SOIL SURVEY OF

Wharton County, Texas

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

Issued March 1974

Major fieldwork for this soil survey was done in the period 1962–67. Soil names and descriptions were approved in 1968. Unless otherwise indicated, statements in this publication refer to conditions in the county in 1967. 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 Wharton County Soil and Water Conservation District.

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, USDA, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

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

Locating Soils

All the soils of Wharton 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 for the pasture group.

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 with a moderate limitation can be colored yellow, and those with 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 pasture groups and woodland groups.

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

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain 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 Soils."

Newcomers to the county may 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 and in "Additional Facts About the County."

Cover: **Brahma cattle grazing on improved pasture of bermudagrass grown on Norwood silt loam, 0 to 1 percent slopes.**

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SOIL SURVEY OF WHARTON COUNTY, TEXAS

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

WHARTON COUNTY is in the south-central part of Texas (fig. 1) in the area called the Gulf Coast Prairie. It has a total area of about 1,079 square miles, or 690,560 acres. Wharton, the county seat, is along the Colorado River about 54 air miles from the Gulf of Mexico. In 1970, according to the U.S. Census, the total population of the county was 36,218. Farming and ranching are the main enterprises.

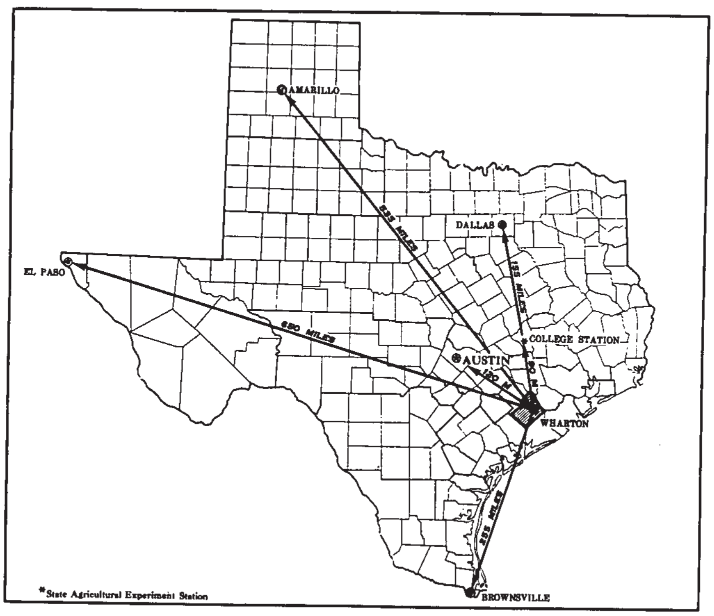

Figure 1.—**Location of Wharton County in Texas.**

The major natural drainageways in the county are the San Bernard River and the Colorado River, which carry water from the creeks and sloughs. The streams are entrenched to a depth of less than 50 feet.

Most of Wharton County is nearly level to gently sloping. The western part of the county has slopes of a 5-foot fall in 1 mile, and the eastern part of the county has slopes of a 2-foot fall in 1 mile. Consequently, runoff moves very slowly off the soil, and most runoff is carried in constructed ditches to the major drainageways (fig. 2).

Figure 2.—**Drainage ditch constructed in Edna soils.**

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Wharton County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some thay 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. Crowley and Lake Charles, 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 soil 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, Lake Charles clay, 0 to 1 percent slopes, is one of several phases within the Lake Charles 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 in the back of this publication was prepared from the 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 other 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 Wharton County—soil complexes and undifferentiated groups.

A soil complex consists of areas of two or more soils, so intermingled 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. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Bernard-Edna complex, 0 to 1 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. The name of an undifferentiated group consists of the names of the dominant soils, joined by "and." Norwood and Lincoln soils is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Alluvial land is a land type in Wharton County.

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

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, managers of woodland and rangeland, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others, 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 present methods of use and management.

General Soil Map

The general soil map at the back of this publication shows, in color, the soil associations in Wharton 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 farming or other land use. Such a map is not useful in planning the management of a farm or field, because the soils in any one association generally differ in slope, depth, drainage, and other characteristics that affect management.

The five soil associations in Wharton County are described in the paragraphs that follow.

1. Edna-Bernard Association

Poorly drained and somewhat poorly drained soils that have a surface layer of fine sandy loam and clay loam and lower layers that are dominantly clay; on uplands

This association consists of poorly drained and somewhat poorly drained fine sandy loams and clay loams on uplands. These soils are underlain by ancient loamy and clayey alluvium (fig. 3).

This association occupies about 31 percent of the county. Edna soils make up about 37 percent of the association; Bernard soils, about 27 percent; and minor soils, the remaining 36 percent.

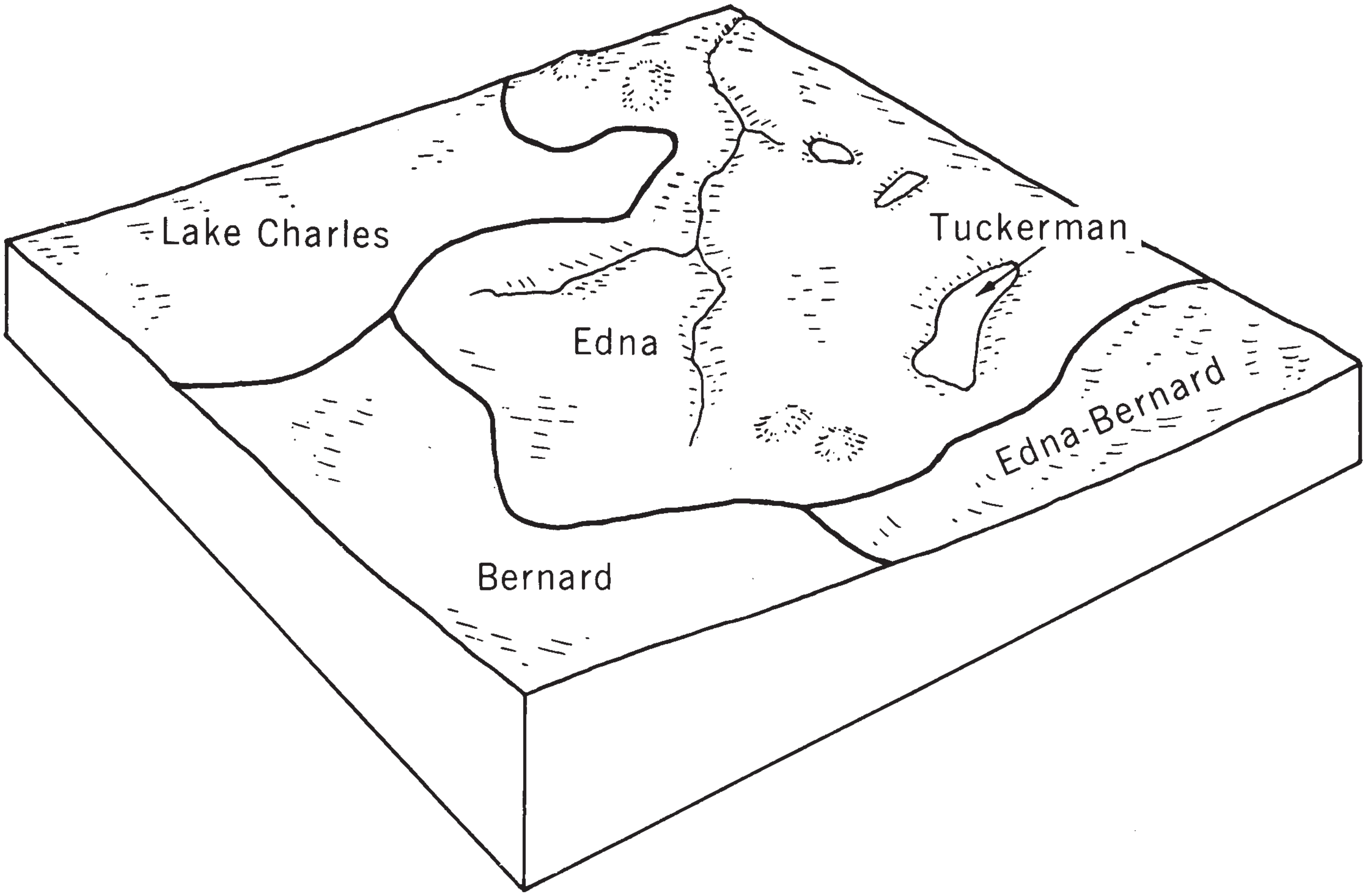

Figure 3.—Typical landscape of the soils in association 1.

Edna soils have a thin, acid surface layer of dark-gray fine sandy loam that is abruptly underlain by gray clay. Bernard soils have a surface layer of very dark gray clay loam underlain by clayey layers that become more alkaline with depth. Permeability is very slow in both soils.

Minor soils in this association are in the Crowley, Earle, Lake Charles, Midland, and Tuckerman series.

About 60 percent of the acreage of this association is used for row crops, and about 30 percent is used for pasture and hay. Because of the nearly level surface, removing runoff water is difficult. Land smoothing and artificial drainage are needed to adapt the areas to rice farming and row crops.

Large quantities of high-quality irrigation water are available in this association.

2. Crowley Association

Somewhat poorly drained soils that have a surface layer of fine sandy loam and lower layers of clay and sandy clay; on uplands

In this association are somewhat poorly drained soils on uplands. These soils are mostly fine sandy loams that are underlain by clay.

This association occupies about 20 percent of the county. Crowley soils occupy 76 percent of the association, and minor soils, the remaining 24 percent.

Crowley soils have a surface layer of neutral, dark grayish-brown fine sandy loam that is abruptly underlain by mottled clay. These soils are very slowly permeable.

Minor soils in this association are in the Arenosa, Earle, Edna, Konawa, and Tuckerman series. Also in this association is the undifferentiated group Bruno soils and Alluvial land.

About 80 percent of the acreage of this association is used for rice grown in rotation with pasture, and about 20 percent is used for row crops or as native pasture. Land smoothing and artificial drainage are needed to prepare the soils for crops.

Large quantities of high-quality irrigation water are available in this association.

3. Lake Charles Association

Somewhat poorly drained soils that have a surface layer and lower layers of clay; on uplands

In this association are large areas of somewhat poorly drained soils on uplands. These soils are black to dark gray and are clayey.

This association occupies about 19 percent of the county. Lake Charles soils make up about 80 percent of the association, and minor soils make up the remaining 20 percent.

Lake Charles soils have a slightly acid to mildly alkaline surface layer of black clay that is underlain by mildly alkaline clay.

Excess surface water is difficult to remove on these nearly level soils. Runoff is very slow. In areas not cultivated the surface is rough and wet as a result of the microrelief.

Minor soils in this association are in the Bernard and Edna series.

About 70 percent of the acreage of this association is used for row crops, and about 20 percent is used for rice grown in rotation with pasture. The remaining 10 percent of the acreage is used for pasture and hay. Land smoothing and artificial drainage are needed if these soils are used for rice and row crops.

Large quantities of high-quality irrigation water are available in this association.

4. Miller-Norwood Association

Moderately well drained and well drained soils that have a surface layer and lower layers of clay and silt loam; on bottom lands

In this association are large areas of moderately well drained and well drained, calcareous soils on flood plains that are underlain by recent loamy and clayey alluvium.

This association occupies about 19 percent of the county. Miller soils make up about 39 percent of the association; Norwood soils, about 23 percent; and minor soils, the remaining 38 percent.

Miller soils are dark reddish-brown, deep, calcareous clays that are firm and moderately well drained. Norwood soils are deep, stratified, friable, calcareous silt loams that are well drained (fig. 4).

Minor soils in this association are in the Asa, Clemville, Earle, Lincoln, and Pledger series.

About 80 percent of the acreage of this association is used for row crops. The remaining acreage is used for pasture, though undeveloped areas have a dense cover of brush and trees. Pecan trees are adapted to these soils, but they are of minor commercial value.

5. Edna-Crowley Association

Poorly drained and somewhat poorly drained soils that have a surface layer of fine sandy loam and lower layers of clay and sandy clay; on uplands

In this association are poorly drained and somewhat poorly drained fine sandy loams on uplands that are underlain by clay.

This association occupies about 11 percent of the county. Edna soils make up about 59 percent of the association; Crowley soils, about 17 percent; and minor soils, the remaining 24 percent.

Edna soils have a thin, acid surface layer of dark-gray fine sandy loam that is abruptly underlain by gray clay. Crowley soils have a dark grayish-brown sandy loam surface layer that is abruptly underlain by mottled clay.

Minor soils in this association are in the Bruno, Earle, Hockley, Kenney, Konawa, Lake Charles, and Tuckerman series.

Most of the acreage of this association is nearly level. As a result, removal of excess surface water is difficult.

About 60 percent of the acreage of this association is used for pasture, and 30 percent is used for rice grown in rotation with pasture. The remaining 10 percent is used for row crops.

Large quantities of high-quality irrigation water are available in this association.

Descriptions of the Soils

This section describes the soil series and mapping units in Wharton County. Each soil series is described in considerable 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 the description of each soil series 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, detailed and in technical terms, is for scientists, engineers, and others who need to make thorough and precise studies of soils. Unless otherwise stated, all color terms are for moist soil.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Alluvial land, for example, does not belong to a soil series. It is mapped in an undifferentiated group with Bruno soils and is listed in alphabetical order along with that series.

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 to a mapping unit is the capability unit and the pasture group in which the mapping unit has been placed. The page for the description of each capability unit and for each pasture group can be found 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 end of this survey, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*11*).[1]

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[1] Italic numbers in parentheses refer to Literature Cited, p. 41.

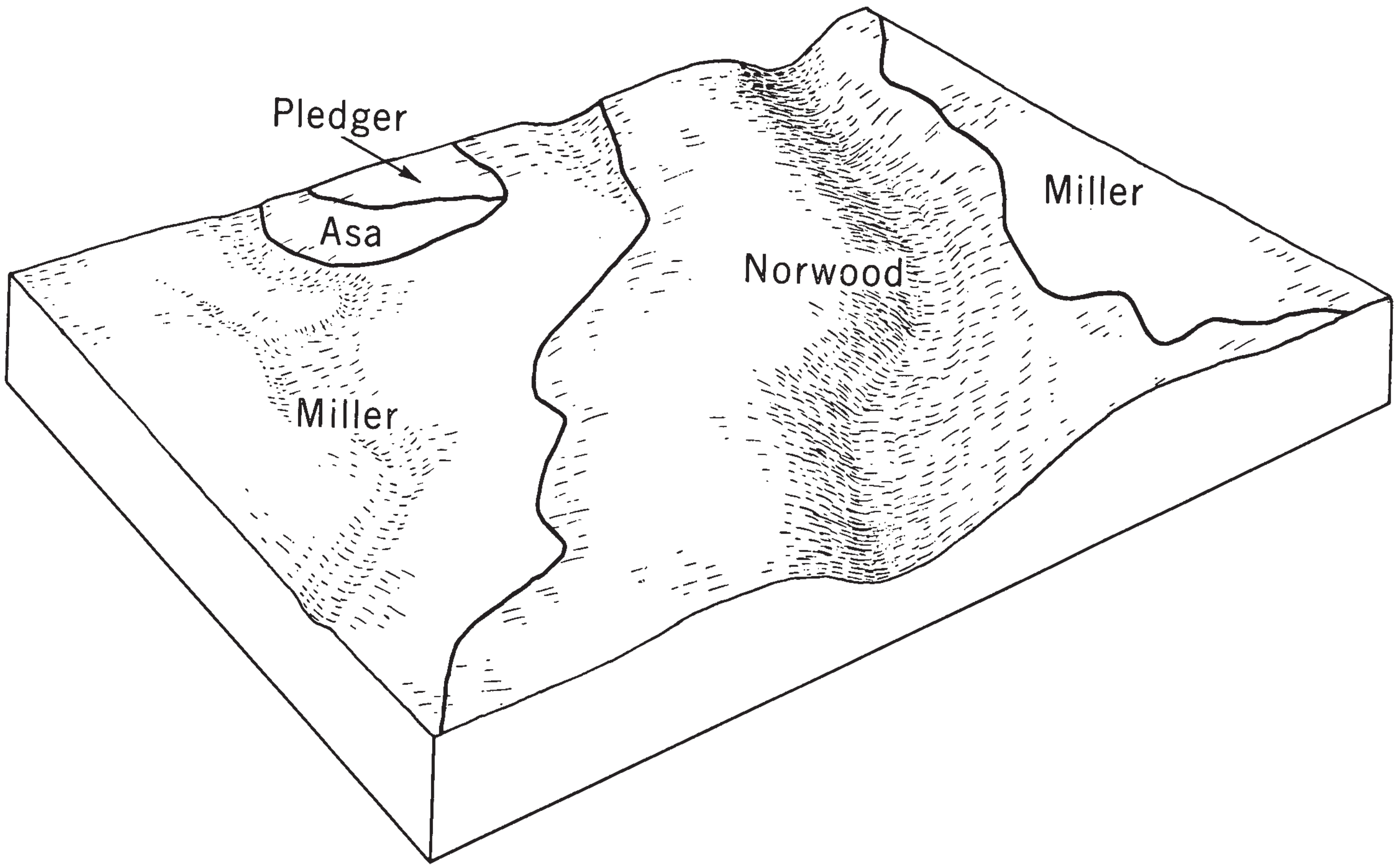

Figure 4.—Relationship of soils to the landscape in association 4.

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

Soil	Acres	Percent	Soil	Acres	Percent
Arenosa and Kenney soils, undulating	3, 205	0. 5	Konawa-Kenney complex, 5 to 8 percent slopes	818	0. 1
Asa silty clay loam	10, 004	1. 4	Lake Charles clay, 0 to 1 percent slopes	156, 886	22. 7
Bernard clay loam, 0 to 1 percent slopes	47, 453	6. 8	Lake Charles clay, 1 to 3 percent slopes	1, 201	. 2
Bernard clay loam, 1 to 3 percent slopes	1, 593	. 2	Midland clay loam	19, 220	2. 8
Bernard-Edna compex, 0 to 1 percent slopes	46, 842	6. 8	Miller clay	51, 281	7. 4
Bruno soils and Alluvial land	3, 355	. 5	Miller clay, ponded	586	. 1
Clemville-Norwood complex	19, 775	2. 9	Norwood silt loam, 0 to 1 percent slopes	20, 798	3. 0
Crowley fine sandy loam	119, 247	17. 3	Norwood silt loam, 3 to 8 percent slopes	3, 594	. 5
Earle soils	1, 751	. 3	Norwood and Lincoln soils	756	. 1
Edna fine sandy loam, 0 to 1 percent slopes	107, 752	15. 6	Pledger clay	23, 499	3. 4
Edna fine sandy loam, 1 to 3 percent slopes	2, 637	. 4	Tuckerman soils, ponded	3, 489	. 5
Edna soils, overwash	3, 629	. 5	Water	5, 363	. 8
Edna-Tuckerman complex, 0 to 1 percent slopes	21, 260	3. 1			
Hockley fine sandy loam, 0 to 3 percent slopes	3, 576	. 5	Total	690, 560	100. 0
Kenney loamy fine sand, 0 to 3 percent slopes	10, 990	1. 6			

Arenosa Series

The Arenosa series consists of well-drained, undulating sands on uplands and terraces. These soils are adjacent to major and minor drainageways.

In a representative profile the surface layer is slightly acid, brown fine sand about 6 inches thick. The underlying material is loose, light yellowish-brown fine sand to a depth of more than 84 inches.

Permeability of these soils is very rapid. Available water capacity is low.

Representative profile of an Arenosa fine sand in an area of Arenosa and Kenney soils, undulating (25 feet north of a private road; 1.9 miles on Farm Road 1300, west of junction with Sandy Creek, north on private road 1.4 miles, and 0.75 miles northeast):

A1—0 to 6 inches, brown (10YR 5/3) fine sand, pale brown (10YR 6/3) dry; single grain (structureless); loose; many roots; slightly acid; clear, smooth boundary.

C—6 to 84 inches +, light yellowish-brown (10YR 6/4) fine sand, very pale brown (10YR 7/4) dry; single grain (structureless); loose; roots are common in the upper part and few in the lower part; neutral.

The A horizon ranges from 4 to 14 inches in thickness and from dark yellowish brown to pale brown in color. Reaction in the A and C horizons is neutral to slightly acid. Depth ranges from 72 to more than 100 inches.

Arenosa and Kenney soils, undulating (AkB).—This undifferentiated group contains the only Arenosa soil mapped in the county. The soils of this unit are on overflow terraces and on uplands on long, narrow, undulating dunes that were worked by wind but that are now stable. The dunes are 4 to 8 feet high. Areas of these soils commonly are 250 acres in size, but in some places they are as much as 1,200 acres.

About 60 percent of this mapping unit is Arenosa soils, and about 25 percent is Kenney soils. Bruno, Crowley, and other soils and creek channels make up the remaining 15 percent. Some mapped areas contain only Arenosa or Kenney soils.

The Kenney soils consist of 40 to 72 inches of acid, pale-brown loamy fine sand that overlies reddish-colored sandy clay loam. These soils occur mostly at the outer margins of the mapped areas.

Available water capacity is low in these soils. The soils of this unit are used mostly for pasture. Capability unit IIIs–2; pasture group 9A.

Asa Series

The Asa series consists of well-drained, nearly level, alkaline soils. These soils formed in alluvium on bottom lands.

In a representative profile the surface layer is noncalcareous, very dark brown silty clay loam about 16 inches thick. The next layer is reddish-brown silty clay loam and silt loam that reaches to a depth of about 40 inches. The underlying material, to a depth of more than 85 inches, is calcareous, stratified, reddish-brown very fine sandy loam and dark reddish-brown silty clay loam.

The surface of the Asa soils is nearly plane, but some areas have convex slopes of about 0.3 percent. The available water capacity is high in these soils.

Representative profile of Asa silty clay loam (100 feet south of a paved county road from a point 150 feet west of the intersection of the county road and U.S. Highway 59; this is 2.2 miles north of the intersection of U.S. Highway 59 and Farm Road 1301):

Ap—0 to 6 inches, very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) dry; weak, medium, granular structure; slightly hard, friable; many fine and very fine pores; common wormcasts; a few fragments of snail shells; mildly alkaline; abrupt, smooth boundary.

A1—6 to 16 inches, very dark brown (10YR 2/2) silty clay loam, very dark grayish brown (10YR 3/2) dry; weak granular and weak, medium, subangular blocky structure; slightly hard, friable; many fine and very fine pores; many wormcasts; a few wormholes filled with soil from the B21 horizon; a few small fragments of snail shells; mildly alkaline; gradual, smooth boundary.

B21—16 to 30 inches, reddish-brown (5YR 4/4) silty clay loam, reddish brown (5YR 5/4) dry; weak, medium and coarse, subangular blocky structure; slightly hard, friable; many fine and very fine pores; many wormcasts, some of which are from the A1 horizon; a few fragments of shells; calcareous; moderately alkaline; gradual, wavy boundary.

B22—30 to 40 inches, reddish-brown (5YR 5/4) silt loam, pink (5YR 7/4) dry; weak, coarse, subangular blocky structure; slightly hard, friable; many fine and very fine pores; common wormcasts; a few fragments of snail shells; a few soft masses of secondary calcium carbonate; calcareous; moderately alkaline; clear, smooth boundary.

C—40 to 85 inches +, stratified reddish-brown (5YR 5/4) very fine sandy loam and dark reddish-brown (5YR 3/4) silty clay loam in layers that are 1 to 3 inches thick; a few soft masses of secondary calcium carbonate; calcareous; moderately alkaline.

The A horizon ranges from 14 to 20 inches in thickness. It ranges from black to dark brown in color and from neutral to moderately alkaline in reaction. The A horizon is noncalcareous in the matrix, but calcareous wormcasts are in the lower third of the horizon.

The B horizon ranges from pink to reddish brown in color. Powdery films and threads of carbonates make up 1 to 5 percent of the volume, and in places small, weakly cemented concretions are at a depth below 30 inches.

The A and B horizons are silty clay loam to silt loam in texture. They are 18 to 35 percent clay and less than 15 percent sand coarser than very fine sand. The A and B horizons combined are about 30 to 50 inches deep over a C horizon of stratified silt loam, silty clay loam, and very fine sandy loam.

Asa silty clay loam (As).—This is the only soil in the Asa series mapped in the county. It is adjacent to major drainageways. The areas are dissected by a network of very shallow, narrow, low drainageways. The surface of the Asa soil is nearly plane, but some areas have convex slopes. These areas are irregular in shape and average about 200 acres, but they are as large as 2,000 acres in places.

Included with this soil in mapping are small areas of the Clemville-Norwood complex and of Miller clay, Norwood silt loam, and Pledger clay.

The available water capacity of this soil is high. The soil is used mostly for crops, but a few areas are used for pasture. Capability unit I–2; pasture group 2B.

Bernard Series

In the Bernard series are somewhat poorly drained, nearly level to gently sloping soils on uplands. Bernard soils occur on a featureless plain.

In a representative profile the surface layer is slightly acid to medium acid, very dark gray clay loam about 7 inches thick. The next layer is very dark gray clay that is medium acid in the upper part and neutral to moderately alkaline in the lower part. This layer is about 45 inches thick. The underlying material is moderately alkaline, grayish-brown clay loam that contains a few pitted concretions of calcium carbonate. Permeability of these soils is very slow, and available water capacity is high.

Representative profile of Bernard clay loam, 0 to 1 percent slopes (along U.S. Highway 59, 0.75 mile west of Pierce, then 0.38 mile north on gravel road and 50 feet east):

Ap—0 to 4 inches, very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; weak, medium, granular structure; slightly hard, friable; a few shotlike concretions of iron and manganese; slightly acid; abrupt, smooth boundary.

A1—4 to 7 inches, very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; weak, medium, subangular blocky and weak, medium, granular structure; hard, friable; a few shotlike concretions of iron and manganese; medium acid; clear, wavy boundary.

B1tg—7 to 15 inches, very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; a few, fine, distinct, yellowish-brown and strong-brown mottles; moderate, medium, subangular blocky and granular structure; very hard, very firm; common fine pores; a few clay films on peds; medium acid; clear, wavy boundary.

B21tg—15 to 26 inches, very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; a few, fine, distinct, red mottles; moderate, medium, subangular blocky and granular structure; common clay films on ped faces; very hard, very firm; fine shotlike concretions of iron and manganese; neutral; gradual, wavy boundary.

B22tg—26 to 40 inches, very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; a few to common, fine, distinct, strong-brown mottles; moderate, medium, blocky and subangular blocky structure; extremely hard, very firm; many clay films on ped faces; common pressure faces; a few concretions of iron and manganese 4 millimeters in diameter; moderately alkaline; gradual, wavy boundary.

B3tg—40 to 52 inches, very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; a few to common, fine, distinct, strong-brown and yellowish-brown mottles; moderate, medium, blocky structure; very hard, very firm; common pressure faces; moderately alkaline; diffuse, wavy boundary.

C—52 to 60 inches +, grayish-brown (10YR 5/2) clay loam, light brownish gray (10YR 6/2) dry; common, medium, distinct, strong-brown (7.5YR 5/6) mottles; structureless; massive; very hard, very firm; a few, small, pitted concretions of calcium carbonate; moderately alkaline.

The A horizon ranges from dark grayish brown to very dark gray in color and from 3 to 8 inches in thickness.

The Bt horizon ranges from black to dark grayish brown. Its structure ranges from compound moderate, fine and medium, subangular blocky and granular to moderate, medium, blocky. The texture ranges from clay loam to clay, and the content of clay ranges from 35 to 50 percent. Mottles in this horizon are distinct to prominent. They generally range from yellowish brown to strong brown in color, though in places faint mottles of gray or light gray are present.

Depth to the C horizon in these cyclic soils ranges from 40 to 70 inches within horizontal distances of 8 to 15 feet. A few concretions of calcium carbonate generally occur at a depth between 36 and 60 inches.

Cracks form in these soils when they dry. The cracks range from 1 to 2 centimeters in width and extend from the surface to a depth of 50 to 75 centimeters.

Bernard clay loam, 0 to 1 percent slopes (BcA).—This soil has the profile described as representative of the Bernard series. It is on uplands. The areas average 200 acres, but some are as large as 1,500 acres.

Included with this soil in mapping are small areas of Edna fine sandy loam, Lake Charles clay, Midland clay loam, and Tuckerman soils. Also included are a few small areas where slopes are more than 1 percent.

This soil is used mostly for crops, but some areas are used for pasture. Capability unit IIw–1; pasture group 7D.

447-965—74——2

Bernard clay loam, 1 to 3 percent slopes (BcB).—This soil is in areas adjacent to major drainageways on uplands. The areas average 25 acres, but some are as large as 200 acres.

The surface layer, about 6 inches thick, is dark-gray clay loam that is free of lime. The next layer, about 36 inches thick, is very dark gray clay that contains free lime in the lower part. The underlying material is clay loam that contains soft and hard concretions of lime.

Included with this soil in mapping are small areas of Edna fine sandy loam, Lake Charles clay, and Midland clay loam. Also included are a few small areas where slopes are slightly less than 1 percent.

This Bernard soil is used mostly for pasture. Capability unit IIe–5; pasture group 7B.

Bernard-Edna complex, 0 to 1 percent slopes (BeA).—This complex consists of deep, nearly level soils on low mounds and in depressions. The areas generally are 350 acres in size, but some areas are as large as 1,500 acres. Bernard clay loam makes up about 60 percent of this complex, and Edna fine sandy loam about 33 percent. Crowley fine sandy loam, Lake Charles clay, Midland clay loam, and Tuckerman soils make up the remaining 7 percent of this complex.

The level to slightly concave Bernard soils occur in areas that are 0.1 to 0.3 foot lower than Edna soils. Cultivating these soils for several years, however, has removed differences in elevation between these soils.

The surface layer of the Bernard soil is very dark gray clay loam about 8 inches thick. The next layer is very dark gray clay about 40 inches thick. It is neutral in the upper part and moderately alkaline in the lower part. The underlying material is grayish-brown clay loam that includes a few pebbles that contain carbonates.

The surface layer of the Edna soil is acid, light-gray fine sandy loam about 6 inches thick. The next layer is dark-gray mottled clay about 35 inches thick. The underlying material is mottled limy clay.

Runoff is very slow on the soils of this complex. Artificial drainage and surface smoothing help to improve management of water in most places.

The soils in this complex are used mostly for crops and pasture. Capability unit IIIw–1; pasture group 7D.

Bruno Series

The Bruno series consists of excessively drained, nearly level to gently undulating soils on natural levees that are adjacent to frequently flooded creek channels.

In a representative profile the surface layer is slightly acid brown sandy clay loam about 3 inches thick. The underlying material, to a depth of more than 54 inches, consists mainly of yellowish-brown sandy material that is stratified with finer textured material within a depth of 40 inches.

Available water capacity is low in these soils, and permeability is rapid.

Representative profile of Bruno soils in an area of Bruno soils and Alluvial land (in western part of county along Sandy Creek, 50 feet east of channel bank and about 250 feet east of highway bridge of Farm Road 1300; 16.2 miles west of intersection of Farm Road

1300 and State Highway 71, and 2.5 miles north of El Campo):

A1—0 to 3 inches, brown (10YR 4/3) sandy clay loam; structureless; firm, hard; many roots and wormcasts; slightly acid; abrupt, smooth boundary.
C1—3 to 10 inches, light yellowish-brown (10YR 6/4) fine sand; loose; many roots; medium acid; abrupt, smooth boundary.
C2—10 to 15 inches, brown (10YR 5/3) loamy fine sand; structureless; very friable; slightly hard; many roots; medium acid; abrupt, smooth boundary.
C3—15 to 30 inches, light yellowish-brown (10YR 6/4) fine sand; structureless; loose; many roots; strongly acid; abrupt, smooth boundary.
C4—30 to 34 inches, dark grayish-brown (10YR 4/2) clay; common, medium mottles of dark gray (10YR 4/1) and dark reddish brown (5YR 3/4); structureless; firm, hard; many roots; evident bedding planes; strongly acid; abrupt, smooth boundary.
C5—34 to 54 inches +, yellowish-brown (10YR 5/4) loamy fine sand; structureless; very friable, slightly hard; common tree roots; strata of sandy loam and sandy clay loam; a few, fine, reddish and yellowish mottles; medium acid in loamy fine sand and strongly acid in the strata of fine sandy loam.

The A horizon ranges from 2 to 14 inches in thickness and from dark yellowish brown to brown in color. Reaction is neutral to slightly acid. The C horizon ranges from fine sand to clay in texture, and from neutral to strongly acid in reaction.

Bruno soils and Alluvial land (Br).—This undifferentiated group contains the only Bruno soils mapped in the county. It is adjacent to and parallels creeks on first benches above the creek channels. The areas are mainly on the flood plain and are about 10 to 20 feet lower in elevation than the adjacent soils on uplands. They are long and concave and range from 400 to 1,200 feet in width but generally are about 800 feet. The soils are nearly level to gently undulating near the creek channel, but they are gently sloping along the creek banks. Slopes are stronger in some areas that are 50 to 200 feet wide and are adjacent to the soils on uplands.

Bruno soils make up about 55 percent of this undifferentiated group and Alluvial land about 30 percent. The remaining 15 percent is clayey alluvium, sandy creek channels, and small areas of soils in the Crowley, Edna, Kenney, and Lincoln series.

The Bruno soils are mostly on natural levees next to the creek channel and on flood plains that are less than 400 feet wide. Alluvial land consists of medium acid, clayey alluvium over loamy alluvium. It is in swales and flats that are farther from the creeks than the Bruno soils. Small ponded areas that are 3 to 4 feet deep and 25 to 50 feet wide are in areas of clayey alluvium.

This mapping unit is used for pasture and for wildlife habitat. Capability unit Vw–1; pasture group 2B.

Clemville Series

The Clemville series consists of calcareous, well-drained, nearly level soils that formed in stratified alluvium over a buried clayey soil. These soils are on flood plains.

In a representative profile the surface layer is calcareous dark-brown silty clay loam about 12 inches thick. The next layer, about 18 inches thick, is calcareous, stratified, light-brown silt loam. The next lower layer is calcareous dark-brown silty clay about 20 inches thick. Below this, to a depth of more than 62 inches, is calcareous reddish-brown silty clay.

Permeability is slow in these soils, and available water capacity is high.

In this county Clemville soils are mapped only in a complex with Norwood soils.

Representative profile of Clemville silty clay loam in an area of Clemville-Norwood complex (200 feet west of gravel road, from a point 1.0 mile south of intersection of the gravel road and Farm Road 2614; this is 2.0 miles west of intersection of Farm Road 2614 and Farm Road 102 at Bonus and about 15.0 miles northwest of the town of Wharton):

Ap—0 to 6 inches, dark-brown (7.5YR 4/4) silty clay loam, brown (7.5YR 5/4) dry; weak, fine, granular structure; hard, friable; many roots; many very fine pores; a few fragments of snail shells; common wormcasts; calcareous; moderately alkaline; abrupt, smooth boundary.
A1—6 to 12 inches, dark-brown (7.5YR 4/4) silty clay loam, brown (7.5YR 5/4) dry; weak, fine, granular structure; hard, friable; many roots; many fine and very fine pores; a few fragments of snail shells; many wormcasts; calcareous; moderately alkaline; clear, smooth boundary.
C—12 to 30 inches, stratified light-brown (7.5YR 6/4) silt loam, and a few thin lenses of reddish-brown (5YR 5/4) and brown (7.5YR 5/4) silty clay loam; structureless, but parts to platy fragments along bedding planes; hard, friable; a few roots; common very fine pores; a few fragments of snail shells; common wormcasts; many evident bedding planes; calcareous; moderately alkaline; abrupt, smooth boundary.
Ab—30 to 50 inches, dark-brown (7.5YR 3/3) silty clay, dark brown (7.5YR 4/3) dry; moderate, medium and fine, blocky structure; very hard, firm; a few fine roots; common wormcasts; a few strongly cemented concretions of calcium carbonate; a few patchy coats of calcium carbonate on ped faces; calcareous; moderately alkaline; gradual, smooth boundary.
Bb—50 to 62 inches +, reddish-brown (5YR 4/3) silty clay, reddish brown (5YR 5/3) dry; weak, medium, blocky structure; very hard, firm; a few strongly cemented concretions of calcium carbonate; a few patchy coats of calcium carbonate on ped faces; calcareous; moderately alkaline.

The A horizon ranges from 4 to 12 inches in thickness and from dark brown to reddish brown in color. The C horizon above the silty clay or clay horizon ranges from light brown to reddish brown in color. The upper 24 to 36 inches of this soil is stratified calcareous silty clay loam and silt loam that contains evident bedding planes. The lower part is silty clay or clay. Depth to the silty clay or clay ranges from about 24 to 36 inches.

Clemville-Norwood complex (Cn).—This complex consists mostly of well-drained alluvial soils on flood plains adjacent to major drainageways. The areas are generally 350 acres in size, but some areas are as large as 1,300 acres. The surface of these soils is nearly plane, but some areas have convex slopes.

Clemville soils make up about 55 percent of this complex, and Norwood soils, about 30 percent. The remaining 15 percent consists of soils that are silty in the upper part and clayey at a depth of less than 24 inches and of small areas of Asa silty clay loam and Miller clay.

Norwood soils in this complex have a surface layer of calcareous brown silt loam about 10 inches thick. The underlying layer to a depth of 60 inches is light-brown silt loam that has strata of silty clay loam.

Runoff is slow on the soils of this complex, and available water capacity is high. The soils are used mostly for crops, but a few areas are used for pasture. Capability unit I–2; pasture group 2B.

Crowley Series

The Crowley series consists of somewhat poorly drained, nearly level soils that are very slowly permeable. These soils are on a featureless plain.

In a representative profile the surface layer, about 11 inches thick, is neutral, dark grayish-brown fine sandy loam. Below this is neutral, grayish-brown fine sandy loam about 4 inches thick. The next layer is neutral, mottled, very dark gray clay about 7 inches thick. The next lower layer is slightly acid sandy clay that is grayish brown in the upper part and light brownish gray in the lower part. The underlying material is slightly acid, mottled, yellow sandy clay to a depth of more than 62 inches.

Available water capacity is high in these soils.

Representative profile of Crowley fine sandy loam (on Farm Road 2546, 4.75 miles west of Farm Roads 1160 and 2546, then 0.25 mile southwest, then 1.75 miles northwest of cattleguard, then 100 feet west in field, and 100 feet south):

Ap—0 to 11 inches, dark grayish-brown (10YR 4/2) fine sandy loam, grayish brown (10YR 5/2) dry; massive (structureless); very hard, very friable; neutral; abrupt, smooth boundary.

A2g—11 to 15 inches, grayish-brown (10YR 5/2) fine sandy loam, light brownish gray (10YR 6/2) dry; a few, medium, faint, reddish-yellow mottles; massive (structureless); soft, very friable; common medium pores; neutral; abrupt, wavy boundary.

B21tg—15 to 22 inches, very dark gray (10YR 3/1) clay, light gray (10YR 6/1) dry; common, fine, distinct yellowish-brown mottles; moderate, medium, blocky structure; extremely hard, very firm; many clay films on peds; vertical cracks contain soil from A2g horizon; neutral; clear, wavy boundary.

B22tg—22 to 38 inches, grayish-brown (10YR 5/2) sandy clay, light gray (10YR 7/2) dry; many, medium and coarse, prominent, yellowish-brown (10YR 5/6 and 5/8) mottles; moderate, medium, blocky structure; extremely hard, very firm; many clay films on peds; vertical cracks contain soil from B21tg horizon; slightly acid; gradual, wavy boundary.

B3—38 to 52 inches, light brownish-gray (10YR 6/2) sandy clay, light gray (10YR 7/2) dry; many, medium and coarse, prominent, yellowish-brown (10YR 5/6) and yellow (10YR 7/8) mottles; moderate, medium, subangular blocky structure; a few stains and concretions of iron and manganese, mainly 3 to 4 millimeters in diameter, that decrease in number with depth; slightly acid; gradual, wavy boundary.

C—52 to 62 inches +, yellow (10YR 7/6) sandy clay, yellow (10YR 8/6) dry; common, coarse, prominent reddish-yellow (7.5YR 6/8) mottles; massive (structureless); very hard and very firm; neutral.

The Ap horizon ranges from 6 to 14 inches in thickness. It ranges from dark gray to grayish brown in color and from slightly acid to neutral in reaction.

The A horizon ranges from 12 to 20 inches in thickness. The A2 horizon ranges from 3 to 6 inches in thickness and from dark gray to light brownish gray in color. In the A horizon reaction ranges from neutral to medium acid.

The B21t horizon ranges from 5 to 30 inches in thickness, and from gray to very dark grayish brown in color. Mottles in this horizon are common to many and distinct to prominent, and they range from yellowish brown and reddish yellow to red in color.

The B22t horizon ranges from 8 to 24 inches in thickness, and from sandy clay to clay in texture. Its color ranges from light gray to grayish brown. The mottles in this horizon are red and yellowish brown, and their number varies from place to place.

The B3 horizon, where present, ranges from 11 to 20 inches in thickness and from sandy clay to sandy clay loam in texture. Its color is similar to that of the B22t horizon. Mottles range from yellow to yellowish brown. The content of extractable sodium in this horizon increases with depth and ranges from about 5 to 15 percent of the exchange capacity in the lower part of the solum.

The C horizon is at a depth between 48 and 60 inches. It ranges from slightly acid to moderately alkaline and contains a few concretions of calcium carbonate.

Crowley fine sandy loam (Cr).—This is the only soil in the Crowley series mapped in the county. Areas of this soil are irregular in shape and about 320 acres in size, but some areas are as large as 1,200 acres.

Included with this soil in mapping are small areas of Edna fine sandy loam, Kenney loamy fine sand, and Tuckerman soils.

Runoff is slow on this soil, and available water capacity is high. Artificial drainage and surface smoothing generally are needed.

This soil is used for crops and pasture. Capability unit IIIw–3; pasture group 7D.

Earle Series

The Earle series consists of nearly level, acid soils on alluvium. These soils are along narrow meandering stream channels and are flooded frequently. The surface is mainly concave.

In a representative profile the surface layer is mottled, medium acid, very dark gray clay about 5 inches thick. The next layer is mottled clay about 21 inches thick. It is dark gray and strongly acid in the upper part and gray and very strongly acid in the lower part. The underlying material, to a depth of more than 48 inches, is grayish-brown fine sandy loam.

Permeability is very slow in these soils, and available water capacity is high.

Representative profile of Earle clay in an area of Earle soils along State Highway 60, 2.5 miles north of the intersection with U.S. Highway 90A in East Bernard; then 0.35 mile east, 1.5 miles south, 0.6 mile east, and 0.2 mile south; then 0.1 mile east at pipeline crossing):

A—0 to 5 inches, very dark gray (10YR 3/1) clay, gray (10YR 5/1) dry; common, medium, distinct, reddish-yellow (7.5YR 6/6) mottles; uppermost 1 inch is silt loam and decaying stems and roots; moderate, medium, subangular blocky structure; very hard, very firm; medium acid; clear, smooth boundary.

B21g—5 to 16 inches, dark-gray (10YR 4/1) clay, gray (10YR 5/1) dry; common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, medium, subangular blocky and moderate, medium, angular blocky structure; very hard, very firm; many fine pores; strongly acid; clear, smooth boundary.

B22g—16 to 26 inches, gray (10YR 5/1) clay, light gray (10YR 6/1) dry; many, medium, distinct, strong-brown and yellowish-brown mottles; moderate, medium, angular blocky structure; very hard, very firm; common dark concretions of iron and manganese; very strongly acid; abrupt, smooth boundary.

IICg—26 to 48 inches +, grayish-brown (10YR 5/2) fine sandy loam, light gray (10YR 7/2) dry; a few, medium, distinct, reddish-yellow and yellowish-brown mottles; structureless; slightly hard, very friable; very strongly acid.

The A horizon ranges from 4 to 10 inches in thickness and from gray to very dark gray and very dark grayish brown in color. In some areas silt loam overwash 1 to 3 inches thick is on the surface.

The B horizon ranges from clay to clay loam in texture and from gray to dark gray in color. It ranges from strongly acid to very strongly acid in reaction. The content of clay in the A and B horizons ranges from 35 to 60 percent.

Depth to the fine sandy loam IICg horizon ranges from 20 to 36 inches. The content of clay in the IICg horizon ranges from 10 to 18 percent. Reaction in the C horizon ranges from strongly acid to very strongly acid.

Earle soils (Ea).—This is the only unit of the Earle series mapped in the county. It occurs in long, narrow areas that generally are 120 acres in size but are as large as 500 acres in places. It is on concave streambanks and narrow channels that are flooded frequently.

The surface layer is mainly clay, but it ranges to clay loam. In places silt loam overwash 1 to 3 inches thick is on the surface.

Included with these soils in mapping are small areas of Edna fine sandy loam and Pledger clay. Also included are eroded channels that are 5 to 6 inches deep. The channels generally are about 6 feet wide, but they range from 2 to 10 feet in width. Most of the channels are in the lower part of smooth, wide, concave slopes.

Earle soils are flooded three or more times a year, and water covers the soil long enough to destroy crops. Runoff from adjacent soils moves slowly over the areas because of the dense vegetation and fairly level slopes. Earle soils are used mostly for pasture and to provide food and cover for wildlife. Capability unit Vw–1; pasture group 1B.

Edna Series

The Edna series consists of poorly drained, nearly level to gently sloping soils on uplands. These soils are on convex, low, round mounds that are about 3 to 12 inches in height and one-tenth of an acre in size.

In a representative profile the surface layer is medium acid, dark-gray fine sandy loam about 9 inches thick. The next layer is slightly acid mottled clay about 29 inches thick. It is gray in the upper part and light gray in the lower part. The next lower layer is mottled light brownish-gray and light yellowish-brown clay loam about 12 inches thick. The underlying material, to a depth of more than 65 inches, is mottled light olive-gray sandy clay loam that contains concretions of carbonate.

Permeability is very slow in these soils, and available water capacity is high.

Representative profile of Edna fine sandy loam, 0 to 1 percent slopes, (2.1 miles northeast of intersection of U.S. Highway 59 and State Highway 60 in Hungerford, then 0.9 mile east of U.S. Highway 59, then 0.6 mile south on shell road, then 0.3 mile southwest on private road, 120 feet north of gate):

Ap—0 to 9 inches, dark-gray (10YR 4/1) fine sandy loam, light gray (10YR 6/1) dry; a few, fine, distinct, brownish-yellow mottles; massive (structureless); extremely hard, friable; many fine roots; medium acid; abrupt, wavy boundary.

B21tg—9 to 19 inches, gray (10YR 5/1) clay, light gray (10YR 6/1) dry; many, fine faint mottles of dark gray and grayish brown, and common, fine, distinct mottles of yellowish brown; moderate, medium and coarse, blocky structure; extremely hard, very firm; common fine roots; common clay films on ped faces; vertical cracks 0.4 inch wide and 18 to 24 inches apart; a few fine concretions of iron and manganese; slightly acid; gradual, wavy boundary.

B22tg—19 to 38 inches, faintly mottled light-gray (5Y 6/1) and light olive-gray (5Y 6/2) clay; common, fine, faint, olive mottles; moderate, medium and coarse, blocky structure; extremely hard, very firm; common fine roots along ped faces; common clay films on ped faces; vertical cracks from B21tg horizon extend through this horizon; a few slickensides that do not intersect; a few fine concretions of iron and manganese; slightly acid; gradual, wavy boundary.

B31tg—38 to 50 inches, medium and coarsely mottled, light brownish-gray (2.5Y 6/2) and light yellowish-brown (2.5Y 6/4) clay loam; weak, medium and coarse, blocky structure; extremely hard, firm; a few roots along ped faces; a few clay films on peds; a few fine concretions of iron and manganese; mildly alkaline; gradual, wavy boundary.

B32tg—50 to 65 inches +, light olive-gray (5Y 6/2) sandy clay loam; a few, fine, faint, olive mottles; weak, medium and coarse, blocky structure; very hard, firm; a few roots; a few clay films on peds; a few concretions of iron and manganese; a few, fine, strongly cemented concretions of calcium carbonate; moderately alkaline.

The A horizon ranges from 4 to 10 inches in thickness and from light gray to very dark gray in color. Texture in this horizon is mainly fine sandy loam but ranges to loam. This horizon ranges from neutral to medium acid in reaction. When dry, the A horizon is massive and very hard to extremely hard.

The B2tg horizon ranges from light gray to dark gray in color. Mottles that are below the abrupt boundary of the A horizon are faint to prominent and range from dark gray to yellowish brown and red in color. The content of extractable sodium increases with depth, and it ranges from 5 to 15 percent of the exchange capacity in the lower part of the B2tg horizon. Vertical streaks of coarser texture are common throughout the B horizon. Depth to the B3tg horizon ranges from 30 to 50 inches. Cracks more than 0.4 inch wide extend from the top of the Btg horizon to a depth of 30 inches or more in some part of the year in most years. Slickensides range from few to common, but they do not intersect in any horizon.

Edna fine sandy loam, 0 to 1 percent slopes (EdA).—This soil has the profile described as representative of the series. It is on uplands in areas that are irregular in shape. The areas generally are about 800 acres in size, but some areas are as large as 2,000 acres.

Included with this soil in mapping are small areas of a more sloping Edna fine sandy loam. Also included are small areas of Bernard clay loam, Crowley fine sandy loam, Midland clay loam, and Tuckerman soils.

Runoff is very slow on this Edna soil. Artificial drainage and surface smoothing are needed in most places to help improve water management. This soil is used for crops and pasture. Capability unit IIIw–1; pasture group 7D.

Edna fine sandy loam, 1 to 3 percent slopes (EdB).—This soil is on uplands adjacent to major and minor drainageways. The areas are mostly long and 95 acres in size, but some are as large as 300 acres.

The surface layer, about 10 inches thick, is acid, grayish-brown fine sandy loam. The next layer is dark grayish-brown to grayish-brown clay about 28 inches thick. It is slightly acid but contains a few concretions of carbonates in the lower part. The underlying material is moderately alkaline silty clay that contains hard concretions of lime.

Included with this soil in mapping are small areas of less sloping Edna fine sandy loam. Also included are small areas of Bernard clay loam, Crowley fine sandy loam, and Midland clay loam.

This Edna soil is used mostly for pasture, but a few areas are used for crops. Capability unit IIIe–1; pasture group 7B.

Edna soils, overwash (Eh).—This mapping unit consists of nearly level soils in broad overwashed areas on uplands adjacent to soils on alluvium. The areas generally are about 300 acres in size, but some areas are as large as 700 acres.

These soils have a surface layer of calcareous dark reddish-brown clay underlain by a buried loam layer that rests abruptly on dark-gray mottled clay layers. The surface layer ranges from 4 to 20 inches in thickness and from silt loam to clay in texture. It is calcareous and mildly alkaline to moderately alkaline.

The buried loam layer ranges from 4 to 10 inches in thickness, from light gray to dark grayish-brown in color, and from neutral to mildly alkaline and noncalcareous in reaction. Many vertical streaks of coarser textured material that are dark gray or darker occur throughout this buried layer.

The buried clay layer ranges from gray to dark grayish brown in color. Its structure ranges from moderate and medium to fine and blocky. Clay films are common on the ped surfaces. Mottles below the abrupt boundary of the surface layer are distinct to prominent and range from gray to yellowish-brown. Depth to the underlying material ranges from 30 to 50 inches.

Included with these soils in mapping are small areas of Bernard clay loam, Edna fine sandy loam, Miller clay, and Norwood silt loam.

Runoff is very slow on these Edna soils. Artificial drainage and surface smoothing are needed in most places to help improve water management.

These soils are used for crops and pasture. Crop growth is limited by droughtiness during years when rainfall is below normal and by very slow runoff during years when rainfall is above normal. Capability unit IIw–3; pasture group 7D.

Edna-Tuckerman complex, 0 to 1 percent slopes (EtA).—This complex is on uplands that contain many enclosed depressions. The areas are irregular in shape and generally are 150 acres in size, but some are as large as 700 acres. The Edna soils make up about 72 percent of this complex, and the Tuckerman soils make up the remaining 28 percent.

The Edna soils are nearly level and have a surface layer of grayish-brown, slightly acid fine sandy loam about 6 inches thick. The next layer is mottled dark-gray to gray clay about 35 inches thick. The underlying material is mottled, calcareous, pale-yellow clay.

The Tuckerman soils are in the depressions. They have a medium acid, gray sandy loam to clay loam surface layer about 8 inches thick. The next layer is grayish-brown clay loam and is more than 30 inches thick.

Included with these soils in mapping are small areas of Crowley fine sandy loam and Lake Charles clay.

Runoff is very slow on these soils. Artificial drainage and surface smoothing are needed in most places to help improve water management. These soils are used for crops and pasture. Capability unit IIIw–1; pasture group 7D.

Hockley Series

The Hockley series consists of moderately well drained, nearly level to gently undulating, acid soils. These soils are on an upland plain that has low ridges and mounds.

In a representative profile the surface layer is slightly acid, dark grayish-brown fine sandy loam about 20 inches thick. The next layer is slightly acid, pale-brown fine sandy loam about 14 inches thick. The next lower layer is mostly yellowish-brown sandy clay loam about 18 inches thick, but the lower 4 inches is very pale brown clay loam. Below this, to a depth of more than 72 inches, is red clay loam.

Available water capacity is high in these soils.

Representative profile of Hockley fine sandy loam, 0 to 3 percent slopes (on State Highway 60, 7.2 miles west of intersection of U.S. Highway 59 and State Highway 60; then west on gravel road 0.7 mile; then southwest 1.0 mile; then north 50 feet in pasture):

A1—0 to 20 inches, dark grayish-brown (10YR 4/2) fine sandy loam, light brownish gray (10YR 6/2) dry; weak, fine, granular structure; hard, very friable, a few very fine pores in upper part; slightly acid; gradual, smooth boundary.

A21—20 to 26 inches, pale-brown (10YR 6/3) fine sandy loam, very pale brown (10YR 7/3) dry; single grain (structureless); loose; slightly acid; gradual, smooth boundary.

A22—26 to 34 inches, pale-brown (10YR 6/3) fine sandy loam, very pale brown (10YR 7/3) dry; very weak, medium, subangular blocky structure; soft, very friable; 5 to 10 percent of the mass is strongly cemented concretions that are as large as three-eighths inch in diameter and are concentrated at a depth of 28 inches; slightly acid; abrupt, smooth boundary.

B21t—34 to 40 inches, yellowish-brown (10YR 5/4) sandy clay loam, very pale brown (10YR 7/4) dry; common, medium, faint, brownish-yellow mottles; weak, medium and coarse, subangular blocky structure; slightly hard, very friable; slightly acid; gradual, wavy boundary.

B22t—40 to 48 inches, yellowish-brown (10YR 5/4) sandy clay loam, very pale brown (10YR 7/4) dry; many coarse, reticulate mottles of red (2.5YR 4/6), yellowish brown (10YR 5/6), and gray (10YR 6/1); moderate and weak, medium, subangular blocky structure; extremely hard, very firm; 5 to 15 percent plinthite; neutral; clear, wavy boundary.

B23t—48 to 52 inches, very pale brown (10YR 7/4) clay loam, very pale brown (10YR 7/4) dry; many, coarse, prominent, red mottles, and many, medium, distinct, gray mottles; moderate, medium, blocky structure; extremely hard, very firm; slightly acid; clear, wavy boundary.

B3t—52 to 72 inches +, red (2.5YR 5/8) clay loam, light red (2.5YR 6/8) dry; weak, medium, blocky structure; hard, firm; neutral.

The A horizon ranges from 20 to 40 inches in thickness. It ranges from dark grayish brown to pale brown in color, and from strongly acid to slightly acid in reaction.

The Bt horizon is more than 60 inches thick. It ranges from sandy clay loam to clay loam in texture and is 18 to 35 percent clay. The upper part of this horizon is yellowish brown or yellow in color. The lower part is very pale brown, red, or yellow, and it has many mottles of red, brown, yellow, or gray. Red plinthite makes up 5 to 20 percent of the material. Structure of the Bt horizon is moderate to weak, medium to coarse, and blocky to subangular blocky.

Round black concretions occur throughout the profile and range from few to many. In some places in the A horizon the iron concretions form an accumulation 3 to 4 inches thick. These concretions make up 5 to 10 percent of the soil material.

Hockley fine sandy loam, 0 to 3 percent slopes (HoB).—This is the only Hockley soil mapped in the county. It is on uplands in areas that are irregular in shape. The areas generally are 80 acres in size, but some areas are as large as 300 acres.

Included with this soil in mapping are small areas of Crowley fine sandy loam, Edna fine sandy loam, and Kenney loamy fine sand.

The hazard of erosion is slight on this soil. The soil is used mostly for pasture, but a few areas are in crops. Capability unit I-1; pasture group 8C.

Kenney Series

The Kenney series consists of well-drained, nearly level to gently undulating, acid soils on uplands.

In a representative profile the surface layer is medium acid, dark-brown loamy fine sand about 18 inches thick. The next layer is medium acid, brown loamy fine sand about 42 inches thick. Below this, to a depth of more than 120 inches, is medium acid, red sandy clay loam.

Permeability is moderate in these soils, and available water capacity is low.

Representative profile of Kenney loamy fine sand, 0 to 3 percent slopes (in El Campo, 11.5 miles north of intersection of State Highway 71 and U.S. Highway 59, 0.4 mile east of State Highway 71 on unpaved road, and then south 200 feet in sand pit):

A1—0 to 18 inches, dark-brown (10YR 4/3) loamy fine sand, pale brown (10YR 6/3) dry; structureless; loose; many fine roots; medium acid; diffuse, wavy boundary.

A2—18 to 60 inches, brown (10YR 5/3) loamy fine sand, very pale brown (10YR 7/3) dry; structureless; loose; a few fine roots; medium acid; clear, wavy boundary.

B2t—60 to 106 inches, red (2.5YR 4/6) sandy clay loam; moderate, medium, blocky and subangular blocky structure; very hard, firm; a few very fine pores; common patchy clay films on ped faces; pale-brown coatings on faces of some peds; medium acid; diffuse, wavy boundary.

B3t—106 to 120 inches +, red (2.5YR 4/6) sandy clay loam; weak, medium and coarse, subangular blocky structure; hard, friable; clay bridges between sand grains; medium acid.

The A horizon ranges from 40 to 72 inches in thickness. The A1 horizon ranges from very dark grayish brown to light yellowish brown in color, and the A2 horizon from brown or strong brown to very pale brown.

The Bt horizon ranges from red to yellowish brown in color. Its texture ranges from fine sandy loam to sandy clay loam or clay loam and the upper 20 inches is between 18 and 35 percent clay.

The solum ranges from 65 inches to more than 120 inches in thickness. Reaction throughout the solum ranges from slightly acid to strongly acid.

Kenney loamy fine sand, 0 to 3 percent slopes (KeB).—This soil is on convex ridges. The areas are irregular in shape and generally are 100 acres in size, but some areas are as large as 800 acres.

Included with this soil in mapping are small areas of Crowley fine sandy loam and Hockley fine sandy loam.

The available water capacity of this soil is low. If this soil is cultivated, the hazard of water erosion is moderate on the longer slopes.

This soil is used mostly for pasture, but in some places it is used for crops. Capability unit IIIs-2; pasture group 9A.

Konawa Series

The Konawa series consists of well-drained, gently sloping, acid soils. These soils are on the upper part of side slopes adjacent to major and minor drainageways.

In a representative profile the surface layer is medium acid, dark-brown fine sandy loam about 7 inches thick. The next layer is strongly acid, dark reddish-brown sandy clay loam about 7 inches thick. Below, to a depth of more than 60 inches, is red sandy clay loam.

Permeability is moderate in these soils, and available water capacity is low.

In this county Konawa soils are mapped only in a complex with Kenney soils.

Representative profile of Konawa fine sandy loam in an area of Konawa-Kenney complex, 5 to 8 percent slopes (200 feet east and 700 feet north of gate at end of county road, which is 2.5 miles north of intersection of county road and U.S. Highway 59; 2.0 miles northeast of Hungerford):

A1—0 to 7 inches, dark-brown (7.5YR 3/2) fine sandy loam, dark brown (7.5YR 4/2) dry; weak, fine, granular structure; hard, very friable; many fine roots; common fine pores; medium acid; gradual, smooth boundary.

B21t—7 to 14 inches, dark reddish-brown (2.5YR 3/4) sandy clay loam, reddish brown (2.5YR 4/4) dry; moderate, coarse, prismatic structure; very hard, friable; common fine roots; common fine pores; ped faces stained slightly darker than interiors; a few clay films; strongly acid; gradual, smooth boundary.

B22t—14 to 48 inches, red (2.5YR 4/8) sandy clay loam, red (2.5YR 5/8) dry; weak, coarse, subangular blocky structure; very hard, friable; a few fine roots; common fine pores; a few clay films; strongly acid; diffuse, smooth boundary.

B3t—48 to 60 inches +, red (2.5YR 5/8) sandy clay loam, light red (2.5YR 6/8) dry; weak, coarse, subangular blocky structure; hard, friable; a few clay films; strongly acid.

The A horizon ranges from dark brown to light yellowish brown in color and from fine sandy loam to loamy fine sand in texture. It ranges from 4 to 20 inches in thickness.

The upper part of the Bt horizon has 5 to 15 percent more clay than the lower part. The B2t horizon ranges from sandy clay loam to clay loam in texture. The B21t horizon ranges from dark reddish brown to red and reddish brown, and the B22t horizon ranges from red to yellowish red. The B3t horizon ranges from fine sandy loam to sandy clay loam in texture. It ranges from yellowish red to red in color, and from strongly acid to slightly acid in reaction.

The solum ranges from 50 to 70 inches in thickness, and from medium acid to strongly acid in reaction.

Konawa-Kenney complex, 5 to 8 percent slopes (KkC).—This complex contains the only Konawa soil mapped in the county. It consists of well-drained soils on uplands. Slopes are smooth and convex. The areas are narrow and generally are 60 acres in size, but some areas are as large as 200 acres. Konawa soils make up 60 percent of the complex, and Kenney soils make up 35 percent. Small areas of Crowley fine sandy loam and of Earle soils make up the remaining 5 percent of the complex.

The Konawa soils are on the higher areas and the ridges around the Kenney soils are on the concave side slopes.

The Kenney soils are deep, sandy, acid, and well drained. Their surface layer is medium acid, dark-brown loamy fine sand about 18 inches thick. The next layer is medium acid, brown loamy fine sand about 42 inches thick. Just below is red sandy clay loam.

If these soils are cultivated, the hazard of water erosion is moderate. The soils in this complex are used mostly for pasture. Capability unit IIIe-2; pasture group 8C.

Lake Charles Series

In the Lake Charles series are somewhat poorly drained, level to gently sloping, neutral clays. These soils are on a featureless plain where slopes are mostly less than 1 percent but range to 3 percent.

In a representative profile the surface layer is neutral black clay about 38 inches thick. The next layer is mildly alkaline very dark gray clay about 22 inches thick. The underlying material, to a depth of more than 63 inches, is mottled, mildly alkaline, gray clay.

Lake Charles soils are cyclic and have microrelief. The surface layer is thinner on the tops of microknolls than in the lower areas. Permeability is very slow, and available water capacity is high.

Representative profile of Lake Charles clay, 0 to 1 percent slopes (1.78 miles east of post office in Pierce, along U.S. Highway 59, then north 0.45 mile on county road, then 100 feet east of road):

Ap—0 to 6 inches, black (10YR 2/1) clay, dark gray (10YR 4/1) dry; moderate, medium, granular structure; extremely hard, very firm; a few iron and manganese shotlike concretions 1 to 3 millimeters in diameter; neutral; abrupt, smooth boundary.

A11—6 to 38 inches, black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; fine angular blocky and very fine angular blocky structure; extremely hard, very firm; shiny pressure faces; intersecting slickensides at a depth below 20 inches; a few iron and manganese shotlike concretions 1 to 3 millimeters in diameter; neutral; clear, wavy boundary.

A12—38 to 45 inches, very dark gray (10YR 3/1) clay; coarse wedge-shaped peds bordered by slickensides; moderate, medium, angular blocky structure; extremely hard, extremely firm; common fine pores; shiny pressure faces; common small shotlike concretions of iron and manganese; mildly alkaline; clear, wavy boundary.

ACg—45 to 60 inches, very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; a few, fine, faint, olive-brown mottles; coarse wedge-shaped peds bordered by slickensides; moderate, medium and fine, angular blocky structure; extremely hard, extremely firm; pressure faces; mildly alkaline; clear, wavy boundary.

Cg—60 to 63 inches +, gray (5Y 5/1) clay, gray (5Y 5/1) dry; common, medium, faint and distinct, light olive-brown mottles; intersecting slickensides bordering angular blocky and wedge-shaped aggregates; extremely hard, extremely firm; many, white, calcareous concretions that have pale-yellow stains and are 2 to 4 millimeters in diameter; matrix is noncalcareous; mildly alkaline.

The A horizon ranges from 12 to 50 inches in thickness and is thinnest on the microknolls and thickest in the microdepressions. It ranges from dark gray to black in color, and it is mostly neutral but ranges from slightly acid to mildly alkaline. Mottles range from none to a few, faint, distinct, brown.

Calcareous concretions, where present, range in size from 2 millimeters in the A horizon to 30 millimeters in the C horizon. As the soil dries it shrinks and cracks. The cracks are 0.4 inch to 3 inches wide and 20 to 48 inches deep. Gilgai relief in areas that have never been plowed consists of knolls that are 3 to 8 feet in diameter and 3 to 12 inches higher than the depressions. Intersecting slickensides begin at a depth that ranges from about 20 to 40 inches.

Lake Charles clay, 0 to 1 percent slopes (LcA).—This soil has the profile described as representative of the Lake Charles series. It is on uplands that have smooth to gilgai surface relief (fig. 5). Most areas are 1,000 acres in size, but some are as large as 6,000 acres.

Included with this soil in mapping are small areas of Bernard clay loam and Edna fine sandy loam. Also included are somewhat larger areas adjacent to the Colorado River, where the soil is red clay similar to the surface layer of Miller clay but is less than 8 inches thick.

This Lake Charles soil is used mostly for row crops, but some areas are used for pasture. Capability unit IIw-2; pasture group 7L.

Lake Charles clay, 1 to 3 percent slopes (LcB).—This soil is adjacent to major drainageways. The areas generally are 65 acres in size, but some are as large as 130 acres.

The surface layer is mostly very dark gray clay about 12 inches thick. The next layer is very dark gray clay that is mottled in the lower part and about 36 inches thick. The underlying lower layers are yellowish-red clay loam that contains soft and hard concretions of lime.

Included with this soil in mapping are small areas of Bernard clay loam and Edna fine sandy loam. Also included are small areas of less sloping Lake Charles clay.

Figure 5.—**Water standing in microdepressions accent gilgai relief of somewhat poorly drained Lake Charles clay.**

This Lake Charles soil is used mostly for row crops, but some areas are used for pasture and for growing rice. Capability unit IIe-1; pasture group 7L.

Lincoln Series

In the Lincoln series are somewhat excessively drained, gently undulating, calcareous sands to loams. These soils formed in recent stratified alluvium. They are adjacent to the Colorado River, mostly on the inner side of a few bends on the first bench above the river channel.

In a representative profile the surface layer is about 18 inches thick. It is brown very fine sandy loam in the upper part and dark brown loam in the lower part. The underlying material, to a depth of more than 70 inches, consists of stratified, light-brown to dark-brown sandy and loamy material. The sandy material has bedding planes.

Permeability is rapid in these soils, and available water capacity is low.

In this county Lincoln soils are mapped only in an undifferentiated unit with Norwood soils.

Representative profile of Lincoln fine sandy loam in an area of Norwood and Lincoln soils (1,400 feet southwest of center of bridge across the Colorado River on Farm Road 960; then 5000 feet northwest to ranch headquarters; then 800 feet northeast; then 1,480 feet north-northeast, and 150 feet west southwest from normal water-level edge):

A11—0 to 10 inches, brown (7.5YR 5/3) very fine sandy loam, light brown (7.5YR 6/3) dry; weak, medium, granular and weak, fine, platy structure; slightly hard, very friable; calcareous; moderately alkaline; abrupt, smooth boundary.

A12—10 to 18 inches, dark-brown (7.5YR 4/3) loam, light brown (7.5YR 6/3) dry; weak, very fine and medium, platy structure; slightly hard, very friable; calcareous; moderately alkaline; abrupt, smooth boundary.

C1—18 to 25 inches, light-brown (7.5YR 6/4) sand, pink (7.5YR 8/4) dry; structureless, single grain; loose; evident bedding planes; calcareous; mildly alkaline; abrupt, smooth boundary.

C2—25 to 38 inches, brown (7.5YR 5/3) loamy fine sand; pink (7.5YR 7/3) dry; structureless; loose; evident bedding planes; calcareous; moderately alkaline; abrupt, smooth boundary.

C3—38 to 46 inches, dark-brown (7.5YR 4/3) silt loam; brown (7.5YR 5/3) dry; moderate, medium, angular blocky and very fine, platy structure; very hard, very firm; splotches of lighter colored silt loam; calcareous; moderately alkaline; abrupt, smooth boundary.

C4—46 to 70 inches +, brown (10YR 5/3) sand; very pale brown (10YR 7/3) dry; structureless; loose; evident bedding planes; calcareous; mildly alkaline.

The A horizon is brown, dark brown, light brown, or pale brown. It ranges from fine sand to loam in texture and from 8 to 20 inches in thickness. It ranges from mildly alkaline to moderately alkaline in reaction.

The C horizon ranges from loam to sand in texture between a depth of 10 and 40 inches. It ranges from mildly alkaline to moderately alkaline in reaction.

These soils are stratified to a depth of 50 inches, and the texture and content of organic matter vary widely in irregular sequence with depth. In some places buried horizons are present.

Midland Series

The Midland series consists of poorly drained, nearly level soils on uplands. These soils are on a plain that has convex, low, round mounds about 4 to 12 inches high and about one-tenth of an acre in size.

In a representative profile the surface layer is strongly acid, dark-gray clay loam about 12 inches thick. The next layer is strongly acid to moderately alkaline, mottled, dark-gray clay about 38 inches thick. The next lower layer is mottled, yellowish-brown clay that has concretions of lime. It extends to a depth of more than 60 inches.

Permeability is very slow in these soils, and available water capacity is high.

Representative profile of Midland clay loam (150 feet east of edge of highway at intersection State Highway 71 and Farm Road 1160, 2.0 miles north of New Taiton and 10 miles north of El Campo):

A11—0 to 6 inches, dark-gray (10YR 4/1) clay loam, gray (10YR 5/1) dry; about 15 percent is distinct, fine, dark yellowish-brown mottles; weak, medium and fine, blocky structure; firm, hard; whitish silt on ped surfaces; strongly acid; clear, smooth boundary.

A12—6 to 12 inches, dark-gray (10YR 4/1) clay loam, gray (10YR 5/1) dry; 15 to 20 percent is distinct, fine, dark yellowish-brown mottles; weak, coarse, prismatic structure that parts to weak, medium, blocky; firm, hard; many roots; strong-brown and yellowish-brown mottles associated with incipient masses of iron and manganese; prisms have white or light-gray silt coatings; strongly acid; abrupt, wavy boundary.

B21tg—12 to 30 inches, dark-gray (10YR 4/1) clay, gray (10YR 5/1) dry; 15 to 20 percent fine and medium, dark yellowish-brown and strong-brown mottles associated with incipient masses of iron and manganese; moderate, coarse, prismatic structure that parts to moderate to strong, medium, blocky; very firm, extremely hard; many fine roots that penetrate peds, but are more concentrated between peds; common clay films on faces of peds and shiny ped surfaces; strongly acid; gradual, wavy boundary.

B22tg—30 to 50 inches, dark-gray (10YR 4/1) clay; about 15 to 20 percent is yellowish-brown (10YR 5/8) and brownish-yellow (10YR 6/6) mottles; moderate, coarse, blocky structure; extremely firm, extremely hard; a few fine roots; distinct clay films on peds; a few small slickensides; common, fine, black and dark-brown, weakly cemented concretions of iron and manganese; mildly alkaline at a depth of 40 inches; gradual, wavy boundary.

B3ca—50 to 60 inches +, yellowish-brown (10YR 5/6) clay, brownish yellow (10YR 6/6) dry; a few, fine, distinct mottles of strong brown (7.5YR 5/6) and yellowish red (5YR 5/6); weak, coarse, blocky structure; very firm, extremely hard; a few strongly cemented concretions of calcium carbonate; a few soft masses of calcium carbonate; a few, fine, dark-brown, weakly cemented concretions of iron and manganese; calcareous; moderately alkaline.

The A horizon ranges from gray to dark grayish brown in color. It is slightly more than 10 inches thick in more than half of the mapped areas.

The upper part of the Bt horizon ranges from gray to dark gray in color. It ranges from 4 to 6 inches in thickness in the crests of the Bt horizon to about 16 or 18 inches in the center of the troughs of the Bt horizon. Mottles are brown or yellow. The upper part of the Bt horizon is clay or silty clay in texture and strongly acid to moderately alkaline in reaction. Depth to the B3ca horizon ranges from 40 to 70 inches. In most years these soils have cracks in them that are a half inch or more wide to a depth of 20 inches.

Midland clay loam (Md).—This is the only Midland soil mapped in the county. It is nearly level to slightly depressional. The areas are irregular in shape and are mostly 800 acres in size, but some areas are as large as 2,000 acres.

Included with this soil in mapping are small areas of Bernard clay loam, Crowley fine sandy loam, and Tuckerman soils.

Runoff is slow on this soil. Artificial drainage and surface smoothing are needed to help improve water management in most places.

This soil is used mostly for crops and pasture, but some areas are used only for wildlife habitat. Capability unit IIIw-1; pasture group 7D.

Miller Series

The Miller series consists of calcareous soils that formed in alluvial clay. Most areas are on a featureless plain, but some areas have convex slopes.

In a representative profile the surface layer is dark reddish-brown clay about 23 inches thick. The next layer is brown silty clay about 4 inches thick. The underlying material is very dark grayish-brown clay to a depth of more than 60 inches.

Permeability is very slow in these soils, and available water capacity is high.

Representative profile of Miller clay (2.0 miles east of intersection of U.S. Highway 59 and Farm Road 1301, then north 3.0 miles, and then east 1.25 miles on south side of road):

Ap—0 to 4 inches, dark reddish-brown (5YR 3/2) clay, dark reddish gray (5YR 4/2) dry; moderate, medium and fine, granular structure; very hard, firm; when dry the soil separates to a mass of fine hard granules; calcareous; moderately alkaline; clear, wavy boundary.

A11—4 to 9 inches, dark reddish-brown (5YR 3/2) clay, dark reddish gray (5YR 4/2) dry; moderate, medium, granular and moderate, medium, subangular blocky structure; very hard, firm; a few, fine, strongly cemented, calcareous concretions and fragments of shells; calcareous; moderately alkaline; clear, smooth boundary.

A12—9 to 16 inches, dark reddish-brown (5YR 3/3) clay, reddish brown (5YR 4/3) dry; moderate, medium, angular blocky structure; very hard, firm; a few, fine, strongly cemented, calcareous concretions and fragments of shells; calcareous; moderately alkaline; clear, smooth boundary.

A13—16 to 23 inches, dark reddish-brown (5YR 3/3) clay, reddish brown (5YR 4/3) dry; moderate, medium, subangular blocky structure; very hard, very firm; a few, fine, strongly cemented, calcareous concretions; calcareous; moderately alkaline; abrupt, smooth boundary.

B21—23 to 27 inches, brown (7.5YR 5/4) silty clay, light brown (7.5YR 6/4) dry; moderate, fine, angular blocky structure; very hard, firm; calcareous; moderately alkaline; abrupt, smooth boundary.

B22b—27 to 60 inches +, very dark grayish-brown (10YR 3/2) clay, dark grayish brown (10YR 4/2) dry; a few, fine, faint, yellowish-brown mottles; moderate, medium, angular blocky structure; very hard, very firm; a few, small, strongly cemented, calcareous concretions; calcareous; moderately alkaline.

The A horizon ranges from dusky red to dark brown in color and from mildly alkaline to moderately alkaline in reaction. The B horizon ranges from weak red to brown in color and is mildly alkaline or moderately alkaline in reaction. In most areas a buried soil of dark grayish brown or very dark grayish brown is at a depth between 24 and 60 inches. In some places strata of silt loam and silty clay loam that are 2 to 3 inches thick are present. The content of clay between a depth of 10 and 50 inches ranges from 35 to 60 percent.

Miller clay (Me).—This soil has the profile described as representative of the series. It is moderately well drained and adjacent to major drainageways. The areas are dissected by a network of very shallow and narrow low drainageways. They generally are 200 acres in size, but some areas are as large as 2,000 acres and are irregular in shape. The surface of this soil is mainly plane, but sloping areas are convex.

Included with this soil in mapping are small areas of Asa silty clay loam, Clemville silty clay loam, Norwood silt loam, and Pledger clay.

Miller clay is used mostly for crops (fig. 6), but a few areas are used for pasture. Capability unit IIs-4; pasture group 1A.

Miller clay, ponded (Mp).—This soil formed in clayey alluvium in oxbows and is flooded frequently. The oxbows are crescent shaped and are remnants of old channels. The surface of the oxbow floors is slightly concave and smooth. The areas generally are about 50 acres in size, but some of them are as large as 120 acres.

The surface layer of this soil is calcareous, dark reddish-brown clay about 24 inches thick. Next are thick, mottled, clayey layers or stratified mottled layers of silt loam, clay, and silty clay loam. Darker colored layers of buried soil are common, as well as thin layers of coarser textured material.

Included with this soil in mapping are small areas of Earle soils, Miller clay, and Pledger clay.

Miller clay, ponded, is used for pasture and as wildlife refuge (fig. 7). A few shallow depressions have been drained and are used for crops. Capability unit IIIw-2; pasture group 1B.

Figure 6.—**Cotton and corn on recently cultivated Miller clay.**

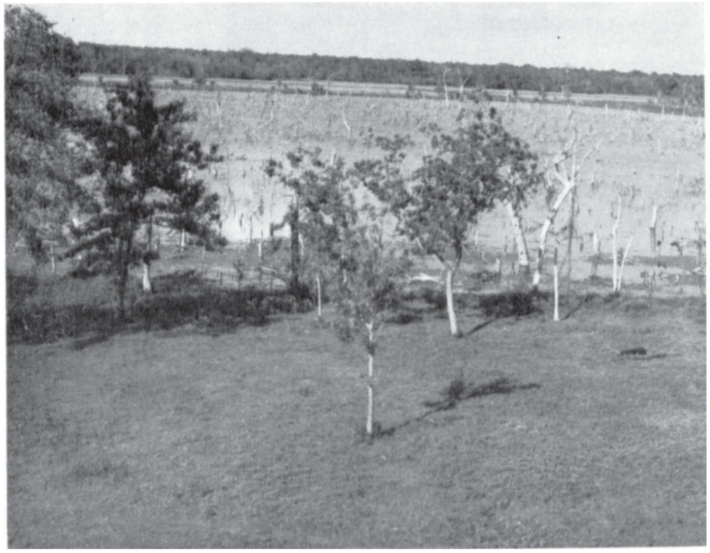

Figure 7.—**Pond used for fishing and duck hunting on Miller clay, ponded.**

Norwood Series

The Norwood series consists of well-drained, calcareous silt loams that formed in alluvium. These soils are on a featureless plain.

In a representative profile the surface layer is calcareous brown silt loam about 10 inches thick. The underlying material, to a depth of more than 60 inches, consists mostly of light-brown silt loam that contains strata of other textures.

Permeability is moderate in these soils, and available water capacity is high.

Representative profile of Norwood silt loam, 0 to 1 percent slopes (300 feet south of intersection of Farm Road 102 and Farm Road 640 and 100 feet south of railroad):

A1—0 to 10 inches, brown (7.5YR 5/4) silt loam, light brown (7.5YR 6/4) dry; weak, medium and fine, granular structure; slightly hard, very friable; many very fine pores; evident bedding planes; a few fragments of snail shells; calcareous; moderately alkaline; clear, smooth boundary.

C—10 to 60 inches +, light-brown (7.5YR 6/4) silt loam, pink (7.5YR 7/4) dry; at a depth of 38 inches is pinkish-gray silty clay loam strata that are 6 inches thick and have a few, medium, faint, yellow mottles; structureless; slightly hard, very friable; evident bedding planes; calcareous; moderately alkaline.

The A horizon ranges from reddish brown to light brown in color and from 8 to 18 inches in thickness.

The C horizon ranges from as thin as 36 inches over a buried, more clayey soil to more than 60 inches in depth. It ranges from light brown to reddish brown in color. This horizon ranges from silt loam to silty clay loam in texture and contains thin strata of soil of other textures.

The soil at a depth between 10 and 50 inches is more than 18 percent clay, but less than 35 percent clay, and is less than 15 percent coarser than very fine sand. Between these depths bedding planes are evident and the strata are 2 to 8 inches thick.

Norwood silt loam, 0 to 1 percent slopes (NoA).—This soil has the profile described as representative of the series. It is adjacent to major streams, and is dissected by a network of very shallow and narrow, low drainageways (fig. 8). The areas generally are 400 acres in size, but some are as large as 1,300 acres and are long and irregular in shape.

The surface of this Norwood soil is mostly plane, but sloping areas are convex.

Included with this soil in mapping are small areas of Asa silty clay loam, Clemville silty clay loam, and Miller clay. Also included are small areas of a more sloping Norwood silt loam.

Runoff is slow on this soil. This soil is used mostly for crops, but a few areas are used for pasture. Capability unit I–2; pasture group 2B.

Norwood silt loam, 3 to 8 percent slopes (NoB).—This soil is along banks of old stream channels. The areas are about 500 feet wide and are several miles long.

The surface layer is about 8 inches thick, and it is calcareous, brown or reddish-brown silt loam. The underlying material is friable, calcareous, brown or reddish-brown stratified silt loam or silty clay loam that extends to a depth of several feet.

Included with this soil in mapping are many areas of Miller clay, ponded, which are on bottom lands along streams and which make up about 12 percent of the mapped areas. Also included are small areas of Asa, Miller, and Pledger soils. Areas of a Norwood soil that has slopes up to 10 percent are also included.

Runoff is rapid on this Norwood soil, and the hazard of erosion is severe in the more sloping areas. If erosion is controlled and management is otherwise good, crops on this soil grow well. Most areas are used for pasture, but some are used for crops. Capability unit IIIe–3; pasture group 2B.

Norwood and Lincoln soils (Nr).—This undifferentiated group of soils is mostly on the inside of a few bends of the Colorado River. These soils are on the first bench above the river channel and are subject to flooding. The areas are about 15 to 30 feet lower in the landscape than other soils on bottom lands in the county. The soils in this unit are gently sloping along the riverbanks in

Figure 8.—**Young crop of cotton growing in very shallow drainageways in areas of a Norwood soil. In the background are pecan trees.**

contrast to the perpendicular banks where other soils join the river. Areas of these soils are crescent shaped and range from 10 to 200 acres.

Norwood soils make up about 40 percent of this unit, and Lincoln soils, about 30 percent. The remaining 30 percent consists of small areas of Miller soils and of soils that are similar to the Lincoln soils but that are clayey at a depth below 14 inches and include sandbars.

Norwood soils have a surface layer of calcareous, brown silt loam about 10 inches thick. Below is light-brown silt loam that contains strata of silty clay loam and is several feet thick. The profile of the Lincoln soils is like that described for the Lincoln series.

Norwood soils are on parallel ridges and swales farther from the river than Lincoln soils. They are in an area 200 to 300 yards wide, and within the areas of Norwood soils are a few ridges of Lincoln soils. Norwood soils occupy slightly lower positions on the landscape than Lincoln soils, but they occupy higher positions than Miller soils. Lincoln soils are on natural levees next to the river channel. The Miller soils are level. Miller clay has a plane surface, and Miller clay, ponded, is in depressional areas along backswamps adjoining soils on uplands.

The soils in this group are used for pasture. Capability unit Vw-2; pasture group 2B.

Pledger Series

In the Pledger series are moderately well drained to somewhat poorly drained, clayey soils on alluvium. These soils are on a featureless plain that has convex slopes.

In a representative profile the surface layer is moderately alkaline, black clay and silty clay about 26 inches thick. The next layer is calcareous, dark yellowish-brown clay loam about 29 inches thick. Below this is dark-brown clay to a depth of more than 64 inches.

Permeability is very slow in these soils, and available water capacity is high.

Representative profile of Pledger clay (1.4 miles east of Newgulf Post Office, then 1.7 miles north on county road, and then 0.4 mile east on north side of the county road):

A11—0 to 11 inches, black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; moderate, medium, subangular blocky and angular blocky structure; very hard, very firm; many pores 1 to 3 millimeters in size; a few, fine, strongly cemented, pitted concretions of calcium carbonate and a few fragments of snail shells; calcareous; moderately alkaline; clear, wavy boundary.

A12—11 to 26 inches, black (10YR 2/1) silty clay, black (10YR 2/1) dry; moderate, medium, granular and subangular blocky structure; hard, very firm; a few, fine, pitted, strongly cemented concretions of calcium carbonate; evidence of mixing of soil material from A11 horizon in cracks caused by shrinking and swelling and by earthworm activity; calcareous; moderately alkaline; gradual, wavy boundary.

B2—26 to 55 inches, dark yellowish-brown (10YR 4/4) clay loam, yellowish brown (10YR 5/4) dry; common, fine and medium, faint, reddish-brown mottles and a few, medium, prominent, black soft masses; moderate, medium, subangular blocky structure; very hard, very firm; a few, fine, strongly cemented concretions of calcium carbonate, and soft, powdery, secondary lime masses; calcareous; moderately alkaline; diffuse, smooth boundary.

Ab—55 to 64 inches +, dark-brown (7.5YR 3/2) clay, dark brown (7.5YR 4/2) dry; common, fine and medium, faint, reddish-brown mottles and common, medium and coarse, prominent, reddish-brown mottles; moderate, medium, angular blocky structure; very hard, very firm; a few, fine, strongly cemented concretions of calcium carbonate, a few soft masses of calcium carbonate; calcareous; moderately alkaline.

The A horizon ranges from black to very dark brown in color and from 20 to 36 inches in thickness. It ranges from neutral through moderately alkaline in reaction.

The B horizon ranges from dark brown to yellowish brown in color and from clay to clay loam in texture. The content of clay between a depth of 10 and 40 inches is more than 35 percent and less than 60 percent. Secondary carbonates are at a depth between 24 and 60 inches.

Pledger clay (Pc).—This is the only Pledger soil mapped in the county. It is adjacent to major drainageways. The areas are crossed by many very shallow, narrow, low drainageways. Most areas are 200 acres in size, but some are as large as 1,500 acres and are irregular in shape.

Included with this soil in mapping are small areas of Asa silty clay loam, Clemville silty clay loam, Miller clay, and Norwood silt loam.

The surface of this soil is mainly plane, but slopes are convex. Runoff is slow.

Pledger clay is used mostly for wooded pasture, but it is also used for crops. Capability unit IIw-3; pasture group 1B.

Tuckerman Series

The Tuckerman series consists of acid, poorly drained, nearly level loams. These soils are in enclosed depressions and in low drainageways. The surface is mainly plane, but slopes are concave.

In a representative profile the surface layer is medium acid, gray loam about 8 inches thick. The next layer is strongly acid, grayish-brown clay loam about 34 inches thick. The underlying material is gray clay loam that extends to a depth of more than 60 inches.

Permeability is slow in these soils, and available water capacity is high.

Representative profile of Tuckerman loam in an area of Tuckerman soils, ponded (1.9 miles northeast of Hungerford via U.S. Highway 59 from intersection of State Highway 60, then 500 feet south of road):

A1g—0 to 8 inches, gray (10YR 5/1) loam, light gray (10YR 6/1) dry; a few faint, fine mottles of yellowish brown; structureless; slightly hard, friable; many fine pores; medium acid; gradual, smooth boundary.

B21tg—8 to 42 inches, grayish-brown (10YR 5/2) clay loam, light brownish gray (10YR 6/2) dry; common, medium, distinct, light-gray and brownish-yellow mottles; moderate, medium, blocky structure; silt coats on prism faces and clay films on blocky ped surfaces; very hard, very firm; a few crayfish krotovinas, a few small concretions of iron and manganese; strongly acid; gradual, wavy boundary.

B22tg—42 to 60 inches +, gray (10YR 5/1) clay loam, light gray (10YR 6/1) dry; common, medium, distinct, brownish-yellow mottles; moderate, medium and coarse, blocky structure; very hard, very firm; clay films on ped surfaces; a few, fine concretions of iron or manganese; strongly acid.

The A horizon ranges from sandy loam to clay loam in texture and is gray, light gray, or light brownish gray in color. In some places this horizon contains brown or yellowish-brown mottles. The A horizon is slightly acid or medium acid.

The B horizon ranges from gray to grayish brown or light gray to light brownish gray in color, and it contains brownish-yellow or pale-yellow mottles. In many places the upper part of the B horizon has vertical streaks of clean sand and silt from which clay has been stripped. The B horizon is clay loam or silty clay loam. It is 18 to 35 percent clay, more than 20 percent silt, and more than 15 percent material that is coarser than very fine sand. It is noncalcareous to calcareous in the lower part.

Tuckerman soils, ponded (Tp).—This unit contains the only Tuckerman soils mapped in the county. These soils are in enclosed depressions. The areas generally are 30 acres in size, but some areas are as large as 500 acres and are oval in shape. Slopes are slightly concave. These soils have a surface layer of sandy loam to clay loam.

Included with these soils in mapping are small areas of Bernard clay loam, Crowley fine sandy loam, and Edna fine sandy loam.

Runoff is slow on these soils. Artificial drainage and surface smoothing are needed in most places to help improve water management.

These soils are used mostly for pasture and for rice farming. Capability unit IVw-1; pasture group 8F.

Use and Management of the Soils

In this section management of the soils for cultivated crops is discussed, the system of capability grouping used by the Soil Conservation Service is explained, and management of the soils by capability groups is given. Next, estimated yields of principal crops grown on the soils at an improved level of management are shown, the system of appraising pastureland is explained, and some suggestions on management of each pasture group are given. Following this, management of wildlife and engineering uses of the soils are discussed.

Management of Cultivated Soils

The chief concerns in managing cultivated soils are removing excess surface water by artificial drainage, conserving moisture, and maintaining fertility.

Improper surface drainage is one of the main hazards to crops in Wharton County. More than 96 percent of the soils in the county have slopes of less than 1 percent. Runoff therefore is slow, and water is likely to pond on the soils (fig. 9).

Farm drainage consists of the construction of main and lateral ditches, field ditches, and planned row direction to provide for the orderly removal of excess surface and subsurface moisture. Drainage systems should be planned, designed, and laid out to provide adequate drainage but not to inhibit the use of regular farm equipment.

Crops on most soils in Wharton County respond well if fertilizer is added. Commercial fertilizer should be applied according to needs determined by soil tests. The amount and kind of fertilizer used varies according to the soil, the crop that is grown, the amount of crop growth desired, and the previous land use or cropping history. Also considered in the choice of fertilizer are the season of the year and the amount of moisture available. For row crops it generally is best to band the fertilizer below and to the side of the seed.

***Figure 9.*—Cotton on a Norwood silt loam. The upper part shows ponded area early in the season, and the lower part shows the effect of the ponding on the crop later in the season.**

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 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 rice, 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, for forest trees, or for engineering.

In the capability system, all kinds of soils are grouped at three levels, the capability class, subclass, and unit. These are discussed 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, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, 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.

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife. (None in Wharton County.)

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife. (None in Wharton County.)

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes. (None in Wharton 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 only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are 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 class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, or recreation.

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–5 or IIIe–3. 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 pages the capability units in Wharton County are described and suggestions for the use and management of the soils are given. The capability unit designations for all the soils in the county can be found in the "Guide to Mapping Units." All of the units in the system are not represented by the soils of Wharton County; therefore the numbers are not consecutive.

Capability unit I–1

Only Hockley fine sandy loam, 0 to 3 percent slopes, is in this capability unit. This soil is deep, moderately well drained, and moderately slowly permeable.

This soil is easy to till. The surface layer dries rapidly after excess water is removed, but the lower layers generally are moist.

This soil is well suited to cultivated crops. The principal crops are cotton, corn, grain sorghum, and rice. Most areas are used for pasture, but a few are used for crops.

The main concerns of management are maintaining soil fertility, providing adequate drainage, and controlling undesirable plants. Other important practices are using soil-improving crops and returning crop residue to the soil. Proper timing of tillage is needed, for the surface layer becomes compacted if tilled when wet.

Capability unit I–2

In this unit are deep, nearly level soils that formed in alluvium and are silty clay loam and silt loam in texture. Available water capacity is high.

These soils are easy to till. They are well suited to crops, and the main crops are cotton and corn. The soils are also used for alfalfa, pecan orchards, and pasture.

The main concerns of management are controlling soil fertility, providing adequate surface drainage, and controlling undesirable plants. A cropping system is needed that includes soil-improving crops and crops that return a large amount of residue to the soil. Because of the level or nearly level slopes, erosion is not a hazard. Artificial drainageways in these soils, however, need protection from excessive washing. A tillage pan forms readily in these soils if soil-depleting crops are grown year after year and if the soil is tilled when too moist. The pan can be broken by chiseling and by growing deep-rooted legumes.

Capability unit IIe–1

Only Lake Charles clay, 1 to 3 percent slopes, is in this capability unit. It is deep, poorly drained, and very slowly permeable. Available water capacity is high. This soil is mostly adjacent to major drainageways, and it is generally moist.

This soil is well suited to cultivated crops and to pasture. It is used mostly for row crops. The main crops are cotton, corn, and grain sorghum.

Terraces are needed to help control erosion in cultivated areas. Growing close-growing crops and farming on the contour also help to control erosion.

Capability unit IIe-5

Only Bernard clay loam, 1 to 3 percent slopes, is in this capability unit. It is adjacent to major drainageways. This soil is deep and very slowly permeable and generally is moist.

This soil is used mostly for pasture, but it is well suited to cotton, corn, grain sorghum, and rice. Terraces are needed in cultivated areas to help control erosion. Choosing a cropping system that includes close-growing crops and farming on the contour also help to control erosion.

Capability unit IIw-1

Only Bernard clay loam, 0 to 1 percent slopes, is in this capability unit. This soil is deep, somewhat poorly drained, and very slowly permeable. Some areas are in shallow depressions, which further impedes drainage. Available water capacity is high.

This soil is well suited to crops and pasture. The main crops are cotton, corn, grain sorghum, and rice. Rice is suited to this soil, but because of the alkaline lower layers, growth is limited.

If this soil is worked when too moist, soil structure is likely to be damaged. Then, movement of air and water is impeded, growth of plant roots is restricted, and plant diseases increase. Artificial drainage is needed.

A suitable cropping system is one that includes crops that produce large amounts of residue and improve the soil. When left on the surface after harvest, the residue of these crops helps to maintain the content of organic matter and to keep the soil in good tilth. Perennial grasses are grown in some years. Land smoothing helps to increase the efficiency of drainage systems and the use of water.

Capability unit IIw-2

The only soil in this capability unit is Lake Charles clay, 0 to 1 percent slopes. This soil is deep, very slowly permeable, and somewhat poorly drained. Available water capacity is high, and the soil is slow to dry after a rain.

This soil is well suited to crops, and the main crops are cotton, grain sorghum, corn, and rice. If this soil is cultivated when it is too moist, a plowpan forms.

The major concerns of management are maintaining tilth and fertility. Growing perennial grasses and legumes helps to improve tilth and reduce the plowpan. A suitable cropping system is one that includes crops that produce a large amount of residue and improve the soil, cover crops, and a rotation of hay and pasture. Leaving the residue on or near the surface after harvest helps to increase intake of water and reduce loss of water by evaporation. It also helps to prevent soil crusting.

Capability unit IIw-3

In this unit are deep soils that formed in alluvium. These soils are very slowly permeable and have high available water capacity.

The soils in this unit are well suited to cultivated crops, and corn, cotton, alfalfa, and grain sorghum are the chief crops. Preparing a good seedbed is difficult because the surface layer dries slowly after a rain. If this soil is worked when too wet, the structure breaks down and a plowpan forms.

A suitable cropping system includes soil-improving crops and crops that produce a large amount of residue. Maintaining tilth and providing artificial drainage are the main concerns of management. Returning all crop residue to the soils helps to increase the intake of water, to reduce the loss of water by evaporation, and to prevent crusting.

Capability unit IIs-4

Miller clay is the only soil in this capability unit. It is deep, very slowly permeable, and moderately well drained.

This soil is well suited to crops and pasture. Corn, cotton, alfalfa, and grain sorghum are the main crops. Grasses grow well on this soil.

The main concerns of management are maintaining tilth and fertility. Preparing a good seedbed is difficult because the surface layer dries slowly after a rain. Soil structure breaks down, and a plowpan forms if the soil is worked when too wet.

A suitable cropping system is one that includes crops that produce a large amount of residue and that improve the soil. Growing perennial grasses or legumes helps to keep a plowpan from forming. Returning all crop residue to the soil helps to reduce loss of moisture by evaporation and prevents crusting.

Capability unit IIIe-1

Only Edna fine sandy loam, 1 to 3 percent slopes, is in this capability unit. This soil is deep, poorly drained, and very slowly permeable. A crust readily forms on the surface of this soil.

This soil is suited to rice, grain sorghum, corn, cotton, and perennial grasses. The main concerns of management are controlling water erosion, reducing loss of moisture by evaporation, and supplying organic matter to the soil.

Terracing and farming on the contour help to protect the soil from water erosion. If terracing is done, a suitable cropping system includes crops that produce a large amount of residue and that improve the soil. If terracing is not done, close-growing crops and crops that produce a large amount of residue should be grown in the cropping system for a longer time. The terraces need protected outlets for removal of excess water. These outlets should empty into a pasture or into a prepared waterway (fig. 10). Leaving all crop residue on or near the surface helps to supply organic matter to the soil and to prevent surface crusting.

Capability unit IIIe-2

Only Konawa-Kenney complex, 5 to 8 percent slopes, is in this capability unit. These soils are moderately permeable and have low to high available water capacity. Some areas have been damaged by water erosion.

The soils in this unit are cultivated, but they are better suited to native grasses or to adapted varieties of introduced grasses.

The main concerns of management are controlling erosion, conserving moisture, and improving fertility. A suitable cropping system includes close-growing crops that improve the soil or that produce a large amount of

Figure 10.—**Gullies in Edna fine sandy loam, 1 to 3 percent slopes, caused by lack of proper outlets to remove runoff.**

residue grown in a rotation of hay and pasture. Keeping a cover of plants on the soils and returning all plant residue to the soils are also needed. Leaving all crop residue on the surface after harvest helps to maintain a high content of organic matter. This practice also helps to control water erosion and to conserve moisture.

Capability unit IIIe-3

The only soil in this capability unit is Norwood silt loam, 3 to 8 percent slopes. This soil is moderately permeable and well drained. Available water capacity is high.

This soil is used mostly for pasture, but cotton and alfalfa are grown on a few broad, more gently sloping areas. The soil is suited to cotton, corn, and grain sorghum. This soil also provides suitable sites for farm ponds and recreational areas.

The main concern of management is establishing an adequate cover of native grass that protects the soil from erosion. Erosion can be controlled and organic matter supplied by growing crops that are spaced closely and crops that produce a large amount of residue.

Capability unit IIIw-1

In this unit are nearly level, very slowly permeable and slowly permeable soils that have a surface layer of clay loam, loam, and fine sandy loam. Available water capacity is high. The lower layers of these soils impede the movement of air, water, and roots.

The soils in this unit are used mostly for rice, which is grown on the same soil for 1 or 2 years in rotation with perennial grasses. These soils are suited to rice, cotton, corn, and grain sorghum.

The main concerns of management are controlling flooding caused by runoff, keeping a plowpan from forming, and maintaining fertility and tilth. Land smoothing and using a drainage system that includes main ditches to carry the water collected from several field ditches help to control flooding and to improve drainage. A suitable cropping system is one that supplies organic matter and prevents the formation of a plowpan. Leaving all residue on or near the surface is beneficial.

Capability unit IIIw-2

Miller clay, ponded, is the only soil in this capability unit. It is very slowly permeable. Available water capacity is high.

If drained, this soil is suited to most crops, and cotton and corn are the main crops. Areas not drained are used for pasture and wildlife refuge.

The main concerns of management are drainage and the formation of a plowpan. Growing grasses and legumes or crops that produce a large amount of residue and crops that improve the soil helps to keep a plowpan from forming. Leaving all plant residue on or near the surface helps to improve tilth and makes preparing a seedbed easier. A suitable cropping system is one that includes soil-improving crops and crops that produce a large amount of residue.

Capability unit IIIw-3

Crowley fine sandy loam is the only soil in this capability unit. This soil is somewhat poorly drained and is very slowly permeable. Water, air, and plant roots readily enter the surface layer. Available water capacity is high.

This soil is well suited to cultivated crops. Rice rotated with perennial grasses is the major crop, but cotton and grain sorghum are also suited.

Using a cropping system that includes crops that produce large amounts of residue and improve the soil helps to maintain the content of organic matter and to keep the soil in good tilth. Growing legumes as soil-improving crops and returning all crop residue to the soil are beneficial practices. Other important practices are providing drainage and land smoothing. Land smoothing or water leveling increases the efficiency of the drainage system and the use of water for growing rice.

Capability unit IIIs-2

This unit consists of nearly level to undulating loamy fine sands and fine sands. These soils are very rapidly permeable and moderately permeable. Available water capacity is low. If these soils are used for crops, the hazard of water erosion is moderate on long slopes.

The soils in this unit are used mostly for pasture, but small grains, corn, and grain sorghum are grown. They are well suited to pasture but are suited only to limited cultivation.

The main concerns of management are conserving moisture, controlling erosion, and maintaining organic matter and fertility. All crop residue should be left on the surface.

Capability unit IVw-1

This unit consists only of Tuckerman soils, ponded. These deep soils are slowly permeable and poorly drained. They have high available water capacity. Most areas of these soils receive runoff from surrounding soils, and the water stands intermittently on the surface. The lower layers impede movement of air, water, and plant roots.

These soils are better suited to native grasses or to adapted kinds of introduced grasses than to other crops. Rice is the main cultivated crop.

A suitable cropping system includes crops that provide a large amount of residue and crops that improve the soil. Another suitable cropping system includes crops that provide a large amount of residue, cover crops, and a rotation of hay and pasture. The main concerns of management are improving tilth, providing artificial drainage, and maintaining the content of organic matter. Tilth can be improved and the content of organic matter can be maintained by growing crops that contain a large amount of residue and returning the residue to the soil. These practices also help to reduce surface crusting. Installing an adequate drainage system and using land smoothing are ways to reduce ponding on these soils.

Capability unit Vw-1

In this capability unit are nearly level soils formed in alluvium. These soils are frequently flooded by runoff from higher lying soils. The nearly level slope and the fairly dense vegetation help to prolong the length of time the areas stay flooded.

Because of flooding, these soils are not suited to cultivated crops. They are better suited to native grasses or to adapted varieties of introduced grasses. The areas are used mainly for pasture and for wildlife refuge. Some sites are suitable for farm ponds and for wildlife or recreational areas.

The main concern of management on these soils is maintaining an adequate cover of plants.

Capability unit Vw-2

This unit consists only of Norwood and Lincoln soils. These soils are moderately permeable to rapidly permeable. They receive runoff water and are subject to flooding if streams overflow.

The soils in this unit are not suited to cultivated crops. They are better suited to native grasses or to adapted kinds of introduced grasses, and keeping an adequate cover of plants on the soils is important. The areas are suitable for wildlife and recreational uses.

Estimated Yields

Crop yields in Wharton County depend on the kind of management the soils receive. Consistently favorable yields can be obtained under management that improves the soils or keeps them in good condition. Table 2 gives estimated average yields per acre under a high level of management for the soils in the county that are suitable for cultivation. Under a high level of management, all the best methods of farming are used. Following are some of these practices:

1. Choosing a cropping system that includes crops that improve the soil, cover crops, and crops that have a large amount of residue.
2. Managing crop residue properly.
3. Conserving moisture by terracing, farming on the contour, and timely application of water to rice.
4. Using timely applications of fertilizer in amounts determined by soil and crop needs.
5. Cultivating, seeding, and harvesting at the proper time.
6. Using suitable measures for controlling weeds, insects, and plant diseases.
7. Selecting proven kinds of crops, planting at the proper time, and spacing properly.
8. Installing and maintaining adequate drainage systems and including land smoothing when needed.

TABLE 2.—*Estimated average yields, per acre, of principal crops grown under a high level of management*

[Only the arable soils are listed in this table. Absence of data indicates that the crop is not suited to the soil specified or generally is not grown on it]

Soil	Cotton	Corn	Grain sorghum	Alfalfa	Rice [1]
	Lbs. of lint	*Bu.*	*Bu.*	*Tons*	*Bbl.*
Asa silty clay loam	620	80	70	6	
Bernard clay loam, 0 to 1 percent slopes	450	60	60		28–43
Bernard clay loam, 1 to 3 percent slopes	425	60	60		
Bernard-Edna complex, 0 to 1 percent slopes	400	35	35		30–45
Clemville-Norwood complex	600	80	75	5	
Crowley fine sandy loam	400	35	35		26–40
Edna fine sandy loam, 0 to 1 percent slopes	400	35	35		30–45
Edna fine sandy loam, 1 to 3 percent slopes	350	35	35		
Edna soils, overwash	375	35	50		28–43
Edna-Tuckerman complex, 0 to 1 percent slopes	370	30	35		28–43
Hockley fine sandy loam, 0 to 3 percent slopes	475	75	60		25–32
Kenney loamy fine sand, 0 to 3 percent slopes	320				
Lake Charles clay, 0 to 1 percent slopes	450	60	60		30–45
Lake Charles clay, 1 to 3 percent slopes	450	60	60		
Midland clay loam	375	30	35		26–42
Miller clay	450	60	60	5	
Norwood silt loam, 0 to 1 percent slopes	500	80	70	5	
Norwood silt loam, 3 to 8 percent slopes	350	35	35	4	
Pledger clay	450	60	60	5	
Tuckerman soils, ponded		30	30		25–35

[1] The first figure in this column is the yield for one cutting, and the second figure is the yield for two cuttings.

Management of the Soils for Hay and Pasture

Described in the following pages are general guidelines for managing soils used for hay and for pasture. Following this, the soils are placed into nine pasture groups and each group is discussed. Those who wish to know the pasture group of a soil can refer to the "Guide to Mapping Units" at the back of this survey. Those desiring detailed information about the management of soils can turn to the section "Descriptions of the Soils."

Management for hay

Hay in Wharton County consists mostly of native bluestem, introduced bluestem, bermudagrass, and bahiagrass. About ½ ton to 6 or more tons of hay per acre are produced, depending on the soil, the kind of grass grown, the amount of fertilizer applied, and the kind of management used.

In general hay should be cut at a height that has been proven best for the grass grown. Grasses that generally are sod forming, such as bermudagrass or bahiagrass, can be mowed lower than such bunchgrasses as the bluestems. Mowing too low or too often damages hay in the same way that overgrazing damages pasture. Mowing at the proper height helps to maintain plant vigor and leaves residue that is returned to the soil to help maintain the content of organic matter. Mowing when the soil is wet tends to pack the surface layer and cause excessive runoff and poor plant growth. Weeds can be controlled by mowing, shredding, or the use of herbicides.

Hay seriously damaged by drought, fire, or poor management should not be cut but should be allowed to make a full season's growth for a year or more. In this way the grasses can reestablish a strong root system and regain their vigor. Grasses that are weakened are easily winterkilled and invaded by weeds.

Well-established native grasses generally can be kept vigorous under good management that does not include the use of fertilizer. The growth of bermudagrass, bahiagrass, and johnsongrass, however, can be improved by the use of commercial fertilizer.

Hay grows best on deep, fertile soils, and management is easier if the surface is relatively smooth. Soils that are low in organic matter or that are in poor tilth should be planted to legumes for a year or more before establishing plants for hay.

Management for pasture

Pasture now in Wharton County consists of warm-season grasses and cool-season legumes, but some acreage is also in cool-season perennial grasses. Common bermudagrass and Coastal bermudagrass are grown on the deep, well-drained soils. Pensacola bahiagrass is grown on both the deep, well-drained soils and on the slightly wet to wet soils. Introduced kinds of bluestem, such as Gordo bluestem, Angleton bluestem, Medio bluestem, and King Ranch bluestem, are grown on a large acreage. Vetch and burclover are the most common legumes. These plants are seeded over established stands of bermudagrass and bahiagrass.

Fertilizing the soil, controlling weeds, and managing grazing are the main concerns in managing pasture. Fertilizer should be applied in the rates and amounts indicated by results of soil tests. Weeds can be controlled either by mechanical means or by mowing or shredding. Controlling weeds on well-managed pastures is not so difficult as on pastures that are overgrazed and poorly managed. A good stand of well-managed grasses tends to crowd out weeds. Pasture plants should not be grazed below the height that is proven best for the particular plant.

Leaving a good cover on the soil in winter helps to control erosion and to protect the grass roots from the cold. The cover also helps to prevent winterkilling and to attain rapid growth in spring. Controlling grazing helps to prevent soil compaction caused by trampling.

The number of beef cattle that can be raised on a farm is directly related to the amount of forage produced. The amount of forage obtained from pasture can be increased by fertilizing, by planting winter legumes, and by controlling weeds and grazing. Temporary pasture is often used to supplement permanent pasture, and small grains provide good winter forage. Sudangrass, johnsongrass, and the sorghum-sudan grasses make good supplemental summer pasture.

A pasture that is well managed consists of only one main grass, is amply supplied with water, and is free of weeds. It is stocked according to the forage available and is grazed only to a height that allows the plants to remain vigorous.

Descriptions of pasture groups

Pasture groups contain soils having in common easily recognized characteristics that are significant in planning treatment and management of pasture. Each group is affected by fluctuations in climate and by the degree of grazing. The degree of grazing depends on the habits of the livestock, the palatability of the forage, and the intensity of use.

A pasture generally is made up of more than one pasture group, but the group that occupies the largest acreage is the key group. This key group can be used as a basis for managing and evaluating grazing of the entire pasture.

Some soils are so intermixed that they cannot feasibly be mapped separately. A mixture of pasture groups generally results from such a complex of soils. In a few places each of the soils that make up the complex is in the same pasture group.

In the following pages nine pasture groups are described and management that is significant to pasture is given.

PASTURE GROUP 1A

Miller clay is the only soil in this pasture group. It is on bottom lands. This soil is moderately well drained and very slowly permeable. Available water capacity is high.

This soil is suited to such plants as bermudagrass, dallisgrass, fescue, white clover, johnsongrass, and introduced bluestems.

PASTURE GROUP 1B

This group consists of fine-textured soils on bottom lands. These soils are very slowly permeable, and their available water capacity is high.

If drainage is provided, the soils in this group are suited to such plants as improved bermudagrass, dallisgrass, fescue, and white clover.

PASTURE GROUP 2B

This group consists of coarse-textured to moderately fine textured, excessively drained to well-drained soils on bottom lands. These soils are rapidly permeable to slowly permeable. Available water capacity is low to high.

The soils in this group are suited to such plants as improved bermudagrass.

PASTURE GROUP 7B

In this group are moderately coarse textured and moderately fine textured, gently sloping soils on uplands. These soils are somewhat poorly drained to poorly drained and are very slowly permeable. Available water capacity is high.

The soils in this group are suited to such plants as improved bermudagrass, bahiagrass, introduced bluestems, and singletary peas.

PASTURE GROUP 7D

This group consists of moderately coarse textured and moderately fine textured, nearly level soils on uplands. These soils are somewhat poorly drained to poorly drained. Permeability is very slow, and available water capacity is high.

The soils in this group are suited to such plants as improved bermudagrass, introduced bluestems, and singletary peas.

PASTURE GROUP 7L

In this group are fine-textured, nearly level to gently sloping soils on uplands. These soils are somewhat poorly drained and slowly permeable. Available water capacity is high.

These soils are suited to such plants as improved bermudagrass, dallisgrass, bahiagrass, fescue, white clover, and singletary peas.

PASTURE GROUP 8C

This group consists of moderately coarse textured to coarse textured, nearly level to gently sloping soils on uplands. These soils are moderately slowly permeable to moderately permeable and are well drained to moderately well drained. Available water capacity is high to low.

Suitable plants on these soils include improved bermudagrass, bahiagrass, lovegrass, crimson clover, singletary peas, and vetch.

PASTURE GROUP 8F

The only mapping unit in this group is Tuckerman soils, ponded. It consists of deep, medium-textured, nearly level soils on uplands. These soils are slowly permeable and poorly drained. Available water capacity is very high.

Suitable plants on these soils are bahiagrass and fescue.

PASTURE GROUP 9A

This group consists of coarse-textured, nearly level to undulating soils on uplands. These soils are well drained and moderately permeable and very rapidly permeable. Available water capacity is low.

Suitable plants on these soils are improved bermudagrass, bahiagrass, lovegrass, crimson clover, vetch, and singletary peas.

Management of Wildlife

The soils and water areas in Wharton County provide wintering grounds for several million ducks and geese and permanent habitats for deer and many fur-bearing animals (fig. 11).

The principal kinds of wildlife in the county are ducks, geese, quail, doves, raccoon, squirrel, nutria, and deer (fig. 12). Many kinds of songbirds live in the county, and it is a winter home for rail, coot, crane, geese, ducks, and many other migratory birds.

Some soils in the county are suitable only for wildlife and should be managed for that use. Soils that are suitable for woodland, crops, and pasture can also be used for wildlife, and some of the soils can be managed for all of these uses at the same time. All kinds of wildlife need food, cover, and water, but no two kinds have exactly the same needs.

The areas for fish in Wharton County are limited to ponds, reservoirs, and streams. If the ponds are properly managed, they are excellent for production of fish. Fish adapted to the waters in the county are bass, channel catfish, and bream.

Descriptions of wildlife sites

The soils of Wharton County are grouped into two wildlife sites. In each site the soils are similar in relief, in kind and amount of vegetation, and in abundance and kinds of wildlife. Also, similar management is required to maintain or to improve the site for the desired kind of wildlife habitat.

The wildlife sites in this county are described, by soil associations, in the paragraphs that follow. Each soil association is described in the section "General Soil Map," and its location is shown on the general soil map at the back of this publication. Further information on developing wildlife habitats and managing fish ponds

Figure 11.—A fawn about 2 hours old finds peaceful habitat on a Lake Charles clay.

Figure 12.—**Wooded area of wildlife habitat on Earle soils. The trees on this site are cyprus, elm, and willow.**

can be obtained from local technicians of the Soil Conservation Service, from the Texas Agricultural Extension Service, and from the Texas Parks and Wildlife Department.

WILDLIFE SITE 1

This site is made up mostly of soils of the Miller-Norwood association. These are moderately well drained to well drained, nearly level, clayey and loamy soils that formed in alluvium on flood plains.

Most of the acreage of this site is used for row crops. Small areas have a cover of pecan, ash, elm, willow, oak, and hackberry trees or are in improved pasture. The wooded areas provide habitat for such wildlife species as deer, squirrel, opossum, rabbit, and raccoon, and many kinds of songbirds. Water is available in most areas from streams, ponds, and windmills in pastures.

WILDLIFE SITE 2

This site is made up of the Edna-Bernard, Crowley, Lake Charles, and Edna-Crowley associations. In these associations are large areas of level to nearly level, poorly drained to somewhat poorly drained soils.

In most areas of these soils, low areas, canals, ditches, and windmills furnish a dependable supply of water for wildlife. Rice, grain sorghum, and other food plants are available for ducks, geese, and sandhill crane.

The wooded areas, ditchbanks, and pastures furnish habitat for deer, quail, doves, rabbit, opossum, raccoon, armadillos, and nutria.

Engineering Uses of the Soils

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

Among properties of soils highly important in engineering are permeability, strength, compaction characteristics, drainage, shrink-swell potential, grain size, plasticity, and reaction. Also important are depth to the water table and to bedrock, and soil slope. 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 other preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables 3 and 4, which show, respectively, several estimated soil properties significant to engineering, and interpretations for various engineering uses.

This information, along with the soil map and other parts of this publication, can be used to make interpretations in addition to those given in tables 3 and 4, and it also can be used to make other useful maps.

The engineering interpretations reported here do not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads and where the excavations are deeper than the depths of layers here reported. Estimates generally are made to a depth of about 5 feet, and interpretations do not apply to greater depths. Also, engineers should not apply specific values to the estimates for bearing capacity and traffic supporting capacity given in this survey. Investigation of each site 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. Even in these situations, however, the soil map is useful in planning more detailed field investigations and for indicating the kinds of problems that may be expected.

TABLE 3.—*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 the instructions for referring to other series

Soil series and map symbols	Hydrologic soil group	Depth to seasonal high water table	Depth from surface of typical profile	Classification: USDA texture
		In.	*In.*	
*Arenosa: AkB. For the Kenney part of this unit, see the Kenney series.	A	>120	0–84	Fine sand
Asa: As	B	>130	0–30	Silty clay loam
			30–40	Silt loam
			40–85	Very fine sandy loam
*Bernard: BcA, BcB, BeA. For the Edna part of BeA, see the Edna series.	D	[1] 30–60	0–7	Clay loam
			7–52	Clay
			52–60	Clay loam
*Bruno: Br. Alluvial land part of this unit is too variable to rate.	A	[2] 0–60	0–3	Sandy clay loam
			3–30	Fine sand
			30–34	Clay
			34–54	Loamy fine sand
*Clemville: Cn. For the Norwood part of this unit, see the Norwood series.	B	>120	0–12	Silty clay loam
			12–30	Silt loam
			30–62	Silty clay
Crowley: Cr	D	[4] 15–30	0–15	Fine sandy loam
			15–22	Clay
			22–38	Sandy clay
			38–62	Sandy clay
Earle: Ea	D	[1] 60–120	0–26	Clay
			26–48	Fine sandy loam
*Edna: EdA, EdB, Eh, EtA. For the Tuckerman part of EtA, see the Tuckerman series.	D	[5] 30–60	0–9	Fine sandy loam
			9–38	Clay
			38–50	Clay loam
			50–65	Sandy clay loam
Hockley: HoB	C	[1] 60–120	0–34	Fine sandy loam
			34–48	Sandy clay loam
			48–72	Clay loam

See footnotes at end of table.

properties of the soils

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

Classification—Continued		Percentage passing sieve—				Permeability	Available water capacity	Reaction	Shrink-swell potential
Unified	AASHO	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)				
						In./hr.	*In./in. of soil*	*pH value*	
SM or SP-SM	A-2	100	100	70-100	10-20	>20. 0	0. 05-0. 08	6. 1-7. 3	Very low.
CL or ML	A-6	100	100	95-100	60-85	0. 63-2. 0	0. 18-0. 19	6. 6-8. 4	Low.
ML	A-6 or A-4	100	100	90-100	70-80	0. 63-2. 0	0. 16-0. 18	7. 9-8. 4	Low.
ML or ML-CL	A-4	100	100	85-95	60-85	0. 63-2. 0	0. 18-0. 19	7. 9-8. 4	Low.
CL	A-6 or A-7	100	100	90-100	70-80	0. 20-0. 63	0. 18-0. 19	5. 6-6. 5	Moderate.
CL or CH	A-6 or A-7	99-100	95-100	90-100	70-90	<0. 06	0. 18-0. 19	5. 6-8. 4	High.
CL or CH	A-6 or A-7	99-100	95-98	90-98	75-95	0. 06-0. 20	0. 18-0. 19	7. 9-8. 4	High.
SC or CL	A-4 or A-6	100	100	80-90	45-55	[3] 0. 63-2. 0	0. 12-0. 13	6. 1-6. 5	Low.
SM or SP-SM	A-2	100	100	60-80	10-20	6. 3-20. 0	0. 07-0. 08	5. 1-6. 0	Low.
CH	A-7 or A-6	100	100	90-100	90-95	[3] 0. 06-0. 20	0. 18-0. 19	5. 1-5. 5	Moderate.
SP-SM or SM	A-2	100	100	50-75	10-20	6. 3-20. 0	0. 08-0. 09	5. 1-5. 5	Low.
ML or CL	A-6	100	100	95-100	80-90	0. 06-0. 20	0. 18-0. 19	7. 9-8. 4	Low.
ML	A-6 or A-4	100	100	90-100	70-80	0. 63-2. 0	0. 16-0. 18	7. 9-8. 4	Low.
CL or CH	A-6 or A-7	100	100	95-100	85-98	0. 06-0. 20	0. 18-0. 19	7. 9-8. 4	High.
SM or ML	A-4	100	100	100	45-55	0. 63-2. 0	0. 14-0. 16	5. 6-7. 3	Low.
CH	A-7	100	100	100	60-80	<0. 06	0. 15-0. 18	6. 1-6. 5	High.
CL or CH	A-6 or A-7	100	100	100	50-60	0. 06-0. 20	0. 14-0. 16	6. 1-6. 5	Moderate.
CL or CH	A-6 or A-7	100	100	100	50-55	0. 06-0. 20	0. 15-0. 18	6. 1-7. 3	Moderate.
CH	A-7	100	100	90-100	90-95	<0. 06	0. 18-0. 19	4. 5-6. 0.	High.
SM or ML	A-4	100	100	75-85	45-55	0. 63-2. 0	0. 14-0. 16	4. 5-5. 5	Low.
SC or CL or ML	A-4	100	100	75-85	45-60	0. 63-2. 0	0. 15-0. 18	5. 6-7. 3	Low.
CH	A-7	100	100	90-100	60-80	<0. 06	0. 18-0. 19	6. 1-6. 5	High.
CL	A-6	100	100	90-100	70-80	0. 06-0. 20	0. 18-0. 19	7. 4-7. 8	High.
CL	A-6	100	100	80-90	60-70	0. 20-0. 63	0. 18-0. 19	7. 9-8. 4	Moderate.
SM or ML	A-4	100	100	70-85	45-55	0. 63-2. 0	0. 14-0. 16	5. 1-6. 5	Low.
CL	A-6	100	100	80-90	50-60	0. 20-0. 63	0. 14-0. 16	6. 1-7. 3	Low.
CL	A-6 or A-7	100	100	90-100	65-75	0. 20-0. 63	0. 14-0. 16	6. 1-7. 3	Low.

TABLE 3.—*Engineering properties*

Soil series and map symbols	Hydrologic soil group	Depth to seasonal high water table	Depth from surface of typical profile	Classification
				USDA texture
		In.	*In.*	
Kenney: KeB	A	>120	0–60	Loamy fine sand
			60–120	Sandy clay loam
*Konawa: KkC	B	>120	0–7	Fine sandy loam
For the Kenney part of this unit, see the Kenney series.			7–48	Sandy clay loam
			48–60	Sandy clay loam
Lake Charles: LcA, LcB	D	[4] 15–30	0–63	Clay
*Lincoln	A	[1] 60–120	0–10	Very fine sandy loam
Mapped only in undifferentiated unit with Norwood soils.			10–18	Loam
			18–25	Sand
			25–38	Loamy fine sand
			38–46	Silt loam
			46–70	Sand
Midland: Md	D	[5] 30–60	0–12	Clay loam
			12–60	Clay
Miller: Me, Mp	D	>120	0–23	Clay
			23–27	Silty clay
			27–60	Clay
*Norwood: NoA, NoB, Nr	B	>120	0–60	Silt loam
For the Lincoln part of Nr, see the Lincoln series.				
Pledger: Pc	D	>120	0–11	Clay
			11–26	Silty clay
			26–55	Clay loam
			55–64	Clay
Tuckerman: Tp	D	[2] 0–15	0–8	Loam
			8–60	Clay loam

[1] For 1 to 2 months a year.
[2] For 2 to 12 months a year.
[3] This layer is not continuous or restrictive.

of the soils—Continued

Classification—Continued		Percentage passing sieve—				Permeability	Available water capacity	Reaction	Shrink-swell potential
Unified	AASHO	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)				
						In./hr.	*In./in. of soil*	*pH value*	
SP–SM or SM	A–2–4	100	100	50–75	10–20	6. 3–20. 0	0. 05–0. 10	5. 1–6. 0	Low.
SC or CL	A–4 or A–6	100	100	80–90	45–55	0. 63–2. 0	0. 10–0. 15	5. 1–6. 0	Low.
SM	A–4	100	100	70–85	35–45	0. 63–2. 0	0. 14–0. 16	5. 1–6. 0	Low.
SC	A–6	100	100	80–90	40–50	0. 63–2. 0	0. 12–0. 15	5. 1–6. 0	Low.
SM or SC	A–4 or A–6	100	100	80–90	35–50	0. 63–2. 0	0. 12–0. 15	5. 1–6. 0	Low.
CH	A–7	100	100	98–100	90–98	<0. 06	0. 18–0. 19	6. 1–7. 8	Very high.
ML	A–4	100	100	50–90	50–65	2. 0–6. 3	0. 14–0. 16	7. 4–8. 4	Low.
ML	A–4	100	100	50–90	60–75	2. 0–6. 3	0. 17–0. 20	7. 4–8. 4	Low.
SM or SP–SM	A–2 or A–3	100	100	50–90	5–15	6. 3–20. 0	0. 05–0. 08	7. 4–8. 4	Low.
SM	A–2	100	100	50–90	15–30	6. 3–20. 0	0. 05–0. 10	7. 4–8. 4	Low.
ML	A–4	100	100	50–90	70–90	2. 0–6. 3	0. 16–0. 18	7. 4–8. 4	Low.
SM or SP–SM	A–2 or A–3	100	100	50–90	5–15	6. 3–20. 0	0. 05–0. 08	7. 4–8. 4	Low.
CL	A–6 or A–7	100	100	100	70–80	0. 06–0. 20	0. 16–0. 18	5. 1–5. 5	Moderate.
CH	A–7	100	100	100	95–100	<0. 06	0. 18–0. 20	5. 1–7. 8	High.
CH	A–7	100	100	90–100	95–99	<0. 06	0. 18–0. 19	7. 4–8. 4	High.
CL	A–6	100	100	95–100	90–99	<0. 06	0. 18–0. 19	7. 4–8. 4	Moderate.
CH	A–7	100	100	90–100	95–99	<0. 06	0. 18–0. 19	7. 4–8. 4	High.
ML or CL	A–6 or A–4	100	100	95–100	85–95	0. 63–2. 0	0. 15–0. 20	7. 9–8. 4	Low.
CH	A–7	100	100	100	95–98	<0. 06	0. 18–0. 19	6. 6–8. 4	High.
CL	A–7	100	100	100	90–99	<0. 06	0. 18–0. 19	6. 6–8. 4	High.
CL	A–6 or A–7	100	100	100	70–80	0. 06–0. 20	0. 15–0. 18	7. 9–8. 4	Moderate.
CH	A–7	100	100	100	95–98	<0. 06	0. 18–0. 19	7. 9–8. 4	High.
ML	A–4	100	100	70–90	50–70	0. 63–2. 0	0. 17–0. 18	5. 6–6. 5	Low.
ML–CL	A–6	100	100	70–90	60–80	0. 06–0. 20	0. 15–0. 17	5. 1–5. 5	Moderate.

[4] For 2 to 6 months a year.
[5] For 1 to 6 months a year.

TABLE 4.—*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 such mapping units may have different

Soil series and map symbols	Suitability as a source of—		Degree of limitations and soil features affecting—				Farm ponds
	Topsoil	Road subgrade	Highway location	Foundations for low buildings	Septic tank filter fields	Sewage lagoons	Reservoir area
*Arenosa: AkB. For Kenney part of this unit, see the Kenney series in this table.	Poor: fine sand texture.	Good.	None to slight.	None to slight.	Severe: inadequate filtration.	Severe: very rapid permeability.	Severe: very rapid permeability.
Asa: As.	Fair: silty clay loam texture.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	None to slight.	None to slight.	Moderate: moderate permeability.	Moderate: moderate permeability.
*Bernard: BcA, BcB, BeA. For Edna part of BeA, see the Edna series in this table.	Fair: clay loam texture.	Poor: poor traffic-supporting capacity; high shrink-swell potential.	Severe: poor traffic-supporting capacity; high shrink-swell potential.	Severe: high shrink-swell potential; wetness.	Severe: very slow permeability.	Slight.	None to slight.
*Bruno: Br. Alluvial land part of this unit too variable to rate.	Poor where material is 2 to 6 inches thick; fair where material is 6 to 14 inches thick.	Good.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: flood hazard; depth of water table is less than 2 feet.	Severe: rapid permeability.	Severe: rapid permeability.
*Clemville: Cn. For Norwood part of this unit, see the Norwood series in this table.	Fair: silty clay loam texture.	Fair: fair traffic-supporting capacity.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: slow permeability; subject to flooding.	Slight.	None to slight.
Crowley: Cr.	Fair: 12 to 20 inches of material.	Poor: high shrink-swell potential.	Severe: high shrink-swell potential; poor traffic-supporting capacity; poorly drained.	Severe: high shrink-swell potential in subsoil; high compressibility; wetness.	Severe: wetness; very slow permeability.	Slight.	None to slight.
Earle: Ea.	Poor: clay texture.	Poor: high shrink-swell potential; poor traffic-supporting capacity.	Severe: high shrink-swell potential; poor traffic-supporting capacity.	Severe: high shrink-swell potential; poorly drained.	Severe: flood hazard; very slow permeability.	Moderate: fine sandy loam below a depth of 26 inches.	Moderate: moderately permeable material below a depth of 26 inches.
*Edna: EdA, EtA, EdB, Eh. For Tuckerman part of EtA, see the Tuckerman series in this table.	Poor: poorly drained.	Poor: high shrink-swell potential; poor traffic supporting capacity.	Severe: high shrink-swell potential; poorly drained; poor traffic-supporting capacity.	Severe: high shrink-swell potential.	Severe: very slow permeability; seasonal high water table.	Slight.	None to slight.
Hockley: HoB.	Good.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	None to slight.	Severe: moderately slow permeability.	Slight.	Moderate: moderately slow permeability.

interpretations of the soils

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]

Degree of limitations and soil features affecting—Continued				Soil features affecting—				
Farm ponds—Con.	Intensive camp and play areas	Picnic areas	Paths and trails	Agricultural drainage	Irrigation for—		Corrosivity	
Embankments					Rice	Crops other than rice	Uncoated steel	Concrete
Severe: poor stability; poor resistance to piping and erosion.	Severe: fine sand texture.	Moderate: fine sand texture.	Severe: fine sand texture.	Well drained	Very rapid permeability.	Low available water capacity; very rapid permeability.	Low	Low.
Moderate; medium compressibility.	Moderate: silty clay loam texture.	Moderate: silty clay loam texture.	Moderate: silty clay loam texture.	All features favorable.	Moderate permeability.	All features favorable.	Moderate: resistivity.	Low.
Moderate: fair slope stability; high compressibility.	Moderate: very slow permeability; clay loam texture; wetness.	Moderate: clay loam texture; wetness.	Moderate: clay loam texture; wetness.	Very slow permeability.	Surface drainage needed.	Very slow intake rate; surface drainage needed.	Very high: somewhat poorly drained; clay texture.	Low.
Severe: poor resistance to piping and erosion.	Severe: subject to flooding.	Moderate: clay loam texture; subject to flooding.	Moderate: clay loam texture; subject to flooding.	Subject to flooding.	Subject to flooding.	Subject to flooding.	Very low	High if pH is 5.1 to 5.5; moderate if pH is 5.6 to 6.0; low if pH is 6.1 to 7.3.
Moderate: medium compressibility.	Slight	Slight	Slight	Subject to flooding.	Subject to flooding.	Subject to flooding.	High: silty clay texture.	Low.
Moderate: high compressibility.	Severe: very slow permeability; wetness.	Severe: wetness	Severe: wetness	Very slow permeability.	Small mounds; surface drainage needed.	Very slow permeability.	High: sandy clay texture.	Low.
Moderate: moderately permeable material below a depth of 26 inches.	Severe: wetness; subject to flooding; clay texture; very slow permeability.	Severe: wetness; subject to flooding; clay texture.	Severe: wetness; clay texture.	Subject to flooding.	Subject to flooding; surface drainage needed.	Subject to flooding; runoff; very slow intake rate.	Very high: clay texture; drainage; somewhat poorly drained.	High if pH is 4.5 to 5.0; moderate if pH is 5.1 to 6.0.
Moderate: high compressibility.	Severe: very slow permeability; wetness.	Severe: wetness	Severe: wetness	Very slow permeability.	Small mounds; surface drainage needed.	Very slow permeability.	High: poorly drained; clay loam texture.	Low.
Moderate: fair stability.	Slight	Slight	Slight	All features favorable.	Small mounds; surface drainage needed.	All features favorable.	Moderate: sandy clay loam texture.	Low.

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TABLE 4.—*Engineering interpretations*

Soil series and map symbols	Suitability as a source of—		Degree of limitations and soil features affecting—				
	Topsoil	Road subgrade	Highway location	Foundations for low buildings	Septic tank filter fields	Sewage lagoons	Farm ponds: Reservoir area
Kenney: KeB	Poor: loamy fine sand texture.	Good	Slight	None to slight	Slight	Severe: rapid permeability between depths of 40 and 72 inches.	Severe: moderately rapid permeability to a depth of 40 inches; rapid permeability between depths of 40 and 72 inches.
*Konawa: KkC. For Kenney part of this unit, see the Kenney series in this table.	Fair where material is 6 to 20 inches thick; poor where material is 4 to 6 inches thick.	Fair: fair traffic-supporting capacity.	Moderate: fair traffic-supporting capacity.	None to slight	Moderate: 5 to 8 percent slopes.	Moderate if slopes are 5 to 7 percent, severe if slopes are 7 to 8 percent; moderate permeability.	Moderate: moderate permeability.
Lake Charles: LcA, LcB	Poor: clay texture.	Poor: poor traffic-supporting capacity; very high shrink-swell potential.	Severe: poor traffic-supporting capacity; very high shrink-swell potential.	Severe: very high shrink-swell potential.	Severe: very slow permeability.	Slight	None to slight
Lincoln. Mapped only in undifferentiated unit with Norwood soils.	Fair: 8 to 20 inches of material.	Fair: fair traffic-supporting capacity.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: rapid permeability.	Severe: rapid permeability.
Midland: Md	Poor: poorly drained.	Poor: poor traffic-supporting capacity; high shrink-swell potential; poorly drained.	Severe: poor traffic-supporting capacity; high shrink-swell potential; poorly drained.	Severe: poorly drained; high shrink-swell potential.	Severe: very slow permeability.	Slight	None to slight
Miller: Me, Mp	Poor: clay texture.	Poor: poor traffic-supporting capacity; high shrink-swell potential.	Severe: poor traffic-supporting capacity; high shrink-swell potential.	Severe: high shrink-swell potential.	Severe: very slow permeability.	Slight	None to slight
*Norwood: NoA, NoB, Nr. For Lincoln part of Nr, see the Lincoln series in this table.	Good	Fair: fair traffic-supporting capacity.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Moderate: moderate permeability.	Moderate: moderate permeability.
Pledger: Pc	Poor: clay texture.	Poor: poor traffic-supporting capacity; high shrink-swell potential.	Severe: poor traffic-supporting capacity; high shrink-swell potential.	Severe: high shrink-swell potential.	Severe: very slow permeability.	Slight	None to slight
Tuckerman: Tp	Poor: poorly drained.	Poor: poorly drained.	Severe: poorly drained.	Severe: poorly drained.	Severe: slow permeability; ponded.	Slight	None to slight

of the soils—Continued

Degree of limitations and soil features affecting—Continued				Soil features affecting—				
Farm ponds—Con.	Intensive camp and play areas	Picnic areas	Paths and trails	Agricultural drainage	Irrigation for—		Corrosivity	
Embankments					Rice	Crops other than rice	Uncoated steel	Concrete
Severe: poor stability; poor resistance to piping.	Moderate: loamy fine sand texture.	Moderate: loamy fine sand texture.	Moderate: loamy fine sand texture.	Well drained	Moderately rapid permeability.	Sloping relief	Low	Moderate if pH is 5.6 to 6.0.
Slight	Slight	Slight	Slight	Well drained	Moderate permeability.	Sloping relief	Moderate: sandy clay loam texture.	Moderate if pH is 5.1 to 6.0, and low if pH is 6.0 to 6.5
Moderate: fair slope stability; high compressibility.	Severe: wetness; clay texture.	Severe: clay texture; wetness.	Severe: wetness; clay texture.	Very slow permeability.	Surface drainage needed.	Very slow intake rate; surface drainage needed.	Very high: clay texture; drainage; somewhat poorly drained.	Low.
Severe: poor slope stability; poor resistance to piping and erosion.	Severe: subject to flooding.	Severe: subject to flooding.	Moderate: subject to flooding.	Subject to flooding.	Subject to flooding.	Subject to flooding.	Very low	Low.
Moderate: fair slope stability; high compressibility.	Severe: very slow permeability; wetness.	Severe: wetness	Severe: wetness	Very slow permeability.	Surface drainage needed.	Very slow intake rate; surface drainage needed.	Very high: clay texture; poorly drained.	Low.
Moderate: fair stability; high compressibility.	Severe: clay texture; very slow permeability.	Severe: clay texture.	Severe: clay texture.	Very slow permeability.	Surface drainage needed.	Very slow intake rate; surface drainage needed.	High: clay texture.	Low.
Moderate: hazards of piping and erosion.	Slight	Slight	Slight	Subject to flooding.	Subject to flooding.	All features favorable.	High: resistivity.	Low.
Moderate: fair slope stability; high compressibility.	Severe: wetness; clay texture; very slow permeability.	Severe: clay texture.	Severe: clay texture.	Very slow permeability.	Surface drainage needed.	Very slow intake rate; surface drainage needed.	High: resistivity; clay loam texture; moderately well drained.	Low.
Moderate: fair slope stability; medium compressibility; hazards of piping and erosion.	Severe: wetness; subject to flooding.	Severe: wetness; subject to flooding.	Severe: wetness; subject to flooding.	Depressional relief.	Surface drainage needed; depressional relief.	Depressional relief; very slow intake rate.	High: poorly drained; clay loam texture.	Moderate if pH is 5.1 to 6.0, and low if pH is 6.1 to 8.2.

Some of the terms used in this soil survey have special meaning to soil scientists not known to all engineers. Many of the terms commonly used in soil science are defined in the Glossary at the back of this survey.

Engineering classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system (*12*) used by the SCS engineers, Department of Defense, and others, and the AASHO system (*1*) adopted by the American Association of State Highway Officials.

In the Unified system soils are classified according to particle size distribution, plasticity, liquid limit, and content of organic matter. 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 AASHO 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, or the best soils for subgrade (foundation). At the other extreme, in group A–7, are clay soils that have low strength when wet and that are 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 estimated AASHO classification for all of the soils in Wharton County is shown in table 3.

Estimated properties of the soils

Several estimated soil properties significant in engineering are given in table 3. These estimates are made for typical soil profiles, by layers sufficiently different to have different significance for soil engineering. No laboratory analyses were made on soil samples in Wharton County. The estimates are based on field observations made in mapping and on experience with the same kinds of soil in other counties. Depth to bedrock is not shown in table 3, because bedrock is at a great depth in this county and is not significant to engineering.

The soils are placed in hydrologic groups in table 3. The groupings are based on estimates of the intake of water during the latter part of a storm of long duration. The estimates are of the intake of water in a soil without protective vegetation after the soil profile is wet and has swelled. The groups range from tight clays (highest runoff potential—group D) to open sands (lowest runoff potential—group A).

Soils in group A have a high infiltration rate, even when thoroughly wet. They have a high rate of water transmission and low runoff potential. The soils of this group are deep and well drained or excessively drained, and they consist chiefly of sand, gravel, or both.

Soils in group B have a moderate infiltration rate when thoroughly wet. Their rate of water transmission and their runoff potential are moderate. These soils are moderately deep or deep, moderately well drained or well drained, and fine textured to moderately coarse textured.

Soils in group C have a slow infiltration rate when thoroughly wet. Their rate of water transmission is slow, and their potential runoff is high. These soils are moderately fine textured to fine textured. Most of them have a layer that impedes the downward movement of water.

Soils in group D have a very slow infiltration rate when thoroughly wet. Their rate of water transmission is very slow, and runoff potential is very high. The soils in this group are chiefly clays that have a high shrink-swell potential. Most of them have a permanent high water table and a claypan or clay layer at or near the surface. Many of the soils are shallow over nearly impervious material.

In table 3 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.

Soil texture is described in table 3 in the standard terms used by the Department of Agriculture. These terms take into account relative percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 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, as for example, "gravelly loamy sand." "Sand," "silt," "clay," and some of the other terms used in USDA textural classification are defined in the Glossary of this soil survey.

The columns headed "Percentage passing sieve—" show the percentage of soil material that is smaller in diameter than the openings in the given sieve. Four different sieve sizes are given.

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 3 do not take into account lateral seepage or such transient soil features as plowpans and surface crusts.

Available water capacity is the ability of soils to hold water for use by most plants. It is commonly defined as the difference between the amount of water in the soil at field capacity and the amount at the wilting point of most crop plants.

Reaction is the degree of acidity or alkalinity of a soil, expressed as a pH value. The pH value and terms used to describe soil reaction are explained in the Glossary.

Shrink-swell potential, in table 3, refers to the change in volume of the soil that results from a change in moisture content. It is estimated on the basis of the amount and type of clay in the soil layers. In general, soils classified as A–7 and CH have high shrink-swell potential, as does most other nonplastic to slightly plastic soil material. Shrinking and swelling of soils does much damage to building foundations, roads, and other structures. A high shrink-swell potential indicates hazards to maintenance of structures constructed in, on, or with such materials.

Engineering interpretations of the soils

Table 4 rates the soils according to their suitability as a source of topsoil and road subgrade material. It also gives facts that would affect use of the soils as sites for highways, buildings, and sewage disposal systems and for agricultural engineering. The information is based on estimated engineering properties of the soils given in table 3 and on experience with the performance of these soils in the field. It applies only to the soil depths indicated in table 3, though the information is reasonably reliable to a depth of 6 feet for most of the soils.

Ratings of the suitability of the soils as a source of sand and gravel are not given in the table. Most of the soils are not suited to this use. The Miller and Norwood soils, however, contain a few deposits of sand and gravel at a depth of 5 to 20 feet.

Topsoil is fertile soil material ordinarily rich in organic matter, used as a topdressing for lawns, gardens, roadbanks, and the like. Some soil features that affect the ratings for this use are texture, thickness, and the content of organic matter and carbonates. Generally, only the surface layer is removed for topsoil, but other layers may also be suitable sources.

The ratings for road subgrade in table 4 indicate the performance of soil material moved from borrow areas for building embankments. Some soil features that affect the ratings for this use are thickness, texture, plasticity, traffic-supporting capacity, shrink-swell potential, and content of water.

Suitability of the soils for the location of highways is influenced by features of the undisturbed soils that affect the construction and maintenance of highways. Some features that affect the ratings are traffic-supporting capacity, shrink-swell potential, slope, and depth to bedrock.

The ratings in table 4 for foundations for low buildings are for structures not more than three stories high. Some soil properties in rating the soils are bearing capacity, shrink-swell potential, flooding hazard, depth to bedrock, and slope.

The population in and around Wharton County is continuing to grow as a part of the industrial development of the Houston metropolitan area. As a result, the demand for structures not related to farming is increasing. Land appraisers, realtors, city planners, builders, and others need to have facts that will help them to know what sites are suitable for homes and other buildings and what areas should be reserved for other uses. An important consideration in residential development is the suitability of the soils for sewage disposal systems.

The main features considered in choosing a site to be used as a reservoir for a farm pond are the rate of seepage, permeability, and depth to underlying material. Among the features considered in rating the suitability of the soils for use as embankment material are compressibility and resistance to piping and erosion.

Intensive camp and play areas are areas that are suitable for tent and camp trailer sites and accompanying activities for outdoor living for periods of at least one week. The suitability of the soils for septic tanks is not considered. Intensive play areas are developed for playgrounds and organized games such as baseball, badminton, volleyball, and the like. They are subject to intensive foot traffic. Generally needed are soils that are nearly level and have good drainage and texture and consistency that give a firm surface. Most of the soils in Wharton County have severe limitations for intensive camp and play areas because of wetness and their sticky clay texture.

Picnic areas are areas suitable for pleasure outings. Properties important in evaluating soils for picnic areas are wetness and soil texture. Most of the soils in Wharton County have moderate to severe limitations because of wetness and their sticky clay texture. The ratings and adverse features listed for picnic areas and intensive camp areas are based on soil features only and do not include other factors, such as the presence of trees or streams, which may affect the suitability of the site.

Paths and trails refer to suitability of the soils for trails to be used for cross-country hiking, bridle paths, and other uses that allow for the random movement of people. Most of the soils in this county have a moderate or severe limitation as a site for paths and trails. The main adverse soil features are wetness and the texture of the soil that limit the ease with which people can move about over the soil on foot, on horseback, or in such small vehicles as motor scooters or golf carts.

In Wharton County agricultural drainage is a major concern. Most of the soils of the county are nearly level and are very slowly permeable to slowly permeable. Consequently excess surface water is a problem that falls on many soils at some time during the growing season. Providing surface drainage is a way to remove excess water and to help keep crops other than rice from being waterlogged for long periods. Land grading or land smoothing is needed to smooth the surface of the soil and to make a slight slope so that excess surface water can be removed.

Rice, row crops, and pasture are grown under irrigation in Wharton County. Table 4 lists features that affect irrigation of rice and irrigation of crops other than rice. Rice is flooded several months during its growing season and is grown on nearly level soils that are slowly permeable to very slowly permeable. Keeping the surface nearly level helps to reduce the number of levees needed to hold the floodwater (fig. 13). Surface drainage is needed to remove excess surface water prior to harvesting.

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 for concrete is influenced mainly by the content of sodium or magnesium sulfate, but also 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 there is a low probability of soil-induced corrosion damage. A rating of *high* means that there is a high probability of damage, so that protective measures for steel and more resistant concrete should be

Figure 13.—Leveling and smoothing low mounds on an Edna fine sandy loam with a 70-foot plane before planting rice.

used to avoid or minimize damage. Steel pipes placed in any soil of the county require a protective coating that helps to retard corrosion.

Formation and Classification of Soils

In this section the factors that affect the formation of the soils in Wharton County are discussed and the current system of classification used in the United States is explained. The soil series in the county, including a profile representative of each series, are described in the section "Descriptions of the Soils."

Factors of Soil Formation

Soil is the product of the interaction of the five major factors of soil formation. These are parent material, climate, plants and animals, relief, and time. All of these factors affect the formation of each soil, but the relative importance of each factor differs from place to place.

Climate and vegetation are the active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it into a natural body with genetically related horizons. The effects of climate and vegetation are conditioned by relief. The parent material also affects the kind of profile that can be formed and, in extreme cases, determines it almost entirely. Finally, time is needed for the changing of the parent material into a soil profile. It may be much or little, but some time is always needed for horizon differentiation. Usually a long time is needed for the development of distinct horizons.

Parent material.—Parent material is the unconsolidated mass from which a soil forms. It determines the limits of the chemical and mineral composition of the soil.

The parent material of the soils of Wharton County consists of old alluvium and marine sediment laid down by ancient streams and the Gulf of Mexico. These materials consist mostly of clay and sandy clay mixed with some clay loam, silt, and sand. They originated from many kinds of soils, rocks, and unconsolidated sediment that existed throughout the flood plains of the ancient streams. The parent material of the soils along the flood plains of the Colorado River, Caney Creek, and the San Bernard River is recent sandy and silty alluvium derived from the highly weathered soils of Central Texas.

The parent material of some soils in Wharton County varies widely in texture because of its mode of origin. Soils formed from such material differ in texture and may also differ in chemical and mineralogical composition. For example, soils that formed in sandy sediment generally contain more quartz than soils that formed in finer textured material. They also are more siliceous and lower in bases.

The parent material was segregated to some extent when it was deposited by the ancient streams and the Gulf of Mexico. This segregation is still occurring on present deltas. As rivers flood their channels, water spreads out over the flood plain and the coarser sediment is dropped first. As the floodwaters continue to spread, they move more slowly and deposit finer sediment, such as silt. After the flood has passed, still water remains in the lower areas of the flood plains and even finer sediment, or clay, settles out.

As the material was deposited, the stream channels cut back and forth across much of their flood plain and in places cut out natural levees. In places the streams deposited sand on top of clay, or clay on top of sand. After the material was deposited, it was modified to some extent by wind and water and then by other soil-forming processes.

Climate.—Throughout Wharton County climate has been a uniform factor in soil development but has made only a slight impression on the soils.

In general, in areas that have a humid, subtropical climate are strongly weathered, leached, acid soils that have low fertility. The soils of Wharton County, however, are young, and time has not been sufficient to allow strong weathering of the sediment in place. The parent material has come mostly from the parts of the country where weathering was not intense. Thus, the kinds of soil generally associated with a subtropical, humid climate do not occur in this county.

Plants and animals.—Plants, animals, insects, earthworms, bacteria, and fungi are important in the formation of soils for the changes their activity brings about as the soils form. Among these changes are gains in organic matter and nitrogen, gains and losses in nutrients, and changes in the structure and porosity of the soils.

In this county plants have affected soil formation more than other organisms. The main differences in the native vegetation under which the soils formed apparently are associated with drainage and salinity. Swampy areas on the flood plains had a cover of cypress trees, grasses, and sedges that could tolerate wetness. In these areas the water is fresh, the water table is permanently high, and the areas seldom are dry to a depth of more than 20 inches. As a result, the soils that formed have a large amount of organic matter on the surface. Examples are Miller clay, ponded, and Norwood silt loam, 3 to 8 percent slopes.

Soils that formed under dense stands of grass, on the other hand, contain more organic matter and are darker to a greater depth than soils that formed under trees.

Also they are less acid and are not leached of bases to so great a depth. Crowley soils, Lake Charles clay, and Edna soils are examples of soils that formed under a dense cover of grass.

Man, through farming, also has changed the soils by changing the kind of vegetation growing on them. Through repeated clearing of the trees and grass, cultivating of the soils, introducing new plant species, adding fertilizer, lime, or sulfur, and building of structures to improve natural drainage and provide irrigation, man continues to influence the kind of soils that form in the county and their rate of development.

Relief.—Relief, or lay of the land, influences soil formation, primarily by its effect on drainage and runoff. Most of Wharton County is a level, featureless plain that has been dissected slightly by streams. The highest elevation is in the northwest corner. From this corner, the slope is gradual and in a southern or southeastern direction toward the Gulf of Mexico. Slopes throughout the county generally are less than one-half percent, though slopes adjacent to the stream channels of the San Bernard River and its tributaries are steeper.

Because the soils are level or nearly level, drainage is slow in most areas. Water moves into the main channels with difficulty.

The way in which the parent material formed and was deposited caused most of the relief in Wharton County. The more sandy material was deposited on the slightly elevated ridges throughout the county by salt water, fresh water, or wind. These areas are well enough drained and sandy enough to allow the leaching of lime and the movement of some clay from the surface into the lower layers by downward percolation of rainwater.

The soils on the more recent deposits of alluvium are weakly developed. Here the major influence in development is the kind and amount of vegetation that grows and has accumulated on the soils.

Time.—Generally a long time is required for a soil to form. Some soils, such as those that formed in alluvium on flood plains have been in place too short a time for distinct horizons to form. Most of the soils on uplands, however, have been in place long enough for distinct horizons to form. Thus, the length of time that parent materials have been in place commonly is reflected in the degree of development of the soil profile. The importance of time as a factor in soil formation always depends on its combination with other factors.

The soils of Wharton County show little evidence that time has been the cause of differences among them. Time has been an important factor, however, in the development of differences between soils that formed on alluvium and in marshes and the other soils of the county. Even though some of the soils on uplands may be older than others, the differences among them are small.

Classification of 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 the use of soil maps, we can apply our knowledge to specific fields and other tracts of land.

Thus, in classification, soils are placed in narrow categories that are used in detailed soil surveys so that knowledge about the soils can be organized and applied in farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. They are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (*2*) and later revised (*9*). The system currently used was adopted for general use by the National Cooperative Soil Survey in 1965. It is under continual study (*8*, *10*). Therefore, readers interested in developments of the current system should search the latest literature available. In table 5 the soil series of Wharton County are placed in some categories of the current system.

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 measurable. The properties are chosen, however, so that the soils of similar origin are grouped together. The classes of the current system are briefly defined in the following paragraphs.

ORDERS: Ten soil orders are recognized. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate these soil orders are those that tend to give broad climatic groupings of soils. Two exceptions, the Entisols and Histosols, occur in many different kinds of climate. The five soil orders in Wharton County are Alfisols, Entisols, Inceptisols, Mollisols, and Vertisols.

Alfisols are soils that have a clay-enriched B horizon that is high in base saturation.

Entisols are recent soils that do not have genetic horizons or that have only the beginnings of such horizons.

Inceptisols generally form on young, but not recent, land surfaces; hence, their name is derived from the Latin *inceptum*, for beginning. These soils have weakly developed or incipient horizons.

Mollisols are soils that have high base supply, a dark A horizon that is friable or soft, and a high content of organic matter.

Vertisols are soils in which natural churning or inversion of soil material takes place, mainly through the swelling and shrinking of clays.

SUBORDERS: Each order is subdivided into suborders, primarily on the basis of those soil characteristics that seem to produce classes having the greatest similarity from the standpoint of their genesis. Suborders narrow the broad climatic range of soils that are in the orders. Soil properties used to separate suborders mainly reflect either the presence or absence of waterlogging or soil differences produced through the effects of climate or vegetation.

GREAT GROUPS: Soil suborders are separated into great groups on the basis of uniformity in the kinds and

TABLE 5.—*Classification of soils by higher categories*

Series	Family	Subgroup	Order
Arenosa	Siliceous, thermic, coated	Typic Quartzipsamments	Entisols.
Asa	Fine-silty, mixed, thermic	Fluventic Haplustolls	Mollisols.
Bernard	Fine, montmorillonitic, thermic	Vertic Argiaquolls	Mollisols.
Bruno	Sandy, mixed, thermic	Typic Udifluvents	Entisols.
Clemville	Fine-silty, mixed (calcareous), thermic	Typic Udifluvents	Entisols.
Crowley [1]	Fine, montmorillonitic, thermic	Typic Albaqualfs	Alfisols.
Earle	Clayey over loamy, montmorillontic, acid, thermic	Vertic Haplaquepts	Inceptisols.
Edna	Fine, montmorillonitic, thermic	Vertic Albaqualfs	Alfisols.
Hockley	Fine-loamy, mixed, thermic (siliceous)	Plinthic Paleudalfs	Alfisols.
Kenney	Loamy, mixed, thermic (siliceous)	Grossarenic Paleudalfs	Alfisols.
Konawa	Fine-loamy, mixed, thermic	Ultic Haplustalfs	Alfisols.
Lake Charles	Fine, montmorillonitic, thermic	Typic Pelluderts	Vertisols.
Lincoln	Sandy, mixed, thermic	Typic Ustifluvents	Entisols.
Midland	Fine, montmorillonitic, thermic	Vertic Ochraqualfs	Alfisols.
Miller	Fine, mixed, thermic	Vertic Haplustolls	Mollisols.
Norwood	Fine-silty, mixed (calcareous), thermic	Typic Udifluvents	Entisols.
Pledger [2]	Fine, mixed, thermic	Udertic Haplustolls	Mollisols.
Tuckerman [3]	Fine-loamy, mixed, thermic	Typic Ochraqualfs	Alfisols.

[1] The soils of Wharton County named for this series are outside the range of the series in that they have more than 30 percent sand in the B horizon.

[2] The soils of Wharton County named for this series are outside the range of the series in that they have secondary lime within 60 inches of the soil surface, and colors in the B horizon are yellower than 7.5YR in hue.

[3] The soils of Wharton County named for the series are outside the range of the series in that they include browner colors in the B horizon.

sequence of major soil horizons and other features. The horizons used as a basis for distinguishing between great groups are those in which (1) clay, iron, or humus have accumulated; (2) a pan has formed that interferes with growth of roots, movement of water, or both; or (3) a thick, dark-colored surface horizon has formed. The other features commonly used are the self-mulching properties of clay, temperature of soil, major difference in chemical composition (mainly calcium, magnesium, sodium, and potassium), or the dark-red or dark-brown colors associated with soils formed in material weathered from basic rocks.

SUBGROUPS: Great soil groups are subdivided into subgroups. One of these represents the central or typic segment of the group. Other subgroups have properties of the group but have one or more properties of another great group, subgroup, or order, and these are called intergrades. Subgroups may also be made for soils that have properties that 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 Udifluvents.

Additional Facts About the County

This section provides facts about the climate of Wharton County. It also gives information about the geology of the county.

Climate [2]

Wharton County has a humid, subtropical climate characterized by warm to hot summers. Prevailing winds are southeasterly to south-southeasterly except in November through February, when frequent passages of high pressure areas bring invasions of polar air and prevailing northerly winds. The nearby Gulf of Mexico, a body of warm water, gives the county many of the characteristics of a mild, marine climate.

Table 6 gives temperature data at the weather station at Pierce for the period 1937–66. Table 7 gives precipitation data at the weather stations at Pierce and at Wharton for the same period.

In summer, the days are warm and humid and a few nights are hot. Breezes from the Gulf diminish in summer and early in fall. The highest temperature recorded at Pierce was 108°, on August 14, 1962.

Winter in Wharton County alternates between clear, cool, dry weather and cloudy, mild, drizzly weather as cold fronts move down from the north and then are pushed back by the warm air lying over the Gulf of Mexico. On about 24 days a year, the minimum temperature drops below 32° F., but seldom does the temperature remain below freezing during the afternoon. The lowest temperature recorded at Pierce since 1907 was 4° above zero on January 31, 1949.

Spring is marked by mild days, brisk winds, and frequent showers. Strong southeasterly to south-southeasterly winds begin in March and diminish toward the end of May. Cloudiness is common, and nearly 50 percent of the days in spring have overcast or nearly overcast skies.

The first norther generally arrives near the beginning of fall late in September. In October and November the days are clear and temperatures are mild; nights are cool. Changes in weather from day to day are common.

The average annual rainfall in Wharton County is 38 to 44 inches. The eastern part of the county generally receives more than the western part over a long period of years. Generally, however, rainfall is fairly evenly

[2] By ROBERT B. ORTON, State climatologist, National Weather Service, U.S. Department of Commerce.

TABLE 6.—*Temperature data taken at Pierce*

[Period of record 1937–66]

Month	Average daily maximum	Average daily minimum	Average	Average maximum	Average minimum	Average [1] number of days with—			
						Maximum temperature of—		Minimum temperature of—	
						90° F. or above	32° F. or below	32° F. or below	0° F. or below
	°F.	°F.	°F.	°F.	°F.	Number	Number	Number	Number
January	62.7	40.5	51.6	79	22	0	(2)	9	0
February	66.6	44.3	55.5	81	27	0	0	5	0
March	72.6	49.0	60.8	85	31	0	0	2	0
April	79.5	57.9	68.7	88	40	1	0	0	0
May	85.8	65.3	75.6	92	53	7	0	0	0
June	91.1	70.9	81.0	96	64	22	0	0	0
July	93.6	72.6	83.1	99	69	28	0	0	0
August	94.1	72.1	83.1	99	67	27	0	0	0
September	89.9	67.8	78.9	97	56	20	0	0	0
October	83.5	58.5	71.0	92	43	5	0	0	0
November	73.0	48.7	60.9	86	31	(2)	0	2	0
December	65.9	42.9	54.4	80	26	0	0	6	0
Year	79.9	57.5	68.7	99	22	110	(2)	24	0

[1] Based on 11-year average from 1956–66. [2] Less than one-half day.

TABLE 7.—*Precipitation data for two weather stations in Wharton County*

PIERCE, TEXAS

Month	Average total	Greatest daily	1 year in 10 will have—		Average [1] number of days with precipitation of—		
			Less than—	More than—	0.10 inch or more	0.50 inch or more	1.00 inch or more
January	2.82	2.32	0.88	4.10	5	2	1
February	2.92	2.50	.36	4.37	6	3	1
March	2.24	3.15	.46	4.32	3	1	1
April	3.00	3.58	.54	6.50	5	2	1
May	3.83	7.35	.43	7.86	4	2	1
June	4.20	6.49	1.23	8.11	6	3	2
July	3.38	4.80	.74	6.29	5	2	1
August	3.51	8.32	.58	7.20	6	2	1
September	3.92	3.07	1.27	7.59	6	3	1
October	3.94	4.91	.16	10.56	5	3	2
November	3.27	10.55	.65	5.97	5	2	1
December	3.22	3.25	1.00	4.99	6	2	1
Year	40.25	10.55	26.42	57.78	62	27	14

WHARTON, TEXAS

Month	Average total	Greatest daily	Less than—	More than—	0.10 inch or more	0.50 inch or more	1.00 inch or more
January	2.66	2.48	0.61	4.70	4	2	1
February	2.89	3.53	.40	4.73	6	2	1
March	2.27	4.65	.34	4.28	3	1	1
April	2.85	3.30	1.06	6.45	6	2	1
May	3.60	6.15	.61	7.21	4	2	1
June	3.84	7.48	.70	6.92	6	3	1
July	3.25	5.31	.61	6.00	4	2	1
August	2.82	6.90	.22	6.70	5	2	1
September	3.91	9.69	.74	7.30	6	2	1
October	3.99	5.03	.08	8.58	5	2	1
November	2.86	8.40	.54	5.84	5	2	1
December	3.13	3.60	.99	5.00	6	2	1
Year	38.07	9.69	24.37	53.95	60	24	12

[1] Based on 11-year average, 1956–66.

distributed throughout the year. March is the driest month. Because much of the precipitation is convective, the supply of moisture is abundant. Also, excessive rains of short duration frequently occur, especially from the middle of April to early in October. Thunderstorms are common at this time. The most persistent rains generally are associated with warm fronts and stationary fronts during the colder season and with tropical lows during the summer and early in fall. The wettest year recorded since 1904 at Pierce was in 1941, when heavy rains in summer and fall made up a total of 63.05 inches for the year. The driest year on record was 1917, when only 20.54 inches of precipitation was recorded.

The amount of snowfall in the county is small, or only about 0.5 inch annually. On February 12, 1960, a snowfall of 8 inches was recorded at Pierce, but in the 6-year period after 1960, no measurable snow fell in Wharton County.

The growing season, or the average number of days between the last reading of 32° or below in spring and the first occurrence of 32° or below in fall, is 266 days. The average date of the last reading of 32° or below in spring is March 5, and the first date in fall is November 26.

The average annual relative humidity at various hours, Central Standard Time, is 87 percent at 6:00 a.m., 60 percent at noon, and 65 percent at 6:00 p.m. These averages vary only slightly from season to season. The sun shines in Wharton County about 64 percent of the possible hours annually. The estimated average annual lake evaporation is 54 inches.

Wharton County is subject to a few tropical disturbances late in summer and early in fall. Torrential rains, and on a few occasions destructive winds, also accompany these storms. Six tornadoes have touched ground in the county during the period 1959–66. Damaging hailstorms occur, but not frequently.

Geology [3]

Wharton County lies in the Coastal Plain of Texas. The soils are underlain by Pleistocene formations that dip gently toward the Gulf of Mexico and in places have a cover of Recent alluvium. The geologic formations and alluvial deposits can roughly be correlated with the soil associations in the county. Each soil association is described under the heading "General Soil Map," and its location is shown on the general soil map at the back of this publication.

The youngest soils in the county are those that formed on Recent alluvium laid down by the meandering Colorado River. These soils are all within the Miller-Norwood association. The sandier soils are on the coarser stream sediment adjacent to meandering streams, such as those in channels, point bars, and levees. The Recent alluvium branches out just south of Wharton.

The Colorado River is actively eroding the south wall of the valley west of Wharton. South of Wharton this river flows through a narrow belt of alluvium. Caney Creek occupies a former course of the Colorado River. It flows along the northern part of the alluvial valley west of Wharton and through the much broader alluvial plain east of Wharton. The elapsed time since diversion was not enough to cause any significant soil differences within the soils that formed from alluvium adjacent to the Colorado River and Caney Creek.

The upland areas of the county are underlain by three Pleistocene formations that cannot be readily correlated with specific soil associations. In general, however, the two large areas of the Crowley association in the northern and western parts of the county formed on the two older formations, the Montgomery and the Bentley, respectively. The rest of the associations on the uplands, the Edna-Crowley association, the Edna-Bernard association, and the Lake Charles association, are all underlain by the younger Beaumont Clay. The soils in all of the associations formed on alluvium or on deltas.

Because of its alluvial origin, the Beaumont Clay has a poorly defined relict pattern of deposition. Roughly, the Beaumont Clay underlies linear belts of the sandier soils, such as the Edna, Crowley, and Bernard, that make up the principal associations, and intervening areas of clayey Lake Charles soils. The sandier belts are mostly the main areas of relict stream channels, levees, and point bars, and the intervening clay areas are the former backswamps. The outlines of the meandering channel segments and oxbows, some of which are occupied by Tuckerman soils, can be seen in the sandier belts on air photos of the county.

The areas of Lake Charles soils are smooth and featureless. The Colorado River during the Pleistocene age successively shifted laterally and then crisscrossed and meandered and consequently helped build up the deposits of the Beaumont Clay. Similar depositional patterns can be seen in areas to the east of Wharton County.

The two older Pleistocene formations, the Montgomery and the Bentley, were part of what was formerly called the Lissie Formation (*6*, *4*). The Montgomery Formation is equivalent to the upper part, or younger, of this formation, and the Bentley is equivalent to the lower, or older, part (*3*).

The Montgomery Formation generally is the parent material for the soils of the Crowley association in the southern part of the county. The Bentley Formation is the parent material for the Crowley association in the northern part of the county. The Montgomery Formation was never deposited extensively in the northern part of the county, or it was partly washed away and later covered by the Beaumont Clay or by Recent alluvium. Both formations are similar to the Beaumont Clay in origin, but the relatively clear relict pattern of deposits typical of the Beaumont Clay is not apparent. The more recent deposits were probably removed through mass wasting, wetting and drying cycles, and local erosion by water and wind occurring over a long period and under climates considerably different than the present one.

The deposits laid down during Pleistocene age are related to the repeated fluctuations of the sea level during the major advances and retreats of the continental ice sheets in North America and elsewhere in the past 1 to 3 million years. During the periods of ice advance, the sea level fell, in places as much as 450 feet below the present sea level, as the water was abstracted from the oceans to

[3] By SAUL ARONOW, Department of Geology, Lamar State College of Technology, based on reconnaissance mapping and a preliminary compilation made for the Texas Bureau of Economic Geology.

form the glaciers. All of the major streams of the Gulf Coast, including the Colorado River, deepened their channels and flowed across the continental shelf. These streams discharged into the Gulf of Mexico many miles beyond the present shoreline.

When the glaciers melted, the sea level rose and the deepened valleys were filled again. Broad coalescing alluvial plains were deposited along the margins of the Gulf of Mexico. These alluvial plains make up the Pleistocene formations, and the present alluvial plains along the Colorado River are formed from these deposits.

The level of the sea began to rise to its present position about 25,000 years ago, and it reached its present level about 5,000 years ago (*3*). During this time the Colorado River filled its deepened channel and built up its alluvial plain, now the Caney Creek, to its present height. Recently, within the past several hundred to several thousand years, the Colorado River has been diverted from its old Caney Creek course to its present course along the south wall of the alluvial valley and in the narrow alluvial belt south of Wharton (*5*, *7*). The course south of Wharton most likely occupies the much enlarged channel of a minor stream that is headed in the direction of the larger alluvial plain. The diversion may be related to faulting and regional tilting in the Eagle Lake area to the north where Caney Creek originates (*7*).

The Beaumont Clay in many parts of the Gulf Coast is older than 40,000 years according to radiocarbon dating of fragments of wood and shell. All of this material, however, is considered beyond the range of accurate analysis. The Beaumont Clay was deposited during the interglacial age, or the period of ice retreat, and is considered mid-Wisconsin (*3*) in age. The older deposits of Beaumont Clay are considered between the Wisconsin and Illinoian in age, or the Sangamon, and are about 70,000 years old. Formations older than this are well beyond the current range of radiocarbon dating, and their age is considered in terms of hundreds of thousands of years.

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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.

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is low from this cause.

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.

Caliche. A more or less cemented deposit of calcium carbonate in many soils of warm-temperate areas, as in the Southwestern States. The material may consist of soft, thin layers in the soil or of hard, thick beds just beneath the solum, or it may be exposed at the surface by erosion.

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.

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.

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 the 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.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

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.

Gleyed soil. A soil in which waterlogging and lack of oxygen have caused the material in one or more horizons to be neutral gray in color. The term "gleyed" is applied to soil horizons with yellow and gray mottling caused by intermittent waterlogging.

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:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms 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 sesequioxides (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.

Humus. The well-decomposed, more or less stable part of the organic matter in mineral soils.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to relatively level plots surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops, or in orchards, to confine the flow of water to one direction.

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.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Irrigation water, released at high points, flows onto the field without controlled distribution.

Loam. The textural class name for a soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand.

Microrelief. Minor surface configurations of the land.

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.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

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.

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	Very strongly alkaline	
Slightly acid	6.1 to 6.5		9.1 and higher

Saline soil. A soil that contains soluble salts in amounts that impair growth of plants but that does not contain excess exchangeable sodium.

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.

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.

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.

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).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

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 (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 topdress roadbanks, lawns, and gardens.

Upland (geological). Land consisting of material unworked by water in recent geologic time and lying, in general, at a higher elevation than the alluvial plain or stream terrace. Land above the lowlands along rivers.

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.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and the soil series to which the mapping unit belongs. In referring to a capability unit read the introduction to the section it is in for general information about the management. For discussion of wildlife sites, see section beginning on page 24 . Other information is given in tables as follows:

Acreage and extent, table 1, page 5.
Estimated yields, table 2, page 22.

Engineering uses of the soils, tables 3 and 4, pages 26 through 33.

Map symbol	Mapping unit	Described on page	Capability unit Symbol	Capability unit Page	Pasture group Name	Pasture group Page
AkB	Arenosa and Kenney soils, undulating-------------	6	IIIs-2	21	9A	24
As	Asa silty clay loam------------------------------	6	I-2	19	2B	24
BcA	Bernard clay loam, 0 to 1 percent slopes---------	7	IIw-1	20	7D	24
BcB	Bernard clay loam, 1 to 3 percent slopes---------	7	IIe-5	20	7B	24
BeA	Bernard-Edna complex, 0 to 1 percent slopes------	7	IIIw-1	21	7D	24
Br	Bruno soils and Alluvial land--------------------	8	Vw-1	22	2B	24
Cn	Clemville-Norwood complex------------------------	8	I-2	19	2B	24
Cr	Crowley fine sandy loam--------------------------	9	IIIw-3	21	7D	24
Ea	Earle soils--------------------------------------	10	Vw-1	22	1B	23
EdA	Edna fine sandy loam, 0 to 1 percent slopes------	10	IIIw-1	21	7D	24
EdB	Edna fine sandy loam, 1 to 3 percent slopes------	10	IIIe-1	20	7B	24
Eh	Edna soils, overwash-----------------------------	11	IIw-3	20	7D	24
EtA	Edna-Tuckerman complex, 0 to 1 percent slopes----	11	IIIw-1	21	7D	24
HoB	Hockley fine sandy loam, 0 to 3 percent slopes---	12	I-1	19	8C	24
KeB	Kenney loamy fine sand, 0 to 3 percent slopes----	12	IIIs-2	21	9A	24
KkC	Konawa-Kenney complex, 5 to 8 percent slopes-----	12	IIIe-2	20	8C	24
LcA	Lake Charles clay, 0 to 1 percent slopes---------	13	IIw-2	20	7L	24
LcB	Lake Charles clay, 1 to 3 percent slopes---------	13	IIe-1	19	7L	24
Md	Midland clay loam--------------------------------	15	IIIw-1	21	7D	24
Me	Miller clay--------------------------------------	15	IIs-4	20	1A	23
Mp	Miller clay, ponded------------------------------	15	IIIw-2	21	1B	23
NoA	Norwood silt loam, 0 to 1 percent slopes---------	16	I-2	19	2B	24
NoB	Norwood silt loam, 3 to 8 percent slopes---------	16	IIIe-3	21	2B	24
Nr	Norwood and Lincoln soils------------------------	16	Vw-2	22	2B	24
Pc	Pledger clay-------------------------------------	17	IIw-3	20	1B	23
Tp	Tuckerman soils, ponded--------------------------	18	IVw-1	21	8F	24

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