concretions make up 0 to 5 percent of the A horizon and the upper part of the Bca horizon and 5 to 15 percent of the lower part of the Bca horizon. In places the fragments are discontinuous broken remnant stone lines. The A horizon is grayish brown, dark grayish brown, very dark grayish brown, brown, or dark brown. It ranges from clay loam to silty clay loam. The B horizon ranges from pale brown, brown, and light yellowish brown to yellowish brown.

Bolar clay loam, 1 to 3 percent slopes (BcB).—This gently sloping soil is on broad uplands. Areas are irregular in shape and are 10 to 100 acres in size, but they are dominantly about 30 acres.

Included with this soil in mapping are spots of Owens and Tarrant soils on slight knolls. Also included are a few areas of soils that are similar to Bolar soils but contain more than 15 percent limestone fragments in broken stone lines. A few areas of soils that have slopes of more than 3 percent are included. Each included area is less than 20 acres in size. Included soils make up less than 20 percent of any mapped area.

This soil is used mostly as native range. A few areas are used for crops. Runoff is medium, and the hazard of erosion is moderate. Capability unit IIe–4; Clay Loam range site.

Bonti Series

The Bonti series consists of moderately deep, gently sloping, loamy soils on uplands. These soils formed over cemented sandstone.

In a representative profile the surface layer is brown fine sandy loam about 4 inches thick. The subsurface layer is grayish-brown fine sandy loam about 2 inches thick. The next layer is yellowish-red sandy clay about 20 inches thick. The underlying material is brownish-yellow strongly cemented sandstone.

Bonti soils are well drained. Permeability is moderately slow, and available water capacity is medium.

These soils are used mostly as range. A few areas are in improved pasture.

Representative profile of Bonti fine sandy loam, 1 to 3 percent slopes, about 6.75 miles east of Eastland on Farm Road 570, then 3.25 miles south on Farm Road 2461 to Lake Leon Dam, then 0.12 mile south of the dam to cattle guard on west side of the road, 0.2 mile north-northwest on a private road and 93 feet west of the road, in a wooded area:

A1—0 to 4 inches, brown (10YR 4/3) fine sandy loam, dark brown (10YR 3/3) moist; weak, fine, subangular blocky and granular structure; slightly hard, friable; common roots; few, small sandstone fragments ⅛ to 3 inches in diameter; neutral; clear, smooth boundary.

A2—4 to 6 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, fine, subangular blocky structure; slightly hard, friable; slightly acid; clear, smooth boundary.

B21t—6 to 16 inches, yellowish-red (5YR 4/6) sandy clay, yellowish red (5YR 4/6) moist; weak, fine, blocky structure; very hard, firm; few thin clay films on faces of peds; medium acid; gradual, smooth boundary.

B22t—16 to 26 inches, yellowish-red (5YR 4/6) sandy clay, yellowish red (5YR 4/6) moist; moderate, fine, blocky structure; very hard, firm; few thin clay films on faces of peds; 53 percent base saturation; medium acid; abrupt, smooth boundary.

R—26 to 28 inches, brownish-yellow strongly cemented sandstone.

The solum ranges from 20 to 40 inches in thickness. Coarse fragments on the surface range from a few to 25 percent and from ⅛ inch to 3 feet in diameter. The A horizon is 4 to 10 inches thick. This horizon is brown, grayish brown, or pale brown and is neutral or slightly acid. It has a few to 10 percent fragments ⅛ inch to 3 inches in diameter. The B2t horizon is reddish brown, red, or yellowish red and is medium acid or strongly acid.

Bonti fine sandy loam, 1 to 3 percent slopes (BnB).—This gently sloping soil is on uplands. Areas are irregular in shape and are 10 to 100 acres in size. This soil has the profile described as representative of the Bonti series.

Included with this soil in mapping are some small areas of Exray, Pedernales, and Truce soils on low knolls, Truce soils have convex slopes. Exray soils are in areas similar to those of Truce soils, but they are shallower to sandstone. Also included are small areas, mostly on foot slopes, of a soil that is similar to Bonti soils, but the depth to underlying sandstone is more than 40 inches. Included areas are less than 15 acres in size and make up less than 30 percent of any mapped area. Any one included soil makes up less than 20 percent of a mapped area.

This soil is used mostly as range. Runoff is medium, and the hazard of erosion is moderate. Capability unit IIe-2; Tight Sandy Loam range site.

Brackett Series

The Brackett series consists of shallow, gently sloping to moderately steep and hilly, stony soils. These soils formed over soft limestone interbedded with hard limestone and chalky marl.

In a representative profile the surface layer is about 6 inches of light brownish-gray, calcareous loam that is about 5 percent, by volume, limestone fragments about 1 inch in diameter. From 1 to 15 percent of the surface is covered by limestone fragments 3 to 24 inches in diameter. The next layer is about 10 inches of light-gray, calcareous loam that is about 8 percent, by volume, limestone fragments about 2 inches in diameter. The underlying material is limy loam interbedded with soft limestone, sandstone, and chalky marl to a depth of 40 inches.

Brackett soils are well drained. Permeability is moderately slow, and available water capacity is very low.

These soils are used as range or wildlife habitat.

Representative profile of Brackett loam in an area of Brackett stony loam, 1 to 8 percent slopes, 4 miles north of Desdemona on Texas Highway 16, then 2 miles east-northeast on a county road and 250 feet north of the road, in range:

A1—0 to 6 inches, light brownish-gray (10YR 6/2) loam, grayish brown (10YR 5/2) moist; moderate, fine, granular and subangular blocky structure; hard, friable; many medium grass roots and worm casts; about 5 percent limestone fragments ⅛ to 1 inch in diameter; about 50 percent calcium carbonate equivalent; calcareous; moderately alkaline; clear, smooth boundary.

B2—6 to 16 inches, light-gray (2.5Y 7/2) loam, light brownish gray (2.5Y 6/2) moist; moderate, fine, subangular blocky structure; hard, friable; many fine roots; about 8 percent, by volume, subrounded, weakly and strongly cemented, limestone fragments mostly ¼ inch to 2 inches in diameter; few soft masses of calcium carbonate; 49 percent calcium carbonate equivalent; calcareous; moderately alkaline; clear, smooth boundary.

C—16 to 40 inches, white (10YR 8/2) limy loam, light gray (10YR 7/2) moist; massive; interbedded soft limestone and sandstone fragments; few fine roots in upper part, none in lower part; calcareous; moderately alkaline.

The solum ranges from 10 to 20 inches in thickness. It is 1 to 10 percent, by volume, limestone gravel or coarse limestone fragments that are as much as 5 inches in diameter. Limestone fragments that are 3 to 30 inches in diameter cover 1 to 15 percent of the surface. The calcium carbonate equivalent ranges from 40 to 60 percent. The A horizon is brown, grayish brown, or light brownish gray. The B horizon is brown, grayish brown, light brownish gray, light gray, or very pale brown. It ranges from loam to clay loam.

Brackett stony loam, 1 to 8 percent slopes (BrD) — This gently sloping to sloping, stony soil is in oval or irregularly shaped areas 20 to 300 acres in size. Slopes are long, are plane to convex, and have a slight "stair-step" appearance. This soil has 1 to 15 percent limestone fragments on the surface that are 3 to 24 inches in diameter. It has the profile described as representative of the Brackett series.

Included with this soil in mapping are spots of Lamar, Owens, and Pedernales soils. Lamar soils are on foot slopes or in areas along drainageways. Owens soils are on the peak of ridges or knolls. Pedernales soils are mostly on slopes above drainageways. Each included area is less than 15 acres in size. Included areas make up less than 30 percent of any mapped area. Any one included soil makes up less than 15 percent of a mapped area.

This soil is used only as range. Runoff is rapid, and the hazard of erosion is moderate. Capability unit VIs–1; Adobe range site.

Brackett complex, 8 to 20 percent slopes (BtE).—This mapping unit is made up of strongly sloping to moderately steep, stony soils on uplands. It is about 70 percent Brackett soils and 30 percent soils that are similar to Brackett soils, but 75 percent or more of the original surface layer has been removed by erosion. Areas are oval to irregular in shape and are 10 to 100 acres in size. The soils have 5 to 15 percent limestone fragments on the surface that are 3 to 30 inches in diameter. They cannot be shown separately at the scale mapped, because they are too intricately intermingled or the areas are too small.

Brackett soils have a surface layer of grayish-brown calcareous loam about 2 inches thick. It is about 10 percent limestone fragements that are 3 to 30 inches in diameter. The next layer is about 10 inches of light-gray, calcareous clay loam that has many small concretions and masses of calcium carbonate. The underlying material is soft, stratified, calcareous loam intermingled with weakly cemented limestone.

Included with these soils in mapping are spots of Lamar, Menard, and Tarrant soils. Lamar soils are in areas on foot slopes and along drainageways. Menard soils are in areas similar to those of Lamar soils. Tarrant soils are mostly in areas around the rim of upper slopes. Each included area is less than 20 acres in size and makes up less than 20 percent of any mapped area.

The soils in this mapping unit are used only as range. Runoff is rapid, and the hazard of erosion is moderate. Capability unit VIIs–1; Steep Adobe range site.

Bunyan Series

The Bunyan series consists of deep, nearly level, loamy soils on bottom lands. These soils formed in stratified alluvial sediment of mixed origin.

In a representative profile the surface layer is brown, neutral fine sandy loam about 8 inches thick. The underlying material is brown, layered alluvial material to a depth of 60 inches. It is neutral sandy clay loam in the upper 16 inches; neutral fine sandy loam in the next 16 inches; calcareous sandy clay loam in the next 6 inches; and calcareous fine sandy loam in the lower 14 inches.

Bunyan soils are well drained. Permeability is moderate, and available water capacity is high. These soils are flooded at intervals that range from one or more times a year to once every 4 to 10 years.

These soils are used mostly as pasture. A few areas are in native range.

Representative profile of Bunyan fine sandy loam in an area of Bunyan soils, frequently flooded, 6.6 miles north of Desdemona on Texas Highway 16 and 336 feet east of the highway, in a pasture near small creek:

A1—0 to 8 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak, fine, subangular blocky structure; hard, friable; few roots; neutral; clear, smooth boundary.

C1—8 to 24 inches, brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) moist; massive; hard, firm; neutral; clear, smooth boundary.

C2—24 to 40 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; massive; hard, friable; thin strata of light sandy clay loam and clay loam that

have evident bedding planes; neutral; clear, smooth boundary.

C3—40 to 46 inches, brown (10YR 5/3) sandy clay loam, dark brown (10YR 3/3) moist; massive; hard, firm; thin strata of very dark grayish-brown fine sandy loam and light clay loam that have evident bedding planes; calcareous; moderately alkaline; clear, smooth boundary.

C4—46 to 60 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; massive; few soft concretions of calcium carbonate; thin strata of clay loam that have evident bedding planes; calcareous; moderately alkaline.

Stratification in the profile ranges from scarcely evident to pronounced. The A horizon is dark grayish brown, grayish brown, light brownish gray, brown, or pale brown. It is neutral or slightly acid. The C horizon is brown, light brown, grayish brown, light grayish brown, pale brown, light yellowish brown, or yellowish brown at a depth of 10 to 40 inches. Also at this depth are thin very dark grayish-brown, dark grayish-brown, or dark-brown strata. At a depth of 10 to 40 inches, this horizon is fine sandy loam, loam, sandy clay loam, or clay loam that is 19 to 35 percent clay and more than 15 percent coarser than very fine sand. The C horizon is neutral or slightly acid in the upper part and slightly acid to moderately alkaline in the lower part. It has common, interbedded, calcareous and noncalcareous strata.

Bunyan fine sandy loam (Bu).—This nearly level soil is on narrow flood plains. The stream channel is sufficiently deep to prevent flooding more than about once every 4 to 10 years. Areas are oblong in shape and are 20 to 100 acres in size. Slopes are 0 to 1 percent.

The surface layer is brown, neutral fine sandy loam about 8 inches thick. The underlying material is brown, layered alluvial material to a depth of 60 inches. It is neutral sandy clay loam in the upper 16 inches, neutral fine sandy loam in the next 16 inches, calcareous sandy clay loam in the next 6 inches, and calcareous fine sandy loam in the lower 14 inches.

Included with this soil in mapping where the flood plains broaden are spots of Elandco soils. Also included are areas of a soil that is similar to this Bunyan soil but is calcareous to the surface. Included areas are less than 50 acres in size and make up less than 30 percent of any mapped area. Any one included soil makes up less than 20 percent of a mapped area.

This soil is used mostly as pasture. Runoff is slow, and the hazard of erosion is slight. Capability unit IIw–1; Loamy Bottomland range site.

Bunyan soils, frequently flooded (By).—This mapping unit is made up of nearly level soils on narrow flood plains. Areas are oblong to irregular in shape and are 20 to 400 acres in size. Bunyan soils make up about 70 percent of the mapping unit. The upper 10 inches of the surface layer ranges from sandy clay loam to fine sandy loam. In many places near the stream channel, the surface has a weakly undulating appearance. Slopes are 0 to 1 percent. A Bunyan soil in this mapping unit has the profile described as representative of the series.

Included with these soils in mapping where the flood plains broaden are spots of Elandco soils. Also included are areas of a soil that is similar to this Bunyan soil but is calcareous to the surface. Each included area is less than 30 acres in size. Included areas make up less than 30 percent of any mapped area. Any one included soil makes up less than 20 percent.

This mapping unit is used as pasture or range. The soils are flooded an average of twice every 3 years. Runoff is slow, and the hazard of erosion is slight. Capability unit Vw–1; Loamy Bottomland range site.

Chaney Series

The Chaney series consists of deep, gently sloping to sloping, sandy soils on uplands. These soils formed in loamy to clayey materials and interbedded sandstone and shale.

In a representative profile the surface layer is pale-brown loamy sand about 12 inches thick. The next layer is sandy clay about 36 inches thick. It is yellowish red in the upper part and light gray in the lower part (fig. 2). The underlying material to a depth of 60 inches is reddish-yellow, massive sandy clay loam interbedded with weakly cemented sandstone that becomes friable upon moistening.

Chaney soils are moderately well drained. Permeability is slow, and available water capacity is medium. The hazard of soil blowing is severe (fig. 3).

These soils are used mostly for crops or pasture. A few areas are in native range.

Representative profile of Chaney loamy sand, 1 to 5 percent slopes, 10 miles south of the county courthouse in Eastland on Texas Highway 6 to Carbon, then 0.7 mile east of the junction of the highway and Loop 389 on the

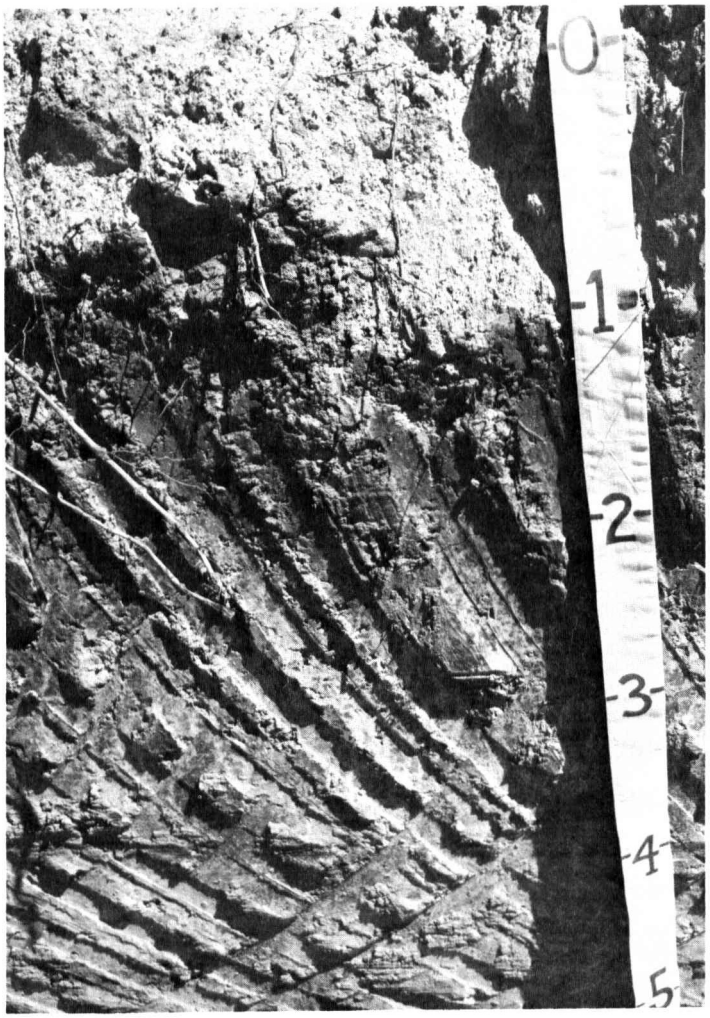

Figure 2.—**Profile of a Chaney loamy sand showing abrupt boundary at a depth of about 12 inches.**

Figure 3.—**Soil blowing in an unprotected area of Chaney loamy sand.**

eastern edge of Carbon, 126 feet north of the highway, in a pasture:

A1—0 to 12 inches, pale-brown (10YR 6/3) loamy sand, brown (10YR 5/3) moist; massive; slightly hard, friable; few small pebbles; slightly acid; abrupt, wavy boundary.

B21t—12 to 20 inches, yellowish-red (5YR 5/6) sandy clay, yellowish red (5YR 4/6) moist; common, medium, distinct mottles of yellowish brown, brownish gray, and red; weak, medium, blocky structure; very hard, very firm; distinct clay films on faces of peds; medium acid; gradual, smooth boundary.

B22t—20 to 30 inches, light-gray (10YR 7/2) sandy clay, light brownish gray (10YR 6/2) moist; common, medium, prominent mottles of brownish yellow and red; weak, medium, blocky structure; very hard, very firm; distinct clay films on faces of peds; medium acid; gradual, smooth boundary.

B3t—30 to 48 inches, light-gray (10YR 7/1) sandy clay, light gray (10YR 6/1) moist; common, coarse, prominent mottles of brownish yellow and red; weak, coarse, blocky structure; very hard, very firm; slightly acid; gradual, smooth boundary.

C—48 to 60 inches, reddish-yellow (7.5YR 6/6) sandy clay loam; massive; interbedded weakly cemented sandstone that becomes friable upon moistening.

The solum ranges from 30 to 50 inches in thickness. Coarse fragments 1 foot to 6 feet in diameter cover 0 to 20 percent of the surface. The A horizon is 6 to 20 inches thick and is brown, pale brown, or reddish yellow. It is neutral or slightly acid loamy sand, fine sandy loam, or sandy clay. The B horizon is red, yellowish red, light gray, or brownish yellow. It is slightly acid or medium acid and ranges from clay to sandy clay. The C horizon is slightly acid or medium acid. It ranges from sandy clay loam interbedded with weakly cemented sandstone to shaly clay.

Chaney loamy sand, 1 to 5 percent slopes (ChC) —This gently sloping soil is on broad uplands. Areas are irregular in shape and are 4 to 200 acres in size, but they are dominantly about 40 acres. This soil has the profile described as representative of the series.

Included with this soil in mapping are some small irregularly shaped areas of Chaney loamy sand, 1 to 5 percent slopes, eroded, in cultivated fields. Also included are spots of Demona, Hassee, and Pedernales soils. Demona soils occur in no definite pattern. Hassee soils are in oval-shaped depressional areas, and Pedernales soils are mostly on low knolls or ridges. A few gravelly areas are included. Also included are areas of a soil that is similar to this Chaney soil but has no gray mottles within 30 inches of the surface. Included areas are less than 10 acres in size and make up less than 20 percent of any mapped area. Any one soil makes up less than 15 percent.

This soil is used mostly for cultivated crops and as improved pasture, for which it is well suited. Some areas are in orchards, and a few areas are used as range. Runoff is slow. The hazard of soil blowing is severe, and the hazard of erosion is slight. Capability unit IIIe–5; Sandy range site.

Chaney loamy sand, 1 to 5 percent slopes, eroded (ChC2).—This gently sloping soil is in irregularly shaped areas on uplands. Areas range from 10 to 150 acres in size, but they are dominantly about 30 acres. Soil blowing and erosion have thinned the surface layer. A few small "galled spots" are in some areas. In these areas sandy clay from the subsoil has been mixed with the loamy sand surface layer, and the present surface layer ranges from sandy clay loam to fine sandy loam. Slopes are plane to convex. A few areas where sand has been removed by rill erosion are near the break or peak of convex slopes.

The surface layer is brown, neutral loamy sand about 6 inches thick. The next layer is mottled yellowish-red to light-gray sandy clay about 36 inches thick. The underlying material to a depth of 60 inches is reddish-yellow, massive sandy clay loam and interbedded weakly cemented sandstone that becomes friable upon moistening.

Included with this soil in mapping are spots of Chaney loamy sand, 1 to 5 percent slopes, that occur in no definite pattern. Also included are spots of Pedernales soils on low knolls or ridges. Included areas make up less than 20

percent of any mapped area. Any one soil makes up less than 10 percent.

This soil is used mostly for crops or improved pasture. Runoff is medium. The hazard of soil blowing is severe, and the hazard of erosion is moderate. Capability unit IIIe–5: Sandy range site.

Chaney stony loamy sand, 1 to 8 percent slopes (CmD) —This gently sloping to sloping soil is on knolls and ridges. Areas are irregular to oval in shape and are 5 to 200 acres in size, but they are dominantly about 50 acres. Slopes are convex. About 5 to 20 percent of the surface is covered by loose, conglomerate sandstones that are 1 foot to 6 feet in diameter. The stones in the profile are mainly in the surface layer; they make up only about 1 percent of the lower layers.

The surface layer is brown stony loamy sand about 10 inches thick. The subsurface layer is light-gray loamy sand about 4 inches thick. The next layer is yellowish-red sandy clay that is mottled in shades of red, gray, and yellow. The underlying material of reddish-yellow shaly clay is at a depth of about 58 inches.

Included with this soil in mapping near the base of slopes are spots of Chaney loamy sand, 1 to 5 percent slopes. Small areas of Owens and Truce soils are included on breaks along upper slopes. Also included are a few areas of a soil that is similar to Chaney stony loamy sand, 1 to 8 percent slopes, but has red lower layers and no gray mottles. Included areas make up less than 20 percent of any mapped area, and any one included soil makes up less than 10 percent.

This soil is better suited to use as range than to most other uses. Runoff is medium. The hazards of soil blowing and erosion are severe. Capability unit VIs–1; Sandy range site.

Chaney soils, 2 to 6 percent slopes, severely eroded (CnD3) —These gently sloping to sloping soils are in small, irregularly shaped areas or fingerlike projections from drainageways. Areas are 4 to 20 acres in size. Slopes are convex and are dominantly about 3 percent. Gullies are in all mapped areas. Some areas are as much as 60 percent gullies, and others are about 10 percent. The gullies are 4 to 10 feet wide, 2 to 6 feet deep, and about 120 to 240 feet long. Soil patterns are not uniform, and they occur without regularity.

The surface layer is reddish-yellow, neutral loamy sand about 6 inches thick. The next layer is mottled, yellowish-red to light-gray sandy clay about 36 inches thick. The underlying material is reddish-yellow shaly clay to a depth of 60 inches.

Included with these soils in mapping are some small inaccessible areas of Chaney loamy sand, 1 to 5 percent slopes, between gullies. Pedernales soils, severely eroded, are included on the upper slopes of some areas. Included soils make up less than 15 percent of any mapped area.

These soils were mainly cultivated in the past, but they are now idle or in permanent pasture. Most areas have active erosion from V-shaped gullies. Mechanically shaping the gullies and converting this acreage to improved pasture help to control erosion and to conserve moisture. Runoff is medium. The hazards of soil blowing and further erosion are severe. Capability unit VIe–1; Sandy range site.

Cisco Series

The Cisco series consists of deep, gently sloping, loamy and sandy soils on uplands. These soils formed in calcareous, loamy sediment.

In a representative profile the surface layer is brown loamy fine sand about 10 inches thick. The next layer is yellowish-red, slightly acid sandy clay loam about 20 inches thick. Below this is reddish-yellow, faintly mottled, neutral sandy clay loam about 20 inches thick. The underlying material is light brownish-gray, calcareous fine sandy loam to a depth of 70 inches.

Cisco soils are well drained. Permeability is moderate, and available water capacity is high.

These soils are used mostly for crops. A few areas are in native range or pasture.

Representative profile of Cisco loamy fine sand, 1 to 5 percent slopes, about 6.6 miles west of Rising Star on Texas Highway 36, then 0.3 mile south on a county road, about 327 feet west of the road, in an abandoned field:

Ap—0 to 10 inches, brown (7.5YR 5/4) loamy fine sand, dark brown (7.5YR 4/4) moist; weak, fine, granular structure; slightly hard, friable; neutral; clear, smooth boundary.

B21t—10 to 14 inches, yellowish-red (5YR 4/6) sandy clay loam, yellowish red (5YR 4/6) moist; moderate, fine, subangular blocky structure; very hard, firm; few medium pores; few clay films on faces of peds; slightly acid; gradual, smooth boundary.

B22t—14 to 30 inches, yellowish-red (5YR 4/6) sandy clay loam, yellowish red (5YR 4/6) moist; weak, medium, subangular blocky structure; very hard, firm; few fine pores; few clay films on faces of peds; slightly acid; gradual, smooth boundary.

B3t—30 to 50 inches, reddish-yellow (7.5YR 6/6) sandy clay loam, strong brown (7.5YR 5/6) moist; weak, coarse, subangular blocky structure; few, medium, faint, brown (7.5YR 4/4) mottles and few, fine, faint, yellowish-red mottles; very hard, firm; few fine concretions of ferromanganese; neutral; clear, wavy boundary.

Cca—50 to 70 inches, light brownish-gray (10YR 6/2) fine sandy loam, light brownish gray (10YR 6/2) moist; common, fine, yellowish-brown mottles; massive; slightly hard, friable; numerous small concretions of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 40 to 70 inches in thickness. Secondary carbonates are at a depth of 36 to 60 inches. The A horizon is 5 to 18 inches thick. It is brown, grayish brown, or pale brown fine sandy loam or loamy fine sand. The B2t horizon is yellowish red, red, or reddish brown sandy clay loam or clay loam. The B3t horizon is reddish yellow, reddish brown, yellowish red, red, or brown. It has yellowish-brown, brown, and red mottles. The Cca horizon is light brownish gray, very pale brown, or white. It is sandy clay loam, fine sandy loam, or limy earth interbedded with weakly cemented packsand.

Cisco loamy fine sand, 1 to 5 percent slopes (CoC).—This gently sloping soil is in broad, shallow valleys. Areas are irregular in shape and are 20 to 100 acres in size. Slopes are plane to slightly concave and average about 2 percent. This soil has the profile described as representative of the Cisco series.

Included with this soil in mapping are some small irregularly shaped areas of Chaney, May, Menard, and Pedernales soils. Chaney soils are in areas similar to those of this Cisco soil. May soils are in areas along weakly defined drainageways. Menard soils are on low knolls, and Pedernales soils are on knolls that have convex slopes. Also included are a few small areas of a soil that is similar to this Cisco soil, but its lower layers are sandy clay loam to a depth of more than 60 inches.

This soil is used mostly for crops. A few areas are used as improved pasture or range. Runoff is slow. The hazard of soil blowing is severe, and the hazard of erosion is slight. Capability unit IIIe–5; Sandy range site.

Cisco fine sandy loam, 1 to 3 percent slopes (CsB).—This gently sloping soil is in broad, shallow valleys. Areas are irregular in shape and are 10 to 100 acres in size. The soil is dissected by weakly defined drainageways in some areas. Slopes are plane to weakly concave.

The surface layer is brown, neutral fine sandy loam about 12 inches thick. The next layer is about 39 inches of neutral sandy clay loam that is yellowish red in the upper part and reddish brown in the lower part. The underlying material is very pale brown, calcareous sandy clay loam to a depth of 60 inches.

Included with this soil in mapping are spots of Menard and Pedernales soils, mostly on small knolls. Also included on lower slopes is a soil that is similar to this Cisco soil but is sandy clay loam to a depth of more than 60 inches. Included soils make up less than 20 percent of any mapped area.

This soil is used mostly for crops. Runoff is slow, and the hazard of erosion is moderate. Capability unit IIe–3; Sandy Loam range site.

Cisco fine sandy loam, 3 to 5 percent slopes (CsC).—This gently sloping soil is on foot slopes. Areas are irregular in shape and are 10 to 100 acres in size. Slopes are weakly convex.

The surface layer is brown, neutral fine sandy loam about 16 inches thick. The next layer is yellowish-red, neutral sandy clay loam about 42 inches thick. The underlying material is very pale brown, calcareous sandy clay loam to a depth of 62 inches.

Included with this soil in mapping are spots of Lamar, Menard, and Pedernales soils on upper slopes. Included areas are less than 10 acres in size and make up less than 30 percent of any mapped area. Also included are small areas of a soil that is similar to Cisco soil, but its lower layers are sandy clay loam to a depth of more than 60 inches.

This soil is used mostly as range or improved pasture. A few areas are cultivated. Runoff is medium and the hazard of erosion is moderate. Capability unit IIIe–4; Sandy Loam range site.

Cisco fine sandy loam, 1 to 5 percent slopes, eroded (CsC2).—This gently sloping soil is on knolls. Areas are irregular in shape and are 5 to 30 acres in size. The surface layer in most areas has been removed by soil blowing and erosion. A few shallow rills or washes 6 inches deep and 40 inches wide are in these mapped areas. Slopes are convex.

The surface layer is brown, neutral fine sandy loam about 3 inches thick. The next layer is slightly acid sandy clay loam about 49 inches thick. It is red in the upper part and yellowish red in the lower part. The underlying material is white, calcareous fine sandy loam to a depth of 62 inches.

Included with this soil in mapping are spots of Menard and Pedernales soils on upper slopes. Included areas are less than 5 acres in size and make up less than 20 percent of any mapped area.

This soil is used mostly as pasture or range. A few areas are in forage sorghums. Runoff is medium, and the hazard of erosion is severe. Capability unit IIIe–4; Sandy Loam range site.

Deleon Series

The Deleon series consists of deep, nearly level, clayey soils on bottom lands. These soils formed in calcareous clayey sediment.

In a representative profile the surface layer is clay about 44 inches thick. It is dark grayish brown and neutral in the upper 30 inches and dark brown in the lower 14 inches. The underlying material is dark-brown, calcareous silty clay loam to a depth of 64 inches.

Deleon soils are moderately well drained. Permeability is slow, and available water capacity is high. These soils are flooded at intervals that range from one or more times a year to once every 3 years. A water table is within 10 feet of the surface during most years.

These soils are used mostly as native range or improved pasture.

Representative profile of Deleon clay, frequently flooded, about 4.25 miles east of Eastland on Farm Road 570, then about 11.75 miles southeast on Farm Road 2214 and 100 feet north of the road, in a pasture:

A11—0 to 6 inches, dark grayish-brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate, medium, granular structure and moderate, fine, angular blocky structure; hard, very firm, very sticky; many roots and pores; cracks ½ inch wide and 15 inches long are throughout this horizon; neutral; clear, smooth boundary.

A12—6 to 30 inches, dark grayish-brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate, medium, angular blocky structure; very hard, very firm, very sticky; common roots and pores; cracks ½ inch wide and 15 inches long are throughout this horizon; few worm casts; neutral; clear, smooth boundary.

A13—30 to 44 inches, dark-brown (10YR 4/3) clay, dark brown (10YR 3/3) moist; moderate, fine, angular blocky structure; very hard, very firm, very sticky; few roots and pores; mildly alkaline; gradual, smooth boundary.

C—44 to 64 inches, dark-brown (10YR 4/3) silty clay loam, dark brown (10YR 3/3) moist; massive; hard, firm; few roots; common films and threads of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 30 to 60 inches in thickness. When the soils are dry, cracks ½ inch to 3 inches wide extend to a depth of 20 to 30 inches. Films, threads, or soft masses of calcium carbonate are at a depth of 28 inches to more than 60 inches. The A horizon is dark grayish brown, very dark grayish brown, or dark brown. This horizon is 40 to 55 percent clay at a depth of 10 to 40 inches. It ranges from neutral to moderately alkaline. The C horizon is brown, light brown, dark brown, dark grayish brown, very dark grayish brown, or yellowish brown. It ranges from silty clay loam to clay. In some places thin strata of loam, clay loam, fine sandy loam, or fine sand are at a depth of more than 40 inches.

Deleon clay, frequently flooded (De).—This nearly level soil is on flood plains, in bands 50 to 400 yards wide. Areas are 100 to 400 acres in size. Slopes are 0 to 1 percent.

Included with this soil in mapping are small bands of Bunyan and Elandco soils. These soils are in slightly high areas near the stream channel. Included areas are less than 20 acres in size and make up less than 20 percent of any mapped area.

This soil is used mostly as native range. Some areas are in improved pasture or pecan orchards. Runoff is slow, and the hazard of erosion is slight. Capability unit Vw–1; Clayey Bottomland range site.

Demona Series

The Demona series consists of deep, nearly level to gently sloping, sandy soils on uplands. These soils formed in loamy to clayey material interbedded with sandstone and shale.

In a representative profile the surface layer is very pale brown loamy sand about 14 inches thick. The subsurface layer is very pale brown loamy sand about 14 inches thick. The next layer is about 10 inches of brownish-yellow sandy clay that has red and light brownish-gray mottles. Below this is about 12 inches of light brownish-gray sandy clay that has red and yellowish-brown mottles. The underlying material is light brownish-gray, slightly acid shaly clay to a depth of 64 inches.

Demona soils are moderately well drained. Permeability is moderately slow, and available water capacity is medium.

These soils are used mostly for crops. Some areas are in pasture or range.

Representative profile of Demona loamy sand, 0 to 5 percent slopes, 6.5 miles south of the county courthouse in Eastland on Texas Highway 6, then 7.5 miles east on Farm Road 2563, 1.5 miles south on Farm Road 2689 to the church in Kokomo, 1.9 miles east-southeast on this road and 54 feet south of the road, in a pasture:

A1—0 to 14 inches, very pale brown (10YR 7/3) loamy sand, pale brown (10YR 6/3) moist; single grained; hard, friable; neutral; clear, smooth boundary.

A2—14 to 28 inches, very pale brown (10YR 8/3) loamy sand, very pale brown (10YR 7/3) moist; single grained; slightly hard, friable; slightly acid; abrupt, wavy boundary.

B21t—28 to 32 inches, brownish-yellow (10YR 6/6) sandy clay, yellowish brown (10YR 5/6) moist; common, medium, distinct mottles of red (2.5YR 4/6) and light brownish gray (10YR 6/2); moderate, fine, blocky structure; very hard, very firm; medium acid; gradual, smooth boundary.

B22t—32 to 38 inches, brownish-yellow (10YR 6/6) sandy clay, yellowish brown (10YR 5/6) moist; common, coarse, prominent mottles of red (2.5YR 4/6) and light brownish gray (10YR 6/2); weak, coarse, blocky structure; very hard, very firm; medium acid; gradual, smooth boundary.

B3—38 to 50 inches, light brownish-gray (10YR 6/2) sandy clay, light brownish gray (10YR 6/2) moist; coarse, prominent, mottles of red (2.5YR 4/6) and yellowish brown (10YR 5/6); weak, coarse, blocky structure; thin seams of reddish loamy sand one-half inch wide; very hard, very firm; medium acid; gradual, smooth boundary.

C—50 to 64 inches, light brownish-gray (10YR 6/2) shaly clay, light brownish gray (10YR 6/2) moist; few, faint, reddish mottles; massive; very hard, very firm; slightly acid.

The solum ranges from 50 to 90 inches in thickness. The A horizon is 20 to 40 inches thick. The A1 horizon is light brown, brown, grayish brown, dark grayish brown, or very pale brown. It is neutral or mildly alkaline. The A2 horizon is white, pale brown, very pale brown, light brown, or reddish yellow. It ranges from neutral to medium acid. The B2t horizon is red or brownish yellow and has red, yellow, brown, and gray mottles. It ranges from strongly acid to slightly acid and from sandy clay to clay. The B3 horizon is red, light gray, light brownish gray, brownish yellow, or reddish yellow and has red, brown, yellow, or gray mottles. The C horizon ranges from sandy clay loam to shaly clay.

Demona loamy sand, 0 to 5 percent slopes (DmC).—This nearly level to gently sloping soil is on broad uplands. Areas are irregular in shape and are 10 to 200 acres in size. Slopes are plane to convex and are weakly undulating in a few areas.

Included with this soil in mapping are spots of Chaney, Hassee, and Nimrod soils. Chaney soils are mostly on slight knolls. Hassee soils are in circular depressional areas. Nimrod soils are in areas similar to those of Demona soils. Each included area is less than 10 acres in size. Included areas make up less than 20 percent of any mapped area. Any one included soil makes up less than 15 percent.

This soil is used mostly for crops. Some areas are in improved pasture or range. Runoff is slow. The hazard of soil blowing is severe, and the hazard of erosion is slight. A perched water table is above the lower layers of sandy clay for a short period during wet seasons. Capability unit IIIe–5; Sandy range site.

Elandco Series

The Elandco series consists of deep, nearly level, loamy soils on bottom lands. These soils formed in loamy, calcareous, alluvial sediment.

In a representative profile the surface layer is mildly alkaline silty clay loam 40 inches thick. It is dark grayish brown in the upper 14 inches, very dark grayish brown in the next 13 inches, and dark brown in the lower 13 inches. The underlying material is dark-brown, calcareous silty clay loam to a depth of 62 inches.

Elandco soils are well drained. Permeability is moderate, and available water capacity is high. These soils are flooded at intervals that range from one or more times each 1 to 3 years to once every 4 to 10 years.

These soils are used mostly as pasture. Some areas are in range or crops.

Representative profile of Elandco silty clay loam, frequently flooded, 1.8 miles east of the county courthouse in Eastland on U.S. Highway 80, then 6 miles east on Farm Road 570, 2.2 miles south and east on Farm Road 2461, and 1,320 feet east of the road, in a pasture on the Colony Creek flood plain:

A11—0 to 14 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate, medium, granular structure; hard, firm; many roots and worm casts; common fine and medium pores; mildly alkaline; clear, smooth boundary.

A12—14 to 27 inches, very dark grayish-brown (10YR 3/2) silty clay loam, very dark brown (10YR 2/2) moist; weak, medium, subangular blocky structure; hard, firm; many roots and pores; mildly alkaline; clear, smooth boundary.

A13—27 to 40 inches, dark-brown (10YR 3/3) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak, medium, subangular blocky structure; hard, firm; many roots and pores; mildly alkaline; clear, smooth boundary.

C—40 to 62 inches, dark-brown (10YR 4/3) silty clay loam; dark-brown (10YR 3/3) moist; massive; hard, firm; common films and threads of calcium carbonate; indistinct bedding planes; calcareous; moderately alkaline.

Secondary carbonates are at a depth of 20 to 60 inches. The A horizon is 20 to 50 inches thick. It is brown, dark brown, dark grayish brown, or very dark grayish brown. The A11 horizon and the A12 horizon range from medium acid to mildly alkaline. The A13 horizon ranges from neutral to moderately alkaline. The C horizon is grayish brown, yellowish brown, dark brown, or dark grayish brown. It is

silty clay loam, clay loam, or silt loam and ranges from neutral to moderately alkaline. This horizon has stratification that ranges from very slight to distinct.

Elandco silty clay loam (Ea).—This nearly level soil is on broad flood plains. Areas are oblong to irregular in shape and are 20 to 200 acres in size. Slopes are 0 to 1 percent.

The surface layer is dark grayish-brown, neutral silty clay loam about 38 inches thick. The underlying material is dark-brown, neutral silty clay loam to a depth of 62 inches. It has thin strata or pockets of calcium carbonate and fine sandy loam (fig. 4).

Included with this soil in mapping are spots of Bunyan and Deleon soils. Bunyan soils are in slightly higher areas near the stream channel. Deleon soils are in areas near sloughs. Also included are areas that have a few spots of a soil that is similar to thin Elandco soil but is calcareous throughout. Each included area is less than 20 acres in size. Included soils make up less than 20 percent of any mapped area.

This soil is used mostly as improved pasture. It is flooded one or more times every 4 to 10 years. A few areas are cultivated or used as native range. Runoff is slow, and the hazard of erosion is slight. Capability unit IIw–1; Loamy Bottomland range site.

Figure 4.—**Profile of Elandco silty clay loam showing depth of root penetration.**

Elandco silty clay loam, frequently flooded (En).—This nearly level soil is on broad flood plains. Areas are oblong to irregular in shape and are 20 to 200 acres in size, but they are dominantly about 50 acres. Slopes are 0 to 1 percent. This soil has the profile described as representative of the Elandco series.

Included with this soil in mapping are small spots of Bunyan and Deleon soils. Bunyan soils are in areas near the stream channel. Deleon soils are in areas near sloughs. Also included are areas of a soil that is similar to this Elandco soil but is calcareous throughout. Included areas are less than 20 acres in size and make up less than 20 percent of any mapped area.

This soil is used as pasture or native range. Most pastures are planted to Coastal bermudagrass. This soil is flooded one or more times every 1 to 3 years. Runoff is slow, and the hazard of erosion is slight. Capability unit Vw–1; Loamy Bottomland range site.

Exray Series

The Exray series consists of very shallow to shallow, gently sloping and hilly soils on uplands. These stony soils formed over sandstone bedrock.

In a representative profile the surface layer is dark-brown, slightly acid fine sandy loam about 3 inches thick. From 1 to 20 percent of the surface is covered by sandstone fragments 1 foot to 4 feet in diameter. The subsurface layer is yellowish-brown, slightly acid fine sandy loam about 4 inches thick. The next layer is red, medium acid clay about 11 inches thick. The underlying material is a thick bed of brownish-yellow, strongly cemented sandstone.

Exray soils are well drained. Permeability is moderately slow, and available water capacity is low.

These soils are used as range.

Representative profile of Exray fine sandy loam, in an area of Exray-Bonti complex, 1 to 8 percent slopes, 1.8 miles east of the county courthouse in Eastland on U.S. Highway 80; then 6.1 miles east on Farm Road 570, then 2.8 miles south and east on Farm Road 2461 and 0.7 mile east of the road, in range:

A1—0 to 3 inches, dark-brown (10YR 4/3) fine sandy loam, dark brown (10YR 3/3) moist; weak, fine, subangular blocky structure parting to massive; slightly hard, friable; sandstone fragments, 1 foot to 4 feet across the long axis, cover from 1 to 20 percent of the surface; slightly acid; clear, smooth boundary.

A2—3 to 7 inches, yellowish-brown (10YR 5/4) fine sandy loam, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, friable; slightly acid; clear, smooth boundary.

B2t—7 to 18 inches, red (2.5YR 4/6) clay, dark red (2.5YR 3/6) moist; moderate, fine, angular blocky structure; very hard, very firm; clay films on faces of peds; medium acid; abrupt, irregular boundary.

R—18 to 24 inches, brownish-yellow strongly cemented sandstone.

The solum ranges from 8 to 20 inches in thickness. It ranges from a few to 30 percent, by volume, gravel and stones. The A horizon ranges from 4 to 8 inches in thickness. The A1 horizon is brown, dark brown, pale brown, strong brown, dark grayish brown, reddish yellow, yellowish brown, or dark yellowish brown. It is neutral or slightly acid. The A2 horizon is brown, dark brown, grayish brown, light brownish gray, yellowish brown, or light yellowish brown. It is neutral or slightly acid. The B2t horizon is red, dark red, reddish brown, or dark reddish brown. This horizon is clay loam, sandy clay, or clay. It ranges from 35 to 50 percent clay and is slightly acid or

medium acid. The underlying sandstone ranges from strongly cemented to indurated.

Exray-Bonti complex, 1 to 8 percent slopes (ErD).—This mapping unit is made up of gently sloping to sloping stony soils on upland ridges. Areas are irregular to elongated in shape and are 20 to 400 acres in size. The soils are commonly dissected by drainageways. They are covered by 1 to 20 percent sandstone fragments that are 1 foot to 4 feet in diameter. This mapping unit is about 61 percent Exray stony fine sandy loam, 24 percent Bonti stony fine sandy loam, and 15 percent other soils or rock outcrop. These soils cannot be shown separately at the scale mapped, because they are too intricately intermingled or the areas are too small.

The Exray soil has the profile described as representative of the Exray series.

The Bonti soil is in elongated areas on lower slopes, mainly near drainageways. This soil has a surface layer of brown fine sandy loam about 7 inches thick. The subsurface layer is pale-brown fine sandy loam about 3 inches thick. The next layer is yellowish-red sandy clay about 20 inches thick. The underlying material is cemented sandstone.

Included with these soils in mapping are small areas of Owens and Truce soils and rock outcrop. Owens soils are in irregularly shaped areas about 2 acres in size and are mostly on the crest of low knolls. Rock outcrops is on elongated ledges on upper slopes. Truce soils are in irregularly shaped areas about 1 acre to 15 acres in size and are on upper side slopes or knolls. Included areas make up less than 20 percent of the mapped area.

The soils in this mapping unit are used as range. About 85 percent of the acreage is too stony for cultivation, and most of the remaining 15 percent is inaccessible or is otherwise not suited to cultivation. Runoff is rapid, and the hazard of erosion is moderate. Capability unit VIs–1; Sandy Loam range site.

Exray stony soils, hilly (ESE).—This mapping unit is made up of stony soils that have 5 to 20 percent sandstone fragments 1 foot to 4 feet in diameter on the surface. Mapped areas are commonly about 37 percent Exray soils, but the range is 20 to 60 percent, and 51 percent other soils that are similar to Exray soils, but they are deeper over sandstone or shale or do not have lower layers of clay. These soils do not occur in all areas. The remaining 12 percent is rock outcrop. Areas are irregular in shape and are 10 to 500 acres in size. Slopes range from about 10 to 30 percent but are mainly about 20 percent. Areas of this mapping unit are much larger and are more variable in composition than are areas of most other mapping units in the county. Mapping has been controlled well enough, however, for the anticipated use of the soils.

Exray soils have a surface layer of dark-brown, slightly acid fine sandy loam about 3 inches thick. The subsurface layer is yellowish-brown, slightly acid fine sandy loam about 4 inches thick. The next layer is red, medium acid clay about 11 inches thick. The underlying material is thick, brownish-yellow, strongly cemented sandstone.

Included with these soils in mapping are small areas of Owens soils on midslopes that generally have a southern exposure. Included areas are mainly less than 10 acres in size and make up 5 to 20 percent of a mapped area.

The soils in this mapping unit are suitable only as range or wildlife habitat or for recreational uses (fig. 5). Runoff is rapid following heavy rain, and the hazard of erosion is severe. Capability unit VIIs–1; Sandstone Hills range site.

Hassee Series

The Hassee series consists of deep, nearly level to gently sloping, loamy soils on uplands. These soils formed in calcareous clayey sediment.

In a representative profile the surface layer is grayish-brown, neutral loam about 10 inches thick. The subsurface layer is light-gray, neutral loam about 4 inches thick. The next layer is dark-gray, neutral clay about 18 inches thick. Below this is about 14 inches of grayish-brown, calcareous clay that has a few medium calcium carbonate concretions. The underlying material is light brownish-gray, calcareous clay loam to a depth of about 72 inches.

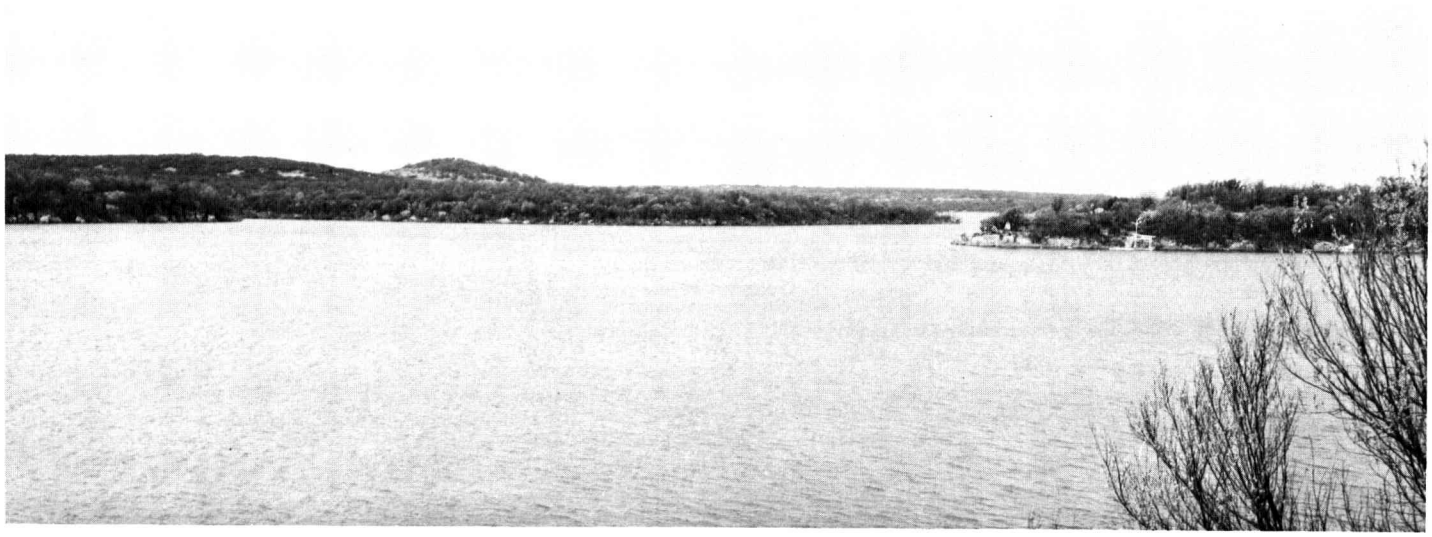

Figure 5.—Lake Cisco in area of Exray stony soils, hilly.

Hassee soils are somewhat poorly drained. Permeability is very slow, and available water capacity is high. Runoff is very slow to slow. These soils receive additional water as runoff from soils in higher lying areas.

These soils are used mostly for crops. A few areas are used as range.

Representative profile of Hassee loam, 0 to 1 percent slopes, about 7 miles north and west of Gorman on Farm Road 2689 to the Kokomo Baptist Church and 0.5 mile west of the church on this road, then 0.5 mile north, 0.5 mile west, 0.4 mile north on a county road and 330 feet east of the road, in a field:

Ap—0 to 10 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; massive; very hard, friable; neutral; clear, smooth boundary.

A2g—10 to 14 inches, light-gray (10YR 7/1) loam, gray (10YR 5/1) moist; massive; very hard, friable; neutral; abrupt, slightly wavy boundary.

B21tg—14 to 22 inches, dark-gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; few, fine, faint, yellowish-brown mottles; coarse, medium blocky structure; extremely hard, extremely firm; continuous clay films on faces of peds; neutral; gradual, smooth boundary.

B22tg—22 to 32 inches, dark-gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; few, fine, faint, yellowish-brown mottles; moderate, medium, blocky structure; very hard, very firm; continuous clay films on faces of peds; few, small, siliceous pebbles; few ferromanganese concretions; neutral; gradual, smooth boundary.

B3tgca—32 to 46 inches, grayish-brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate, fine, blocky structure; very hard, very firm; few small concretions of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

Cca—46 to 72 inches, light brownish-gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) moist; massive; very hard, very firm; common concretions and soft masses of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 40 to 72 inches in thickness. Calcium carbonate masses or concretions are at a depth of 28 to 50 inches. The A horizon is 8 to 16 inches thick and is neutral or slightly acid. The A1 horizon is very dark grayish brown, dark grayish brown, or grayish brown. The A2g horizon is light gray, gray, grayish brown, or light brownish gray. The B2tg horizon is dark gray, very dark gray, or very dark grayish brown. It is 45 to 60 percent clay and ranges from neutral to moderately alkaline. Some profiles have few to common, fine, reddish or yellowish mottles. The B3tg horizon and the Cca horizon are light gray, gray, light brownish gray, or grayish brown.

Hassee loam, 0 to 1 percent slopes (HaA).—This nearly level soil is in depressional areas on uplands. Areas are oval to irregular in shape and are 5 to 25 acres in size. Slopes are plane to concave. This soil has the profile described as representative of the Hassee series.

Included with this soil in mapping are spots of Thurber soils. Included areas are less than 15 acres in size and make up less than 15 percent of any mapped area.

This soil is used mostly for crops or as range. Some areas are ponded for a short period following rain. Runoff is very slow, and the hazard of erosion is slight. Capability unit IIIw–1; Claypan range site.

Hassee loam, 1 to 2 percent slopes (HaB).—This gently sloping soil is in depressional areas on uplands. Areas are oval or irregular in shape and are 5 to 100 acres in size. Slopes are plane to concave.

The surface layer is dark grayish-brown, neutral loam about 4 inches thick. The subsurface layer is light-gray, neutral loam about 4 inches thick. The next layer is about 42 inches of very dark grayish-brown, neutral clay that has a few, fine, faint, yellowish-brown mottles. The underlying material is light brownish-gray, calcareous clay loam to a depth of 62 inches.

Included with this soil in mapping are spots of Thurber soils. Included areas are less than 10 acres in size and make up less than 15 percent of any mapped area.

This soil is used mostly for crops or as range. Runoff is slow, and the hazard of erosion is slight. Capability unit IIIe–1; Claypan range site.

Hensley Series

The Hensley series consists of shallow, gently sloping, loamy soils on uplands. These soils formed over thick beds of hard limestone.

In a representative profile the surface layer is reddish-brown loam about 4 inches thick. About 2 percent of the surface layer is made up of, and about 5 percent of the surface is covered by, flat limestone fragments 6 to 30 inches across the long axis. The next layer is dark reddish-brown clay about 12 inches thick. The underlying material is limestone bedrock.

Hensley soils are well drained. Permeability is slow, and available water capacity is low.

These soils are used mostly as range. A few areas are in crops.

Representative profile of Hensley loam in an area of Hensley stony loam, 1 to 5 percent slopes, about 4.5 miles southeast of Carbon on Texas Highway 6, then 2.2 miles south on a county road to an intersection, 0.4 mile south on the same county road and 81 feet west of the road, in a pasture:

A1—0 to 4 inches, reddish-brown (5YR 4/4) loam, dark reddish brown (5YR 3/4) moist; weak, subangular blocky structure parting to weak granular; hard, friable; flat limestone fragments, 6 to 30 inches in diameter, make up about 2 percent of the solum and cover approximately 5 percent of the surface; numerous roots; slightly acid; clear, smooth boundary.

B2t—4 to 16 inches, dark reddish-brown (2.5YR 3/4) clay, dark reddish brown (2.5YR 3/4) moist; moderate, medium, blocky structure; extremely hard, very firm; common distinct clay films on faces of peds; neutral; abrupt, smooth boundary.

R—16 to 18 inches, hard limestone bedrock.

The solum ranges from 10 to 20 inches in thickness. Flat limestone fragments that are 6 to 30 inches across the long axis cover 0 to about 20 percent of the surface. The A horizon is 4 to 10 inches thick. It is reddish brown or brown and is neutral or slightly acid. The B2t horizon is reddish-brown, dark reddish-brown, red, or dark-red clay or clay loam. It is 35 to 50 percent clay and is neutral or mildly alkaline.

Hensley loam, 1 to 3 percent slopes (HeB).—This gently sloping soil is on broad uplands. Areas are irregular to oval in shape and are 20 to 100 acres in size.

The surface layer is reddish-brown loam about 5 inches thick. The next layer is reddish-brown clay loam about 11 inches thick. The underlying material is limestone bedrock.

Included with this soil in mapping are spots of Hensley stony loam and spots of Lindy soils. Hensley stony loam is mostly on low knolls. Lindy soils are mostly in slightly lower areas. Included areas are less than 10 acres in size and make up less than 20 percent of any mapped area. Any one included soil makes up less than 10 percent.

This soil is used mostly as range. A few areas are cultivated. Runoff is medium, and the hazard of erosion is moderate. Capability unit IIIe–6; Redland range site.

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Hensley stony loam, 1 to 5 percent slopes (HnC).—This gently sloping soil is on broad uplands. Areas are irregular in shape and are 10 to 500 acres in size. The soil is covered by 5 to 20 percent flat limestone fragments that are 1 foot to 3 feet across the long axis. It has the profile described as representative of the Hensley series (fig. 6).

Included with this soil in mapping are spots of Hensley loam and spots of Lindy and Tarrant soils. Hensley loam and Lindy soils are in areas near the center of broad mapped areas. Tarrant soils are mostly in areas on or near the break of a ridge. Included areas are less than 15 acres in size and make up less than 20 percent of any mapped area. Any one included soil makes up less than 15 percent.

This soil is used as range. Runoff is medium, and the hazard of erosion is slight. Capability unit VIs–1; Redland range site.

Lamar Series

The Lamar series consists of moderately deep to deep, gently sloping to sloping, loamy soils on uplands. These calcareous soils formed in limy colluvial sediment.

In a representative profile the surface layer is brown loam about 15 inches thick. The next layer is light yellowish-brown friable loam about 30 inches thick. The underlying material is brownish-yellow massive loam to a depth of 60 inches.

Lamar soils are well drained. Permeability is moderate, and available water capacity is medium.

These soils are used mostly as range.

Representative profile of Lamar loam, 2 to 5 percent slopes, 3.8 miles north of Desdemona on Texas Highway 16, then 1 mile east on a county road, 1.3 miles north and east on another county road to an intersection, then 2.5 miles north on another county road and 30 feet east of the road, in range:

A1— 0 to 15 inches, brown (10YR 5/3) loam, brown (10YR 4/3) moist; moderate, fine, subangular blocky and granular structure; hard, friable; few soft masses of white calcium carbonate; few films and threads of calcium carbonate in the lower part; 8 percent calcium carbonate equivalent; calcareous; moderately alkaline; gradual, smooth boundary.

B2ca—15 to 45 inches, light yellowish-brown (10YR 6/4) loam, yellowish brown (10YR 5/4) moist; moderate, fine, subangular blocky structure; hard, friable; many medium pores; common films and threads of calcium carbonate; 20 percent calcium carbonate equivalent; calcareous; moderately alkaline; gradual, smooth boundary.

Cca—45 to 60 inches, brownish-yellow (10YR 6/6) loam, yellowish brown (10YR 5/6) moist; massive; hard, friable; few soft masses of calcium carbonate; 10 percent calcium carbonate equivalent; calcareous; moderately alkaline.

The solum ranges from 20 to 50 inches in thickness. At a depth of 10 to 40 inches, the soil ranges from loam to silty clay loam that is 18 to 25 percent clay and less than 15 percent material coarser than very fine sand. Films, threads, and concretions of calcium carbonate range from barely discernable to an estimated 15 to 20 percent, by volume, but they amount to less than 40 percent of the calcium carbonate equivalent. The A horizon is dark grayish brown, grayish brown, light brownish gray, pale brown, brown, light yellowish brown, olive brown, yellowish brown, or dark yellowish brown. The B horizon and the C horizon are dark grayish brown, grayish brown, light brownish gray, very pale brown, brown, light yellowish brown, brownish yellow, olive yellow, yellowish brown, light olive brown, or dark yellowish brown. In this survey area these soils are outside the range of the Lamar series in that they have a slightly thicker A horizon and are on foot slopes. Their behavior, use, and management are similar to those of soils of the Lamar series.

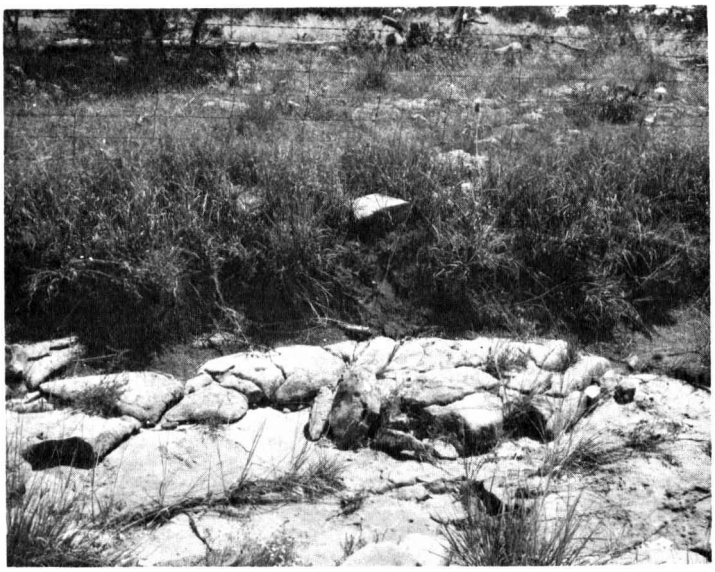

Figure 6.—**Area of a Hensley stony loam underlain by thick bed of Pennsylvanian limestone.**

Lamar loam, 2 to 5 percent slopes (LaC).—This gently sloping soil is on broad foot slopes. Areas are irregular to oblong in shape and are 15 to 50 acres in size, but they are dominantly about 30 acres. This soil has the profile described as representative of the Lamar series.

Included with this soil in mapping are some small areas of Brackett and Menard soils on knolls. Included areas make up less than 15 percent of any mapped area. Any one included soil makes up less than 10 percent.

This soil is used mostly as native range. A few small areas are in improved pasture. Runoff is medium, and the hazard of erosion is moderate. Capability unit IIIe–7; Clay Loam range site.

Lamar loam, 5 to 8 percent slopes (LaD).—This sloping soil is on breaks. Areas are irregular in shape and are 10 to 100 acres in size. Runoff received from soils on upper slopes has formed drainageways in areas downslope. The drainageways are 3 to 6 feet deep and are at intervals of about 1,000 feet.

The surface layer is yellowish-brown, calcareous loam about 8 inches thick. The next layer is very pale brown, calcareous loam about 34 inches thick. These layers have a few small soft concretions and masses of calcium carbonate throughout (fig. 7). The underlying material is very pale brown, calcareous sandy clay loam that is massive.

Included with this soil in mapping are spots of Brackett, Cisco, and Pedernales soils. These soils are in areas similar to those of this Lamar soil. Included areas are less than 15 acres in size and make up less than 25 percent of any mapped area.

This soil is better suited to use as range than to most other uses. A few small areas are cultivated. Runoff is medium, and the hazard of erosion is severe. Capability unit IVe–2; Clay Loam range site.

Figure 7.—**Profile of a Lamar loam showing soft masses of calcium carbonate.**

Leeray Series

The Leeray series consists of deep, nearly level to gently sloping, clayey soils on uplands. These soils formed in calcareous clay.

In a representative profile the surface layer is calcareous clay about 54 inches thick. It is dark grayish brown in the upper 6 inches, very dark grayish brown in the next 12 inches, and dark brown in the lower 36 inches. This layer has deep cracks when it is dry and prominent grooved slickensides. The next layer is brown, calcareous clay to a depth of 64 inches.

Leeray soils are well drained. These soils have a gilgai microrelief. They crack and take in water readily when dry, but permeability is very slow when they are wet. Available water capacity is high.

These soils are used mostly for crops or as range.

Representative profile of Leeray clay, 1 to 3 percent slopes, 4.8 miles west on Farm Road 2945 from its intersection with U.S. Highway 80 on the western edge of Cisco, 285 feet north of the highway, in range:

A11—0 to 6 inches, dark grayish-brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate, fine, subangular blocky and granular structure; very hard; very firm; many fine roots; few, fine, rounded siliceous pebbles; calcareous; moderately alkaline; clear, wavy boundary.

A12—6 to 18 inches, very dark grayish-brown (10YR 3/2) clay, very dark grayish brown (10YR 3/2) moist; moderate, fine, angular blocky structure; extremely hard, very firm; many fine roots; few, fine, rounded siliceous pebbles and limestone fragments; few soft masses of calcium carbonate in lower part; calcareous; moderately alkaline; gradual, wavy boundary.

A13—18 to 54 inches, dark-brown (10YR 3/3) clay, dark brown (10YR 3/3) moist; distinct parallelepipeds that have the long axis tilted 30 degrees from the horizontal parting to moderate fine blocky structure; extremely hard, very firm; few fine roots; prominent grooved slickensides that intersect; few fine siliceous pebbles; few strongly cemented concretions and few soft powdery masses of calcium carbonate; few streaks of grayer soil along closed cracks; calcareous; moderately alkaline; gradual, wavy boundary.

AC—54 to 64 inches, brown (7.5YR 5/4) clay, dark brown (7.5YR 4/4) moist; moderate, medium, blocky structure; extremely hard, very firm; prominent grooved slickensides that intersect; about 5 percent soft powdery masses of calcium carbonate; many films and threads of calcium carbonate; few fine ferromanganese concretions; calcareous; moderately alkaline.

The solum ranges from 40 to 90 inches in thickness. When the soils are dry, cracks as much as 1 inch wide extend from the surface to a depth of more than 20 inches. Intersecting slickensides begin at a depth of about 16 to 24 inches. The gilgai microrelief is microknolls and microdepressions 8 to 23 feet apart. In undisturbed areas the microknolls are 3 to 12 inches higher than the microdepressions. The extremes of amplitude, or waviness, of the boundary between the A horizon and the AC horizon are about 15 to 50 inches from the center of the microknoll to the center of the microdepression. The A horizon is grayish brown, dark grayish brown, very dark grayish brown, brown, dark brown, or very dark brown. The AC horizon is grayish brown, dark grayish brown, dark brown, pale brown, brown, dark yellowish brown, olive brown, or light olive brown. This horizon has few to many concretions or soft powdery masses of calcium carbonate. The Cca horizon, where present, is brown, light brown, pale brown, very pale brown, light brownish gray, reddish brown, light olive brown, light yellowish brown, dark yellowish brown, or yellowish brown. In some places the Cca horizon is very thin or is lacking, and the profile is underlain by shale or limestone.

Leeray clay, 0 to 1 percent slopes (LeA).—This nearly level soil is in broad valleys on uplands. Areas are irregular in shape and are 10 to 100 acres in size. In undisturbed areas the gilgai microrelief is prominent (fig. 8).

The surface layer is dark grayish-brown, calcareous clay in the upper 8 inches and dark-brown, calcareous clay in the lower 12 inches. The next layer is brown, calcareous, blocky clay about 30 inches thick. The underlying material is pale-brown shaly clay that has numerous calcium carbonate concretions to a depth of 62 inches.

Included with this soil in mapping are spots of Bolar and Thurber soils in areas similar to those of Leeray soils. Included areas are 2 to 8 acres in size. These soils make up as much as 25 percent of some mapped areas.

This soil is mostly cultivated. The rest is in native range. Runoff is slow, and the hazard of erosion is slight. Capability unit IIIs-1; Clay Flat range site.

Leeray clay, 1 to 3 percent slopes (LeB).—This gently sloping soil is in broad valleys and in areas of wide divides or mesas. Areas are irregular in shape and are 10 to 200 acres in size. This soil has the profile described as representative of the Leeray series.

Included with this soil in mapping are spots of Bolar and Thurber soils. Bolar soils are on low knolls. Thurber soils

Figure 8.—**Gilgai ponding of rainfall on Leeray clay, 0 to 1 percent slopes.**

are in areas similar to those of Leeray soils. Included areas are less than 10 acres in size and make up less than 20 percent of any mapped area.

This soil is mostly cultivated. Runoff is medium, and the hazard of erosion is moderate. Capability unit IIe–5; Clay Flat range site.

Lindy Series

The Lindy series consists of moderately deep, gently sloping, loamy soils on uplands. These soils formed over thick beds of hard limestone.

In a representative profile the surface layer is brown loam about 6 inches thick. The next layer is red, neutral clay about 22 inches thick. The underlying material is limestone bedrock.

Lindy soils are well drained. Permeability is slow, and available water capacity is medium.

These soils are used mostly as range. A few areas are in crops.

Representative profile of Lindy loam, 1 to 3 percent slopes, 4 miles south of Carbon on Farm Road 1027, then 0.3 mile south on a county road and 120 feet west of the road, in range:

A1—0 to 6 inches, brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; weak, granular structure and weak, fine subangular blocky structure; hard, friable; common roots; neutral; clear, smooth boundary.

B21t—6 to 14 inches, red (2.5YR 4/6) clay, dark red (2.5YR 3/6) moist; moderate, medium, blocky structure; very hard, very firm; neutral; gradual, smooth boundary.

B22t—14 to 28 inches, red (2.5YR 4/6) clay, red (2.5YR 4/6) moist; strong, fine, blocky structure; very hard, very firm; common distinct clay films on surface of peds; few, small, ferromanganese and siliceous pebbles; neutral; abrupt, smooth boundary.

R—28 to 30 inches, strongly cemented limestone bedrock.

The solum ranges from 20 to 40 inches in thickness. It is 0 to 10 percent, by volume, coarse fragments and gravel and is neutral or slightly acid. The A horizon is 5 to 16 inches thick. It is dark grayish brown, brown, or dark brown. The B2t horizon is yellowish red, reddish brown, or red clay or clay loam.

Lindy loam, 1 to 3 percent slopes (LnB).—This gently sloping soil is on broad uplands. Areas are irregular in shape and are 20 to 200 acres in size.

Included with this soil in mapping are some small areas of Hensley, Leeray, and Thurber soils. These soils are all in depressional areas, but Hensley soils are shallower to limestone. Also included are small areas of a soil that is similar to this Lindy soil but has an underlying material of calichelike material instead of hard limestone. Included areas are less than 20 acres in size and make up less than 20 percent of any mapped area. Any one included soil makes up less than 15 percent.

This soil is used mostly as range. A few areas are cultivated. Runoff is medium, and the hazard of erosion is moderate. Capability unit IIIe–1; Deep Redland range site.

May Series

The May series consists of deep, nearly level to gently sloping, loamy soils on uplands. These soils formed in loamy alluvial sediment.

In a representative profile the surface layer is brown, slightly acid fine sandy loam about 14 inches thick. The next layer is brown and strong-brown, neutral sandy clay loam about 16 inches thick. Below this is light-brown, mildly alkaline sandy clay loam about 18 inches thick. The underlying material is very pale brown, calcareous loam to a depth of 60 inches.

May soils are well drained. Permeability is moderate, and available water capacity is medium. These soils receive additional water as runoff from soils in higher lying areas.

These soils are used mostly for crops. A few areas are in native range or pasture.

Representative profile of May fine sandy loam, 1 to 3 percent slopes, 10 miles east of Ranger on Interstate 20 to its intersection with Texas Highway 16, then 1.4 miles east on Interstate 20, 8.5 miles south on a county road to an intersection, then 0.1 mile east on another county road and 30 feet north from a gate, in a pasture:

Ap—0 to 14 inches, brown (10YR 4/3) fine sandy loam, dark brown (10YR 3/3) moist; weak, fine, subangular blocky structure; hard, friable; slightly acid; clear, smooth boundary.

B21t—14 to 24 inches, brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) moist; moderate, fine, subangular blocky structure; hard, firm; few thin clay films on faces of peds; neutral; gradual, smooth boundary.

B22t—24 to 30 inches, strong-brown (7.5YR 5/6) sandy clay loam, strong brown (7.5YR 5/6) moist; moderate, fine, subangular blocky structure; hard, firm; neutral; gradual, smooth boundary.

B3t—30 to 48 inches, light-brown (7.5YR 6/4) sandy clay loam, brown (7.5YR 5/4) moist; weak, fine, subangular blocky structure; hard; mildly alkaline; gradual, smooth boundary.

Cca—48 to 60 inches, very pale brown (10YR 7/3) loam, pale brown (10YR 6/3) moist; massive; slightly hard, friable; common medium films and threads and a few soft bodies of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 40 to 70 inches in thickness. Films, threads or soft masses of calcium carbonate are at a depth of 36 to 62 inches. The A horizon is 10 to 18 inches thick. It ranges from brown, grayish brown, or dark grayish brown to dark yellowish brown or yellowish brown and from slightly acid to mildly alkaline. The Bt horizon is brown, dark grayish brown, strong brown, yellowish brown, light brown, or light yellowish brown. It is neutral or mildly alkaline. The Cca horizon is very pale brown, light gray, or white.

May fine sandy loam, 0 to 1 percent slopes (MfA).—This nearly level soil is on narrow uplands. Most areas are on the first bench above flood plains or within drainageways. They are irregular to oblong in shape and are 10 to 50 acres in size, but they are dominantly about 20 acres. Slopes are plane to concave.

The surface layer is dark grayish-brown, neutral fine sandy loam about 12 inches thick. The next layer is dark grayish-brown, neutral sandy clay loam about 25 inches thick. Below this is brown, calcareous sandy clay loam about 8 inches thick. The underlying material is light-gray, calcareous loam to a depth of 60 inches.

Included with this soil in mapping are spots of Bunyan, Cisco, Elandco, and Hassee soils. Bunyan and Elandco soils are on flood plains. Cisco soils are in positions similar to those of May soils, but they have yellowish-red lower layers. Hassee soils are in small depressional areas. Included areas are less than 10 acres in size and make up less than 20 percent of any mapped area. Any one included soil makes up less than 15 percent.

This soil is mostly cultivated. It is well suited to most crops commonly grown in the county. A few areas are in pasture or native range. Runoff is slow, and the hazard of erosion is slight. Capability unit I–1; Sandy Loam range site.

May fine sandy loam, 1 to 3 percent slopes (MfB).—This soil is along small streams or drainageways, in areas only slightly higher than the streambank or drainageway. Areas are oblong in shape and are 10 to 50 acres in size. This soil has the profile described as representative of the May series.

Included with this soil in mapping are spots of Bunyan, Cisco, Menard, and Pedernales soils. Bunyan soils are in narrow strips along flood plains. Cisco soils are in positions similar to those of May soils, but they have yellowish-red lower layers. Menard and Pedernales soils are on slight ridges or knolls. Also included are small areas of a soil that is similar to this May soil but has secondary carbonates within 20 to 36 inches of the surface. Included areas are less than 20 acres in size and make up less than 30 percent of any mapped area. Any one included soil makes up less than 15 percent.

This soil is mostly cultivated. It is well suited to most crops commonly grown in the county. A few areas are in pasture or native range. Runoff is medium, and the hazard of erosion is moderate. Capability unit IIe–1; Sandy Loam range site.

Menard Series

The Menard series consists of moderately deep to deep, gently sloping, loamy soils on uplands. These soils formed in calcareous loamy sediment.

In a representative profile the surface layer is brown; neutral fine sandy loam about 6 inches thick. The next layer is yellowish-red, neutral sandy clay loam about 23 inches thick. Below this is about 2 inches of yellowish-red, calcareous sandy clay loam that has a few soft masses and concretions of calcium carbonate. The underlying material is very pale brown, calcareous sandy clay loam to a depth of 64 inches.

Menard soils are well drained. Permeability is moderate, and available water capacity is medium.

These soils are used mostly as range. A few areas are in crops.

Representative profile of Menard fine sandy loam, 1 to 3 percent slopes, about 4.5 miles north of Pioneer on Farm Road 569 to its intersection with Farm Road 2731, then 0.6 mile north on Farm Road 569 and 747 feet east, in range:

A1—0 to 6 inches, brown (10YR 4/3) fine sandy loam, dark brown (10YR 3/3) moist; weak, granular structure; hard, friable; neutral; clear, smooth boundary.

B21t—6 to 14 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; weak, medium, subangular blocky structure; very hard, firm; few thin clay films on faces of peds; many fine pores; neutral; gradual, smooth boundary.

B22t—14 to 29 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; weak, coarse, subangular blocky structure; very hard, firm; few thin clay films on faces of peds; few fine pores; neutral; gradual, wavy boundary.

B3ca—29 to 31 inches, yellowish-red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; few, medium, distinct, brown mottles; weak, medium, subangular blocky structure; very hard, firm; a few soft masses and concretions of calcium carbonate; calcareous; moderately alkaline; gradual, wavy boundary.

Cca—31 to 64 inches, very pale brown (10YR 8/4) sandy clay loam, very pale brown (10YR 7/4) moist; massive; hard, friable; approximately 40 percent calcium carbonate concretions; calcareous; moderately alkaline.

The solum ranges from 30 to 50 inches in thickness. The A horizon is 6 to 10 inches thick. It is brown or grayish brown and is neutral or mildly alkaline. The B2t horizon is reddish brown, yellowish red, or red. It is 25 to 35 percent clay and ranges from slightly acid to mildly alkaline. The B3ca horizon is calcareous and is at a depth of 20 to 36 inches.

Menard fine sandy loam, 1 to 3 percent slopes (MnB).—This gently sloping soil is on low knolls. Areas are irregular in shape and average about 30 acres in size. Slopes are plane to weakly convex. This soil has the profile described as representative of the Menard series.

Included with this soil in mapping are spots of Cisco, Lamar, and Pedernales. Cisco soils are on foot slopes or in shallow valleys. Lamar soils are on the peak of small, circular knolls. Pedernales soils are in lower areas that have convex slopes. Included areas are less than 10 acres in size and make up less than 20 percent of any mapped area.

This soil is used mostly as range. Runoff is medium, and the hazard of erosion is slight. Capability unit IIe–3; Sandy Loam range site.

Menard fine sandy loam, 3 to 5 percent slopes (MnC).—This gently sloping soil is on upland side slopes and foot slopes. Areas are irregular in shape and are 10 to 50 acres in size.

The surface layer is grayish-brown, neutral fine sandy loam about 8 inches thick. The next layer is reddish-brown, neutral sandy clay loam about 21 inches thick. Below this is about 2 inches of yellowish-red, calcareous sandy clay loam that has a few soft masses and concretions of calcium carbonate. The underlying material is very pale brown, calcareous sandy clay loam to a depth of 60 inches.

Included with this soil in mapping are spots of Cisco and Pedernales soils. Cisco soils are on lower foot slopes. Pedernales soils are on upper slopes. Included areas are less than 5 acres in size and make up less than 20 percent of any mapped area.

This soil is used mostly as range. A few areas are used for crops or pasture. Runoff is medium, and the hazard of erosion is moderate. Capability unit IIIe–4; Sandy Loam range site.

Nimrod Series

The Nimrod series consists of deep, nearly level to gently undulating, sandy soils on uplands. These soils formed in sandy and loamy sediment that has been reworked by wind.

In a representative profile the surface layer is dark grayish-brown, slightly acid fine sand about 6 inches thick. The subsurface layer is very pale brown, slightly acid fine sand about 24 inches thick. The next layer is mottled, brownish-yellow and reddish-yellow, strongly acid sandy clay loam about 18 inches thick. Below this is mottled, light-gray, strongly acid sandy clay loam to a depth of 72 inches.

Nimrod soils are moderately well drained. Permeability is moderately slow, and available water capacity is low. The surface layer is rapidly permeable, and a perched water table forms above the less permeable lower layers following periods of rain.

These soils are used mostly for crops and pasture. A few areas are in native range.

Representative profile of Nimrod fine sand, 0 to 5 percent slopes, 6 miles south of the county courthouse in Eastland on Texas Highway 6, then 3 miles east on Farm Road 2563, 1 mile south on a county road, then 0.3 mile east on private lane, and 60 feet north, in range:

A1—0 to 6 inches, dark grayish-brown (10YR 4/2) fine sand, very dark grayish brown (10YR 3/2) moist; single grained; loose; slightly acid; clear, smooth boundary.

A2—6 to 30 inches, very pale brown (10YR 7/4) fine sand, light yellowish brown (10YR 6/4) moist; single grained; loose; slightly acid; abrupt, wavy boundary.

B21t—30 to 40 inches, brownish-yellow (10YR 6/6) sandy clay loam, yellowish brown (10YR 5/6) moist; common, coarse, distinct, light brownish-gray (10YR 6/2), and red (2.5YR 4/6) mottles; moderate, fine, subangular blocky structure; very hard, firm; few thin clay films on faces of peds; strongly acid; gradual, smooth boundary.

B22t—40 to 48 inches, reddish-yellow (7.5YR 6/6) sandy clay loam, strong brown (7.5YR 5/6) moist; common, coarse, distinct mottles of pinkish gray (7.5YR 6/2); weak, medium, subangular blocky structure; very hard, firm; few thin clay films on faces of peds; strongly acid; gradual, smooth boundary.

B3—48 to 72 inches, light-gray (10YR 7/2) sandy clay loam, light brownish gray (10YR 6/2) moist; common, medium and coarse, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; very hard, firm; strongly acid.

The solum ranges from 60 to 80 inches in thickness. The A horizon is 20 to 40 inches thick. It is dark grayish brown, grayish brown, brown, pale brown, or very pale brown and ranges from medium acid to neutral. The B2t horizon is brownish yellow, yellowish brown, reddish yellow, or light gray and is mottled in shades of brown, pink, red, and gray. This horizon is 29 to 35 percent clay and is strongly acid or medium acid.

Nimrod fine sand, 0 to 5 percent slopes (NmC).—This nearly level to gently undulating soil is on broad uplands. Areas are irregular in shape and are 15 to 300 acres in size, but they are mainly about 30 acres. The surface is concave, convex, or plane, and slopes average about 2 percent.

Included with this soil in mapping are small areas of Cisco, Demona, and Patilo soils. Cisco soils are in shallow valleys or on foot slopes, and Demona soils are in areas similar to those of Nimrod soils. Patilo soils are on slight hummocky knolls. Included areas are less than 20 acres in size and make up less than 20 percent of any mapped area. Any one included soil makes up less than 15 percent of a mapped area.

This soil is mostly cultivated or used as improved pasture. Some areas are in native range, and a few areas are in fruit and nut orchards. Runoff is slow. The hazard of soil blowing is severe, and the hazard of erosion is slight. Capability unit IIIe–2; Sandy range site.

Owens Series

The Owens series consists of shallow, gently sloping and hilly, clayey soils on uplands. These soils formed in beds of clayey shale.

In a representative profile the surface layer is light olive-brown, calcareous clay about 5 inches thick. The next layer is light yellowish-brown, calcareous clay about 13 inches thick. The underlying material is light olive-brown, calcareous shaly clay to a depth of about 36 inches.

Owens soils are well drained. Permeability is very slow, and available water capacity is low.

These soils are used mostly as range. A few small areas are cultivated.

Representative profile of Owens clay, 1 to 3 percent slopes, 4.25 miles east of the county courthouse in Eastland on Farm Road 870, 5.25 miles southeast on Farm Road 2214, then 1.5 miles north on a county road and 99 feet west of the road, in range:

A1—0 to 5 inches, light olive-brown (2.5Y 5/4) clay, olive brown (2.5Y 4/4) moist; weak, fine, blocky structure; very hard, very firm; few roots; few limestone fragments on surface; calcareous; moderately alkaline; gradual, smooth boundary.

B2ca—5 to 18 inches, light yellowish-brown (2.5Y 6/4) clay, light olive brown (2.5Y 5/4) moist; few distinct mottles of red and olive yellow; moderate to strong, medium, blocky structure; extremely hard, very firm; few roots; few soft masses of calcium carbonate, approximately 2 percent; calcareous; moderately alkaline; gradual, smooth boundary.

C—18 to 36 inches, light yellowish-brown (2.5Y 6/4) shaly clay, light olive brown (2.5Y 5/4) moist; massive; extremely hard, extremely firm; very few roots; calcareous; moderately alkaline.

The solum ranges from about 12 to 20 inches in thickness. It is 40 to 50 percent clay. In places the surface is covered by sandstone, limestone, and ironstone. The A horizon is 4 to 10 inches thick and is light olive brown or light brownish gray. The Bca horizon is 8 to 13 inches thick and is olive, brownish yellow, or light yellowish brown. The C horizon is olive, olive brown, or light olive brown.

Owens clay, 1 to 3 percent slopes (OcB).—This gently sloping soil is on low knolls or foot slopes. Areas are circular to irregular in shape and are 10 to 50 acres in size, but they are dominantly about 15 acres. This soil has the profile described as representative of the Owens series.

Included with this soil in mapping are spots of Owens stony soils, hilly, and small spots of Tarrant stony clay, 1 to 8 percent slopes. Also included are small areas of an

Owens clay that has slopes of 3 to 5 percent. Included areas make up less than 20 percent of any mapped area. Any one included soil makes up less than 15 percent.

This soil is used mostly as range. A few small areas are cultivated. Runoff is rapid, and the hazard of erosion is severe. Capability unit IVe–1; Shallow Clay range site.

Owens stony soils, hilly (OWE).—This mapping unit is made up of shallow stony soils on escarpments and in hilly areas 125 to 1,000 feet wide. It is about 75 percent Owens soils and about 25 percent shale outcrop and soils that are similar to Owens soils but are less than 10 inches deep to shale. Owens soils and shallow gullies are in all mapped areas, but the soils associated with Owens soils are not. The soils are covered by 5 to 20 percent sandstone, limestone, or ironstone fragments that are 6 to 30 inches in diameter. Slopes are dominantly 10 to 20 percent but are as much as 30 percent. In areas where these soils are on both sides of a hill, the mapping units are wider. Areas of this mapping unit are much larger and are more variable in composition than are areas of most other mapping units in the county. Mapping has been controlled well enough, however, for the anticipated use of the soils.

An Owens soil in this mapping unit has a surface layer, about 4 inches thick, of light olive-brown, calcareous clay that has granular and blocky structure and common roots. The next layer is about 8 inches of light yellowish-brown blocky clay that has a few calcium carbonate concretions. The underlying material is massive, light olive-brown shaly clay to a depth of about 40 inches.

Included with these soils in mapping are spots of Owens clay, Tarrant stony soils, hilly, and Truce soils, eroded. The Tarrant soils are on ridgetops. The Owens soil and the Truce soils are on lower slopes. Included areas are less than 10 acres in size and make up less than 30 percent of any mapped area.

The soils in this mapping unit are used only as range. They support very little vegetation and are so hilly or stony that improvement by mechanical or management practices is difficult. Runoff is rapid, and the hazard of erosion is severe. Capability unit VIIs–1; Shallow Clay range site.

Patilo Series

The Patilo series consists of deep, nearly level to gently sloping, sandy soils on uplands. These soils formed in thick sandy beds that have been reworked by wind.

In a representative profile the surface layer is brown, neutral fine sand about 6 inches thick. The subsurface layer is very pale brown, slightly acid fine sand about 40 inches thick. The next layer to a depth of 62 inches is brownish-yellow and reddish-yellow, strongly acid sandy clay loam that has many, coarse, red and gray mottles.

Patilo soils are moderately well drained. Permeability is moderately slow, and available water capacity is low.

About half the acreage of these soils is used for crops or improved pasture. The rest support a dense stand of mixed kinds of scrub oak.

Representative profile of Patilo fine sand, 0 to 3 percent slopes, 9 miles south of the county courthouse in Eastland on Texas Highway 6 and 30 feet west of the highway, in a wooded area:

A1—0 to 6 inches, brown (10YR 4/3) fine sand, dark brown (10YR 3/3) moist; single grained; loose; many roots; neutral; clear, smooth boundary.

A2—6 to 46 inches, very pale brown (10YR 7/3) fine sand, pale brown (10YR 6/3) moist; single grained; loose, many roots in upper part, few in lower part; slightly acid; abrupt, wavy boundary.

B21t—46 to 56 inches, brownish-yellow (10YR 6/6) sandy clay loam, yellowish brown (10YR 5/6) moist; many, coarse, distinct mottles of red and light brownish gray; weak, coarse, blocky structure; very hard, very firm; few distinct clay films; strongly acid; gradual, smooth boundary.

B22t—56 to 62 inches, reddish-yellow (7.5YR 6/8) sandy clay loam, strong brown (7.5YR 5/8) moist; many, coarse, prominent mottles of light brownish gray and few, medium, faint mottles of red; weak, medium, subangular blocky structure; hard, firm; strongly acid.

The solum ranges from 65 inches to more than 100 inches in thickness. The A horizon is 40 to 80 inches thick and is neutral or slightly acid. The A1 horizon is brown, dark grayish brown, or very pale brown. The A2 horizon is very pale brown, light gray, or white. The B2t horizon is very pale brown, brownish yellow, or reddish yellow and is coarsely mottled in shades of yellow, red, or gray. It is 18 to 35 percent clay and ranges from strongly acid to slightly acid.

Patilo fine sand, 0 to 3 percent slopes (PaB).—This nearly level to gently sloping soil is on broad uplands. Areas are irregular in shape and are 15 to 200 acres in size. The soil is slightly undulating in many places, and slopes are intermingled concave and convex.

Included with this soil in mapping are spots of Chaney, Nimrod, and Pedernales soils. Chaney and Pedernales soils are mostly on slight knolls or ridges. Nimrod soils are in areas similar to those of this Patilo soil. Also included are small areas of a soil that is similar to this Patilo soil, but its surface layer of fine sand extends to a depth of more than 80 inches. Included areas are less than 30 acres in size and make up less than 25 percent of any mapped area.

This soil is mostly cultivated or is used for fruit and nut orchards. Some areas are used for improved pasture (fig. 9). The range areas originally supported a dense stand of mixed kinds of scrub oak. Runoff is slow. The hazard of soil blowing is severe, and the hazard of erosion is slight. Capability unit IIIs–2; Deep Sand range site.

Pedernales Series

The Pedernales series consists of deep, gently sloping to sloping soils on uplands. These soils formed in calcareous loamy to clayey material.

In a representative profile the surface layer is brown, slightly acid fine sandy loam about 6 inches thick. The next layer is reddish-brown, slightly acid sandy clay about 22 inches thick. Below this is about 12 inches of yellowish-red, neutral sandy clay that has a few, faint, yellowish mottles. The underlying material to a depth of 60 inches is pink sandy clay loam that has many soft concretions and masses of calcium carbonate.

Pedernales soils are well drained. Permeability is moderately slow, and available water capacity is high.

These soils are used mostly for crops or improved pasture. A few areas are in native range.

Representative profile of Pedernales fine sandy loam, 1 to 3 percent slopes, about 0.6 mile northeast of the Callahan County line on Texas Highway 206 and 150 feet south of the highway, in a field:

Ap—0 to 6 inches, brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) moist; weak, fine, subangular blocky and granular structure; hard, friable; slightly acid; abrupt, smooth boundary.

Figure 9.—**Lovegrass on a Patilo fine sand.**

B21t—6 to 18 inches, reddish-brown (5YR 4/4) sandy clay, dark reddish brown (5YR 3/4) moist; moderate, medium, blocky structure; very hard, very firm; few roots; discontinuous clay films on faces of peds; slightly acid; gradual, smooth boundary.

B22t—18 to 28 inches, reddish-brown (5YR 4/4) sandy clay, dark reddish brown (5YR 3/4) moist; weak, coarse, blocky structure; very hard, very firm; slightly acid; gradual, smooth boundary.

B3—28 to 40 inches, yellowish-red (5YR 5/6) sandy clay, yellowish red (5YR 4/6) moist; weak, coarse, blocky structure; very hard, very firm; few, fine, faint, yellowish mottles; neutral; clear, wavy boundary.

Cca—40 to 60 inches, pink (7.5YR 8/4) sandy clay loam, pink (7.5YR 7/4) moist; massive; very hard, firm; many soft concretions and soft masses of calcium carbonate; calcareous; moderately alkaline.

The solum ranges from 35 to 60 inches in thickness. The profile has secondary carbonates at a depth of 28 to 50 inches. The A horizon is 3 to 15 inches thick. It is reddish brown, yellowish red, brown, light brown, pale brown, or light yellowish brown. It is fine sandy loam or loamy fine sand and ranges from slightly acid to mildly alkaline. The Bt horizon is sandy clay or clay. It is 35 to 55 percent clay and ranges from slightly acid to mildly alkaline. The B2t horizon and the B3 horizon are red, reddish brown, yellowish red, or reddish yellow. In some places the B3 horizon has yellowish or brownish mottles. The Cca horizon is pinkish gray, light reddish brown, pink, light brown, reddish yellow, or pinkish gray.

Pedernales loamy fine sand, 1 to 5 percent slopes (PdC).—This gently sloping soil is on broad uplands. Areas are irregular in shape and are 10 to 100 acres in size.

The surface layer is brown loamy fine sand about 4 inches thick. The subsurface layer is pale-brown, neutral loamy fine sand about 4 inches thick. The next layer is neutral sandy clay about 32 inches thick. It is red in the upper part and yellowish red in the lower part. The underlying material is light-brown, calcareous sandy clay loam to a depth of 60 inches.

Included with this soil in mapping are spots of Chaney and Cisco soils. These soils are mostly in lower, slightly depressional areas. Included areas are less than 15 acres in size and make up less than 20 percent of any mapped area. Any one soil makes up less than 15 percent.

This soil is mostly cultivated. Some areas are in fruit and nut orchards (fig. 10). Some areas are planted to improved pasture, and a few areas are used as native range. Runoff is medium. The hazard of soil blowing is severe, and the hazard of erosion is slight. Capability unit IIIe–5; Sandy range site.

Pedernales fine sandy loam, 1 to 3 percent slopes (PeB).—This gently sloping soil is on broad uplands. Areas are irregular in shape and are 10 to 200 acres in size, but they are dominantly about 30 acres. This soil has the profile described as representative of the Pedernales series.

Included with this soil in mapping are spots of Bonti, Cisco, Menard, and Truce soils. Bonti and Truce soils are on slight sandstone ridges. Menard soils are on small knobs. Cisco soils are in shallow valleys that have weakly defined drainageways. Included areas are less than 10 acres in size and make up less than 20 percent of any mapped area. Any one included soil makes up less than 10 percent.

This soil is used mostly for crops. Some areas are planted to pasture, and some areas are in native range. Runoff is medium, and the hazard of erosion is moderate. Capability unit IIe–2; Tight Sandy Loam range site.

Pedernales fine sandy loam, 3 to 5 percent slopes (PeC).—This gently sloping soil is on uplands. Areas are

Figure 10.—**Peach orchard on a Pedernales loamy fine sand.**

irregular in shape and are 5 to 30 acres in size. Slopes are plane to convex.

The surface layer is brown, neutral fine sandy loam about 8 inches thick. The next layer is neutral sandy clay about 28 inches thick. It is red in the upper part and reddish yellow in the lower part. The underlying material to a depth of 60 inches is pinkish-gray, calcareous sandy clay loam that has many calcium carbonate concretions.

Included with this soil in mapping are spots of Pedernales soils, eroded, and small spots of Truce soils on slight knolls. Included areas are less than 10 acres in size and make up less than 15 percent of any mapped area.

This soil is used mostly as native range. Some areas are cultivated. Runoff is medium, and the hazard of erosion is severe. Capability unit IIIe-3; Tight Sandy Loam range site.

Pedernales fine sandy loam, 1 to 5 percent slopes, eroded (PeC2).—This soil is in small areas in cultivated fields, abandoned fields, or overgrazed range. Areas are irregular in shape and are 10 to 30 acres in size. About 75 percent of the original surface layer has been removed by sheet erosion. A few shallow gullies about 6 inches deep are in most areas, but they can be crossed by farm machinery.

The surface layer is brown, neutral fine sandy loam about 3 inches thick. The next layer is yellowish-red, neutral sandy clay about 35 inches thick. The underlying material is light-brown, calcareous, massive sandy clay loam to a depth of about 60 inches.

Included with this soil in mapping are spots of Lamar soils and Pedernales fine sandy loam, 1 to 3 percent slopes. Lamar soils are on the highest point of knolls. Also included on some upper slopes is a soil that is similar to this Pedernales soil, but it has carbonates at a depth of less than 28 inches. Included areas are less than 10 acres in size and make up less than 20 percent of any mapped area.

This soil was mostly cultivated in the past, but many areas are now planted to grass. Runoff is medium, and the hazard of erosion is severe. Capability unit IIIe-3; Tight Sandy Loam range site.

Pedernales soils, 2 to 8 percent slopes, severely eroded (PsD3).—These gently sloping to sloping soils are on uplands. They are in irregularly shaped areas 5 to 20 acres in size. Mapped areas consist of Pedernales soils and gullied areas. V-shaped gullies 1 foot to 4 feet deep are at intervals of 30 to 40 feet. Pedernales soils are in all mapped areas, but the number of gullies is not uniform in all mapped areas.

A Pedernales soil in this mapping unit has a surface layer of brown, slightly acid fine sandy loam about 3 inches thick. The next layer is red, slightly acid sandy clay about 11 inches thick. Below this is about 24 inches of yellowish-red, slightly acid sandy clay that has common red mottles. The underlying material is pinkish-gray, calcareous sandy clay loam to a depth of about 60 inches.

Included with these soils in mapping are spots of Cisco and Menard soils. Cisco soils are mostly in areas at the base of slopes and are characterized by straight-walled gullies. Menard soils are in areas near the top of the slope. Included areas are less than 5 acres in size and make up less than 15 percent of any mapped area.

These soils are used mostly as range. A few gullied areas have been mechanically shaped and planted to improved pasture. Runoff is medium, and the hazard of erosion is severe. Capability unit VIe-1; Tight Sandy Loam range site.

Tarrant Series

The Tarrant series consists of very shallow to shallow, stony, gently sloping to sloping and hilly soils on uplands. These clayey soils formed in material weathered from limestone.

In a representative profile the surface layer is very dark grayish-brown, calcareous clay about 10 inches thick. From 3 to 60 percent of the surface is covered by limestone fragments 3 to 15 inches across the long axis. The underlying material is fractured, indurated, and platy limestone bedrock.

Tarrant soils are well drained. Permeability is moderately slow, and available water capacity is very low.

These soils are used as range.

Representative profile of Tarrant clay in an area of Tarrant stony clay, 1 to 8 percent slopes, 4 miles south of Carbon on Farm Road 1027, then 0.3 mile south on a county road to a gate on the west side of the road, 1 mile south on a ranch road and 300 feet west of the road:

A11ca—0 to 4 inches, very dark grayish-brown (10YR 3/2) clay, very dark brown (10YR 2/2) moist; moderate, very fine, subangular blocky structure and strong, medium granular structure; very hard, firm; common roots; few fine pores; about 25 percent, by volume, limestone fragments 3 to 15 inches across the long axis; fragments cover from 3 to 60 percent of the surface; stone fragments coated with secondary calcium carbonates; calcareous; moderately alkaline; clear, irregular boundary.

A12ca—4 to 10 inches, very dark grayish-brown (10YR 3/2) clay, very dark grayish brown (10YR 3/2) moist; moderate, very fine, angular blocky structure and moderate, medium, granular structure; very hard, firm; common roots and pores in both vertical and horizontal bands of clay; approximately 40 percent, by volume, limestone fragments 3 to 12 inches across the long axis and 30 percent limestone fragments 2 millimeters to 3 inches across the long axis; secondary calcium carbonate coating on fragments; calcareous; moderately alkaline; abrupt, wavy boundary.

R—10 to 14 inches, fractured, indurated, and platy limestone bedrock; about 1 percent, by volume, brown (10YR 4/3) clay, dark brown (10YR 3/3) moist in vertical and horizontal bands ¼ to ½ inch wide; moderate, fine, subangular blocky structure; very hard, firm; few roots that extend into the clay and crevices between the plates of the limestone; calcareous; moderately alkaline.

The solum ranges from 6 to 20 inches in thickness. The profile is 35 to 65 percent coarse fragments, and 3 to 50 percent of the surface is covered by limestone fragments. The A horizon is very dark grayish-brown, brown, or dark-brown silty clay or clay. It is 40 to 60 percent clay. The A11 horizon is 10 to 60 percent coarse fragments, and the A12 horizon is 70 to 90 percent coarse fragments. The strata of the underlying fractured bedrock range from 2 to 42 inches in thickness.

Tarrant stony clay, 1 to 8 percent slopes (TaD).—This gently sloping to sloping soil is on stony ridges. Areas are irregular in shape and are 10 to 200 acres in size, but they are dominantly about 50 acres. The soil is covered by 3 to 50 percent limestone fragments that are 6 to 36 inches in size. It has the profile described as representative of the Tarrant series (fig. 11).

Included with this soil in mapping are spots of Bolar, Bonti, Exray, Hensley, and Owens soils. Bolar soils are mostly in areas on lower foot slopes. Bonti and Exray soils are in a narrow belt around slopes. Hensley soils are on ridgetops, and Owens soils are in areas near upper slopes. Also included in some areas is a soil that is similar to this Tarrant soil, but it is not stony on the surface and has less than 35 percent fragments in the surface layer. Each included area is less than 20 acres in size. Included areas make up less than 20 percent of any mapped area. Any included soil makes up less than 15 percent.

Figure 11.—**Profile of Tarrant stony clay, 1 to 8 percent slopes.**

This soil is used as native range. Runoff is rapid, and the hazard of erosion is slight. Capability unit VIIs–1; Low Stony Hills range site.

Tarrant stony soils, hilly (TNE).—This mapping unit is made up of stony soils. It is 50 to 85 percent Tarrant soils and 15 percent soils that are similar to Tarrant soils but are less clayey or are deeper over limestone or shale. Tarrant soils are in all mapped areas, but the soils associated with them are not. The soils are covered by 5 to 20 percent limestone fragments that are 15 to 40 inches in diameter. Areas are mostly long and narrow in shape and are 20 to 300 acres in size. Slopes range from about 10 to 30 percent but are dominantly about 14 percent. Areas of this mapping unit are much larger and are in more variable composition than are areas of other mapping units in the county. Mapping has been controlled well enough, however, for the anticipated use of the soils.

A tarrant soil in this mapping unit has a surface layer of very dark grayish-brown, calcareous clay about 16 inches thick. It is 50 percent, by volume, limestone fragments in the upper 8 inches and 80 percent in the lower 8 inches. The fragments are dominantly 3 to 6 inches across the long axis and have thin coatings of secondary carbonates. The underlying material is fractured, indurated and platy, limestone bedrock that has carbonate coatings about one-half inch thick.

Included with these soils in mapping are spots of Bolar, Exray, and Owens soils. Bolar soils are on foot slopes or in

areas along narrow drainageways. Exray soils are in narrow belts 30 to 100 feet wide that encircle hills in some areas. Included areas are 10 to 20 acres in size, and they make up as much as 40 percent of some mapped areas. Any one included soil makes up less than 20 percent of any mapped area.

The soils in this mapping unit are used as range. Runoff is rapid, and the hazard of erosion is severe. Capability unit VIIs–1; Low Stony Hills range site.

Thurber Series

The Thurber series consists of deep, nearly level to gently sloping, loamy soils on uplands. These soils formed in calcareous clayey sediment.

In a representative profile the surface layer is dark grayish-brown, neutral clay loam about 5 inches thick. The next layer is very dark grayish-brown, neutral clay about 17 inches thick over 26 inches of dark grayish-brown, calcareous clay. The underlying material is very pale brown, calcareous shaly clay to a depth of 70 inches.

Thurber soils are moderately well drained. Permeability is very slow, and available water capacity is high.

These soils are used for crops and as range.

Representative profile of Thurber clay loam, 1 to 3 percent slopes, 2.6 miles north of the schoolhouse in Olden on a county road and 400 feet east of the road, in a field:

Ap—0 to 5 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; massive; very hard, very firm; neutral; abrupt, smooth boundary.

B21t—5 to 22 inches, very dark grayish-brown (10YR 3/2) clay, very dark brown (10YR 2/2) moist; strong, fine, blocky structure; very hard, very firm; common distinct clay films; neutral; gradual, smooth boundary.

B22t—22 to 38 inches, dark grayish-brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; strong, fine, blocky structure; very hard, very firm; few medium concretions and soft masses of calcium carbonate; calcareous; moderately alkaline; gradual, smooth boundary.

B3t—38 to 48 inches, dark grayish-brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; strong, fine, blocky structure; very hard, very firm; many small concretions of calcium carbonate; calcareous; moderately alkaline: gradual, smooth boundary.

Cca—48 to 70 inches, very pale brown (10YR 8/3) shaly clay, very pale brown (10YR 7/3) moist; massive; very hard, firm; approximately 10 percent, by volume, concretions and masses of calcium carbonate; few ferromanganese concretions; calcareous; moderately alkaline.

The solum ranges from 40 to 50 inches in thickness. Films, threads, or soft masses of calcium carbonate are at a depth of 15 to 28 inches. The A horizon is 4 to 12 inches thick and is brown, dark brown, dark grayish brown, or very dark grayish brown. It is massive and very hard when dry and is neutral or slightly acid. The Bt horizon is very dark grayish brown, dark grayish brown, grayish brown, brown, dark brown, yellowish brown, dark yellowish brown, olive brown, or light olive brown. It is 35 to 55 percent clay. The B21t horizon is neutral or mildly alkaline, and the B22t horizon is mildly alkaline or moderately alkaline. The Cca horizon is very pale brown or olive gray and ranges from clay loam to shaly clay.

Thurber clay loam, 0 to 1 percent slopes (TrA).—This nearly level soil is on broad uplands. Areas are irregular to oval in shape and are 5 to 150 acres in size, but they are dominantly about 40 acres. Slopes are concave in some areas.

The surface layer is dark grayish-brown, slightly acid clay loam about 8 inches thick. The next layer is very dark grayish-brown, neutral clay about 15 inches thick. Below this is about 12 inches of very dark grayish-brown, calcareous clay that has a few small masses of calcium carbonate. The next layer is dark grayish-brown, calcareous clay about 8 inches thick. The underlying material is very pale brown, calcareous shaly clay to a depth of 60 inches.

Included with this soil in mapping are some small areas of Hassee and Leeray soils. Hassee soils are in areas that are somewhat poorly drained. Leeray soils are in areas similar to those of this Thurber soil, but they have deep surface cracks and a gilgai microrelief. Included areas are less than 10 acres in size and make up less than 15 percent of any mapped area.

This soil is used for crops and as range. Runoff is slow, and the hazard of erosion is slight. Capability unit IIIs–1; Claypan range site.

Thurber clay loam, 1 to 3 percent slopes (TrB).—This gently sloping soil is on broad uplands. Areas are irregular in shape and are 15 to 150 in size, but they are dominantly about 40 acres. This soil has the profile described as representative of the Thurber series.

Included with this soil in mapping are small spots of Hassee and Leeray soils. Hassee soils are in small depressional areas. Leeray soils are in areas similar to those of this Thurber soil, but they have deep surface cracks and a gilgai microrelief. Included areas are less than 15 acres in size and make up less than 15 percent of any mapped area.

This soil is used for crops and as range. Runoff is slow, and the hazard of erosion is moderate. Capability unit IIIe–1; Claypan range site.

Truce Series

The Truce series consists of deep, gently sloping, loamy soils on uplands. These soils formed in material weathered from shale interbedded with sandstone strata.

In a representative profile the surface layer is yellowish-brown, slightly acid fine sandy loam about 4 inches thick. The subsurface layer is light yellowish-brown, slightly acid fine sandy loam about 1 inch thick. The next layer is reddish-brown and brown, neutral clay about 29 inches thick. Below this is light olive-brown, calcareous shaly clay about 12 inches thick. The underlying material is olive and gray brittle shale to a depth of about 62 inches.

Truce soils are well drained. Permeability is slow, and available water capacity is medium.

These soils are used mostly as range. A few areas are in crops or pasture.

Representative profile of Truce fine sandy loam, 1 to 3 percent slopes, 0.9 mile north of the county courthouse in Eastland on Texas Highway 6, then 0.5 mile west on a county road and 60 feet north of the road, in range:

A1—0 to 4 inches, yellowish-brown (10YR 5/4) fine sandy loam, dark yellowish brown (10YR 4/4) moist; weak, fine, subangular blocky structure; very hard, friable; slightly acid; clear, smooth boundary.

A2—4 to 5 inches, light yellowish-brown (10YR 6/4) fine sandy loam, yellowish brown (10YR 5/4) moist; weak, fine, subangular blocky structure; very hard, friable; slightly acid; abrupt, smooth boundary.

B21t—5 to 20 inches, reddish-brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; strong, medium,

blocky structure; extremely hard, extremely firm; common distinct clay films on faces of peds; neutral; gradual, smooth boundary.

B22t—20 to 34 inches, brown (7.5YR 5/4) clay, dark brown (7.5YR 4/4) moist; moderate, medium, blocky structure; extremely hard, very firm; common distinct clay films on faces of peds; neutral; gradual, smooth boundary.

B3t—34 to 46 inches, light olive-brown (2.5Y 5/4) shaly clay, olive brown (2.5Y 4/4) moist; weak, blocky structure; extemely hard, very firm; calcareous; moderately alkaline; gradual, smooth boundary.

C—46 to 62 inches, olive and gray brittle shale; massive; extremely hard, extremely firm; calcareous; moderately alkaline.

The solum ranges from 40 to 60 inches in thickness. The A horizon is 2 to 13 inches thick and is 0 to 25 percent, by volume, sandstone fragments that are 2 millimeters to 18 inches in diameter. It is neutral or slightly acid and ranges from fine sandy loam to clay loam. The A1 horizon is brown, pale brown, yellowish brown, or dark grayish brown. The A2 horizon is 1 or 2 units of value lighter in color than the A1 horizon. The Bt horizon is 35 percent to about 50 percent clay. The B21t horizon is reddish brown, dark reddish brown, or yellowish red and ranges from slightly acid to mildly alkaline. The B22t horizon is brown, strong brown, yellowish brown, reddish yellow, or reddish brown. The B3t horizon is yellowish brown, light olive brown, olive brown, or dark yellowish brown. It ranges from neutral to moderately alkaline. The C horizon ranges from brittle shaly clay to shale.

Truce fine sandy loam, 1 to 3 percent slopes (TuB).—This soil is on eroded uplands. Areas are irregular in shape and are 10 to 100 acres in size, but they are dominantly about 30 acres. Slopes are convex. This soil has the profile described as representative of the Truce series.

Included with this soil in mapping are spots of Bonti and Owens soils. Bonti soils are on ridgetops that have plane slopes. Owens soils are on slight knolls. Rock outcrop is included in some areas. Included areas are less than 10 acres in size and make up less than 15 percent of any mapped area.

This soil is used mostly as native range. Some areas are used for improved pasture and some for crops. Runoff is rapid, and the hazard of erosion is moderate. Capability unit IIe–6; Tight Sandy Loam range site.

Truce fine sandy loam, 3 to 5 percent slopes (TuC).—This gently sloping soil is on loamy uplands. Areas are irregular in shape and are about 10 to 50 acres in size, but they are dominantly about 15 acres. Slopes are short and convex.

The surface layer is dark grayish-brown, slightly acid fine sandy loam about 3 inches thick. The subsurface layer is grayish-brown fine sandy loam about 5 inches thick. Below this is dark reddish-brown and strong-brown, neutral clay about 28 inches thick. The next layer is olive-brown, calcareous shaly clay about 12 inches thick. The underlying material is mottled or streaked, dark-red and olive-gray, calcareous shale to a depth of 60 inches.

Included with this soil in mapping are spots of Bonti, Exray, Owens, and Pedernales soils. Bonti and Pedernales soils are on lower slopes, and Exray and Owens soils are on upper slopes. Included areas are less than 5 acres in size and make up less than 20 percent of any mapped area.

This soil is used mostly as range. Runoff is rapid, and the hazard of erosion is severe. Capability unit IIIe–8; Tight Sandy Loam range site.

Truce fine sandy loam, 1 to 5 percent slopes, eroded (TuC2).—This gently sloping soil is on uplands. Areas are irregular in shape and are 5 to 30 acres in size, but they are dominantly about 15 acres. About 75 percent of the original surface layer has been removed by erosion. A few shallow gullies about 6 inches deep and 3 feet wide are in some areas.

The surface layer is brown, slightly acid fine sandy loam about 4 inches thick. The next layer is reddish-brown, slightly acid clay about 16 inches thick. Below this is light olive-brown, mildly alkaline clay about 24 inches thick. The underlying material is massive, light olive-brown, calcareous shale to a depth of 60 inches.

Included with this soil in mapping are spots of Bonti, Owens, and Pedernales soils. Bonti soils are on ridgetops that have plane slopes. Owens soils are on slight ridges or knolls. Pedernales soils are in areas similar to those of Truce soils. Included areas are less than 5 acres in size and make up less than 20 percent of any mapped area.

This soil is used mostly as native range. Runoff is rapid, and the hazard of erosion is severe. Capability unit IIIe–8; Tight Sandy Loam range site.

Use and Management of the Soils

Major uses, limitations, and management needs of the soils of Eastland County are discussed in this section. The system of capability grouping used by the Soil Conservation Service is explained, and the management of the soils by capability units is discussed. Predicted yields of the principal crops are given. The management of soils for crops and pasture, as range, and as wildlife habitat is discussed. The properties and features that affect engineering practices are given, mainly in tables.

Management of the Soils for Crops and Pasture

This section outlines general soil management practices that increase production or maintain a high level of production of tilled crops on the soils suitable for crop production in Eastland County. Erosion control, drainage, conservation of soil moisture, and maintenance of fertility are the main objectives of good management.

The type and intensity of management needed depend upon the kinds of soil farmed and the kind of farming operation carried out. An important aid in managing soils is a good cropping system. A good cropping system is one that maintains or improves the physical condition of the soil; protects the soil during critical periods, such as during heavy rains or flooding, drought, and strong winds; aids in the control of weeds, insects, and plant disease; and provides an adequate economic return.

A good cropping system consists of growing crops in a sequence, or rotation, in which soil-improving crops balance soil-depleting crops. Soil-improving crops are those that leave a large amount of residue, such as grasses and legumes. Row crops, in general, are soil-depleting crops.

Most soils in Eastland County respond economically to some type of fertilization. The use of commercial fertilizers should be based on crop needs as determined by soil tests. The amount and type of fertilizer needed vary according to the nature of the soil, the crop to be grown, the production desired, the previous land-use or cropping practices, the season, and the amount of available moisture.

Approximately 10,000 acres of peanuts is irrigated from shallow water wells in the county. The irrigation water is limited in quality and quantity.

Capability grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The groups are made according to the limitations of the soils when used for field crops, the risk of damage when they are so used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to horticultural crops or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range or for engineering.

In the capability system, the kinds of soil are grouped at three levels; the capability class, the subclass, and the unit. These levels are described in the following paragraphs.

Capability Classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, 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 require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife habitat.

Class VI soils have severe limitations that make them generally unsuitable for cultivation and that limit their use largely to pasture, range, woodland, or wildlife habitat.

Class VII soils have very severe limitations that make them unsuitable for cultivation and that restrict their use largely to pasture, range, woodland, or wildlife habitat.

Class VIII soils and landforms have limitations that preclude their use for commercial crop production and restrict their use to recreation, wildlife habitat, or water supply, or to use for esthetic purposes. (No class VIII soils are in Eastland County).

Capability Subclasses are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless 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 some parts of the United States but not in Eastland County, shows that the chief limitation is climate that is too cold or too dry.

Class I has no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in it are subject to little or no erosion. These soils have other limitations, however, that restrict their use largely to pasture, range, woodland, wildlife habitat, or recreational purposes.

Capability Units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe–4 or IIIe–6. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

In the following paragraphs the capability units in Eastland County are described and suggestions for the use and management of the soils are given. The capability unit designations for all of the soils in the county can be found in the "Guide to Mapping Units" at the back of this survey. The capability units are not numbered consecutively in Eastland County, because not all of the capability units used in Texas are in this county.

CAPABILITY UNIT I–1

May fine sandy loam, 0 to 1 percent slopes, is the only soil in this unit. This deep, nearly level soil is on uplands. It has a surface layer of fine sandy loam and lower layers of sandy clay loam. The hazard of erosion is slight. Permeability is moderate, and available water capacity is medium.

Grain sorghum and forage sorghum are the main crops. A few areas are in small grain or alfalfa. Such pasture grasses as bermudagrass and lovegrass are well suited to this soil.

Maintaining and improving soil productivity and tilth are the main management objectives. A suitable cropping system is one that includes grasses and legumes grown in rotation with other crops. Leaving residue on or near the surface helps to maintain a lower soil temperature and to conserve moisture.

CAPABILITY UNIT IIe-1

May fine sandy loam, 1 to 3 percent slopes, is the only soil in this unit. This deep, gently sloping soil is on uplands. It has a surface layer of fine sandy loam and lower layers of sandy clay loam. The hazard of erosion is moderate. Permeability is moderate, and available water capacity is medium.

Sorghum and small grain for grazing are the main crops. Most crops commonly grown in the county are well suited to this soil. Such pasture grasses as bermudagrass, Kleingrass, or lovegrass are also well suited.

Controlling erosion and maintaining soil productivity and tilth are the main management objectives. Terracing and contour farming help to control erosion. Leaving

residue from high residue producing crops on the surface helps to maintain a lower soil temperature, to slow runoff, and to conserve moisture. Response to applications of commercial fertilizer is good in most years.

CAPABILITY UNIT IIe-2

This unit consists of moderately deep to deep, gently sloping soils on uplands. These soils have a surface layer of fine sandy loam and lower layers of sandy clay. A crust forms on the surface when these soils are dry. The hazard of erosion is moderate. Permeability is moderately slow, and available water capacity is medium or high.

A few areas of these soils are cultivated, but most are in pasture or range. Such pasture grasses as Kleingrass or King Ranch bluestem are well suited to these soils. Sorghum and small grain are the main crops.

Controlling erosion and maintaining soil productivity and tilth are the main management objectives. A suitable cropping system is one that returns a large amount of residue to the surface layer. Terracing and contour farming help to control erosion. Response to applications of commercial fertilizer is good in most years.

CAPABILITY UNIT IIe-3

This unit consists of moderately deep to deep, gently sloping soils on uplands. These soils have a surface layer of fine sandy loam and lower layers of sandy clay loam. A crust forms on the surface when these soils are dry. The hazard of erosion is slight to moderate. Permeability is moderate, and available water capacity is medium or high.

Most areas of these soils are cultivated. The rest are in pasture or range. Sorghum, small grain, and peanuts are the main crops. Such pasture grasses as bermudagrass and lovegrass are well suited to these soils.

Controlling erosion and maintaining soil productivity and tilth are the main management objectives. A suitable cropping system is one that returns a large amount of residue to the surface layer. Leaving the residue on the surface helps to maintain a lower soil temperature, to reduce runoff, and to conserve moisture. Terracing and contour farming help to control erosion. Response to applications of commerical fertilizer is good in most years.

CAPABILITY UNIT IIe-4

Bolar clay loam, 1 to 3 percent slopes, is the only soil in this unit. This moderately deep, gently sloping soil is on uplands. It has a surface layer and lower layers of clay loam. The hazard of erosion is moderate. Permeability is moderate, and available water capacity is medium.

Sorghum and small grain are the main crops. A small area is in cotton. Many areas are in range. Such pasture grasses as Kleingrass and King Ranch bluestem are well suited to this soil.

Controlling erosion and maintaining soil productivity and tilth are the main management objectives. Terracing and contour farming help to control erosion. Leaving residue from high residue producing crops on the surface helps to slow runoff and conserve moisture. Response to applications of commercial fertilizer is good in most years.

CAPABILITY UNIT IIe-5

Leeray clay, 1 to 3 percent slopes, is the only soil in this unit. This deep, gently sloping soil is on uplands. It has a surface layer and lower layers of clay. The hazard of erosion is moderate. Permeability is very slow, and available water capacity is high.

Sorghum and small grain are the main crops. Small areas are in alfalfa and cotton. Such pasture grasses as Kleingrass or King Ranch bluestem are well suited to this soil.

Selecting suitable crops for this soil, controlling erosion, and maintaining tilth are the main management objectives. Terracing and contour farming help to prevent erosion. Leaving residue from high residue producing crops on the surface helps to maintain a lower soil temperature and to conserve moisture. Cultivating the soil when it is too moist compacts the surface layer and reduces the rate of water intake. Response to applications of commercial fertilizer is good in most years.

CAPABILITY UNIT IIe-6

Truce fine sandy loam, 1 to 3 percent slopes, is the only soil in this unit. This deep, gently sloping soil is on uplands. It has a surface layer of fine sandy loam and lower layers of clay. The hazard of erosion is moderate. Permeability is slow, and available water capacity is medium.

This soil is used mainly for forage sorghums. Such pasture grasses as Kleingrass and King Ranch bluestem are suited to this soil.

Controlling erosion and maintaining soil productivity and tilth are the main management objectives. A suitable cropping system is one that returns a large amount of residue to the surface layer. Leaving the residue on the surface helps to maintain tilth and a lower soil temperature and to control erosion. Terracing and contour farming help to control erosion. Response to applications of commercial fertilizer is good in most years.

CAPABILITY UNIT IIw-1

This unit consists of deep, nearly level soils on bottom lands. These soils have a surface layer of fine sandy loam or silty clay loam and lower layers of silty clay loam, fine sandy loam, or sandy clay loam. The hazard of erosion is slight. Permeability is moderate, and available water capacity is high.

Grain sorghum and forage sorghum are the main crops. Small areas are in alfalfa or small grain. Such pasture grasses as bermudagrass and lovegrass are well suited to these soils.

Maintaining and improving soil productivity and tilth are the main management objectives. A cropping system that includes grasses and legumes grown in rotation with other crops helps to maintain tilth and productivity. Leaving residue on the surface helps to maintain a lower soil temperature and to conserve moisture.

CAPABILITY UNIT IIIe-1

This unit consists of deep to moderately deep, gently sloping soils. These soils have a surface layer of loam to clay loam and lower layers of clay. The hazard of erosion is slight to moderate. Permeability is slow to very slow, and available water capacity is medium or high.

Sorghum and small grain are the main crops. Such pasture grasses as Kleingrass and King Ranch bluestem are suited to these soils.

Controlling erosion, selecting suitable crops for these soils, and maintaining soil productivity and tilth are the main management objectives. A suitable cropping system is one that returns a large amount of residue to the surface layer. Leaving the residue on the surface helps to maintain

a lower soil temperature, reduce runoff, and improve tilth. Terracing and contour farming help to prevent erosion. Response to applications of commercial fertilizer is good in most years.

CAPABILITY UNIT IIIe-2

Nimrod fine sand, 0 to 5 percent slopes, is the only soil in this unit. This deep, nearly level to gently sloping soil is on uplands. It has a surface layer of fine sand and lower layers of sandy clay loam. The hazard of soil blowing is severe. Permeability is moderately slow, and available water capacity is low. The surface layer takes in water rapidly but lacks adequate storage capacity, and it is droughty if rainfall is not well distributed.

Peanuts, peas, sorghum, and watermelons are the main crops. Some areas are in vineyards, peach orchards, and pecan orchards. Such pasture grasses as bermudagrass and lovegrass are well suited to this soil.

Controlling soil blowing and selecting suitable crops for these soils are the main management objectives. A suitable cropping system is one that returns a large amount of residue to the surface layer. Leaving the residue on the surface helps to prevent soil blowing and to maintain soil tilth.

CAPABILITY UNIT IIIe-3

This unit consists of deep, gently sloping soils on uplands. These soils have a surface layer of fine sandy loam and lower layers of sandy clay. A crust forms on the surface when these soils are dry. The hazard of erosion is severe, and past erosion has produced rills and shallow gullies in some areas. Permeability is moderately slow, and available water capacity is medium.

Forage sorghum and small grain are the main crops. Such pasture grasses as bermudagrass and Kleingrass are well suited to these soils.

Controlling erosion and maintaining and improving soil productivity and tilth are the main management objectives. A suitable cropping system is one that returns a large amount of residue to the surface layer. Leaving the residue on the surface helps to maintain a lower soil temperature, control runoff, and conserve moisture. Terracing and contour farming help to prevent erosion. Response to applications of commercial fertilizer is good in most years.

CAPABILITY UNIT IIIe-4

This unit consists of moderately deep to deep, gently sloping soils on uplands. These soils have a surface layer of fine sandy loam and lower layers of sandy clay loam. The hazard of erosion is moderate to severe. Permeability is moderate, and available water capacity is medium or high.

Forage sorghum and small grain are the main crops. Such pasture grasses as bermudagrass and lovegrass are suited to these soils.

Controlling erosion and maintaining soil productivity are the main management objectives. A suitable cropping system is one that produces a large amount of crop residue. Terracing and contour farming help to control erosion and conserve moisture. Grassed waterways and diversion terraces help to control runoff. Response to applications of commercial fertilizer is good in most years.

CAPABILITY UNIT IIIe-5

This unit consists of deep, nearly level to gently sloping, sandy soils on uplands. These soils have a surface layer of loamy sand to loamy fine sand and lower layers of sandy clay to sandy clay loam. A crust forms on the surface when these soils are dry. The hazard of soil blowing is severe. Permeability is slow to moderate, and available water capacity is medium or high.

Peanuts, peas, sorghum, and watermelons are the main crops. Peach and pecan trees and such pasture grasses as bermudagrass and lovegrass are well suited to these soils.

Controlling soil blowing, selecting suitable crops for these soils, and maintaining and improving soil productivity are the main management objectives. A suitable cropping system is one that returns a large amount of residue to the surface layer. Cover cropping, fertilizing, and stripcropping help to prevent erosion and improve soil productivity.

CAPABILITY UNIT IIIe-6

Hensley loam, 1 to 3 percent slopes, is the only soil in this unit. This shallow, gently sloping soil is on uplands. It has a surface layer of loam and a lower layer of clay. The hazard of erosion is moderate. Permeability is slow, and available water capacity is low.

This soil is mostly in range, but a few areas are cultivated. Forage sorghum and small grain are the main crops. Such pasture grasses as Kleingrass and King Ranch bluestem are suited to this soil.

Selecting suitable crops for this soil and maintaining soil productivity are the main management objectives.

A suitable cropping system is one that returns a large amount of residue to the surface layer. Leaving the residue on the surface helps to reduce runoff, maintain a lower soil temperature, and conserve moisture. Response to applications of commercial fertilizer is good in most years.

CAPABILITY UNIT IIIe-7

Lamar loam, 2 to 5 percent slopes, is the only soil in this unit. This moderately deep to deep, gently sloping soil is on uplands. It has a surface layer and lower layers of loam. The hazard of erosion is moderate. Permeability is moderate, and available water capacity is medium.

This soil is mostly in range, but a few areas are cultivated. Forage sorghum is the main crop. Such pasture grasses as Kleingrass and King Ranch bluestem are suited to this soil.

Controlling erosion and maintaining soil productivity are the main management objectives. Leaving residue on the surface helps to maintain a lower soil temperature, reduce runoff, and conserve moisture. Terracing and contour farming help to control erosion and conserve moisture. Grassed waterways and diversion terraces help to control runoff. Response to applications of commercial fertilizer is good in most years.

CAPABILITY UNIT IIIe-8

This unit consists of deep, gently sloping soils. These soils have a surface layer of fine sandy loam and lower layers of clay. The hazard of erosion is severe, and past erosion has caused rills and shallow gullies in some areas. Permeability is slow, and available water capacity is medium.

The choice of crops is mostly restricted to forage sorghum. The soils are not well suited to row crops. Such pasture grasses as Kleingrass and King Ranch bluestem are suited.

Controlling erosion and selecting suitable crops for use on these soils are the main management objectives.

A suitable cropping system is one that includes closely growing, high residue producing crops. Leaving the residue on the surface helps to reduce runoff, conserve moisture, and maintain tilth. Terracing and contour farming help to prevent erosion. Response to applications of commercial fertilizer is good in most years.

CAPABILITY UNIT IIIw-1

Hassee loam, 0 to 1 percent slopes, is the only soil in this unit. This deep, nearly level soil is on uplands. It has a surface layer of loam and lower layers of clay. A crust forms on the surface when this soil is dry, and permeability is very slow. The permeability and crustiness make this soil difficult to use and manage. The hazard of erosion is slight. Available water capacity is high.

The choice of crops is mostly restricted to sorghum and small grain. Such pasture grasses as Kleingrass and King Ranch bluestem are suited to this soil.

A suitable cropping system is one that returns a large amount of residue to the surface layer. Leaving the residue on the surface helps to maintain a lower soil temperature and improve tilth. Cultivating the soil when it is too moist compacts the surface layer and reduces the rate of water intake. Response to applications of commercial fertilizer is good in most years.

CAPABILITY UNIT IIIs-1

This unit consists of deep, nearly level soils on uplands. These soils have a surface layer of clay loam or clay and lower layers of clay. The hazard of erosion is slight. Permeability is very slow, and available water capacity is high.

Sorghum and small grain are the main crops. A few areas are in alfalfa. Such pasture grasses as Kleingrass and King Ranch bluestem are suited to these soils.

Adapting crops to these soils and maintaining soil productivity and tilth are the main management objectives. A suitable cropping system is one that returns a large amount of residue to the surface layer. Leaving the residue on the surface helps to maintain a lower soil temperature, conserve moisture, and improve tilth.

CAPABILITY UNIT IIIs-2

Patilo fine sand, 0 to 3 percent slopes, is the only soil in this unit. This deep, nearly level to gently sloping soil is on uplands. It has a surface layer of fine sand and lower layers of sandy clay loam. The hazard of soil blowing is severe. Permeability is moderately slow, and available water capacity is low.

Peanuts and grain sorghum are the main crops. Pecan orchards are suited to this soil. Such pasture grasses as bermudagrass and lovegrass are well suited.

Controlling soil blowing, maintaining and improving soil productivity, and selecting suitable crops for this soil are the main management objectives. A suitable cropping system is one that returns a large amount of residue to the surface layer to help control soil blowing. Cover cropping and stripcropping help to prevent soil blowing. Response to applications of commercial fertilizer is good in most years.

CAPABILITY UNIT IVe-1

Owens clay, 1 to 3 percent slopes, is the only soil in this unit. This shallow, gently sloping soil is on uplands. It has a surface layer and lower layers of clay. The hazard of erosion is severe, and past erosion has produced rills and shallow gullies in some areas. Permeability is very slow, and available water capacity is low.

The choice of crops is mostly restricted to forage sorghum. This soil is not well suited to row crops. Such pasture grasses as Kleingrass and King Ranch bluestem are suited.

Controlling erosion and selecting suitable crops for this soil are the main management objectives. A suitable cropping system is one that includes closely spaced, high residue producing crops. Leaving the residue on the surface helps to reduce runoff, conserve moisture, and maintain tilth. Terracing and contour farming help to prevent erosion. Response to applications of commercial fertilizer is good in most years.

CAPABILITY UNIT IVe-2

Lamar loam, 5 to 8 percent slopes, is the only soil in this unit. This moderately deep to deep, sloping soil is on uplands. It has a surface layer and lower layers of loam. The hazard of erosion is severe. Permeability is moderate, and available water capacity is medium.

This soil is mostly in range. A few areas are cultivated. Forage sorghum and small grain are the main crops. Such pasture grasses as bermudagrass and Kleingrass are well suited to this soil.

Controlling erosion, maintaining soil productivity, and selecting suitable crops for this soil are the main management objectives. A suitable cropping system is one that returns a large amount of residue to the surface layer. Leaving the residue on the surface helps to maintain a lower soil temperature, reduce runoff, and conserve moisture. Terracing and contour farming help to reduce erosion. Diversion terraces help to control runoff. Response to applications of commercial fertilizer is good in most years.

CAPABILITY UNIT Vw-1

This unit consists of deep, nearly level soils on the flood plain of streams. These soils have a surface layer of fine sandy loam, silty clay loam, or clay and lower layers of fine sandy loam, sandy clay loam, silty clay loam, or clay. They are flooded more often than once every 4 years. Permeability is slow to moderate, and available water capacity is high.

The soils in this unit are better suited to use as pasture or range than to most other uses. Such pasture grasses as bermudagrass, Kleingrass, and lovegrass are well suited.

CAPABILITY UNIT VIe-1

This unit consists of deep, gently sloping to sloping soils on uplands. These soils have a surface layer of fine sandy loam or loamy sand and lower layers of sandy clay. The hazard of erosion is severe. Gullies 1 foot to 6 feet deep are about 30 to 100 feet apart. The gullies cannot be crossed by farm machinery. Permeability is slow to moderately slow, and available water capacity is medium or high.

The soils in this unit are better suited to use as range than to most other uses. Where the gullies have been shaped with heavy machinery, such pasture grasses as bermudagrass, King Ranch bluestem, or lovegrass are well suited.

CAPABILITY UNIT VIs-1

The unit consists of very shallow to deep, gently sloping to sloping soils on uplands. These soils have a surface layer of loamy sand to loam and lower layers of loam to

clay. The hazard of erosion is slight to severe. Permeability is slow to moderately slow, and available water capacity is very low to medium.

The soils in this unit are too stony for cultivated crops. They are better suited to use as range or wildlife habitat than to most other uses.

CAPABILITY UNIT VIIs-1

This unit consists of very shallow to shallow, gently sloping to moderately steep and hilly soils on uplands. These soils have a surface layer of fine sandy loam to clay and lower layers of loam to clay. The hazard of erosion is slight to severe. Permeability is very slow to moderately slow, and available water capacity is low and very low.

The soils in this unit are too steep and stony for cultivation. They are better suited to use as range or wildlife habitat than to most other uses.

Predicted yields

The predicted yields of the principal crops grown in Eastland County are given in table 2. The predictions are based on estimates made by farmers, soil scientists, and others who have knowledge of yields in the county and on information taken from research data. The predicted yields are average yields per acre that can be expected by good commercial farmers at the level of management that tends to produce the highest economic returns. The yields are given for dryland soils. Soils that are used only as range or for recreation are not listed in this table. Crops other than those shown in table 2 are grown in the county, but their predicted yields are not included, because their acreage is small or reliable data on yields are not available.

The predicted yields given in table 2 can be expected if the following management practices are used on dryland and irrigated soils:

1. Rainfall is effectively used and conserved.
2. A surface or subsurface drainage system, or both, are installed.
3. Crop residue is managed to maintain soil tilth.
4. Tillage is minimal but timely.
5. Insect, disease, and weed control measures are consistently used.
6. Fertilizer is applied according to soil test and crop needs.
7. Suited crop varieties are used at recommended seeding rates.

TABLE 2.—*Predicted average acre yields of principal crops*

[Absence of a figure indicates that the crop is not commonly grown on the specified soil]

Soil	Peanuts (dryland)	Grain sorghum	Oats	Forage sorghum	Coastal bermudagrass
	Lb	*Lb*	*Bu*	*AUM*[1]	*AUM*[1]
Bolar clay loam, 1 to 3 percent slopes		2,500	40	4.0	
Bonti fine sandy loam, 1 to 3 percent slopes		2,000	40	5.0	4.0
Bunyan fine sandy loam	1,200	3,000	50	6.0	6.0
Bunyan soils, frequently flooded					6.0
Chaney loamy sand, 1 to 5 percent slopes	1,200	2,000		6.0	6.0
Chaney loamy sand, 1 to 5 percent slopes, eroded	1,000	2,000		5.0	5.0
Cisco loamy fine sand, 1 to 5 percent slopes	1,200	2,000		6.0	6.0
Cisco fine sandy loam, 1 to 3 percent slopes	1,000	2,000	40	6.0	6.0
Cisco fine sandy loam, 3 to 5 percent slopes	800	1,700	30	5.0	5.0
Cisco fine sandy loam, 1 to 5 percent slopes, eroded	800	1,500		4.0	4.5
Deleon clay, frequently flooded					4.5
Demona loamy sand, 0 to 5 percent slopes	1,200	2,250		6.0	6.0
Elandco silty clay loam	1,000	3,000	50	6.0	6.0
Elandco silty clay loam, frequently flooded					6.0
Hassee loam, 0 to 1 percent slopes		2,000	30	4.0	
Hassee loam, 1 to 2 percent slopes		2,000	30	4.0	4.0
Hensley loam, 1 to 3 percent slopes		1,500	35	5.0	4.0
Lamar loam, 2 to 5 percent slopes		2,500	35	5.0	5.5
Lamar loam, 5 to 8 percent slopes		2,000	30	4.5	4.5

Footnote at end of table

TABLE 2.—*Predicted average acre yields of principal crops*—Continued

Soil	Peanuts (dryland)	Grain sorghum	Oats	Forage sorghum	Coastal bermudagrass
	Lb	*Lb*	*Bu*	*AUM*[1]	*AUM*[1]
Leeray clay, 0 to 1 percent slopes	----------	3, 000	40	3. 0	----------
Leeray clay, 1 to 3 percent slopes	----------	2, 500	40	3. 0	----------
Lindy loam, 1 to 3 percent slopes	----------	2, 500	40	5. 0	5. 0
May fine sandy loam, 0 to 1 percent slopes	1, 200	3, 000	50	6. 0	6. 0
May fine sandy loam, 1 to 3 percent slopes	1, 200	2, 500	50	6. 0	6. 0
Menard fine sandy loam, 1 to 3 percent slopes	1, 000	1, 800	40	5. 5	5. 5
Menard fine sandy loam, 3 to 5 percent slopes	800	1, 500	30	5. 0	5. 0
Nimrod fine sand, 0 to 5 percent slopes	1, 050	2, 000	----------	6. 0	5. 0
Owens clay, 1 to 3 percent slopes	----------	1, 500	15	2. 0	----------
Patilo fine sand, 0 to 3 percent slopes	750	1, 500	----------	4. 0	4. 0
Pedernales loamy fine sand, 1 to 5 percent slopes	1, 000	2, 000	----------	6. 0	6. 0
Pedernales fine sandy loam, 1 to 3 percent slopes	1, 000	2, 000	40	5. 0	4. 0
Pedernales fine sandy loam, 3 to 5 percent slopes	800	2, 000	30	4. 0	4. 0
Pedernales fine sandy loam, 1 to 5 percent slopes, eroded	750	2, 000	30	4. 0	4. 0
Thurber clay loam, 0 to 1 percent slopes	----------	1, 750	35	4. 5	4. 0
Thurber clay loam, 1 to 3 percent slopes	----------	1, 750	35	4. 5	4. 0
Truce fine sandy loam, 1 to 3 percent slopes	----------	2, 000	30	3. 0	3. 5
Truce fine sandy loam, 3 to 5 percent slopes	----------	1, 750	20	2. 5	4. 0
Truce fine sandy loam, 1 to 5 percent slopes, eroded	----------	1, 500	15	2. 0	3. 0

[1] AUM stands for animal-unit-month, a term used to express the amount of forage or feed required to maintain one animal unit, 1,000 pounds live weight, for a period of 30 days.

Range [2]

About 375,900 acres in Eastland County is native range, which makes up about 61 percent of the total agricultural land. At the time of the survey, 48 ranch units were in operation. Most of the ranches are operated as cow-calf enterprises. Many ranchers supplement their operations with winter stockers or carryover calves. Most ranches have some areas in crops and some in pasture. The cultivated areas are used to grow supplemental forage that is either grazed or stored as silage or hay. Improved pasture consists mainly of Coastal bermudagrass, Kleingrass, and weeping lovegrass. Where water is available, irrigated pasture supplies supplemental forage. The main crops grown for supplemental forage are Johnsongrass, small grain, and sorghum.

The range sites vary throughout the county from shallow clay to sandy soils. Native grass cover ranges from short grasses on shallow clays to tall grasses on sandy soils. The native range has been heavily grazed for several generations. As a result, the clayey soils are covered mostly with buffalograss and annual grasses. The tight sandy loams now produce buffalograss, Texas grama, and three-awn. Mesquite is rapidly invading these sites. Bluestem still grows on the sands, but the vegetation is dominantly dropseed, silver bluestem, three-awn, and shin oak.

Range sites and condition classes

Soils differ in their capacity to produce grass and other plants for grazing. Soils that produce about the same kind and amount of forage, if the range is in similar condition, make up a range site.

Range sites are kinds of rangeland that differ in their ability to produce vegetation. The soils of any one range site produce about the same kind and amount of climax vegetation. The climax vegetation consists of the plants that were growing on any given site when the region was first settled. If cultivated crops are not grown, the most productive combination of forage plants on a range site is generally the climax vegetation.

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

[2] By DOUGLAS V. SELLARS, range conservationist, Soil Conservation Service.

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

Invaders are plants that cannot compete with plants in the climax plant community for moisture, nutrients, and light. Hence, invaders come in and grow along with increasers after the climax vegetation has been reduced by grazing. Many are annual weeds, and some are shrubs that have some grazing value, but others have little value for grazing.

Four range condition classes are used to indicate the degree of departure from the potential, or climax, vegetation brought about by grazing or other uses. Range condition class indicates the present condition of the native vegetation on a range site in relation to the native vegetation that could grow there.

A range is in *excellent* condition if 76 to 100 percent of the vegetation is of the same kind as that in the climax stand. It is 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 less than 25.

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

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

Descriptions of the range sites

In this section the 16 range sites of Eastland County are described, and the climax plants and principal invaders on the sites are named. Also given is an estimate of the potential average annual acre yield of air-dry herbage under favorable and unfavorable growing conditions in both wet and dry years for each site where it is in excellent condition. The soils in each site can be determined by referring to the "Guide to Mapping Units" at the back of this survey.

ADOBE RANGE SITE

Brackett stony loam, 1 to 8 percent slopes, is the only soil in this range site. This shallow, gently sloping, well-drained soil is on uplands. It has a surface layer of loam. Permeability is moderately slow, and available water capacity is very low.

If this site is in climax condition, it is a mixture of tall and mid grasses and scattered Texas oak, live oak, and juniper trees. Annual production, by weight, is 10 percent indiangrass; 40 percent little bluestem; 15 percent side-oats grama; 10 percent tall hairy grama; and 5 percent seep muhly. Such trees as Texas oak, live oak, and juniper make up 5 percent. Wild alfalfa and dotted gayfeather each make up 5 percent, and sedges and queen's-delight make up 5 percent.

If the site is continuously heavily grazed by cattle, indiangrass, little bluestem, side-oats grama, and tall grama decrease in the plant community. Such plants as hairy grama, perennial three-awn, red grama, Texas grama, hairy tridens, queen's-delight, and graygold aster increase and dominate the site. Texas oak trees and juniper trees make up as much as 30 to 50 percent of the canopy cover. If overgrazing is prolonged, annual weeds and annual grasses make up a substantial part of the annual production, and the total production is reduced.

Where this site is in excellent condition, the average annual acre yield of air-dry herbage ranges from 3,000 pounds in wet years to 1,500 pounds in dry years. Approximately 85 percent of this production is from plants that furnish forage for cattle or goats.

CLAYEY BOTTOMLAND RANGE SITE

Deleon clay, frequently flooded, is the only soil in this range site. This deep, nearly level, moderately well drained soil is on flood plains. It is flooded at intervals that range from one or more times a year to once every 3 years. Permeability is slow, and available water capacity is high.

If this site is in climax condition, it is a mixture of tall and mid grasses, forbs, and trees. Annual production, by weight, is 25 percent vine-mesquite; 10 percent white tridens; 10 percent Canada wildrye; 15 percent Texas wintergrass; 10 percent Arizona cottontop; 10 percent little bluestem; 5 percent buffalograss; and 5 percent indiangrass. Such woody plants as elm, live oak, and hackberry make up 5 percent of the yield, and Maximilian sunflower, Engelmanndaisy, coreopsis, and greenthread make up 5 percent.

If the site is continuously heavily grazed, vine-mesquite, western wheatgrass, Canada wildrye, white tridens, Arizona cottontop, and Engelmanndaisy decrease in the plant community. Such plants as buffalograss, Texas wintergrass, coreopsis, lotebush, pricklypear, and tasajillo increase. If overgrazing is prolonged, annual weeds, such as coreopsis and coneflower, and grasses, such as rescuegrass, make up a substantial part of the annual production, and the total production is greatly reduced.

Where this site is in excellent condition, the average annual acre yield of air-dry herbage ranges from 5,000 pounds in wet years to 3,000 pounds in dry years. Approximately 90 percent of this production is from plants that furnish forage for cattle, sheep, or goats.

CLAY FLAT RANGE SITE

This range site is made up of deep, nearly level to gently sloping, well-drained soils on uplands. These clayey soils crack when dry, and they have a gilgai microrelief. Permeability is very slow, and available water capacity is high.

If this site is in climax condition, it is a mixture of mid and short grasses, forbs, and woody plants. Annual production, by weight, is 25 percent vine-mesquite; 15 percent white tridens; 10 percent Texas wintergrass; 10 percent meadow dropseed; 10 percent silver bluestem; 10 percent curly mesquite; 5 percent buffalograss; and 5 percent Canada wildrye and side-oats grama. Such woody plants as elm, hackberry, and lotebush make up 5 percent of the yield, and catclaw sensitivebrier, heath aster, and Engelmanndaisy make up 5 percent.

If the site is continuously heavily grazed, vine-mesquite, white tridens, Canada wildrye, and meadow dropseed decrease in the plant community. Texas wintergrass, silver bluestem, curly mesquite, buffalograss, and purple three-awn increase. If overgrazing is prolonged, hairy tridens, Texas grama, lotebush, tasajillo, and upright prairie coneflower invade and dominate the site and mesquite readily invades. If a wet fall and winter is followed by a wet spring, this site has an abundance of

broomweed, regardless of the amount of vegetative cover.

Where this site is in excellent condition, the average annual acre yield of air-dry herbage ranges from 4,300 pounds in wet years to 3,000 pounds in dry years. Approximately 90 percent of this production is from plants that furnish forage for cattle, sheep, or goats.

CLAY LOAM RANGE SITE

This range site is made up of moderately deep to deep, gently sloping to sloping, loamy soils on uplands. These soils are well drained. Permeability is moderate, and available water capacity is medium.

If this site is in climax condition, it is an open prairie supporting an abundant growth of mid grasses. Woody plants are not significant in the climax vegetation. Annual production, by weight, is 25 percent side-oats grama; 20 percent vine-mesquite; 10 percent cane bluestem and silver bluestem; 10 percent buffalograss; 10 percent Texas wintergrass; 5 percent Texas cupgrass; 5 percent white tridens; and 5 percent meadow dropseed. Such forbs as yellow neptunia, catclaw sensitivebrier, Engelmanndaisy, prairie-clover, heath aster, dalea, and Maximilian sunflower make up about 10 percent.

If the site is continuously heavily grazed by cattle, side-oats grama, vine-mesquite, Canada wildrye, and Texas cupgrass decrease in the plant community. Texas wintergrass, silver bluestem, and buffalograss increase. If overgrazing is prolonged, buffalograss, hairy tridens, Texas grama, western ragweed, and annual broomweed dominate the site.

Where this site is in excellent condition, the average annual acre yield of air-dry herbage ranges from 5,500 pounds in wet years to 2,800 pounds in dry years. Approximately 90 percent of this production is from plants that furnish forage for cattle, sheep, or goats.

CLAYPAN RANGE SITE

This range site is made up of deep, nearly level to gently sloping, loamy soils on uplands (fig. 12). These soils are somewhat poorly drained to moderately well drained. When these soils are dry, a crust forms on the surface and the surface layer becomes very hard. Permeability is very slow, and available water capacity is high.

If this site is in climax condition, it is an open prairie that has mid and short grasses. Condalia and ephedra are scattered throughout the site. Annual production, by weight, is 25 percent vine-mesquite; 10 percent side-oats grama; 5 percent buffalograss; 10 percent Arizona cottontop; 5 percent blue grama; 5 percent western

Figure 12.—**Area of a Thurber clay loam in Claypan range site.**

wheatgrass; 5 percent Texas wintergrass; 5 percent tall dropseed; 5 percent meadow dropseed; 5 percent perennial three-awn; 5 percent sand dropseed; 5 percent white tridens; and 5 percent silver bluestem. Such forbs as heath aster, Engelmanndaisy, greenthread, catclaw sensitivebrier, Maximilian sunflower, and western ragweed make up 5 percent of the yield.

If the site is continuously heavily grazed by cattle, silver bluestem, side-oats grama, and white tridens decrease in the plant community. Such plants as buffalograss, curly mesquite, and Texas wintergrass increase. If overgrazing is prolonged, mesquite, condalia, tasajillo, pricklypear, ragweed, annual weeds, and annual grasses invade the site, and the total production is greatly reduced.

Where this site is in excellent condition, the average annual acre yield of air-dry herbage ranges from 3,500 pounds in wet years to 2,000 pounds in dry years. Approximately 95 percent of this production is from plants that furnish forage for cattle or sheep.

DEEP REDLAND RANGE SITE

Lindy loam, 1 to 3 percent slopes, is the only soil in this range site. This moderately deep, gently sloping loamy soil is on uplands. It is well drained. Permeability is slow, and available water capacity is medium.

If this site is in climax condition, it is a mixture of tall and mid grasses and forbs. Live oak and post oak trees are in a few areas. Annual production, by weight, is 20 percent indiangrass; 25 percent little bluestem; 10 percent big bluestem; 10 percent side-oats grama; 10 percent Texas cupgrass; 5 percent cane bluestem; 5 percent tall dropseed; 5 percent Texas wintergrass; and 5 percent buffalograss. Such forbs as wild vetch, sida, filaree, trailing ratany, Engelmanndaisy, and bushsunflower make up 5 percent.

If the site is continuously heavily grazed, tall and mid grasses, such as side-oats grama, cane bluestem, vine-mesquite, Engelmanndaisy, and bushsunflower, decrease in the plant community. Such plants as Texas wintergrass, buffalograss, and silver bluestem increase. Continued overgrazing causes an increase in such grasses as perennial three-awn, hairy tridens, and Texas grama and such kinds of brush as live oak, tasajillo, pricklypear, greenbrier, and elbowbush. If overgrazing is prolonged, annual weeds and annual grasses dominate the site, and the total production is greatly reduced.

Where this site is in excellent condition, the average annual acre yield of air-dry herbage ranges from 5,000 pounds in wet years to 3,000 pounds in dry years. Approximately 85 percent of this production is from plants that furnish forage for livestock.

DEEP SAND RANGE SITE

Patilo fine sand, 0 to 3 percent slopes, is the only soil in this range site. This deep, nearly level to gently sloping, sandy soil is on uplands. It is moderately well drained. Permeability is moderately slow, and available water capacity is low.

If this site is in climax condition, it is a mixture of tall and mid grasses, an open stand of post oak, blackjack oak, and other kinds of brush, and forbs scattered throughout. Annual production, by weight, is 10 percent sand lovegrass; 5 percent sand dropseed; 5 percent indiangrass and big bluestem; 5 percent purpletop tridens; 5 percent fringeleaf pasapalum; 5 percent Scribner's panicum; 10 percent annual grasses; 15 percent post oak; 10 percent blackjack oak; 5 percent bumelia; 5 percent greenbrier; and 5 percent skunkbush sumac and prickly-ash. Such forbs as trailing wildbean, lespedeza, erect dayflower, oenothera, and bundleflower make up about 15 percent of the yield.

If the site is continuously heavily grazed by cattle, sand lovegrass, indiangrass, big bluestem, and purpletop tridens decrease. Brush, particularly oak, frequently increases and dominates the site.

Where this site is in excellent condition, the average annual acre yield of air-dry herbage ranges from 3,000 pounds in wet years to 1,000 pounds in dry years. Approximately 55 percent of this production is from plants that furnish forage for cattle or goats.

LOAMY BOTTOMLAND RANGE SITE

This range site is made up of deep, nearly level, loamy soils on floods plains (fig. 13). These soils are well drained. Permeability is moderate, and available water capacity is high. The soils are flooded at intervals ranging from one or more times each year to once every 4 to 10 years.

If this site is in climax condition, it is a savanna that has tall grass and a 10 to 15 percent canopy of tall trees along streams. Pecan is the main kind of woody plant along the larger streams, and elm and live oak are the main ones along the smaller streams. Annual production, by weight, is 20 percent indiangrass; 15 percent little bluestem; 10 percent big bluestem; 15 percent switchgrass; 5 percent side-oats grama; 5 percent meadow dropseed and Canada wildrye; 5 percent vine-mesquite; 5 percent Texas wintergrass; and 5 percent tall dropseed. Such kinds of woody plants as pecan, elm, live oak, and hackberry make up 10 percent, and such forbs as Engelmanndaisy, catclaw sensitivebrier, Maximilian sunflower, trailing wildbean, baldwin ironweed, and western ragweed make up 5 percent.

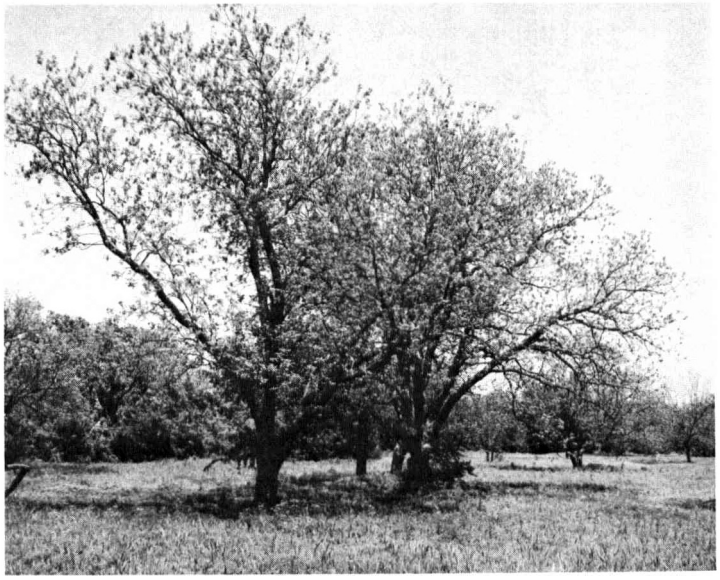

Figure 13.—**Large pecan trees on Elandco silty clay loam in Loamy Bottomland range site.**

If the site is continuously heavily grazed, tall grasses decrease. Side-oats grama, hairy dropseed, meadow dropseed, Texas wintergrass, and vine-mesquite increase. Western ragweed, nightshade, and buffalograss invade. If overgrazing is prolonged, this site eventually regresses to a dense stand of brush and invading forbs.

Where this site is in excellent condition, the average annual acre yield of air-dry herbage ranges from 7,000 pounds in wet years to 3,700 pounds in dry years. Approximately 85 percent of this production is from plants that furnish forage for cattle or goats.

LOW STONY HILLS RANGE SITE

This range site is made up of very shallow to shallow, gently sloping to sloping and hilly, clayey soils on uplands. These soils are well drained. Permeability is moderately slow, and available water capacity is very low.

If this site is in climax condition, it is a mixture of tall and mid grasses, and motts of brush and trees are scattered throughout. Annual production, by weight, is 20 percent little bluestem; 10 percent indiangrass; 10 percent side-oats grama; 10 percent tall dropseed; 5 percent big bluestem; 5 percent green sprangletop; 5 percent Texas wintergrass; 5 percent Texas cupgrass; 5 percent slender tridens; and 5 percent cane bluestem. Live oak, Texas oak, post oak, and shin oak make up 10 percent of the yield, and sumac, skunkbush, elbowbush, redbud, bush honeysuckle, Texas sophora, and greenbrier make up 5 percent. Such forbs as dotted gayfeather, Engelmanndaisy, yellow neptunia, sensitivebrier, bushsunflower, and orange zexmenia make up about 5 percent.

If the site is continuously heavily grazed, brush and perennial three-awns increase. Hairy tridens and Texas grama invade. Desirable forbs, such as Engelmanndaisy, yellow neptunia, sensitivebrier, heath aster, and bushsunflower, are replaced by annual broomweed and upright prairie coneflower, and production is reduced as much as 1,000 pounds per acre.

Where this site is in excellent condition, the average annual acre yield of air-dry herbage ranges from 1,700 pounds in wet years to 900 pounds in dry years. Approximately 80 percent of this production is from plants that furnish forage for cattle or goats.

REDLAND RANGE SITE

This range site is made up of shallow, gently sloping, loamy soils on uplands (fig. 14). These soils are well drained. Permeability is slow, and available water capacity is low.

If this site is in climax condition, it is a mixture of tall and mid grasses, forbs, and live oak trees. Annual production, by weight, is 30 percent little bluestem; 10 percent indiangrass; 10 percent big bluestem; 10 percent side-oats grama; 5 percent tall dropseed; 5 percent vine-mesquite, curly mesquite, and buffalograss; 5 percent Texas cupgrass; and 5 percent cane bluestem and silver bluestem. Post oak and live oak make up 5 percent of the yield, and hackberry, catclaw sensitivebrier, prickly ash,

Figure 14.—Cattle grazing on a Hensley stony loam in Redland range site.

bumelia, and elm make up 5 percent. Such forbs as Englemanndaisy, indian mallow, sagewort, purple prairie-clover, and bushsunflower make up 5 percent.

If the site is continuously heavily grazed by cattle, little bluestem, big bluestem, indiangrass, Englemanndaisy, bushsunflower, purple prairie-clover, and sagewort decrease. Texas cupgrass, Texas wintergrass, and side-oats grama increase, then decrease when overgrazing is continued. If overgrazing is prolonged, such brush as mesquite and juniper and such plants as perennial three-awn and annual weeds make up a substantial part of the annual yield, and production is reduced as much as 2,000 pounds per acre.

Where this site is in excellent condition, the average annual acre yield of air-dry herbage ranges from 5,000 pounds in wet years to 2,700 pounds in dry years. Approximately 90 percent of this production is from plants that furnish forage for cattle and goats.

SANDY RANGE SITE

This range site is made up of deep, nearly level to sloping and gently undulating, sandy soils on uplands. These soils are moderately well drained to well drained. Permeability is slow to moderately slow, and available water capacity is low to high.

If this site is in climax condition, it is a post oak and blackjack oak savanna. Post oak is the dominant kind of woody plant. Tall grasses and some mid grasses make up the understory, and an abundant variety of forbs is produced. Annual production, by weight, is 25 percent little bluestem; 10 percent big bluestem; 10 percent indiangrass; 5 percent sand lovegrass; 5 percent purpletop tridens; 5 percent tall dropseed; 5 percent silver bluestem; 5 percent hairy grama; and 5 percent Scribner's panicum. Post oak and blackjack oak make up 15 percent of the yield, and skunkbush, greenbrier, bumelia, pricklyash, hackberry, poison-oak, and blackhaw make up 5 percent. Such forbs as erect dayflower, trailing wildbean, lespedeza, and prairie-clover make up about 5 percent.

If the site is continuously heavily grazed by cattle, little bluestem, sand lovegrass, indiangrass, big bluestem, and purpletop tridens decrease in the plant community. Such plants as dropseed, hairy grama, and silver bluestem increase. If overgrazing is prolonged, fringeleaf paspalum, silverleaf nightshade, gummy lovegrass, tumble lovegrass, and annual grasses invade. Blackjack oak and post oak increase in some areas and shade this site, which prevents grass growth (fig. 15).

Where this site is in excellent condition, the average annual acre yield of air-dry herbage ranges from 4,000 pounds in wet years to 2,000 pounds in dry years. Approximately 80 percent of this production is from plants that furnish forage for cattle or goats.

SANDY LOAM RANGE SITE

This range site is made up of deep to very shallow, nearly level to sloping, loamy soils on uplands. These soils are well drained. Permeability is moderate to moderately slow, and available water capacity is low to high.

If this site is in climax condition, it is an open savanna of post oak and blackjack oak trees and an understory of tall and mid grasses. Annual production, by weight, is 30 percent little bluestem; 10 percent big bluestem; 10 percent indiangrass; 10 percent side-oats grama; 5 percent cane bluestem and silver bluestem; 5 percent Scribner's panicum; 5 percent Texas wintergrass; and 5 percent Arizona cottontop. Post oak and blackjack oak make up 5 percent of the yield, and elm, prickly ash, bumelia, hackberry, and skunkbush sumac make up 5 percent. Such forbs as yellow neptunia, scurfpea, western ragweed,

Figure 15.—**Area of a Nimrod fine sand. Land at right has been cleared of post oak brush and planted to weeping lovegrass. Land on left is untreated.**

Engelmanndaisy, bundleflower, skunkbush sumac, dalea, and prairie-clover make up 10 percent.

If the site is continuously heavily grazed by cattle, little bluestem, indiangrass, big bluestem, switchgrass, and purpletop tridens decrease in the plant community. Such plants as side-oats grama, hooded windmillgrass, and Texas wintergrass increase. If overgrazing is prolonged, annual weeds and woody plants make up a substantial part of the annual production, and the total production is greatly reduced.

Where this site is in excellent condition, the average annual acre yield of air-dry herbage ranges from 6,000 pounds in wet years to 3,500 pounds in dry years. Approximately 85 percent of this production is from plants that furnish forage for cattle or goats.

SANDSTONE HILLS RANGE SITE

Exray stony soils, hilly, are the only soils in this range site. These shallow to very shallow, well-drained soils are on uplands (fig. 16). Permeability is moderately slow, and available water capacity is low.

If this site is in climax condition, it has an open stand of post oak trees and an understory of tall and mid grasses. Annual production, by weight, is 35 percent little bluestem; 10 percent indiangrass; 10 percent side-oats grama; 5 percent big bluestem; 5 percent switchgrass; 5 percent sand lovegrass; 5 percent cane bluestem and silver bluestem; and 5 percent Scribner's panicum. Post oak and blackjack oak make up 10 percent of the yield, and other brush, such as elm, Texas ash, skunkbush sumac, elbowbush, bumelia, pricklyash, bush honeysuckle, make up 5 percent. Such forbs as Engelmanndaisy, bundleflower, prairie-clover, lespedeza, and western ragweed make up 5 percent.

If the site is continuously heavily grazed by cattle, indiangrass, little bluestem, switchgrass, and sand lovegrass decrease in the plant community. Such plants as side-oats grama and silver bluestem increase. If overgrazing is prolonged, annual weeds and woody plants make up a substantial part of the annual production, and the total production is greatly reduced.

Where this site is in excellent condition, the average annual acre yield of air-dry herbage ranges from 5,000 pounds in wet years to 3,500 pounds in dry years. Approximately 80 percent of this production is from plants that furnish forage for cattle and goats.

SHALLOW CLAY RANGE SITE

This range site is made up of shallow, gently sloping to hilly, clayey soils on uplands (fig. 17). These soils are well drained. Permeability is very slow, and available water capacity is low. The soils are covered by sandstone, ironstone, and limestone fragments in some areas.

If this site is in climax condition, it is a mixture of mid and short grasses. A few kinds of woody plants are scattered throughout the site. Annual production, by weight, is 30 percent side-oats grama; 15 percent cane bluestem and silver bluestem; 10 percent buffalograss; 10 percent vine-mesquite; 5 percent curly mesquite; 5 percent Texas wintergrass; 5 percent Arizona cottontop; 5 percent hairy grama; and 5 percent rough tridens. Such woody plants as ephedra, hackberry, wolfberry, dalea, catclaw sensitivebrier, and agrito make up 5 percent of the yield. Such forbs as western ragweed, Louisiana sagewort, bundleflower, and Engelmanndaisy make up 5 percent.

If the site is continuously heavily grazed by cattle, side-oats grama and silver bluestem decrease in the plant

Figure 16.—Area of Exray stony soils, hilly, in Sandstone Hills range site.

community. Such plants as buffalograss, curly mesquite, and Texas wintergrass increase. If overgrazing is prolonged, three-awns, condalia, hairy tridens, small mesquite, pricklypear, and tasajillo invade.

Where this site is in excellent condition, the average annual acre yield of air-dry herbage ranges from 1,700 pounds in wet years to 900 pounds in dry years. Approximately 90 percent of this production is from plants that furnish forage for cattle.

STEEP ADOBE RANGE SITE

Only Brackett complex, 8 to 20 percent slopes, is in this range site. These shallow, strongly sloping to moderately steep, loamy soils are on uplands (fig. 18). The soils are well drained. Permeability is moderately slow, and available water capacity is very low.

If this site is in climax condition, it is a mixture of tall and mid grasses. Motts of Texas oak, live oak, and a few juniper are scattered throughout the site. Annual production, by weight, is 30 percent little bluestem; 10 percent indiangrass; 10 percent side-oats grama; 10 percent tall grama; 5 percent hairy dropseed; 5 percent silver bluestem; 5 percent rough tridens; and 5 percent hairy grama. Such woody plants as Texas oak, live oak, juniper, flameleaf sumac, and skunkbush sumac make up 15 percent of the yield. Such forbs as queen's-delight, big top dalea, white milkwort, dotted gayfeather, and wild alfalfa make up 5 percent.

If the site is continuously heavily grazed by cattle, little bluestem, indiangrass, side-oats grama, and tall grama decrease in the plant community. Such plants as silver bluestem, hairy grama, perennial three-awn, and queen's-delight increase. If overgrazing is prolonged, annual weeds and annual grasses make up a substantial part of the annual production, and the total production is reduced.

Where this site is in excellent condition, the average annual acre yield of air-dry herbage ranges from 2,500 pounds in wet years to 1,500 pounds in dry years. Approximately 75 percent of this production is from plants that furnish forage for cattle or goats.

TIGHT SANDY LOAM RANGE SITE

This range site is made up of moderately deep to deep, loamy soils on uplands. These soils are well drained. Permeability is slow to moderately slow, and available water capacity is medium or high.

If this site is in climax condition, it is a mixture of mid and short grasses and forbs. Annual production, by weight, is 30 percent side-oats grama; 15 percent Arizona cottontop; 15 percent vine-mesquite; 5 percent blue grama; 5 percent silver bluestem; 5 percent buffalograss; 5 percent Texas wintergrass; 5 percent purple three-awn; and 5 percent little bluestem. Such woody plants as post oak, lotebush, agrito, and bumelia make up 5 percent of the yield, and such forbs as western ragweed, catclaw sensitivebrier, and guara make up 5 percent.

If the site is continuously heavily grazed by cattle, side-oats grama, Arizona cottontop, blue grama, and silver bluestem decrease in the plant community. Such plants as buffalograss, Texas wintergrass, and slim tridens increase. If overgrazing is prolonged, annual weeds, annual grasses, and woody plants make up a substantial part of the annual production, and the total production is reduced. Post

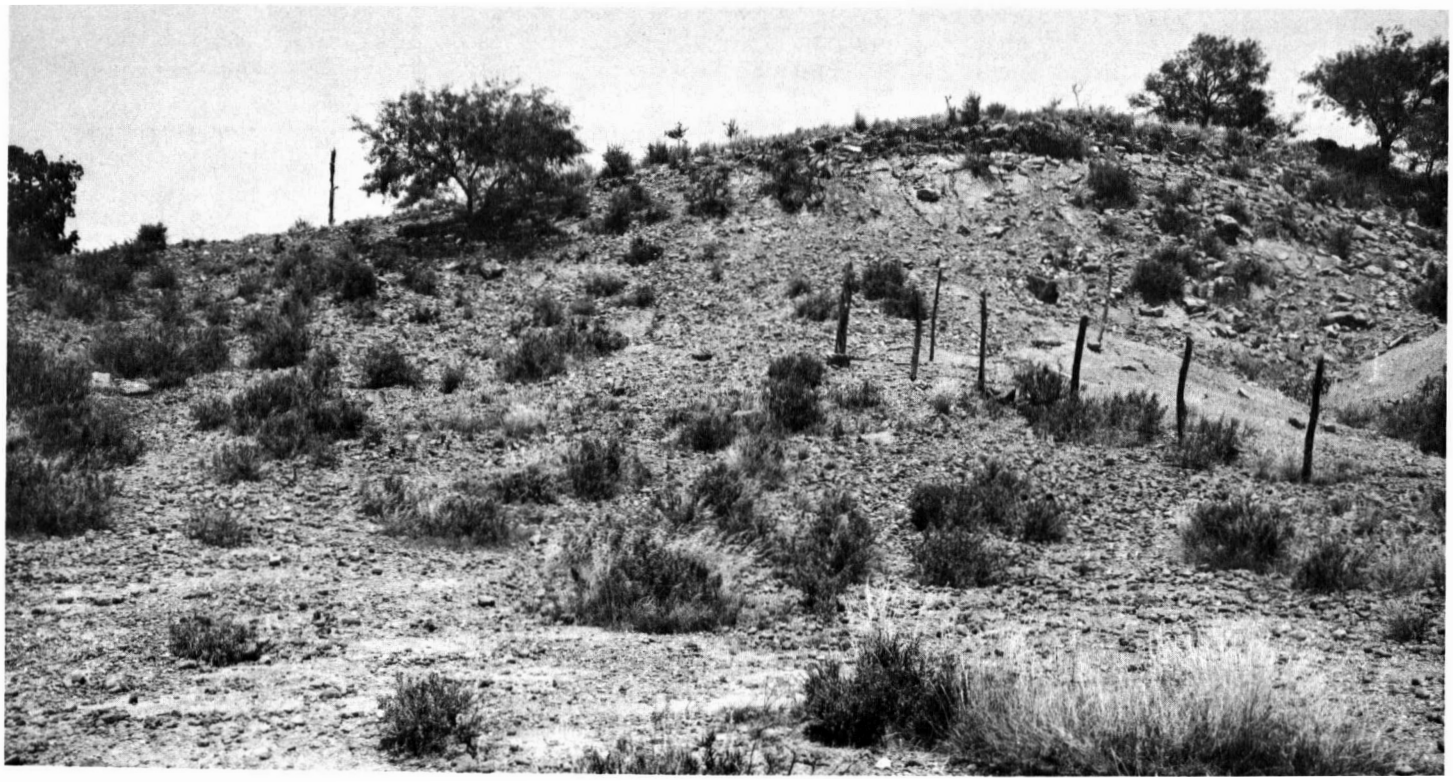

Figure 17.—**Area of an Owens clay in Shallow Clay range site.**

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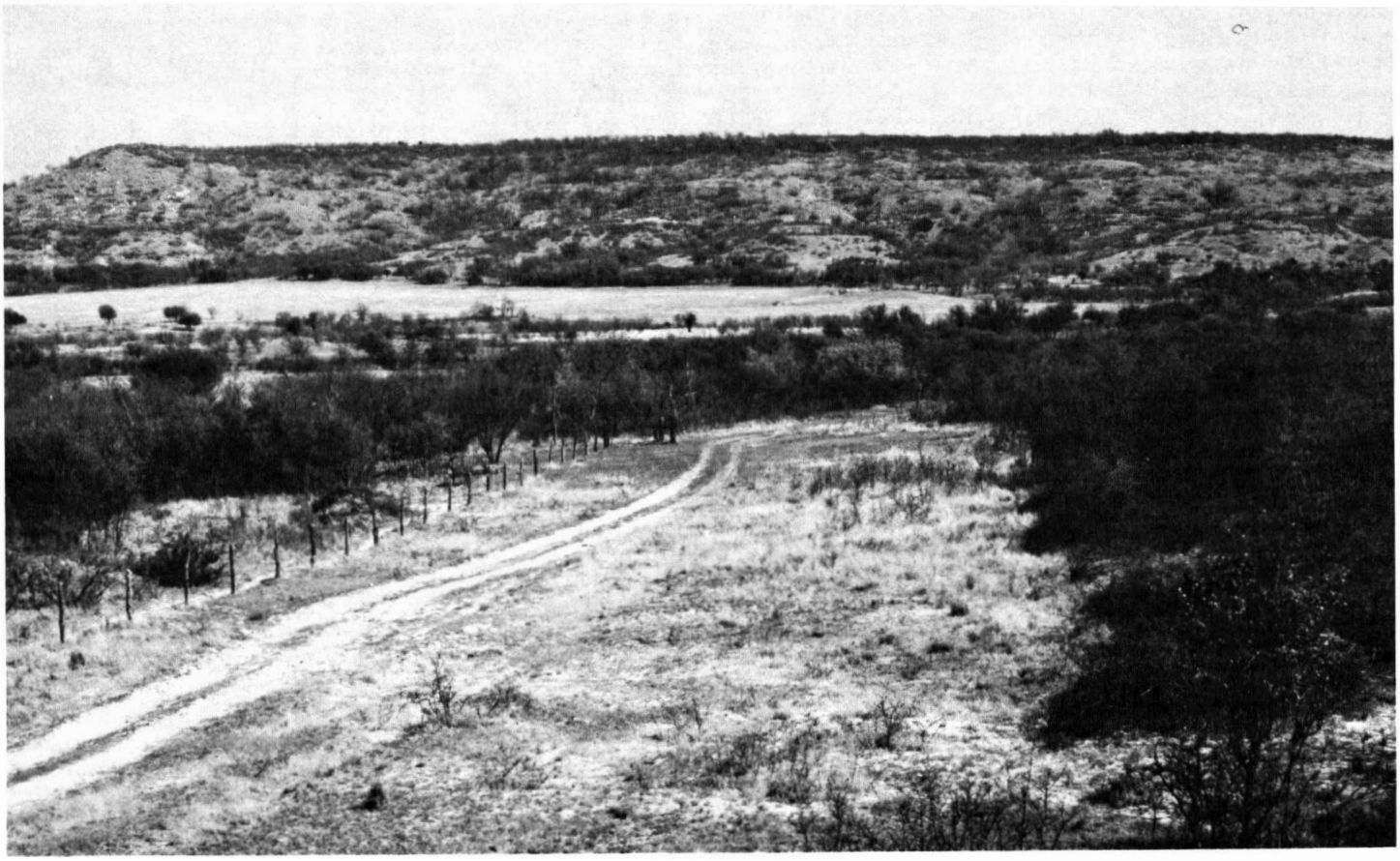

Figure 18.—**Area of Lamar soils in foreground and of stony Brackett soils in background.**

oak does not invade this site as readily as does condalia, tasajillo, and mesquite.

Where this site is in excellent condition, the average annual acre yield of air-dry herbage ranges from 3,500 pounds in wet years to 2,000 pounds in dry years. Approximately 70 percent of this production is from plants that furnish forage for cattle or sheep.

Wildlife [3]

Soils directly influence the kind and amount of vegetation and the amount of water available. In this way they indirectly influence the kinds of wildlife that can live in an area. Soil properties that affect the growth of wildlife habitat are (1) thickness of soil useful to crops, (2) texture of the surface layer, (3) available water capacity to a depth of 40 inches, (3) wetness, (5) surface stoniness or rockiness, (6) hazard of flooding, (7) slope, and (8) permeability of the soil to air and water.

In table 3, the soils of Eastland County are rated according to their suitability for producing six elements of wildlife habitat and for three groups, or kinds, of wildlife. The ratings indicate relative suitability for various elements. A rating of *good* indicates that habitat is generally easily created, improved, or maintained. The soil has few or no limitations that affect management, and satisfactory results can be expected when the soil is used for the prescribed purpose.

A rating of *fair* indicates that habitat can be created, improved, or maintained in most places, but the soil has moderate limitations that affect management or development. A moderate intensity of management and fairly frequent attention may be required to insure satisfactory results.

[3] By LYNN J. POST, biologist, Soil Conservation Service.

TABLE 3.—*Suitability of the soils for elements of wildlife habitat and for kinds of wildlife*

Soil series and map symbols	Elements of wildlife habitat						Kinds of wildlife		
	Grain and seed crops	Domestic grasses and legumes	Wild herbaceous plants	Shrubs	Wetland food and cover plants	Shallow water developments	Open-land	Rangeland	Wetland
Bolar: BcB	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Bonti: BnB	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Brackett:									
Brd	Poor	Poor	Fair	Fair	Poor	Very poor	Poor	Fair	Very poor.
BtE	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Fair	Very poor.
Bunyan:									
Bu	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
By	Very poor	Poor	Fair	Good	Poor	Very poor	Poor	Fair	Very poor.
Chaney:									
ChC, ChC2, CnD3	Fair	Good	Good	Good	Poor	Poor	Good	Good	Poor.
CmD	Poor	Poor	Good	Good	Poor	Very poor	Fair	Good	Very poor.
Cisco:									
CoC	Fair	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
CsB	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
CsC, CsC2	Fair	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Deleon: De	Very poor	Poor	Poor	Good	Poor	Poor	Poor	Fair	Poor.
Demona: DmC	Fair	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Elandco:									
Ea	Good	Good	Fair	Good	Poor	Very poor	Good	Fair	Very poor.
En	Very poor	Poor	Fair	Good	Poor	Very poor	Poor	Fair	Very poor.
Exray:									
ErD. For Bonti part of ErD, see Bonti series.	Poor	Poor	Fair	Fair	Very poor	Very poor	Poor	Fair	Very poor.
ESE	Poor	Poor	Fair	Fair	Very poor	Very poor	Poor	Fair	Very poor.
Hassee: HaA, HaB	Fair	Fair	Good	Fair	Fair	Fair	Good	Fair	Fair.
Hensley: HeB, HnC	Poor	Poor	Fair	Fair	Very poor	Very poor	Poor	Fair	Very poor.
Lamar: LaC, LaD	Fair	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Leeray: LeA, LeB	Good	Good	Poor	Fair	Poor	Good	Fair	Fair	Fair.
Lindy: LnB	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
May: MfA, MfB	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Menard: MnB, MnC	Fair	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Nimrod: NmC	Poor	Good	Good	Good	Poor	Very poor	Fair	Good	Very poor.
Owens:									
OcB	Fair	Good	Poor	Fair	Poor	Very poor	Fair	Fair	Very poor.
OWE	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Poor	Very poor.
Patilo: PaB	Fair	Good	Good	Fair	Poor	Very poor	Good	Fair	Very poor.
Pedernales: PdC, PeB, PeC, PeC2, PsD3.	Fair	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.
Tarrant: TaD, TNE	Very poor	Poor	Fair	Fair	Very poor	Very poor	Poor	Fair	Very poor.
Thurber: TrA, TrB	Good	Good	Fair	Fair	Poor	Good	Fair	Fair	Fair.
Truce: TuB, TuC, TuC2	Fair	Good	Good	Good	Poor	Very poor	Good	Good	Very poor.

A rating of *poor* indicates that habitat can be created, improved, or maintained in most places, but the soil has severe limitations. Management is difficult, expensive, and requires intensive effort. Results are questionable.

A rating of *very poor* indicates that under the prevailing soil conditions, it is impractical to attempt to create, improve, or maintain habitat. Soil conditions are very severe, and unsatisfactory results are probable.

Each soil is rated in table 3 according to its suitability for producing various kinds of plants and other elements that make up wildlife habitats. The ratings take into account mainly the characteristics of the soils and closely related natural factors of the environment. They do not take into account climate, present use of soils, or present distribution of wildlife and people. For this reason, selection of the site for development as a habitat for wildlife requires inspection at the site.

The six elements of wildlife habitat rated in table 3 are briefly defined in the following paragraphs.

Grain and seed crops are crops that produce annual grain, such as corn, sorghum, oats, and dove proso.

Domestic grasses and legumes are domestic grasses and legumes that are established by planting They provide food and cover for wildlife. Grasses include hardinggrass, Kleingrass, and ryegrass; legumes include alfalfa, winter-pea, vetch, and other clovers.

Wild herbaceous plants are native or introduced perennial grasses, forbs, and weeds that provide food and cover for upland wildlife. Beggarweed, guara, and wildbean are examples of these plants. On range typical plants are side-oats grama, perennial forbs, and legumes.

Shrubs are shrubby plants in subhumid and drier parts of the country (moisture regime drier than udic) that produce buds, twigs, bark, or foliage used as food by wildlife or that provide cover and shade for some kinds of wildlife. Honeysuckle, elbowbush, and skunkbush sumac are typical kinds of plants in this category.

Wetland food and cover plants are annual and perennial herbaceous plants that grow wild on moist and wet sites. They furnish food and cover mostly for wetland wildlife. Typical examples of plants are smartweed, spikerush and other rushes, and sedges. Submerged and floating aquatics are not included in this category.

Shallow water developments are impoundments or excavations for controlling water, generally not more than 5 feet deep, to create habitats that are suitable for waterfowl. Some are designed to be drained, planted, and then flooded; others are permanent impoundments that grow submersed aquatics.

Table 3 also rates soils according to their suitability as habitat for the three kinds of wildlife in the county—open-land, rangeland, and wetland wildlife. These ratings are related to ratings made for the elements of wildlife habitat. For example, soils rated very poor for shallow water developments are rated very poor for wetland wildlife. The kinds of wildlife for which the soils are rated in table 3 are briefly described in the following paragraphs.

Open-land wildlife consists of birds and mammals that normally live in meadows, pastures, and open areas where grasses, herbs, and shrubby plants grow. Quail, dove, meadowlark, field sparrow, cottontail rabbit, jackrabbit, and fox are typical examples of open-land wildlife.

Rangeland wildlife consists of birds and mammals that normally live in areas of natural rangeland. Antelope, bobcat, bunting, chukar, coyote, deer, meadowlark, quail, and raccoon are typical examples of rangeland wildlife.

Wetland wildlife consists of birds and mammals that normally live in wet areas, marshes, and swamps. Ducks, geese, heron, mink, nutria, rail, and shore birds are typical examples of wetland wildlife.

Engineering Uses of the Soils [4]

This section is useful to those who need information about soils used as structural material or as foundation upon which structures are built. Among those who can benefit from this section are planning commissions, town and city managers, land developers, engineers, contractors, and farmers.

Among the soil properties most important in engineering are permeability, shear strength, compaction characteristics, compressibility, soil drainage condition, shrink-swell potential, grain-size distribution, plasticity, and reaction. Depth to the water table, depth to bedrock, and slope are also important. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section of the soil survey can be helpful to those who—

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the kinds of soil on which they are built for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables 4, 5, and 6, which show, respectively, several estimated soil properties significant to engineering; interpretations for various engineering uses; and results of engineering laboratory tests on soil samples.

This information, along with the soil map and other parts of this survey, can be used to make interpretations in addition to those given in table 5, and it also can be used to make other useful maps.

[4] By LERON E. SATTERWHITE, area engineer, Soil Conservation Service.

This information, however, does not eliminate need for further investigations at sites selected for engineering works, especially works that involve heavy loads or that require excavations to a depth greater than those shown in the tables, generally a depth of more than 6 feet. In addition, inspection of sites, especially the small ones, is needed because many delineated areas of a given soil mapping unit may contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil engineering.

Some of the terms used in this soil survey have different meanings in soil science than in engineering. Many of these terms commonly used in soil science are defined in the Glossary.

Engineering classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified soil classification system,[5] used by the SCS engineers, Department of Defense, and others, and the AASHTO system,[6] adopted by the American Association of State Highway and Transportation Officials.

In the Unified soil classification system, soils are classified according to particle-size distribution, plasticity index, liquid limit, and organic-matter content. Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes; for example, ML–CL. The letters used in class designation mean: G, gravel; S, sand; M, silt; and C, clay. Clean sands are identified by SW or SP; sands that have fines of silt and clay by SM or SC; silt and clay that have a low liquid limit by ML and CL; and silt and clay that have a high liquid limit by MH and CH.

The AASHTO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system, a soil is placed in one of seven basic groups ranging from A–1 through A–7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A–1 are gravelly soils of high bearing strength, the best soils for subgrade (foundation). At the other extreme, in group A–7, are clay soils that have low strength when wet, the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A–1, A–2, and A–7 groups are divided as follows: A–1–a, A–1–b, A–2–4, A–2–5, A–2–6, A–2–7, A–7–5, and A–7–6. As additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The AASHTO classification for tested soils, with group index numbers in parentheses, is shown in table 6; the estimated classification, without group index numbers, is given in table 4 for all soils mapped in the survey area.

[5] American Society for Testing and Materials. 1974. Method for classification of soils for engineering purposes. ASTM Stand. D 2487–69. *In* 1974 Annual Book of ASTM Standards, Part 19, 464 pp., illus.

[6] American Association of State Highway [and Transportation] Officials. Standard specifications for highway materials and methods of sampling and testing. Ed. 8, 2 v., illus. 1961.

Estimated soil properties significant to engineering

Several estimated soil properties significant to engineering are given in table 4. These estimates are made for typical soil profiles by layers sufficiently different to behave in a different way when used for engineering purposes. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other counties. In the following paragraphs the columns in table 4 are explained.

In the column headed "Hydrologic group," the runoff potential from rainfall is given. Four major soil groups are used, and the soils are classified on the basis of intake of water at the end of long-duration storms that occur after prior wetting and opportunity for swelling and without the protective effects of vegetation.

The major soil groups are briefly described in the following paragraphs.

Group A consists of soils that have a high infiltration rate even when thoroughly wetted. They are chiefly deep, well-drained to excessively drained sand or gravel, or both. These soils have a high rate of water transmission and a low runoff potential.

Group B consists of soils that have a moderate infiltration rate when thoroughly wetted. They are chiefly moderately deep to deep, moderately well drained to well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission and a moderate runoff potential.

Group C consists of soils that have a slow infiltration rate when thoroughly wetted. They are chiefly soils that have a layer that impedes downward movement of water or soils that have moderately fine texture to fine texture. These soils have a slow rate of water transmission and a high runoff potential.

Group D consists of soils that have a very slow infiltration rate when thoroughly wetted. They are chiefly clay soils that have a high swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very slow rate of water transmission and a very high runoff potential.

Depth to bedrock is the distance from the surface of the soil to the upper surface of the rock layer.

In the column headed "Depth from surface," the depth is given in inches for the major distinctive layers of the soil profile.

Depth to seasonal high water table is the distance from the surface of the soil to the highest level that ground water reaches in the soil in most years. This column was not included in the table, because this is not of concern in Eastland County. Deleon soils have a water table at about 10 feet, and Demona soils have a temporary perched water table in wet seasons.

Soil texture is described in table 4 in the standard terms used by the U.S. Department of Agriculture. These terms take into account relative percentages of sand, silt, and clay in soil material that is less than 2.0 millimeters in diameter. "Loam," for example, is soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added; for example, "gravelly loamy sand." "Sand," "silt," "clay," and other terms used in USDA textural classification are defined in the Glossary.

TABLE 4.—*Estimates of soil*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils for referring to other series that appear in the first column of this table. The symbol > means more

Soil series and map symbols	Hydrologic group	Depth to bedrock	Depth from surface	Dominant USDA texture	Classification		Coarse fraction greater than 3 inches
					Unified	AASHTO	
		In	*In*				*Pct*
Bolar: BcB	C	20 to 40	0–12	Clay loam	CL	A–6, A–7	0–5
			12–38	Clay loam	CL	A–6, A–7	0–10
			38–40	Fractured hard limestone bedrock.			
Bonti: BnB	C	20 to 40	0–6	Fine sandy loam	CL–ML, SC, SM, SM–SC, ML	A–4, A–2	0–25
			6–26	Sandy clay	CL	A–6, A–7	0–4
			26–28	Strongly cemented sandstone.			
Brackett: Brd, BtE	C	10 to 20	0–6	Loam	SC, CL	A–6	1–10
			6–16	Loam	SC, CL	A–6	1–8
			16–40	Limy loam interbedded with soft limestone and sandstone fragments.			
Bunyan: Bu, By	B	>72	0–8	Fine sandy loam	SC, CL	A–4, A–6	
			8–24	Sandy clay loam	SC, CL	A–4, A–6	
			24–40	Fine sandy loam	SC, CL	A–4, A–6	
			40–46	Sandy clay loam	SC, CL	A–4, A–6	
			46–60	Fine sandy loam	SC, CL	A–4, A–6	
Chaney: ChC, ChC2, CmD, CnD3	C	>72	0–12	Loamy sand	SM, SM–SP	A–3, A–2–4	0–20
			12–48	Sandy clay	CL, CH	A–7	0–10
			48–60	Sandy clay loam	CL	A–6, A–7	0–10
Cisco:							
CoC	B	>72	0–10	Loamy fine sand	SM	A–4, A–2–4	
			10–50	Sandy clay loam	SC	A–6	
			50–70	Fine sandy loam	SC	A–4, A–6	
CsB, CsC, CsC2	B	>72	0–12	Fine sandy loam	SM, ML, SM–SC, CL–ML	A–4	
			12–60	Sandy clay loam	SC, CL	A–6	
Deleon: De	C	>72	0–44	Clay	CH, CL	A–7–6	
			44–64	Silty clay loam	CL, CH	A–7, A–6	
Demona: DmC	C	>72	0–28	Loamy sand	SM, SM–SC	A–2–4	
			28–50	Sandy clay	CL, CH	A–7	
			50–64	Shaly clay.			
Elandco: Ea, En	B	>72	0–40	Silty clay loam	CL, ML	A–7, A–6	
			40–62	Silty clay loam	CL, ML	A–6, A–7	
*Exray: ErD, ESE	D	8 to 20	0–7	Fine sandy loam	SC, CL, CL–ML, SM, SC	A–4	1–20
For Bonti part of ErD, see Bonti series.			7–18	Clay	SC, CL	A–6, A–7	
			18–24	Strongly cemented sandstone.			
Hassee: HaA, HaB	D	>72	0–14	Loam	CL	A–4, A–6	
			14–46	Clay	CH	A–7–6	
			46–72	Clay loam	CH, CL	A–7–6	
Hensley: HeB, HnC	D	10 to 20	0–4	Loam	CL	A–6	0–20
			4–16	Clay	CL, CH	A–7, A–6	0–5
			16–18	Hard limestone.			

properties significant in engineering

in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions than; the symbol < means less than. Absence of data indicates that no estimate was made]

Percentage passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity to—	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
						In per hr	*In per in of soil*	*pH*			
75–95	75–95	70–90	51–70	30–45	15–30	0. 6–2. 0	0. 11–0. 20	7. 9–8. 4	Moderate	High	Low.
75–95	75–95	70–90	51–70	30–50	20–30	0. 6–2. 0	0. 11–0. 20	7. 9–8. 4	Moderate	High	Low.
90–100	90–100	70–100	25–70	18–35	2–10	0. 6–2. 0	0. 11–0. 15	6. 1–7. 3	Low	Low	Low.
100	99	70–100	51–75	30–45	18–25	0. 2–0. 60	0. 15–0. 20	5. 1–6. 0	Moderate	High	Moderate.
93–100	85–100	65–95	45–85	30–40	11–20	0. 2–0. 60	0. 10–0. 15	7. 9–8. 4	Low	High	Low.
93–100	85–100	65–95	45–75	30–40	11–20	0. 2–0. 60	0. 10–0. 15	7. 9–8. 4	Low	High	Low.
100	95–100	70–85	45–60	25–35	8–20	2. 0–6. 0	0. 11–0. 15	6. 1–7. 3	Low	Moderate	Low.
100	95–100	80–85	40–75	25–40	10–25	0. 6–2. 0	0. 15–0. 19	6. 1–7. 3	Low	Moderate	Low.
100	95–100	80–85	45–60	25–35	8–20	2. 0–6. 0	0. 11–0. 15	6. 1–7. 3	Low	Moderate	Low.
100	95–100	80–85	45–80	25–40	10–25	0. 6–2. 0	0. 15–0. 19	6. 1–8. 4	Low	Moderate	Low.
100	95–100	80–85	45–60	30–40	8–25	2. 0–6. 0	0. 11–0. 15	6. 1–8. 4	Low	Moderate	Low.
90–100	90–100	60–98	7–30	<30	[1] NP–6	2. 0–6. 0	0. 05–0. 10	6. 1–7. 3	Very low	Low	Low.
90–100	90–100	90–100	51–85	42–65	25–45	0. 06–0. 20	0. 15–0. 18	5. 6–6. 5	Moderate	High	Moderate.
90–100	90–100	80–90	51–65	30–50	15–30	0. 06–0. 20	0. 15–0. 17	5. 6–6. 5	Moderate	Moderate	Moderate.
100	95–100	80–100	15–45	<25	NP–3	2. 0–6. 0	0. 07–0. 11	6. 6–7. 3	Very low	Low	Low.
100	95–100	85–100	40–49	30–40	11–21	0. 6–2. 0	0. 15–0. 19	6. 1–7. 3	Moderate	Moderate	Low.
95–100	95–100	85–95	40–49	20–30	8–15	2. 0–6. 0	0. 11–0. 17	7. 9–8. 4	Low	Moderate	Low.
100	95–100	90–100	40–55	<26	NP–7	2. 0–6. 0	0. 11–0. 15	6. 6–7. 3	Low	Low	Low.
95–100	95–100	85–100	40–51	30–40	11–21	0. 6–2. 0	0. 15–0. 19	6. 1–8. 4	Moderate	Moderate	Low.
95–100	95–100	95–100	85–100	41–60	25–35	0. 06–0. 20	0. 14–0. 18	6. 6–8. 4	High	High	Low.
95–100	95–100	90–100	85–100	35–60	20–35	0. 06–0. 20	0. 14–0. 22	7. 9–8. 4	High	High	Low.
90–100	90–100	60–95	15–30	20–30	2–6	2. 0–6. 0	0. 05–0. 10	5. 6–7. 8	Very low	Low	Low.
90–100	90–100	90–100	50–85	42–65	30–45	0. 2–0. 6	0. 15–0. 18	5. 1–6. 5	Moderate	High	Moderate.
100	100	95–100	85–95	30–45	11–20	0. 6–2. 0	0. 15–0. 22	5. 6–8. 4	Moderate	Moderate	Low.
100	100	95–100	75–90	30–45	11–20	0. 6–2. 0	0. 15–0. 22	6. 6–8. 4	Moderate	Moderate	Low.
90–100	75–100	65–100	40–75	20–30	5–10	0. 6–2. 0	0. 11–0. 20	6. 1–7. 3	Low	Low	Low.
80–100	80–100	80–100	48–80	30–45	15–25	0. 2–0. 6	0. 12–0. 20	5. 6–6. 5	Moderate	High	Moderate.
95–100	95–100	80–95	51–75	20–35	8–16	0. 6–2. 0	0. 11–0. 20	6. 1–7. 3	Low	Low	Low.
95–100	95–100	95–100	75–95	51–60	30–40	<0. 06	0. 12–0. 18	6. 6–8. 4	High	High	Low.
95–100	95–100	90–100	70–95	41–60	25–40	<0. 06	0. 12–0. 20	7. 9–8. 4	High	High	Low.
80–100	75–100	70–95	60–80	20–40	11–20	0. 2–0. 06	0. 10–0. 18	6. 1–7. 3	Low	Low	Low.
80–100	75–100	70–100	60–95	38–55	18–30	0. 06–0. 02	0. 08–0. 20	6. 1–7. 8	Moderate	High	Low.

TABLE 4.—*Estimates of soil*

Soil series and map symbols	Hydrologic group	Depth to bedrock	Depth from surface	Dominant USDA texture	Classification		Coarse fraction greater than 3 inches
					Unified	AASHTO	
		In	*In*				*Pct*
Lamar: LaC, LaD	B	>72	0–60	Loam	CL, CL–ML	A–4, A–6	0–2
Leeray: LeA, LeB	D	>72	0–54	Clay	CH	A–7–6	0–2
			54–64	Clay	CH, CL	A–7–6	0–2
Lindy: LnB	C	20 to 40	0–6	Loam	CL	A–4, A–6	0–5
			6–28	Clay	CL, CH	A–7	0–5
			28–30	Strongly cemented limestone.			
May: MfA, MfB	B	>72	0–14	Fine sandy loam	CL, SC, CL–ML, SM–SC	A–4	
			14–48	Sandy clay loam	SC, CL	A–6	
			48–60	Loam	SC, CL	A–4, A–6	
Menard: MnB, MnC	B	>72	0–6	Fine sandy loam	SM, SM–SC, ML, CL–ML	A–4	
			6–31	Sandy clay loam	SC, CL	A–6	
			31–64	Sandy clay loam	SC, CL	A–4, A–6	0–5
Nimrod: NmC	C	>72	0–30	Fine sand	SP–SM, SM	A–2–4, A–3	
			30–72	Sandy clay loam	SC, CL	A–2–6, A–6	
Owens: OcB, OWE	D	>72	0–18	Clay	CL, CH	A–7–6	0–10
			18–36	Shaly clay	CL, CH	A–7–6, A–6	0–10
Patilo: PaB	C	>72	0–46	Fine sand	SM–SP, SM	A–2–4, A–3	
			46–62	Sandy clay loam	SC	A–6, A–2–6	
Pedernales:							
PdC	C	>72	0–8	Loamy fine sand	SM, SM–SC	A–2–4	
			8–40	Sandy clay	CH, CL	A–6, A–7	
			40–60	Sandy clay loam	SC, CL	A–6, A–7	0–5
PeB, PeC, PeC2, PsD3	C	>72	0–6	Fine sandy loam	SM, ML, CL–ML, SM–SC	A–4	
			6–40	Sandy clay	CH, CL	A–7, A–6	
			40–60	Sandy clay loam	SC, CL	A–6, A–7	0–5
Tarrant: TaD, TNE	D	6–20	0–10	Clay	CH	A–7	3–50
			10–14	Fractured indurated and platy limestone bedrock.			
Thurber: TrA, TrB	D	>72	0–5	Clay loam	CL	A–4, A–6	
			5–48	Clay	CL, CH	A–7	
			48–70	Shaly clay	CL	A–7, A–6	
Truce: TuB, TuC, TuC2	C	>72	0–5	Fine sandy loam	CL–ML, SC, SM–SC, CL	A–4	0–3
			5–46	Clay and shaly clay	CL	A–6, A–7	0–3
			46–62	Shale.			

[1] NP = Nonplastic.

properties significant in engineering—Continued

Percentage passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity to—	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
						In per hr	*In per in of soil*	*pH*			
95–100	95–100	90–100	70–80	20–35	6–12	0. 6–2. 0	0. 12–0. 15	7. 9–8. 4	Low	Moderate	Low.
95–100	95–100	85–100	75–95	51–70	30–45	<0. 06	0. 12–0. 18	7. 9–8. 4	Very high	High	Low.
95–100	95–100	85–100	70–95	41–60	25–40	<0. 06	0. 10–0. 15	7. 9–8. 4	Very high	High	Low.
80–100	85–98	85–95	60–75	20–40	10–20	0. 60–2. 0	0. 12–0. 14	6. 1–7. 3	Low	Low	Low.
90–100	90–100	90–98	65–80	41–55	20–30	0. 06–0. 20	0. 16–0. 20	6. 1–7. 3	Moderate	High	Low.
95–100	95–100	80–95	40–60	20–30	4–10	2. 0–6. 0	0. 11–0. 15	6. 1–7. 8	Low	Low	Low.
95–100	95–100	80–100	40–75	30–40	15–25	0. 6–2. 0	0. 12–0. 20	6. 6–7. 8	Moderate	High	Low.
95–100	95–100	75–95	40–75	20–40	8–25	0. 6–2. 0	0. 11–0. 20	7. 9–8. 4	Moderate	High	Low.
95–100	95–100	75–90	40–60	<25	NP–7	2. 0–6. 0	0. 11–0. 17	6. 6–7. 8	Low	Low	Low.
95–100	95–100	80–100	36–60	30–40	12–22	0. 6–2. 0	0. 15–0. 19	6. 1–8. 4	Low	High	Low.
80–95	75–95	65–80	40–55	20–35	8–20	2. 0–6. 0	0. 11–0. 17	7. 9–8. 4	Low	High	Low.
95–100	95–100	90–100	8–20	<25	NP–3	6. 0–20. 0	0. 05–0. 10	5. 6–7. 3	Very low	Low	Low.
95–100	95–100	90–100	25–55	20–35	11–20	0. 2–0. 6	0. 14–0. 17	5. 1–6. 0	Low	High	Moderate.
95–100	95–100	90–100	80–95	45–60	20–30	<0. 06	0. 13–0. 17	7. 9–8. 4	High	High	Low.
90–100	85–100	80–100	55–95	40–55	25–35	<0. 06	0. 03–0. 08	7. 9–8. 4	High	High	Low.
100	95–100	90–100	8–20	<25	NP–3	6. 0–20. 0	0. 05–0. 08	6. 1–7. 3	Very low	Low	Low.
90–100	90–100	90–100	25–50	20–35	11–20	0. 2–0. 6	0. 14–0. 18	5. 1–6. 5	Low	Low	Moderate.
95–100	90–100	90–95	15–30	<25	NP–4	2. 0–6. 0	0. 07–0. 11	6. 1–7. 8	Low	Low	Low.
90–100	90–100	85–100	55–75	35–55	20–35	0. 2–0. 6	0. 15–0. 20	6. 1–7. 8	High	High	Low.
95–100	90–100	80–90	36–55	30–45	20–30	0. 2–0. 6	0. 12–0. 20	7. 9–8. 4	Moderate	High	Low.
95–100	90–100	75–100	36–55	<25	NP–7	0. 6–2. 0	0. 12–0. 17	6. 1–7. 8	Low	Low	Low.
90–100	90–100	85–100	55–75	35–55	20–35	0. 2–0. 6	0. 15–0. 20	6. 1–7. 8	High	High	Low.
95–100	90–100	80–90	36–55	30–45	20–30	0. 2–0. 6	0. 15–0. 20	7. 9–8. 4	Moderate	High	Low.
80–100	80–100	70–90	70–95	55–70	30–40	0. 2–0. 6	0. 15–0. 17	7. 9–8. 4	High	High	Low.
95–100	95–100	90–100	60–90	25–35	8–20	0. 2–0. 6	0. 15–0. 22	6. 1–7. 3	Moderate	Low	Low.
95–100	95–100	90–100	70–95	41–63	25–41	<0. 06	0. 12–0. 18	6. 6–8. 4	High	High	Low.
95–100	85–100	75–100	51–85	30–50	20–35	<0. 06	0. 12–0. 18	7. 9–8. 4	High	High	Low.
75–100	75–100	70–100	40–75	18–30	5–10	0. 6–2. 0	0. 11–0. 15	6. 1–7. 3	Low	Low	Low.
80–100	80–100	80–100	51–80	30–45	20–30	0. 06–0. 20	0. 12–0. 18	6. 1–8. 4	Moderate	High	Low.

TABLE 5.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in for referring to other series that appear

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings without basements	Sanitary landfill [1]	Local roads and streets
Bolar: BcB	Severe: rippable bedrock at a depth of 20 to 40 inches.	Severe: rippable bedrock at a depth of 20 to 40 inches.	Moderate: rippable bedrock at a depth of 20 to 40 inches.	Moderate: moderate shrink-swell potential; rippable bedrock at a depth of 20 to 40 inches.	Severe: rippable bedrock at a depth of 20 to 40 inches.	Severe: low strength; rippable bedrock at a depth of 20 to 40 inches.
Bonti: BnB	Severe: moderately slow permeability; bedrock at a depth of 20 to 40 inches.	Severe: bedrock at a depth of 20 to 40 inches.	Severe: bedrock at a depth of 20 to 40 inches.	Moderate: moderate shrink-swell potential; bedrock at a depth of 20 to 40 inches.	Severe: bedrock at a depth of 20 to 40 inches.	Moderate: bedrock at a depth of 20 to 40 inches.
Brackett: BrD	Severe: moderately slow permeability.	Moderate: slope of 1 to 8 percent; 1 to 15 percent coarse fragments.	Moderate: rippable bedrock at a depth of 10 to 20 inches.	Moderate: rippable bedrock at a depth of 10 to 20 inches.	Severe: rippable bedrock at a depth of 10 to 20 inches; 1 to 15 percent stones.	Moderate: low strength; rippable bedrock at a depth of 10 to 20 inches.
BtE	Severe: moderately slow permeability; slope of 8 to 20 percent.	Severe: slope of 8 to 20 percent.	Moderate: rippable bedrock at a depth of 10 to 20 inches; slope of 8 to 20 percent.	Moderate: rippable bedrock at a depth of 10 to 20 inches; slope of 8 to 20 percent.	Severe: rippable bedrock at a depth of 10 to 20 inches; 1 to 15 percent stones.	Moderate: low strength; rippable bedrock at a depth of 10 to 20 inches; slope of 8 to 20 percent.
Bunyan: Bu	Severe: hazard of flooding.	Severe: hazard of flooding.	Severe: hazard of flooding.	Severe: hazard of flooding.	Severe: hazard of flooding.	Moderate: hazard of flooding.
By	Severe: hazard of flooding.	Severe: hazard of flooding.	Severe: hazard of flooding.	Severe: hazard of flooding.	Severe: hazard of flooding.	Severe: hazard of flooding.
Chaney: ChC, ChC2, CnD3	Severe: slow permeability.	Moderate: slope of 1 to 8 percent.	Moderate: moderately well drained; sandy clay.	Moderate: low strength; moderate shrink-swell potential.	Moderate: loamy sand and sandy clay.	Severe: low strength.
CmD	Severe: slow permeability.	Moderate: slope of 1 to 8 percent; 5 to 20 percent stones.	Severe: 5 to 20 percent stones.	Severe: 5 to 20 percent stones.	Severe: 5 to 20 percent stones.	Severe: low strength; 5 to 20 percent stones.

interpretations

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions in the first column of this table]

Degree and kind of limitation for—		Suitability as a source of—		Soil features affecting—		
Pond reservoir areas	Pond embankments	Road fill	Topsoil	Irrigation	Terraces and diversions	Waterways
Severe: bedrock at a depth of 20 to 40 inches.	Moderate: 20 to 40 inches of borrow material.	Poor: low load-supporting capacity.	Fair: 10 to 20 inches of clay loam.	Depth of soil	All features favorable.	All features favorable.
Severe: bedrock at a depth of 20 to 40 inches.	Moderate: 20 to 40 inches of borrow material.	Poor: 20 to 40 inches of material.	Fair: 4 to 12 inches of material.	Depth of soil	All features favorable.	All features favorable.
Severe: permeable substratum.	Moderate: medium compressibility; fair resistance to erosion.	Poor: 10 to 20 inches of material.	Poor: 40 to 60 percent calcium carbonate equivalent.	Depth of soil; slope; stoniness.	Depth of soil; slope; stoniness.	Depth of soil; slope; stoniness.
Severe: permeable substratum.	Moderate: medium compressibility; fair resistance to erosion.	Poor: 10 to 20 inches of material.	Poor: 40 to 60 percent calcium carbonate equivalent; slope of 8 to 20 percent.	Depth of soil; slope; stoniness.	Depth of soil; slope; stoniness.	Depth of soil; slope; stoniness.
Moderate: moderate permeability.	Moderate: fair to poor resistance to piping and erosion.	Fair: low strength.	Fair: 6 to 18 inches of fine sandy loam.	Limited rate of water intake; hazard of flooding.	Hazard of flooding.	Hazard of flooding.
Moderate: moderate permeability.	Moderate: fair to poor resistance to piping and erosion.	Fair: low strength.	Fair: 6 to 18 inches of fine sandy loam.	Hazard of flooding.	Hazard of flooding.	Hazard of flooding.
Slight	Moderate: fair resistance to piping and erosion.	Poor: low strength.	Poor: loamy sand.	Limited rate of water intake.	Hazard of soil blowing.	Hazard of soil blowing.
Slight	Moderate: fair resistance to piping and erosion.	Poor: low strength; 5 to 20 percent stones.	Poor: loamy sand; 5 to 20 percent stones.	Limited rate of water intake.	Stoniness	Stoniness.

TABLE 5.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings without basements	Sanitary landfill [1]	Local roads and streets
Cisco:						
CoC	Moderate: moderate permeability.	Moderate: moderate permeability; slope of 1 to 5 percent.	Slight	Moderate: moderate shrink-swell potential.	Moderate: loamy fine sand.	Moderate: low strength; moderate shrink-swell potential.
CsB, CsC, CsC2	Moderate: moderate permeability.	Moderate: moderate permeability; slope of 1 to 5 percent.	Slight	Moderate: moderate shrink-swell potential.	Slight	Moderate: low strength; moderate shrink-swell potential.
Deleon: De	Severe: hazard of flooding; slow permeability.	Severe: hazard of flooding.	Severe: clay; hazard of flooding.	Severe: hazard of flooding; high shrink-swell potential.	Severe: clay; hazard of flooding.	Severe: hazard of flooding; high shrink-swell potential.
Demona: DmC	Severe: moderately slow permeability.	Severe: seepage; rapid permeability of surface layer.	Moderate: moderately well drained; sandy clay.	Moderate: moderately well drained; low strength.	Moderate: loamy sand and sandy clay.	Moderate: moderately well drained; low strength.
Elandco: Ea, En	Severe: hazard of flooding.	Severe: hazard of flooding.	Severe: hazard of flooding.	Severe: hazard of flooding.	Severe: hazard of flooding.	Severe: hazard of flooding.
*Exray: ErD, ESE. For Bonti part of ErD, see Bonti series.	Severe: moderately slow permeability; bedrock at a depth of 8 to 20 inches.	Severe: bedrock at a depth of 8 to 20 inches.	Severe: bedrock at a depth of 8 to 20 inches.	Severe: bedrock at a depth of 8 to 20 inches; 1 to 20 percent stones.	Severe: bedrock at a depth of 8 to 20 inches; 1 to 20 percent stones.	Severe: bedrock at a depth of 8 to 20 inches; low strength.
Hassee: HaA, HaB	Severe: very slow permeability.	Slight	Severe: clay; somewhat poorly drained.	Severe: high shrink-swell potential; somewhat poorly drained.	Severe: clay	Severe: high shrink-swell potential.
Hensley:						
HeB	Severe: bedrock at a depth of 10 to 20 inches.	Severe: bedrock at a depth of 10 to 20 inches.	Severe: bedrock at a depth of 10 to 20 inches.	Severe: bedrock at a depth of 10 to 20 inches.	Severe: bedrock at a depth of 10 to 20 inches.	Severe: bedrock at a depth of 10 to 20 inches; low strength.
HnC	Severe: bedrock at a depth of 10 to 20 inches; 5 to 20 percent stones.	Severe: bedrock at a depth of 10 to 20 inches.	Severe: bedrock at a depth of 10 to 20 inches; 5 to 20 percent stones.	Severe: bedrock at a depth of 10 to 20 inches; 5 to 20 percent stones.	Severe: bedrock at a depth of 10 to 20 inches; 5 to 20 percent stones.	Severe: bedrock at a depth of 10 to 20 inches.
Lamar: LaC, LaD	Slight	Moderate: moderate permeability.	Slight	Slight	Slight	Moderate: low strength.

interpretations—Continued

Degree and kind of limitation for—		Suitability as a source of—		Soil features affecting—		
Pond reservoir areas	Pond embankments	Road fill	Topsoil	Irrigation	Terraces and diversions	Waterways
Moderate: moderate permeability.	Moderate: good to fair resistance to piping and erosion.	Fair: low strength; moderate shrink-swell potential.	Poor: loamy fine sand.	All features favorable.	Hazard of soil blowing.	Hazard of soil blowing.
Moderate: moderate permeability.	Moderate: good to fair resistance to piping and erosion.	Fair: low strength; moderate shrink-swell potential.	Fair: 8 to 12 inches of fine sandy loam.	All features favorable.	All features favorable.	All features favorable.
Slight	Moderate: fair slope stability; medium to high compressibility.	Poor: high shrink-swell potential; plastic material.	Poor: clay; very firm consistency.	Slow rate of water intake; hazard of flooding.	Hazard of flooding.	Hazard of flooding.
Moderate: moderately slow permeability.	Moderate: poor resistance to piping and erosion.	Fair: moderately well drained.	Poor: loamy sand.	High rate of water intake in upper 28 inches; hazard of soil blowing; limited available water capacity.	Hazard of soil blowing; loamy sand.	Hazard of soil blowing.
Moderate: moderate permeability.	Moderate: fair to poor resistance to piping and erosion.	Poor: low strength.	Fair: silty clay loam.	Hazard of flooding.	Hazard of flooding.	Hazard of flooding.
Severe: bedrock at a depth of 8 to 20 inches.	Severe: 8 to 20 inches of borrow material.	Poor: low strength.	Poor: 4 to 8 inches of fine sandy loam; 1 to 20 percent stones.	Depth of soil; stoniness.	Depth to sandstone; stoniness.	Depth to sandstone; stoniness.
Slight	Moderate: fair slope stability.	Poor: high shrink-swell potential.	Fair: 8 to 16 inches of loam.	Very slow rate of water intake.	All features favorable.	Somewhat poorly drained.
Severe: bedrock at a depth of 10 to 20 inches.	Severe: 10 to 20 inches of borrow material.	Poor: low strength.	Poor: 4 to 10 inches of loam.	Depth of soil	Depth of soil	Depth of soil.
Severe: bedrock at a depth of 10 to 20 inches.	Severe: 10 to 20 inches of borrow material; 5 to 20 percent stones.	Poor: low strength.	Poor: 5 to 20 percent stones.	Depth of soil; stoniness; slope.	Depth of soil; stoniness.	Depth of soil; stoniness.
Moderate: moderate permeability.	Moderate: medium compressibility; fair resistance to piping and erosion.	Fair: low strength.	Good	Slope	Slope	Slope.

TABLE 5.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings without basements	Sanitary landfill [1]	Local roads and streets
Leeray: LeA, LeB	Severe: very slow permeability.	Slight	Severe: clay	Severe: very high shrink-swell potential.	Severe: clay	Severe: very high shrink-swell potential.
Lindy: LnB	Severe: bedrock at a depth of 20 to 40 inches; slow permeability.	Severe: bedrock at a depth of 20 to 40 inches.	Severe: clay; bedrock at a depth of 20 to 40 inches.	Moderate: moderate shrink-swell potential; bedrock at a depth of 20 to 40 inches.	Severe: clay; bedrock at a depth of 20 to 40 inches.	Severe: low strength.
May: MfA, MfB	Slight	Moderate: moderate permeability.	Slight	Moderate: moderate shrink-swell potential.	Slight	Moderate: moderate shrink-swell potential; low strength.
Menard: MnB, MnC	Moderate: moderate permeability.	Moderate: moderate permeability; depth to pervious material.	Slight	Slight	Slight	Moderate: low strength.
Nimrod: NmC	Severe: moderately slow permeability.	Severe: rapid permeability of surface layer; seepage.	Severe: fine sand.	Slight	Severe: fine sand.	Slight
Owens: OcB	Severe: very slow permeability.	Moderate: slope of 1 to 3 percent.	Severe: clay	Severe: high shrink-swell potential; low strength.	Severe: clay	Severe: high shrink-swell potential.
OWE	Severe: very slow permeability; 5 to 20 percent stones.	Severe: slope of 8 to 20 percent.	Severe: clay; 5 to 20 percent stones.	Severe: high shrink-swell potential; low strength; 5 to 20 percent stones.	Severe: clay; 5 to 20 percent stones.	Severe: high shrink-swell potential; slope of 5 to 20 percent.
Patilo: PaB	Severe: moderately slow permeability.	Severe: rapidly permeable fine sand surface layer.	Severe: sloughing of fine sand surface layer.	Slight	Severe: fine sand.	Slight
Pedernales: PdC	Severe: moderately slow permeability	Moderate: slope of 1 to 5 percent.	Moderate: sandy clay	Severe: high shrink-swell potential; low strength.	Moderate: sandy clay.	Severe: high shrink-swell potential; low strength.
PeB, PeC, PeC2, PsD3.	Severe: moderately slow permeability.	Moderate: slope of 1 to 8 percent.	Moderate: sandy clay.	Severe: high shrink-swell potential; low strength.	Moderate: sandy clay.	Severe: high shrink-swell potential; low strength.

interpretations—Continued

Degree and kind of limitation for—		Suitability as a source of—		Soil features affecting—		
Pond reservoir areas	Pond embankments	Road fill	Topsoil	Irrigation	Terraces and diversions	Waterways
Slight	Moderate: fair slope stability.	Poor: very high shrink-swell potential; low strength.	Poor: clay	Very slow rate of water intake.	All features favorable.	All features favorable.
Severe: bedrock at a depth of 20 to 40 inches.	Moderate: fair slope stability; high compressibility; thickness of material.	Poor: 20 to 40 inches of material; low strength.	Fair: 5 to 16 inches of loam.	Slow rate of water intake; depth of soil.	All features favorable.	All features favorable.
Moderate: moderate permeability.	Moderate: fair to good resistance to piping and erosion.	Fair: moderate shrink-swell potential; low strength.	Fair: 10 to 18 inches of fine sandy loam.	All features favorable.	All features favorable.	All features favorable.
Moderate: moderate permeability; depth to unsuitablematerial.	Moderate: resistance to piping and erosion.	Fair: low strength.	Fair: 6 to 10 inches of fine sandy loam.	Slope	Slope	Slope.
Moderate: moderately slow permeability.	Moderate: erodibility.	Good	Poor: fine sand.	Hazard of soil blowing; rapidly permeable fine sand surface layer; slope.	Hazard of soil blowing; fine sand surface layer.	Hazard of soil blowing; fine sand surface layer.
Slight	Moderate: fair to good slope stability; high compressibility.	Poor: high shrink-swell potential; low strength.	Poor: clay; very firm consistence.	Very slow rate of water intake; depth of root zone.	Slope; plant growth.	Erodibility; slope; very slow permeability.
Slight	Severe: 5 to 20 percent stones.	Poor: high shrink-swell potential; 5 to 20 percent stones.	Poor: clay; very firm consistence; 5 to 20 percent stones.	Steepness of slope; stoniness.	Slope; stoniness.	Slope; stoniness.
Severe: rapidly permeable fine sand surface layer.	Severe: erodibility.	Good	Poor: fine sand.	Rapid rate of water intake; hazard of soil blowing; limited available water capacity.	Fine sand more than 40 inches thick; hazard of soil blowing.	Siltation from soil blowing.
Moderate: depth to unsuitable material.	Moderate: fair to good slope stability; high compressibility.	Poor: high shrink-swell potential.	Poor: sand	Hazard of soil blowing.	Hazard of soil blowing; siltation.	Steepness of slope; siltation from soil blowing on loamy fine sand.
Moderate: depth to unsuitable material.	Moderate: fair to good slope stability; high compressibility.	Poor: high shrink-swell potential.	Poor: 3 to 8 inches of material.	Slope	Slope	Erodibility.

TABLE 5.—*Engineering*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings without basements	Sanitary landfill [1]	Local roads and streets
Tarrant: TaD	Severe: bedrock at a depth of 6 to 20 inches; 3 to 50 percent stones.	Severe: bedrock at a depth of 6 to 20 inches; 3 to 50 percent stones.	Severe: bedrock at a depth of 6 to 20 inches.	Severe: bedrock at a depth of 6 to 20 inches; high shrink-swell potential; 3 to 50 percent stones.	Severe: bedrock at a depth of 6 to 20 inches; 3 to 50 percent stones.	Severe: bedrock at a depth of 6 to 20 inches; 3 to 50 percent stones.
TNE	Severe: bedrock at a depth of 6 to 20 inches; 5 to 20 percent stones; slope of 10 to 30 percent.	Severe: bedrock at a depth of 6 to 20 inches; slope of 10 to 30 percent.	Severe: bedrock at a depth of 6 to 20 inches.	Severe: bedrock at a depth of 6 to 20 inches; slope of 10 to 30 percent; 5 to 20 percent stones.	Severe: bedrock at a depth of 6 to 20 inches; 5 to 20 percent stones.	Severe: bedrock at a depth of 6 to 20 inches; slope of 10 to 30 percent; 5 to 20 percent stones.
Thurber: TrA, TrB	Severe: very slow permeability.	Slight	Severe: clay	Severe: high shrink-swell potential; low strength.	Severe: clay	Severe: high shrink-swell potential; low strength.
Truce: TuB, TuC, TuC2	Severe: slow permeability.	Moderate: slope of 1 to 5 percent.	Severe: clay	Moderate: moderate shrink-swell potential; low strength.	Severe: clay	Severe: low strength.

[1] Onsite studies of the underlying strata, water table, and hazards of aquifer pollution and drainage into ground water need to be

TABLE 6.—*Soil*

[Tests performed by the Texas Highway Department in accordance with standard

Soil name and location	Parent material	Texas report number	Depth from surface	Shrinkage		
				Limit	Linear	Ratio
			Inches	*Pct*	*Pct*	
Bonti fine sandy loam: About 6.75 miles east of Eastland on Farm Road 570, then 3.25 miles south on Farm Road 2461 to Lake Leon Dam, 0.12 mile south of the dam to a cattle guard on the west side of the road, 0.2 mile north-northwest on a private road and 93 feet west of the road, in a wooded area. (Modal)	Strongly cemented sandstone interbedded with shale.	70-61-R 70-62-R	0-4 16-26	21 15	4. 3 10. 2	1. 64 1. 94
Chaney loamy fine sand: About 10 miles south of the county courthouse in Eastland on Texas Highway 6 to Carbon, 0.7 mile east of the junction of the highway and Loop 369 on the east side of Carbon, 126 feet north of the highway, in a pasture. (Modal)	Shale and sandstone.	70-455-R 70-456-R	0-12 12-20	18 14	. 3 14. 5	1. 74 1. 91

interpretations—Continued

Degree and kind of limitation for—		Suitability as a source of—		Soil features affecting—		
Pond reservoir areas	Pond embankments	Road fill	Topsoil	Irrigation	Terraces and diversions	Waterways
Severe: bedrock at a depth of 6 to 20 inches.	Severe: bedrock at a depth of 6 to 20 inches; 3 to 50 percent stones.	Poor: bedrock at a depth of 6 to 20 inches; 3 to 50 percent stones; high shrink-swell potential.	Poor: clay; 3 to 50 percent stones.	Depth to bedrock; slope; stoniness.	Depth to bedrock; slope; stoniness.	Depth to bedrock; slope; stoniness.
Severe: bedrock at a depth of 6 to 20 inches.	Severe: bedrock at a depth of 6 to 20 inches; 5 to 20 percent stones.	Poor: bedrock at a depth of 6 to 20 inches; 5 to 20 percent stones; slope of 10 to 30 percent.	Poor: clay; 5 to 20 percent stones.	Depth to bedrock; slope; stoniness.	Depth to bedrock; slope; stoniness.	Depth to bedrock; slope; stoniness.
Slight	Moderate: fair to good slope stability.	Poor: low strength; high shrink-swell potential.	Poor: 4 to 12 inches of clay loam.	Very slow rate of water intake.	All features favorable.	All features favorable.
Slight	Moderate: fair slope stability.	Poor: low strength.	Poor: 2 to 13 inches of fine sandy loam.	Slow rate of water intake; slope.	Slope	Erodibility; slope.

made for landfill deeper than 5 or 6 feet.

test data

procedures of the American Association of State Highway [and Transportation] Officials (AASHTO)]

Mechanical analyses [1]											Liquid limit	Plasticity index	Classification [2]	
Percentage passing sieve—							Percentage smaller than—							
⅞ inch	⅝ inch	¾ inch	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	0.05 mm	0.02 mm	0.005 mm	0.002 mm			AASHTO [3]	Unified [4]
				100	98	70					30	7	A-4(7)	ML-CL
			100	99	97	70					34	20	A-6(11)	CL
	100	99	99	99	98	7					21	2	A-3(0)	SM-SP
		100	99	99	98	52					46	29	A-7-6(11)	CL

TABLE 6.—*Soil*

Soil name and location	Parent material	Texas report number	Depth from surface	Shrinkage		
				Limit	Linear	Ratio
			Inches	*Pct*	*Pct*	
Cisco loamy fine sand: About 6.6 miles west of Rising Star on Texas Highway 36, 0.3 mile south on a county road, 327 feet west of the road, up a cross fence, in an abandoned field. (Modal)	Calcareous sandy clay loam.	70–72–R	0–10	16	.9	1.80
		70–73–R	10–14	14	11.0	1.92
		70–74–R	50–70	14	5.4	1.94
Deleon clay: About 4.25 miles east of Eastland on Farm Road 570, about 11.75 miles southeast on Farm Road 2214 and 100 feet north of the road, in a pasture. (Modal).	Clayey alluvium	70–443–R	6–30	16	14.4	1.87
Hensley stony loam: About 4.5 miles southeast of Carbon on Texas Highway 6, 2.2 miles south on a county road to an intersection, 0.4 mile on the same county road and 81 feet west of the road, in a pasture. (Modal)	Interbedded clay and limestone.	70–67–R	0–4	14	8.6	1.88
		70–68–R	4–16	13	16.2	1.97
Leeray clay: About 4.8 miles west on Farm Road 2945 from its intersection with U.S. Highway 80 on the western edge of Cisco, 285 feet north of the road, in range. (Modal)	Calcareous massive clay.	70–69–R	6–18	12	19.1	2.00
Lindy loam: About 4 miles south of Carbon on Farm Road 1027, 0.3 mile south on a county road 120 feet west of the road, in a pasture. (Modal)	Interbedded clay and limestone.	70–65–R	0–6	17	7.2	1.84
		70–66–R	14–28	14	13.1	1.91
Nimrod fine sand: About 6 miles south of Eastland on Texas Highway 6, 3 miles east on Farm Road 2563, 1 mile south on a county road, 0.3 mile east on the same county road, 60 feet north of the road, in a wooded area. (Modal)	Trinity sand	70–453–R	6–30	18	0	1.78
		70–454–R	30–40	16	6.6	1.82
Owens clay: About 4.25 miles east of Eastland on Farm Road 570, 5.25 miles southeast on Farm Road 2214, 1.5 miles north on a county road and 99 feet west of the road, in a pasture. (Modal)	Olive shaly clay	70–63–R	5–18	16	15.3	1.88
		70–64–R	18–36	21	14.1	1.77
Pedernales fine sandy loam: About 0.6 mile northeast of the Callahan County line on Texas Highway 206 and 150 feet south of the highway, in a cultivated field. (Modal)	Limy material	70–447–R	0–6	16	2.7	1.87
		70–448–R	6–18	14	12.2	1.92
		70–449–R	40–60	15	9.7	1.91
Thurber clay loam: About 2.6 miles north of Olden on a county road, 400 feet east of the road, in a cultivated field. (Modal)	Calcareous clay and clay loam.	70–444–R	0–5	14	8.8	1.91
		70–445–R	5–22	13	20.9	2.02
		70–446–R	48–70	15	13.7	1.93
Truce fine sandy loam: About 0.9 mile north of the county courthouse in Eastland on Texas Highway 6, 0.5 mile west on a county road and 60 feet north of the road, in a pasture. (Modal)	Shaly clay	70–450–R	0–4	15	3.5	1.87
		70–451–R	5–20	13	13.2	1.96
		70–452–R	46–62	17	10.8	1.88

[1] Mechanical analyses according to the AASHTO Designation T–88 (see footnote 6, p. 43). Results by this procedure frequently differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHTO procedure, the fine material is analyzed by the hydrometer method, and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method, and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes for soil.

test data—Continued

Mechanical analyses [1]											Liquid limit	Plasticity index	Classification [2]	
Percentage passing sieve—							Percentage smaller than—							
⅞ inch	⅝ inch	⅜ inch	No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	0.05 mm	0.02 mm	0.005 mm	0.002 mm			AASHTO [3]	Unified [4]
------	------	------	--------	100	96	19	13	------	6	3	17	3	A–2–4(0)	SM
------	------	------	--------	100	98	46	42	------	31	29	35	21	A–6(5)	SC
------	------	100	99	97	93	49	42	------	24	15	24	13	A–6(4)	SC
------	------	------	--------	--------	--------	99	97	------	57	43	48	27	A–7–6(16)	CL
------	------	100	99	97	95	73	64	------	25	20	31	16	A–6(10)	CL
------	100	99	99	99	97	83	77	------	56	51	48	26	A–7–6(16)	CL
------	------	------	100	99	98	91	86	------	58	48	56	36	A–7–6(19)	CH
100	99	99	98	98	95	65	58	------	23	15	30	15	A–6(8)	CL
------	------	100	99	99	95	66	61	------	48	45	42	22	A–7–6(11)	CL
------	------	------	100	99	94	8	3	------	2	1	20	2	A–3(0)	SM–SP
------	------	------	100	99	94	30	29	------	23	22	29	16	A–2–6(1)	SC
------	------	100	99	97	93	90	88	------	63	47	51	30	A–7–6(18)	CH
------	100	99	99	99	98	94	92	------	77	55	54	30	A–7–6–(19)	CH
------	------	------	--------	--------	100	48	------	------	------	------	21	7	A–4(3)	SM
------	------	------	--------	100	99	63	------	------	------	------	38	24	A–6(11)	CL
------	------	100	97	93	85	55	------	------	------	------	34	20	A–6(8)	CL
------	------	100	99	98	95	64	------	------	------	------	31	17	A–6(9)	CL
------	------	------	100	99	97	79	------	------	------	------	63	41	A–7–6(20)	CH
------	100	99	96	88	78	50	------	------	------	------	44	30	A–7–6(10)	CL
100	99	99	98	97	95	58	47	------	15	17	21	5	A–4(5)	CL–ML
------	------	------	100	99	97	75	69	------	51	16	40	23	A–6(13)	CL
[5] 96	94	93	89	85	82	75	67	------	37	29	30	20	A–6(12)	CL

[2] Unified and AASHTO classifications made by Soil Conservation Service personnel.
[3] Based on AASHTO Designation M 145–49 (see footnote 6, p. 43).
[4] Based on the Unified soil classification system (see footnote 5, p. 43).
[5] 100 percent passed a 1-inch sieve.

The percentage passing sieve estimates are given for a range in percentage of soil material passing sieves of four sizes. This information is useful in helping to determine suitability of the soil as a material for construction purposes.

Liquid limit and plasticity index indicate the effect of water on the strength and consistency of soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from a semisolid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material changes from the semisolid to plastic state, and the liquid limit from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic. Liquid limit and plasticity index are estimated in table 4, but in table 6 the data on liquid limit and plasticity index are based on tests of soil samples.

Permeability is that quality of a soil that enables it to transmit water or air. It is estimated on the basis of those soil characteristics observed in the field, particularly structure and texture. The estimates in table 4 do not take into account lateral seepage or such transient soil features as plowpans and surface crusts. These ratings should not be confused with the coefficient of permeability, or k-value, used by engineers.

Available water capacity is the ability of a soil to hold water for use by most plants. It commonly is defined as the numerical difference between the amount of water in the soil at field capacity and the amount of water at the time most crop plants wilt. The rate is expressed as inches of water per inch of soil depth.

Reaction is the degree of acidity or alkalinity of a soil expressed as pH. The pH value and terms used to describe soil reaction are explained in the Glossary.

Salinity refers to the amount of soluble salts in the soil. It is expressed as the electrical conductivity of the saturation extract, in millimeters per centimeter at 25° C. Salinity affects the suitability of a soil for crop production, its stability when used as construction material, and its corrosiveness to metals and concrete. Salinity is not a problem in Eastland County, and this column was not included in table 4.

Shrink-swell potential is the relative change in volume to be expected of the soil material with changes in moisture content; that is, the extent to which the soil shrinks as it dries out or swells when it gets wet. Extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils causes much damage to building foundations, roads, and other structures. A *high* shrink-swell potential indicates a hazard to the maintenance of structures built in, on, or of material having this rating.

Corrosivity, as used in table 4, pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. Rate of corrosion of uncoated steel is related to soil properties such as drainage, texture, total acidity, and electrical conductivity of the soil material. Corrosivity to concrete is influenced mainly by the content of sodium or magnesium sulfate as well as by soil texture and acidity. Installations of uncoated steel that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations entirely in one kind of soil or in one soil horizon. A corrosivity rating of *low* means that the probability of soil-induced corrosion damage is low. A rating of *high* means that the probability of damage is high, so that protective measures for steel and a more resistant type of concrete should be used to avoid or minimize damage.

Subsidence is settlement of organic soils or of soils containing semifluid mineral layers. Ratings for subsidence take into account (1) rapid initial loss of elevation resulting from drainage and lowering of the level of the ground water and (2) later and slower loss of elevation that results from oxidation of organic materials. The maximum possible loss of elevation is called *potential subsidence*. A column for subsidence was not included in the table, because subsidence is not a problem with the soils of the county.

Engineering interpretations

The estimated interpretations in table 5 are based on the engineering properties of soils shown in table 4, on test data for soils in this survey area and others nearby or adjoining, and on the experience of engineers and soil scientists with the soils of Eastland County. In table 5, ratings are used to summarize limitation or suitability of the soils for all listed purposes other than for irrigation, waterways, and terraces and diversions. For these particular uses, table 5 lists those soil features not to be overlooked in planning, installing, and maintaining structures.

Soil limitations are indicated by the ratings slight, moderate, and severe. *Slight* means that soil properties are generally favorable for the rated use, or, in other words, that limitations are minor and easily overcome. *Moderate* means that soil properties are unfavorable but can be overcome or modified by special planning and design. *Severe* means that soil properties are so unfavorable and so difficult to correct or overcome as to require major soil reclamation, special designs, or intensive maintenance.

Soil suitability is rated by the terms *good*, *fair*, and *poor*, which have, respectively, meanings approximately parallel to the terms slight, moderate, and severe.

In the following paragraphs the columns in table 5 are explained.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into natural soil. The soil material between depths of 18 inches and 6 feet is evaluated. The soil properties considered are those that affect both absorption of effluent and construction and operation of the system. Properties that affect absorption are permeability, depth to water table or rock, and susceptibility to flooding. Slope affects the difficulty of layout and construction and also the risk of soil erosion, lateral seepage, and downslope flow of effluent. Large rocks or boulders increase construction costs.

Sewage lagoons are shallow ponds constructed to hold sewage within a depth of 2 to 5 feet long enough for bacteria to decompose the solids. A lagoon has a nearly level floor and sides, or embankments, of compacted soil material. The assumptions are made that the embankment is compacted to medium density and that the pond is protected from flooding. Properties are considered that affect the pond floor and the embankment. Those that affect the pond floor are permeability, organic-matter

content, and slope; if the floor needs to be leveled, depth to bedrock becomes important. The soil properties that affect the embankment are the engineering properties of the embankment material, as interpreted from the Unified soil classification, and the amounts of stones, if any, that influence the ease of excavation and compaction of the embankment material.

Shallow excavations are those that require digging or trenching to a depth of less than 6 feet, such as excavations for pipelines, sewerlines, phone and power transmission lines, basements, open ditches, and cemeteries. Desirable soil properties are good workability, moderate resistance to sloughing, gentle slopes, absence of rock outcrops or big stones, and freedom from flooding or from a high water table.

Dwellings without basements, as rated in table 5, are not more than three stories high and are supported by foundation footings placed in undisturbed soil. The features that affect the rating of a soil for dwellings are those that relate to capacity to support load and resist settlement under load, and those that relate to ease of excavation. Soil properties that affect capacity to support load are wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. Those that affect excavation are wetness, slope, depth to bedrock, and content of stones and rocks.

Sanitary landfill is a method of disposing of refuse in dug trenches. The waste is spread in thin layers, compacted, and covered with soil throughout the disposal period. Landfill areas are subject to heavy vehicular traffic. Some soil properties that affect suitability for landfill are ease of excavation, hazard of polluting around water, and trafficability. The best soils have moderately slow permeability, withstand heavy traffic, and are friable and easy to excavate. Unless otherwise stated, the ratings in table 5 apply only to a depth of about 6 feet; therefore, limitation ratings of *slight* or *moderate* may not be valid if trenches are to be much deeper than that. Even though reliable predictions can be made to a depth of 10 to 15 feet for some soils, every site should be investigated before it is selected.

Local roads and streets, as rated in table 5, have an all-weather surface expected to carry automobile traffic all year. They have a subgrade of underlying soil material; a base consisting of gravel, crushed rock, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly of asphalt or concrete. These roads are graded to shed water and have ordinary provisions for drainage. They are built mainly from soil at hand, and most cuts and fills are less than 6 feet deep. Soil properties that most affect design and construction of roads and streets are load-supporting capacity, stability of the subgrade, and workability and quantity of cut and fill material available. The AASHTO and Unified classifications of the soil material as well as the shrink-swell potential indicate traffic-supporting capacity. Wetness and flooding affect stability of the material. Slope, depth to hard rock, content of stones and rocks, and wetness affect the ease of excavation and the amount of cut and fill needed to reach an even grade.

Pond reservoir areas hold water behind a dam or embankment. Soils suitable for pond reservoir areas have low seepage, which is related to their permeability and their depth to fractured or permeable bedrock or other permeable material.

Pond embankments, dikes, and levees require soil material that is resistant to seepage and piping and has favorable stability, shrink-swell potential, shear strength, and compactibility. Presence of stones or organic material in a soil are unfavorable factors.

Road fill is soil material used in embankments for roads. The suitability ratings reflect (1) the predicted performance of a soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage and (2) the relative ease of excavating the material at borrow areas.

Sand and gravel are used in great quantities in many kinds of construction. A column was not included in the table, however, because the soils of Eastland County are not good sources of sand and gravel.

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material, as for preparing a seedbed; natural fertility of the material, or the response of plants grown on the soil when fertilizer is applied; and absence of substances toxic to plants. Texture of the soil material and its content of stone fragments affect suitability. Damage that will result at the area from which topsoil is taken is also considered in the rating. Excess lime refers to calcium carbonate equivalent of a soil. The percentage of calcium carbonate equivalent is given in the range of characteristics of those soils where this characteristic is important. A calcium carbonate equivalent greater than 15 percent will cause chlorosis in many plants. The chlorosis can be helped with the application of iron supplements and large amounts of organic residues. A calcium carbonate equivalent that exceeds 30 percent is impractical to correct for use as topsoil.

Drainage of cropland and pasture is affected by such soil properties as permeability, texture, and structure; depth to claypan, rock, or other layers that influence rate of water movement; depth to the water table; slope; stability in ditchbanks; susceptibility to stream overflow; salinity or alkalinity; and availability of outlets for drainage. A column was not included in the table, because this is not a problem with soils of the county.

Irrigation of a soil is affected by such features as slope; susceptibility to stream overflow, erosion, or soil blowing; soil texture; content of stones; accumulations of salts and alkali; depth of root zone; rate of water intake at the surface; permeability of soil layers below the surface layer and in fragipans or other layers that restrict movement of water; amount of water held available to plants; and need for drainage, or depth to water table or bedrock.

Terraces and diversions are embankments, or ridges, constructed across the slope to intercept runoff so that it soaks into the soil or flows slowly to a prepared outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock or other unfavorable material; presence of stones; permeability; and resistance to erosion, soil slipping, and soil blowing. A soil suitable for these structures provides outlets for runoff and is not difficult to vegetate.

Waterways are either natural or shaped channels seeded with grass to carry runoff without causing erosion. The suitability of a soil for grassed waterways is determined by the erosion hazard and the amount of shaping that can be done. This depends upon such features as slope, stoniness, and depth to bedrock. The ease of establishing

vegetation in the waterway is also an important soil feature.

Soil test data

Table 6 contains the results of engineering tests performed by the Texas Highway Department on several soils in Eastland County.

The table shows the specific location where samples were taken, the depth to which sampling was done, and the results of tests to determine particle-size distribution and other properties significant in soil engineering.

Shrinkage limit is the maximum water content at which a reduction in water content will not cause a decrease in volume of the soil mass. Since clay is the major soil fraction that causes shrinkage, the shrinkage limit of a soil is a general index of clay content and will, in general, decrease with an increase in clay content.

Linear shrinkage is the decrease in one dimension, expressed as a percentage of the original dimension, of the soil mass when the moisture content is reduced from the given value to the shrinkage limit. It is used to give some indication of the amount of cracking that will take place in a soil as a result of drying.

Shrinkage ratio is the ratio of a given volume change, expressed as a percentage of the dry volume, to the corresponding change in water content above the shrinkage limit, expressed as a percentage of the weight of the ovendried soil.

Mechanical analyses show the percentages, by weight. of soil particles that would pass sieves of specified sizes, Sand and other coarser materials do not pass through the No. 200 sieve. Silt and clay pass through the No. 200 sieve. Silt is that material larger than 0.002 millimeter in diameter that passes through the No. 200 sieve, and clay is that fraction passing through the No. 200 sieve that is smaller than 0.002 millimeter in diameter.

Liquid limit and plasticity index indicate the effect of water on the strength and consistence of soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from a solid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material passes from solid to plastic. The liquid limit is the moisture content at which the material changes from plastic to liquid. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a material is plastic.

The AASHTO and Unified classifications have been explained earlier in the engineering section.

Use of the Soils for Recreational Development

Knowledge of soils is necessary for planning, developing, and maintaining areas used for recreation. In table 7 the soils of Eastland County are rated according to limitations that affect their suitability for camp areas, picnic areas, playgrounds, and paths and trails.

The soils are rated as having slight, moderate, or severe limitations for the specified uses. For all of these ratings, it is assumed that a good cover of vegetation can be established and maintained. A limitation of *slight* means that soil properties are generally favorable and limitations are so minor that they easily can be overcome. A *moderate* limitation can be overcome or modified by planning, by design, or by special maintenance. A *severe* limitation means that costly soil reclamation, special design, or intense maintenance, or a combination of these activities is required.

Camp areas are used intensively for tents and small camp trailers and the accompanying activities of outdoor living. Little preparation of the site is required, other than shaping and leveling for tent and parking areas. Camp areas are subject to heavy foot traffic and limited vehicular traffic. The best soils have mild slopes, good drainage, a surface free of rocks and coarse fragments, freedom from flooding during periods of heavy use, and a surface that is firm after rains but not dusty when dry.

TABLE 7.—*Degree of limitation and soil features affecting recreational development*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for referring to other series that appear in the first column of this table]

Soil series and map symbols	Camp areas	Picnic areas	Playgrounds	Paths and trails
Bolar: BcB	Moderate: clay loam surface layer.	Moderate: clay loam surface layer.	Moderate: clay loam surface layer.	Moderate: clay loam surface layer.
Bonti: BnB	Moderate: moderately slow permeability.	Slight	Moderate: bedrock at a depth of 20 to 40 inches; moderately slow permeability; slopes.	Slight.
Brackett:				
BrD	Moderate: moderately slow permeability.	Slight	Moderate: moderately slow permeability; slope of 1 to 8 percent.	Slight.
BtE	Severe: 5 to 15 percent stones.	Moderate: slope of 8 to 20 percent; 5 to 15 percent stones.	Severe: slope of 8 to 20 percent; 5 to 15 percent stones.	Severe: 5 to 15 percent stones.
Bunyan:				
Bu	Severe: hazard of flooding.	Moderate: hazard of flooding.	Moderate: hazard of flooding.	Slight.
By	Severe: hazard of flooding.	Severe: hazard of flooding.	Severe: hazard of flooding.	Moderate: hazard of flooding.

TABLE 7.—*Degree of limitation and soil features affecting recreational development*—Continued

Soil series and map symbols	Camp areas	Picnic areas	Playgrounds	Paths and trails
Chaney:				
ChC, ChC2, CnD3	Moderate: loamy sand surface layer; slow permeability; moderately well drained.	Moderate: loamy sand surface layer.	Moderate: loamy sand surface layer; slow permeability; slope of 1 to 8 percent.	Moderate: loamy sand surface layer.
CmD	Severe: 5 to 20 percent stones.	Moderate: loamy sand surface layer; 5 to 20 percent stones.	Severe: 5 to 20 percent stones.	Severe: 5 to 20 percent stones.
Cisco:				
CoC	Moderate: loamy fine sand surface layer.	Moderate: loamy fine sand surface layer.	Severe: loamy fine sand surface layer.	Moderate: loamy fine sand surface layer.
CsB, CsC, CsC2	Slight	Slight	Moderate: slope of 1 to 5 percent.	Slight.
Deleon: De	Severe: clay surface layer; hazard of flooding.	Severe: clay surface layer; hazard of flooding.	Severe: clay surface layer; hazard of flooding.	Severe: clay surface layer; hazard of flooding.
Demona: DmC	Moderate: loamy sand surface layer.	Moderate: loamy sand surface layer.	Severe: loamy sand surface layer.	Moderate: loamy sand surface layer.
Elandco: Ea, En	Severe: hazard of flooding.	Moderate: silty clay loam surface layer; hazard of flooding.	Moderate: silty clay loam surface layer; hazard of flooding.	Moderate: silty clay loam surface layer; hazard of flooding.
*Exray:				
ErD For Bonti part see Bonti series.	Severe: 1 to 20 percent stones.	Moderate: 1 to 20 percent stones.	Severe: bedrock at a depth of 8 to 20 inches.	Severe: 1 to 20 percent stones.
ESE	Severe: 5 to 20 percent stones.	Severe: 5 to 20 percent stones.	Severe: bedrock at a depth of 8 to 20 inches.	Severe: 5 to 20 percent stones.
Hassee: HaA, HaB	Severe: very slow permeability; somewhat poorly drained.	Moderate: somewhat poorly drained.	Severe: very slow permeability; somewhat poorly drained.	Moderate: somewhat poorly drained.
Hensley:				
HeB	Moderate: slow permeability.	Slight	Severe: bedrock at a depth of 10 to 20 inches.	Slight.
HnC	Severe: 5 to 20 percent stones.	Moderate: 5 to 20 percent stones.	Severe: bedrock at a depth of 10 to 20 inches; 5 to 20 percent stones.	Severe: 5 to 20 percent stones.
Lamar:				
LaC	Slight	Slight	Moderate: slope of 2 to 5 percent.	Slight.
LaD	Slight	Slight	Severe: slope of 5 to 8 percent.	Slight.
Leeray: LeA, LeB	Severe: clay surface layer; very slow permeability.	Severe: clay surface layer.	Severe: clay surface layer; very slow permeability.	Severe: clay surface layer.
Lindy: LnB	Moderate: slow permeability.	Slight	Moderate: bedrock at a depth of 20 to 40 inches; slow permeability.	Slight.
May: MfA, MfB	Slight	Slight	Slight	Slight.
Menard:				
MnB	Slight	Slight	Slight	Slight.
MnC	Slight	Slight	Moderate: slope of 3 to 5 percent.	Slight.
Nimrod: NmC	Severe: fine sand surface layer.	Severe: fine sand surface layer.	Severe: fine sand surface layer.	Severe: fine sand surface layer.
Owens: OcB, OwE	Severe: clay surface layer; very slow permeability.	Severe: clay surface layer.	Severe: clay surface layer; very slow permeability.	Severe: clay surface layer.
Patilo: PaB	Severe: loose sand surface layer; subject to blowing.	Severe: loose sand surface layer; subject to blowing.	Severe: loose sand surface layer; subject to blowing.	Severe: loose sand surface layer.
Pedernales:				
PdC	Moderate: moderately slow permeability.	Moderate: loamy fine sand surface layer.	Moderate: loamy fine sand surface layer; moderately slow permeability.	Moderate: loamy fine sand surface layer.
PeB, PeC, PeC2, PsD3.	Moderate: moderately slow permeability.	Slight	Moderate: moderately slow permeability; slope of 1 to 8 percent.	Slight.

TABLE 7.—*Degree of limitation and soil features affecting recreational development*—Continued

Soil series and map symbols	Camp areas	Picnic areas	Playgrounds	Paths and trails
Tarrant: TaD, TNE----	Severe: clay surface layer; 3 to 50 percent stones.	Severe: clay surface layer; 3 to 50 percent stones.	Severe: clay surface layer; less than 20 inches to bedrock; 3 to 50 percent stones.	Severe: clay surface layer; 3 to 50 percent stones.
Thurber: TrA, TrB----	Severe: very slow permeability.	Moderate: clay loam surface layer.	Severe: very slow permeability.	Moderate: clay loam surface layer.
Truce: Tub, TuC, TuC2.	Moderate: slow permeability.	Slight----------	Moderate: slow permeability.	Slight.

Picnic areas are attractive natural or landscaped tracts used primarily for preparing meals and eating outdoors. These areas are subject to heavy foot traffic. Most of the vehicular traffic, however, is confined to access roads. The best soils are firm when wet but not dusty when dry, are free of flooding during the season of use, and do not have slopes or stoniness that greatly increase cost of leveling sites or of building access roads.

Playgrounds are areas used intensively for baseball, football, badminton, and similar organized games. Soils suitable for this use need to withstand intensive foot traffic. The best soils have a nearly level surface free of coarse fragments and rock outcrops, good drainage, freedom from flooding during periods of heavy use, and a surface that is firm after rains but not dusty when dry. If grading and leveling are required, depth to rock is important.

Paths and trails are used for local and cross-country travel by foot or on horseback. Design and layout should require little or no cutting and filling. The best soils are at least moderately well drained, are firm when wet but not dusty when dry, are flooded not more than once during the season of use, have a slope of less than 15 percent, and have few or no rocks or stones on the surface.

Formation and Classification of the Soils

The major factors of soil formation and how they have affected the soils of Eastland County are discussed in this section. The important processes in the development of soil horizons are briefly described. In addition, the system for classifying soils is defined, and the soil series of the county are classified according to this system.

Factors of Soil Formation

Soil is the product of the interaction of five major factors of soil formation. The factors are climate, living organisms (especially vegetation), parent material, topography, and time.

Climate

The warm-temperate, subtropical climate in Eastland County has promoted moderately rapid soil development. The climate is uniform throughout the county, although its effect is modified locally by runoff and the direction of slope exposure. The south-facing slopes are dominated by Owens soils and the north-facing slopes by Exray soils.

Living organisms

Plants, animals, insects, bacteria, and fungi are important in the formation of soils. Gains in organic matter and nitrogen in the soil, gains or losses in plant nutrients, and changes in structure and porosity are among the changes caused by living organisms.

The effects of vegetation can be seen in many of the soils of the county. The Patilo soils, under the influence of hardwood tree vegetation, have a surface layer that is low in organic-matter content. The Tarrant soils, which formed under grassland vegetation, have a dark surface layer that is high in organic-matter content.

Parent material

Parent material is the unconsolidated mass from which a soil is formed. It determines the chemical and mineralogical composition of the soil.

The soils in Eastland County developed in four major kinds of parent material: residuum derived from Pennsylvanian shale, sandstone, and limestone; loamy to clayey outwash or old alluvium; recent alluvium; and residuum derived from Cretaceous formations.

Formations of Pennsylvanian age consist of members in the Strawn, Cisco, and Canyon Groups. The materials consist of sediment laid down in an ancient sea. They are exposed in highway cuts in the northern and eastern parts of the county. Hensley and Tarrant are typical of soils that developed from materials of Pennsylvanian age.

In the southeastern part of the county layers of old alluvium or outwash material were deposited. These deposits are several feet thick and are loamy in texture. May soils formed in old alluvial sediment.

Materials of Cretaceous age make up a large part of the southern half of the county. Most of the soils formed over Cretaceous materials and are loamy or sandy in the surface layer. Examples are Chaney and Cisco soils.

Soils that formed in recent alluvium are on the flood plains of streams. Examples are Deleon and Elandco soils.

Topography

Topography, or relief, affects soil formation through its influence on drainage, erosion, plant cover, and soil temperature. The topography of Eastland County ranges from nearly level to moderately steep and hilly.

Nearly level to gently sloping Thurber soils are deeper and have more distinct horizons than do the gently sloping and hilly Owens soils on hilltops and ridges. They are different because the Thurber soils in lower positions

receive additional water, have less runoff, and are subject to less erosion.

On the steeper slopes geological erosion occurs almost as fast as the soil material is formed. An example is the Tarrant soils. These soils have been forming as long as the less sloping Bolar soils, but they are much shallower in their development.

Time

A long time is required for the formation of distinct horizons. The differences in length of time that parent material has been in place are generally reflected in the degree of development of the soil profile.

The soils in Eastland County range from young to old. The young soils have very little horizon development, and the old soils have well-expressed soil horizons. Bunyan soils are an example of young soils that have little horizon development. Except for a slight accumulation of organic matter and darkening of the surface layer, Bunyan soils retain most of the characteristics of their parent material. Truce soils are an example of older soils that have well-developed soil horizons. They have distinct A and B horizons that bear little resemblance to the original parent material.

Processes of Horizon Differentiation

Three main processes are involved in the formation of horizons in the soils of Eastland County: (1) accumulation of organic matter, (2) leaching of calcium carbonates and bases, and (3) formation and translocation of silicate clay minerals. In most soils more than one of these processes have been active.

Accumulation of organic matter in the upper layer to form an A1 horizon has been important. The soils of Eastland County range from medium to low in organic-matter content.

Some leaching of carbonates and bases has occurred in nearly all of the soils. Leaching of bases in soils usually precedes translocation of silicate clay minerals. Most soils in the county are moderately leached, and this has contributed to the development of horizons. Calcium carbonates have been leached from the upper horizons of most of the soils. The amount of rainfall, however, has not been great enough to leach all the carbonates from the soil. Many of the soils have a layer in which calcium carbonates have accumulated.

In several soils the downward translocation of clay minerals has contributed to horizon development. Bonti, Chaney, Demona, and Truce are examples of soils that have translocated silicate clays accumulated in the Bt horizon. The Bt horizon of these soils contains appreciably more silicate clay than the A horizon. Leaching of bases and translocation of silicate clays are among the more important processes in horizon differentiation in the soils of Eastland County.

Classification of the Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulation. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The narrow categories of classification, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas such as countries and continents.

The system of soil classification was adopted by the National Cooperative Soil Survey in 1965. Because this system is under continual study, readers interested in developments of the system should search the latest literature available.[7]

The current system of classification has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measureable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped. In table 8, the soil series of Eastland County are placed in three categories of the current system. Classes of the current system are briefly defined in the following paragraphs.

ORDER: Ten soil orders are recognized. The properties used to differentiate among soil orders are those that tend to give broad climatic groupings of soils. The two exceptions to this are the Entisols and Histosols, which occur in many different climates. Each order is named with a word of three or four syllables ending in *sol* (Ent-i-sol).

The five orders of the soils of Eastland County are Alfisols, Entisols, Inceptisols, Mollisols, and Vertisols.

Alfisols have a light-colored surface layer that is low in organic matter and have a clay-enriched B horizon, an accumulation of aluminum and iron, and a base saturation of more than 35 percent.

Entisols have little or no evidence of development of pedogenic horizons.

Inceptisols have a light-colored surface layer that is low in organic matter, but they lack a clay-enriched B horizon.

Mollisols have a dark-colored surface layer that is high in organic matter, and they have a base saturation of more than 50 percent.

Vertisols are clayey soils that have deep, wide cracks during a part of each year in most years.

SUBORDER: Each order is divided into suborders that are based primarily on those soil characteristics that seem to produce classes with the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or the absence of waterlogging or soil differences that result from the climate or vegetation. The names of suborders have two syllables. The last syllable indicates the order. An example is *Aquent* (*Aqu*, meaning water or wet, and *ent*, from Entisol).

GREAT GROUP: Each suborder is separated into great groups on the basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to

[7] United States Department of Agriculture. Soil classification, a comprehensive system, 7th Approximation. 265 pp., illus., 1960. [Supplements issued in March 1967 and September 1968]

TABLE 8.—*Classification of soil series*

Series	Family	Subgroup	Order
Bolar	Fine-loamy, carbonatic, thermic	Typic Calciustolls	Mollisols.
Bonti	Fine, mixed, thermic	Ultic Paleustalfs	Alfisols.
Brackett	Loamy, carbonatic, thermic, shallow	Typic Ustochrepts	Inceptisols.
Bunyan	Fine-loamy, mixed, nonacid, thermic	Typic Udifluvents	Entisols.
Chaney	Fine, mixed, thermic	Aquic Paleustalfs	Alfisols.
Cisco	Fine-loamy, siliceous, thermic	Udic Haplustalfs	Alfisols.
Deleon	Fine, mixed, thermic	Udertic Haplustolls	Mollisols.
Demona	Clayey, mixed, thermic	Aquic Arenic Paleustalfs	Alfisols.
Elandco	Fine-silty, mixed, thermic	Cumulic Haplustolls	Mollisols.
Exray	Clayey, mixed, thermic	Lithic Rhodustalfs	Alfisols.
Hassee	Fine, montmorillonitic, thermic	Mollic Albaqualfs	Alfisols.
Hensley	Clayey, mixed, thermic	Lithic Rhodustalfs	Alfisols.
Lamar [1]	Fine-silty, mixed, thermic	Typic Ustochrepts	Inceptisols.
Leeray	Fine, montmorillonitic, thermic	Typic Chromusterts	Vertisols.
Lindy	Fine, mixed, thermic	Udic Haplustalfs	Alfisols.
May	Fine-loamy, mixed, thermic	Udic Haplustalfs	Alfisols.
Menard	Fine-loamy, mixed, thermic	Typic Haplustalfs	Alfisols.
Nimrod	Loamy, siliceous, thermic	Aquic Arenic Paleustalfs	Alfisols.
Owens	Clayey, mixed, thermic, shallow	Typic Ustochrepts	Inceptisols.
Patilo	Loamy, siliceous, thermic	Grossarenic Paleustalfs	Alfisols.
Pedernales	Fine, mixed, thermic	Udic Paleustalfs	Alfisols.
Tarrant	Clayey-skeletal, montmorillonitic, thermic	Lithic Calciustolls	Mollisols.
Thurber	Fine, montmorillonitic, thermic	Typic Haplustalfs	Alfisols.
Truce	Fine, mixed, thermic	Udic Paleustalfs	Alfisols.

[1] The soils in Eastland County named for this series are taxadjuncts to the series because they have a slightly thicker A horizon and are on foot slopes. Their behavior, use, and management, however, are very similar to those of normal Lamar soils.

make separations are those in which clay, iron, or humus have accumulated; those that have pans that interfere with growth of roots or movement of water, or both; and those that have a thick, dark-colored surface horizon. The features used are the self-mulching properties of clay, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), dark-red and dark-brown colors associated with basic rocks, and the like. The names of great groups have three or four syllables and are made by adding a prefix to the name of the suborder. An example is Haplaquents (*Hapl*, meaning simple horizons, *aqu* for wetness or water, and *ent*, from Entisols).

SUBGROUP: Great groups are subdivided into subgroups, one representing the central (typic) segment of the group, and others, called intergrades, that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is Typic Haplaquents (a typical Haplaquent).

FAMILY: Soil families are separated within a subgroup primarily on the basis of properties important to the growth of plants or on the behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence. A family name consists of a series of adjectives preceding the subgroup name. The adjectives are the class names for texture, mineralogy, and so on, that are used as family differentiae. An example is the coarse-loamy, siliceous, acid, thermic family of Typic Haplaquents.

SERIES: The series consists of a group of soils that have major horizons that, except for texture of the surface layer, are similar in important characteristics and in arrangement in the profile.

Climate [8]

The climate of Eastland County is typically continental and is characterized by large variations in annual extremes of temperature (table 9). Rainfall averages 27.35 inches annually. Amounts vary considerably from month to month and from year to year. More than 70 percent of the average total precipitation falls during the warm season, April through October. A total of 43.67 inches fell at Eastland in 1957, the wettest year of record since 1892, and only 14.19 inches fell in 1943, the driest year.

Prevailing winds are southerly throughout the year. The relative humidity is fairly uniform throughout the year, although it is slightly lower during the summer than in other seasons. Average relative humidity is about 78 percent at 6:00 a.m., 51 percent at noon, and 46 percent at 6:00 p.m. The Eastland area receives about 67 percent of the total possible sunshine annually.

In winter, surges of cold continental air are common. Cold fronts often are accompanied by strong northerly winds and sudden drops in temperature. Temperatures at night drop to 32° F or below about two-thirds of the time. The daily maximum average is 58.4°. Cold waves are of short duration, rarely lasting more than about 48 hours before sunshine and southerly winds bring rapid warming. In some years, snow falls once or twice a month, but it is most often light. Because moisture from the Gulf of Mexico is cut off rather effectively, the least amount of precipitation is received during this season.

[8] By ROBERT B. ORTON, climatologist for Texas, National Weather Service, U.S. Department of Commerce.

In spring, temperatures are pleasant. March and April are often windy; warm and cool periods follow each other in rapid succession. Thundershowers increase and reach a peak of intensity in May. A few thunderstorms late in spring or early in summer are accompanied by damaging winds or hail.

During summer, daytime temperatures are high. Precipitation decreases during July and August, and the day-to-day weather seldom changes. The relative humidity is sufficiently low for evaporative-type home air-conditioners to operate effectively about 90 percent of the time.

Fall is pleasant, and the weather is more varied than in summer. Temperatures are moderate, and there are long uninterrupted periods of fair weather and relatively light winds. Precipitation increases in September, as cool fronts become more frequent, but it decreases in November.

The average length of the growing season (freeze-free period) at Eastland is 229 days. The average date of the last occurrence of 32° or below in spring is March 27, and the first occurrence of 32° or below in fall is November 11. Average annual lake evaporation is 64 inches. Thunderstorms occur on an average of 41 days each year.

Glossary

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as crumbs, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity (also termed 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 capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

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 clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Claypan. A compact, slowly permeable soil horizon that contains more clay than the horizon above and below it. A claypan is commonly hard when dry and plastic or stiff when wet.

Coarse fragments. Mineral or rock particles more than 2 millimeters in diameter.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Contour farming. Plowing, cultivating, planting, and harvesting in rows that are at right angles to the natural direction of the slope or that are parallel to terrace grade.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, 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 different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Deferred grazing. The practice of delaying grazing until range plants have reached a definite stage of growth, in order to increase the vigor of the forage and to allow the desirable plants to produce seed. Contrasts with continuous grazing and rotation grazing.

Diversion, or diversion terrace. A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect areas downslope from the effects of such runoff.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Genesis, soil. The manner in which a soil originates. Refers especially to the processes initiated by climate and organisms that are responsible for the development of the solum, or true soil, from the unconsolidated parent material, as conditioned by relief and age of landform.

Gilgai. Typically, the microrelief of Vertisols—clayey soils that have a high coefficient of expansion and contraction with changes in moisture; usually a succession of microbasins and microknolls, in nearly level areas, or of microvalleys and microridges that run with the slope.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rains. The distinction between gully and rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by normal tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage. V-shaped gullies result if the material is more difficult to erode with depth; whereas U-shaped gullies result if the lower material is more easily eroded than that above it.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material may be sandy or clayey, and it may be cemented by iron oxide, silica, calcium carbonate, or other substance.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms

TABLE 9.—*Temperature*

[Data recorded at Eastland; period of record, 1938–67.

Month	Temperature [1]				Precipitation			
						Probability of receiving—		
	Average daily maximum	Average monthly maximum	Average daily minimum	Average monthly minimum	Average total	0 or trace	0.50 inch or more	1 inch or more
	°F	°F	°F	°F	In	Pct	Pct	Pct
January	56.0	78.2	30.1	12.0	1.62	<1	75	50
February	60.2	81.4	34.6	19.1	1.43	<1	76	55
March	68.2	87.2	41.0	22.5	1.48	<1	80	60
April	77.5	93.0	51.2	33.3	3.04	<1	96	82
May	83.4	96.1	59.4	44.4	4.22	<1	>99	99
June	91.6	99.7	61.4	57.3	3.08	<1	85	73
July	96.3	103.7	70.4	62.8	2.10	4	80	62
August	97.0	105.5	69.5	61.1	2.03	7	69	50
September	89.3	100.9	64.7	47.9	2.45	2	80	70
October	82.3	92.9	52.1	35.2	2.76	3	85	85
November	67.3	84.3	40.0	24.1	1.75	7	73	55
December	59.0	77.8	33.0	17.4	1.39	5	80	60
Year	77.3	91.7	51.1	36.4	27.35			

[1] Length of record, 28 years.
[2] Length of record, 12 years.

are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

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.

Furrow.—Water is applied in small ditches made by cultivation implements used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineralogical, and biological properties of the various horizons, and their thickness and arrangement in the soil profile.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of 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 these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimensions; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimensions.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Phase, soil. A subdivision of a soil, series, or other unit in the soil classification system made because of differences in the soil that affect its management but do not affect its classification in the natural landscape. A soil type, for example, may be divided into phases because of differences in slope, stoniness, thickness, or some other characteristic that affects its management but not its behavior in the natural landscape.

pH value. A numerical means for designating acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value, acidity.

Plowpan. A compacted layer formed in the soil immediately below the plowed layer.

Poorly graded. A soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles in poorly graded soil material, density can be increased only slightly by compaction.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		pH
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

and precipitation

The symbol < means less than, the symbol > means more than]

Precipitation—Continued										
Probability of receiving—Continued					Average number of days with precipitation of—[2]			Snow and sleet		
2 inches or more	3 inches or more	4 inches or more	5 inches or more	6 inches or more	0.10 inch or more	0.50 inch or more	1 inch or more	Average total[1]	Maximum[1]	Greatest depth[2]
Pct	*Pct*	*Pct*	*Pct*	*Pct*				*In*	*In*	*In*
30	15	10	5	1	3	1	(3)	1.9	12.0	6
30	15	10	5	2	4	1	1	.8	5.0	----------
30	15	8	2	1	3	1	(3)	.1	1.0	1
60	40	20	10	5	5	2	1	.1	2.0	0
90	70	55	36	20	6	3	2	0	0	0
55	35	25	15	14	4	2	1	0	0	0
39	21	13	9	5	3	2	1	0	0	0
30	16	8	4	3	3	2	1	0	0	0
50	30	21	15	9	5	2	1	0	0	0
51	34	22	15	9	4	2	1	0	0	0
27	14	5	3	1	4	2	1	.3	7.1	0
30	15	8	4	1	4	1	(3)	.4	6.0	1
----------	----------	----------	----------	----------	48	21	10	3.6	12.0	----------

[3] Less than one-half day.

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock. Only the upper part of this, modified by organisms and other soil-building forces, is regarded by soil scientists as soil. Most American engineers speak of the whole regolith, even to great depths, as "soil."

Relief. The elevations or inequalities of a land surface, considered collectively.

Rill. A steep-sided channel resulting from accelerated erosion. A rill normally is a few inches in depth and width and is not large enough to be an obstacle to farm machinery.

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. If two sequa are present in a single soil profile, it is said to have a bisequum.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on relatively steep slopes and in swelling clays, where there is marked change in moisture content.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles, less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *Very coarse sand* (2.0 to 1.0 millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter). The separates recognized by the International Society of Soil Science are as follows: I (2.0 to 0.2 millimeter); II (0.2 to 0.02 millimeter); III (0.02 to 0.002 millimeter); IV (less than 0.002 millimeter).

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Stone line. A concentration of coarse rock fragments in soils that generally represents an old weathering surface. In a cross section, the line may be one stone or more thick. The line generally overlies material that weathered in place, and it is ordinarily overlain by sediment of variable thickness.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. 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 grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Substratum. Technically, the part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

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."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil. A presumed fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to top-dress roadbanks, lawns, and gardens.

Trace elements. The chemical elements found in soils in extremely small amounts, yet which are essential to plant growth. Some of the trace elements are zinc, cobalt, manganese, copper, and iron.

Variant, soil. A soil having properties sufficiently different from those of other known soils to suggest establishing a new soil series, but a soil of such limited known area that creation of a new series is not believed to be justified.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Well-graded soil. A soil or soil material consisting of particles that are well distributed over a wide range in size or diameter. Such a soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which plants (specifically sunflower) wilt so much that they do not recover when placed in a dark, humid atmosphere.

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GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. In referring to a capability unit or a range site, read the introduction to the section it is in for general information about its management. Other information is given in tables as follows:

Acreage and extent, table 1, page 5.
Predicted yields, table 2, page 31.
Suitability for wildlife, table 3, page 41.
Engineering uses of soils, tables 4, 5, and 6, pages 44 through 57.
Recreational development, table 7, page 60.

Map symbol	Mapping unit	Page	Capability unit		Range site	
			Symbol	Page	Name	Page
BcB	Bolar clay loam, 1 to 3 percent slopes	6	IIe-4	28	Clay Loam	34
BnB	Bonti fine sandy loam, 1 to 3 percent slopes	6	IIe-2	28	Tight Sandy Loam	39
BrD	Brackett stony loam, 1 to 8 percent slopes	7	VIs-1	30	Adobe	33
BtE	Brackett complex, 8 to 20 percent slopes	7	VIIs-1	31	Steep Adobe	39
Bu	Bunyan fine sandy loam	8	IIw-1	28	Loamy Bottomland	35
By	Bunyan soils, frequently flooded	8	Vw-1	30	Loamy Bottomland	35
ChC	Chaney loamy sand, 1 to 5 percent slopes	9	IIIe-5	29	Sandy	37
ChC2	Chaney loamy sand, 1 to 5 percent slopes, eroded	9	IIIe-5	29	Sandy	37
CmD	Chaney stony loamy sand, 1 to 8 percent slopes	10	VIs-1	30	Sandy	37
CnD3	Chaney soils, 2 to 6 percent slopes, severely eroded	10	VIe-1	30	Sandy	37
CoC	Cisco loamy fine sand, 1 to 5 percent slopes	10	IIIe-5	29	Sandy	37
CsB	Cisco fine sandy loam, 1 to 3 percent slopes	11	IIe-3	28	Sandy Loam	37
CsC	Cisco fine sandy loam, 3 to 5 percent slopes	11	IIIe-4	29	Sandy Loam	37
CsC2	Cisco fine sandy loam, 1 to 5 percent slopes, eroded	11	IIIe-4	29	Sandy Loam	37
De	Deleon clay, frequently flooded	11	Vw-1	30	Clayey Bottomland	33
DmC	Demona loamy sand, 0 to 5 percent slopes	12	IIIe-5	29	Sandy	37
Ea	Elandco silty clay loam	13	IIw-1	28	Loamy Bottomland	35
En	Elandco silty clay loam, frequently flooded	13	Vw-1	30	Loamy Bottomland	35
ErD	Exray-Bonti complex, 1 to 8 percent slopes	14	VIs-1	30	Sandy Loam	37
ESE	Exray stony soils, hilly	14	VIIs-1	31	Sandstone Hills	38
HaA	Hassee loam, 0 to 1 percent slopes	15	IIIw-1	30	Claypan	34
HaB	Hassee loam, 1 to 2 percent slopes	15	IIIe-1	28	Claypan	34
HeB	Hensley loam, 1 to 3 percent slopes	15	IIIe-6	29	Redland	36
HnC	Hensley stony loam, 1 to 5 percent slopes	16	VIs-1	30	Redland	36
LaC	Lamar loam, 2 to 5 percent slopes	16	IIIe-7	29	Clay Loam	34
LaD	Lamar loam, 5 to 8 percent slopes	16	IVe-2	30	Clay Loam	34
LeA	Leeray clay, 0 to 1 percent slopes	17	IIIs-1	30	Clay Flat	33
LeB	Leeray clay, 1 to 3 percent slopes	17	IIe-5	28	Clay Flat	33
LnB	Lindy loam, 1 to 3 percent slopes	18	IIIe-1	28	Deep Redland	35
MfA	May fine sandy loam, 0 to 1 percent slopes	19	I-1	27	Sandy Loam	37
MfB	May fine sandy loam, 1 to 3 percent slopes	19	IIe-1	27	Sandy Loam	37
MnB	Menard fine sandy loam, 1 to 3 percent slopes	19	IIe-3	28	Sandy Loam	37
MnC	Menard fine sandy loam, 3 to 5 percent slopes	19	IIIe-4	29	Sandy Loam	37
NmC	Nimrod fine sand, 0 to 5 percent slopes	20	IIIe-2	29	Sandy	37
OcB	Owens clay, 1 to 3 percent slopes	20	IVe-1	30	Shallow Clay	38
OWE	Owens stony soils, hilly	21	VIIs-1	31	Shallow Clay	38
PaB	Patilo fine sand, 0 to 3 percent slopes	21	IIIs-2	30	Deep Sand	35
PdC	Pedernales loamy fine sand, 1 to 5 percent slopes	22	IIIe-5	29	Sandy	37
PeB	Pedernales fine sandy loam, 1 to 3 percent slopes	22	IIe-2	28	Tight Sandy Loam	39
PeC	Pedernales fine sandy loam, 3 to 5 percent slopes	22	IIIe-3	29	Tight Sandy Loam	39

Map symbol	Mapping unit	Page	Capability unit		Range site	
			Symbol	Page	Name	Page
PeC2	Pedernales fine sandy loam, 1 to 5 percent slopes, eroded	23	IIIe-3	29	Tight Sandy Loam	39
PsD3	Pedernales soils, 2 to 8 percent slopes, severely eroded	23	VIe-1	30	Tight Sandy Loam	39
TaD	Tarrant stony clay, 1 to 8 percent slopes	24	VIIs-1	31	Low Stony Hills	36
TNE	Tarrant stony soils, hilly	24	VIIs-1	31	Low Stony Hills	36
TrA	Thurber clay loam, 0 to 1 percent slopes	25	IIIs-1	30	Claypan	34
TrB	Thurber clay loam, 1 to 3 percent slopes	25	IIIe-1	28	Claypan	34
TuB	Truce fine sandy loam, 1 to 3 percent slopes	26	IIe-6	28	Tight Sandy Loam	39
TuC	Truce fine sandy loam, 3 to 5 percent slopes	26	IIIe-8	29	Tight Sandy Loam	39
TuC2	Truce fine sandy loam, 1 to 5 percent slopes, eroded	26	IIIe-8	29	Tight Sandy Loam	39

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