SOIL SURVEY OF

Coal County, Oklahoma

Issued July 1974

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

Major fieldwork for this soil survey was done in the period 1962-68. Soil names and descriptions were approved in 1969. Unless otherwise indicated, statements in this publication refer to conditions in the county in 1969. This survey was made cooperatively by the Soil Conservation Service and the Oklahoma Agricultural Experiment Station. It is part of the technical assistance furnished to the Coal 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 farming, industry, and recreation.

Locating Soils

All the soils of Coal County are shown on the detailed map at the back of this survey. 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 pasture and hayland group, range site, and woodland suitability group in which the soil has been placed.

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

Foresters and others can refer to the section "Use of the Soils as Woodland," where the soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Use of the Soils for Wildlife Habitat."

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

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

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

Newcomers in Coal 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 the section "General Nature of the County."

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SOIL SURVEY OF COAL COUNTY, OKLAHOMA

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SOIL CONSERVATION SERVICE

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

COAL COUNTY is located in the southeastern part of Oklahoma (fig. 1). It has an area of 336,640 acres, or 526

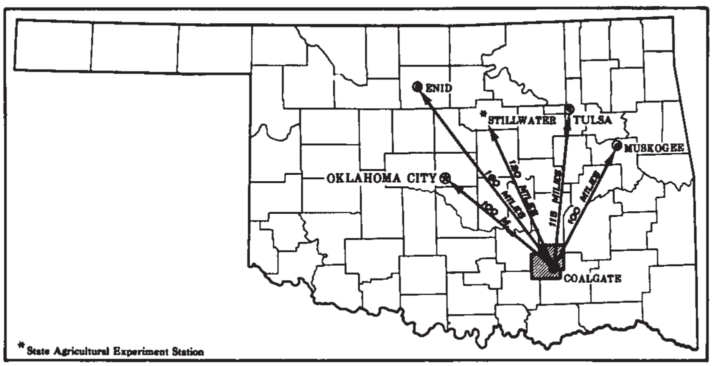

Figure 1.—Location of Coal County in Oklahoma.

square miles. The county seat is Coalgate, which has a population of about 1,700.

Raising beef cattle is the chief enterprise in the county. The principal farm crops are cotton and alfalfa. Most of the crops are grown in the southwestern part of the county on nearly level to gently sloping uplands and on the flood plains along Clear Boggy Creek.

The soils of Coal County are about equally divided between those formed under woodland and those formed under grasses.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Coal 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 they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey (*5*).[1]

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. Bates and Parsons, 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 indicates a feature that affects management. For example, Bates fine sandy loam, 1 to 3 percent slopes, is one of several phases within the Bates 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 survey 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. Three such kinds of mapping units are shown on the soil map of Coal County—the soil complex, the soil variant, and the undifferentiated group.

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

[1] Italic numbers in parentheses refer to Literature Cited, page 58.

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.

A soil variant has properties sufficiently different from those of other known soils to suggest establishing a new soil series, but it is a soil of such limited known area that creation of a new series is not believed to be justified.

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." Bates and Bonham soils, 2 to 5 percent slopes, severely eroded, 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. Mine pits and dumps is a land type in Coal 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 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 survey shows, in color, the soil associations in Coal County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

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

Not all soil boundaries and names on the Coal County General Soil Map join those on maps of Hughes County, which was surveyed earlier. Most differences result from refinement in the current system of soil classification.

The eight soil associations in Coal County are described in the pages that follow. The terms for texture used in the title for each association apply to the surface layer. For example, in the title for association 1, the words "loamy soils" mean that the surface layer of the major soils is loamy.

1. Lanton-Ennis-Robinsonville Association

Deep, nearly level to gently sloping, loamy soils underlain by loamy or clayey sediment; on flood plains

Lanton soils make up about 50 percent of this association, Ennis soils about 15 percent, Robinsonville soils about 15 percent, and minor soils about 20 percent. This association makes up about 8 percent of the county.

Lanton soils are deep, nearly level and gently sloping, and poorly drained. They have a loamy surface layer that is underlain by loamy or clayey sediment.

Ennis soils are deep, nearly level and gently sloping, and well drained. These soils are loamy throughout.

Robinsonville soils are deep, nearly level to gently sloping, and well drained. They are loamy throughout.

Minor soils in this association are in the Lightning and Carytown series.

Most of the acreage is used for tame pasture, range, or woodland. The main crops are alfalfa, grain sorghum, and cotton. Chief management concerns are maintaining soil structure, installing drainage systems, and providing protection against damaging overflow.

2. Crockett-Burleson-Wilson Association

Deep, nearly level to gently sloping, loamy and clayey soils that have a clayey subsoil over clayey sediment or shale; on uplands

Crockett soils make up about 28 percent of this association, Burleson soils about 25 percent, Wilson soils about 15 percent, and minor soils the remaining 32 percent. The association makes up about 5 percent of the county.

Burleson soils are deep, nearly level and gently sloping, and moderately well drained. These soils are clayey throughout.

Crockett soils are deep, very gently sloping to gently sloping, and moderately well drained. These soils are loamy, and they have a clayey subsoil.

Wilson soils are deep, nearly level, and somewhat poorly drained. They are loamy but have a clayey subsoil.

Minor soils in the association are in the Carytown, Chaney, and Steedman series.

The soils in this association are used for cultivated crops, tame pasture, and range. The main crops are small grain, cotton, grain sorghum, and alfalfa.

Chief management concerns are maintaining soil structure and fertility and controlling water erosion.

3. Homa-Rock Outcrop Association

Deep, moderately steep and steep, loamy soils that have a clayey subsoil over shale or clay, and rock outcrops; on uplands

Homa soils make up about 65 percent of this association, Rock outcrop about 12 percent, and minor soils about 23 percent. This association makes up about 15 percent of the county.

Homa soils are deep, moderately steep and steep, moderately well drained, loamy soils. They have a clayey subsoil. Rock outcrop is mostly sandstone.

Minor soils in this association are in the Hartsells, Lanton, Robinsonville, and Steedman series.

Soils in this association are used for range. Their use for tame pasture and cultivated crops is impractical because of the steep slopes and rock outcrops. Some small areas support trees of commercial potential. Other areas are in tame pasture. Chief management concerns are steep slopes and rock outcrops.

4. Hartsells-Homa Association

Moderately deep and deep, very gently sloping to sloping, loamy soils that have a loamy or clayey subsoil over shale, clay, or sandstone; on uplands

Hartsells soils make up about 42 percent of this association, Homa soils about 28 percent, and minor soils about 30 percent. This association makes up about 28 percent of the county.

Hartsells soils are moderately deep, very gently sloping to sloping, and well drained. They are loamy throughout.

Homa soils are deep, very gently sloping and gently sloping, moderately well drained, loamy soils. They have a clayey subsoil.

Minor soils in this association are in the Chaney, Dougherty, Konawa, Steedman, and Stidham series.

The soils in this association are used mainly for range and tame pasture. A small acreage is used for cultivated crops. The main crops are peanuts, grain sorghum, and cotton.

Chief management concerns are maintaining soil fertility, controlling water erosion in cultivated areas, and controlling brush on the range and in areas used for tame pasture.

5. Talpa-Rock Outcrop Association

Very shallow and shallow, sloping to steep, loamy soils over limestone, and rock outcrops; on uplands

Talpa soils make up about 55 percent of this association, Rock outcrop about 25 percent, and minor soils about 20 percent. This association makes up about 2 percent of the county.

Talpa soils are very shallow and shallow, sloping to steep, and well drained. They are loamy throughout. Rock outcrop is mostly limestone.

Minor soils in this association are in the Burleson, Ferris, and Steedman series.

Because the soils are shallow and steep, nearly all of this association is used for range.

The chief management concern is the invasion of brush and weeds in areas that have been poorly managed.

6. Steedman-Collinsville Association

Moderately deep to very shallow, very gently sloping to steep, loamy soils that have a clayey or loamy subsoil over shale or sandstone; on uplands

Steedman soils make up about 70 percent of this association, Collinsville soils about 20 percent, and minor soils about 10 percent. This association makes up about 2 percent of the county.

Steedman soils are moderately deep, very gently sloping to steep, well-drained, loamy soils that have a clayey subsoil.

Collinsville soils are very shallow and shallow, sloping to moderately steep, and well drained to somewhat excessively drained. They are loamy throughout.

Minor soils in this association are in the Bates and Bonham series.

The soils in this association are used mostly for range and tame pasture. A small acreage is used for cultivated crops. Crops commonly grown are small grain and grain sorghum. The chief concerns of management are shallowness and steep slopes.

7. Bonham-Bates-Parsons Association

Deep and moderately deep, nearly level to gently sloping, loamy soils that have a clayey and loamy subsoil over sandstone, shale, or loamy or clayey sediment; on uplands

Bonham soils make up about 30 percent of this association, Bates soils about 15 percent, Parsons soils about 12 percent, and minor soils about 43 percent. This association makes up about 35 percent of the county.

Bonham soils are deep, very gently sloping to gently sloping, moderately well drained, loamy soils. They have a clayey subsoil.

Bates soils are moderately deep, very gently sloping to gently sloping, and well drained. They are loamy throughout.

Parsons soils are deep, nearly level to very gently sloping, somewhat poorly drained, and loamy. They have a clayey and loamy subsoil.

Minor soils in this association are in the Carytown, Choteau, Collinsville, Hartsells, Lanton, Robinsonville, and Steedman series. The land type Mine pits and dumps is also in this association. Most soils in this association are used for range, tame pasture, and hay. A small acreage is used for cultivated crops. The main crops are small grain, cotton, peanuts, and grain sorghum. The chief management concerns are preserving soil structure and maintaining fertility.

8. Lanton-Kaufman-Robinsonville Association

Deep, nearly level to gently sloping, loamy and clayey soils underlain by loamy or clayey sediment on flood plains

Lanton soils make up about 55 percent of this association, Kaufman soils about 20 percent, Robinsonville soils about 20 percent, and minor soils about 5 percent. This association makes up about 5 percent of the county.

Lanton soils are deep, nearly level to gently sloping, and poorly drained. They are loamy throughout.

Kaufman soils are deep, nearly level, and somewhat poorly drained. They are clayey throughout.

Robinsonville soils are deep, nearly level to gently sloping, and well drained. They are loamy throughout.

Minor soils in this association are mostly in the Ennis series.

Most of the acreage is cultivated. The main crops are cotton, small grain, alfalfa, grain sorghum, and peanuts. Small acreages are used for range, tame pasture, and woodland.

Chief management concerns are maintaining soil structure and fertility, and providing protection from damaging overflow and drainage.

Descriptions of the Soils

In this section the soils of Coal County are described, and their use and management are discussed. Each soil series is described in detail, and then, briefly, the mapping units 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 is much more detailed and is for those who need to make thorough and precise studies of soils. The profile described in the soil series is representative for mapping units in that series. If a given mapping unit has a profile in some ways different from the one described in the series, these differences are stated in the description of the mapping unit, or they are apparent in the name of the mapping unit. The description of each mapping unit contains suggestions on how the soil can be managed.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. The land type Mine pits and dumps, for example, does not belong to a soil series but nevertheless is listed in alphabetic order along with the soil 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 of a mapping unit is the capability unit, pasture and hayland suitability group, range site, and woodland suitability group in which the mapping unit has been placed. The page for the description of each capability unit or other interpretive 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, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*5*).

Not all boundaries and names on the Coal County soil map join with those on the map of Hughes County, which was surveyed and published earlier. Most of the differences result from refinement in the current system of soil classification.

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

Soil	Acres	Percent
Bates, fine sandy loam, 1 to 3 percent slopes	3,457	1.0
Bates fine sandy loam, 3 to 5 percent slopes	3,982	1.2
Bates fine sandy loam, 2 to 5 percent slopes, eroded	5,001	1.5
Bates and Bonham soils, 2 to 5 percent slopes, severely eroded	9,504	2.8
Bates-Collinsville complex, 1 to 5 percent slopes	6,560	1.9
Bonham loam, 1 to 3 percent slopes	12,321	3.7
Bonham loam, 3 to 5 percent slopes	4,881	1.4
Bonham loam, 2 to 5 percent slopes, eroded	16,315	4.8
Burleson clay, 0 to 1 percent slopes	2,304	.7
Burleson clay, 1 to 3 percent slopes	2,229	.7
Carytown silt loam, thin surface	5,105	1.5
Chaney loam, 3 to 5 percent slopes	7,261	2.2
Choteau loam, 1 to 3 percent slopes	950	.3
Crockett loam, 1 to 4 percent slopes	5,143	1.5
Dougherty loamy fine sand, 3 to 8 percent slopes	616	.2
Ennis loam	4,538	1.3
Ferris silty clay, acid surface variant, 3 to 5 percent slopes	544	.2
Hartsells fine sandy loam, 1 to 3 percent slopes	3,902	1.2
Hartsells fine sandy loam, 3 to 5 percent slopes	11,687	3.5
Hartsells fine sandy loam, 2 to 5 percent slopes, eroded	6,716	2.0
Hartsells soils, 2 to 6 percent slopes, severely eroded	3,822	1.1
Homa-Hartsells complex, 2 to 5 percent slopes	20,894	6.2
Homa soils and Rock outcrop, moderately steep	68,378	20.3
Homa soils and Rock outcrop, steep	2,392	.7
Kaufman silty clay	4,564	1.3
Konawa fine sandy loam, 2 to 5 percent slopes	1,022	.3
Lanton silt loam	15,432	4.6
Lanton silty clay loam, moderately wet	8,355	2.5
Lightning-Carytown complex	4,125	1.2
Mine pits and dumps	1,200	.4
Parsons silt loam, 0 to 1 percent slopes	4,631	1.4
Parsons silt loam, 1 to 3 percent slopes	10,520	3.1
Robinsonville and Lanton soils, channeled	25,167	7.5
Steedman clay loam, 2 to 5 percent slopes	13,820	4.1
Steedman-Collinsville complex, 5 to 20 percent slopes	26,477	7.9
Steedman-Robinsonville complex, 5 to 30 percent slopes	2,061	.6
Stidham loamy fine sand, 1 to 3 percent slopes	698	.2
Talpa-Rock outcrop complex, 5 to 30 percent slopes	7,297	2.2
Wilson silt loam	2,769	.8
Total	336,640	100.0

Bates Series

The Bates series consists of well-drained, very gently sloping and gently sloping soils on uplands. These soils formed under a cover of mid and tall grasses in material weathered from sandstone.

In a representative profile the surface layer is 13 inches of very dark grayish-brown fine sandy loam. The upper part of the subsoil, to a depth of 17 inches, is brown loam. The lower part, to a depth of 32 inches, is yellowish-brown silty clay loam. The underlying material is sandstone.

Permeability in Bates soils is moderate. Available water capacity is high.

Representative profile of Bates fine sandy loam, 1 to 3 percent slopes, 435 feet south and 2,535 feet east of the NW. corner of sec. 19, T. 2 N., R. 11 E.:

A1—0 to 13 inches, very dark grayish-brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; weak, medium, granular structure; very friable, soft; slightly acid; gradual, smooth boundary.

B1—13 to 17 inches, brown (10YR 5/3) loam, pale brown (10YR 6/3) dry; weak, medium and coarse, subangular blocky structure; very friable, slightly hard; common earthworm casts; medium acid; gradual, smooth boundary.

B2t—17 to 28 inches, yellowish-brown (10YR 5/4) sandy clay loam, light yellowish brown (10YR 6/4) dry; common, medium, faint mottles of brown (10YR 5/3); weak, medium, subangular blocky structure; friable, hard; patchy clay films on faces of peds; common earthworm casts; strongly acid; gradual, smooth boundary.

B3—28 to 32 inches, yellowish-brown (10YR 5/6) sandy clay loam, brownish yellow (10YR 6/6) dry; common, medium, faint mottles of brown (10YR 5/3) and dark grayish brown (10YR 4/2); weak, medium, subangular blocky structure; friable, hard; thin patchy clay films on faces of peds; few sandstone fragments; medium acid; abrupt, wavy boundary.

R—32 to 36 inches, sandstone; weathered and fractured near upper boundary.

The A horizon is typically fine sandy loam but in places is loam. It is very dark grayish brown to dark brown. Reaction is medium acid to slightly acid. The Bt horizon is brown to yellowish-brown loam to sandy clay loam. Mottles in this horizon are brownish or reddish. Reaction is strongly acid to slightly acid. Depth to sandstone ranges from 20 to 40 inches.

Bates soils are less clayey in the B2t horizon than the associated Bonham, Choteau, and Steedman soils. They are deeper over sandstone than the associated Collinsville soils.

Bates fine sandy loam, 1 to 3 percent slopes (BaB).—This very gently sloping soil is on uplands. It has the profile described as representative for the series (fig. 2).

Included with this soil in mapping are areas of Bonham loam. This inclusion makes up about 5 percent of the mapped areas. Also included are small areas of Collinsville fine sandy loam and Collinsville loam.

This Bates soil is used dominantly for range and tame pasture but is also suitable for cotton, peanuts, corn, grain sorghum, alfalfa, and small grain. Management is needed that maintains fertility and soil structure and provides protection against erosion. Terracing, contour farming, stripcropping, and the use of crop residue and fertilizer reduce the hazard of erosion. Plant cover is needed to protect against soil blowing and water erosion in winter and spring. Sown crops can be grown continuously if fertilizer is added and crop residue is returned to the soil. Terracing and contour farming are needed if row crops are grown. Excessive tillage should be avoided. Capability unit IIe-1; pasture and hayland suitability group 8A; Loamy Prairie range site; woodland suitability group 5o0.

Bates fine sandy loam, 3 to 5 percent slopes (BaC).—This gently sloping soil is on uplands. It has a profile similar to

Figure 2.—Profile of Bates fine sandy loam.

the one described as representative for the series, but it is generally a few inches deeper over bedrock.

Included with this soil in mapping are areas of Bonham loam, Collinsville fine sandy loam, Collinsville loam, and soils that are 40 to 60 inches deep but are otherwise similar to Bates soils. These inclusions make up about 10 percent of the mapped areas.

This Bates soil is used dominantly for range and tame pasture but is suited to cotton, corn, grain sorghum, peanuts, and small grain. Management is needed that maintains fertility and soil structure and protects the soils against erosion. The erosion hazard can be reduced by terracing, contour farming, stripcropping, fertilizing, and returning crop residue to the soil. Plant cover is needed to help control soil blowing and water erosion in winter and spring. Fertilizing and using crop residue also help in conserving moisture and maintaining soil structure. Capability unit IIIe-1; pasture and hayland suitability group 8A; Loamy Prairie range site; woodland suitability group 5o0.

Bates fine sandy loam, 2 to 5 percent slopes, eroded (BaC2).—This moderately eroded, very gently sloping and gently sloping soil is on uplands. It has a profile similar to that described as representative for the series, but part of the original surface layer has been removed by erosion in about 40 percent of the mapped areas. Few to many crossable gullies are on the surface of this soil. Sheet erosion occurs in these gullied areas, and the surface layer and subsoil have become mixed where such areas are cultivated.

Included with this soil in mapping, and making up about 5 percent of the mapped areas, are areas of Bonham loam and small areas of Collinsville fine sandy loam and loam.

This Bates soil is used dominantly for tame pasture but is also suitable for cotton, corn, grain sorghum, peanuts, small grain, and range.

Terraces, contour farming, crop-residue management, and plant cover are needed to protect against soil blowing and water erosion in winter and spring. Management is also needed for improving soil structure and fertility. Fertilizing improves the suitability of this soil for cultivation and increases growth of crops. Capability unit IIIe-2; pasture and hayland suitability group 8A; Loamy Prairie range site; woodland suitability group 5o0.

Bates and Bonham soils, 2 to 5 percent slopes, severely eroded (BbC3).—Bates fine sandy loam or Bates loam makes up about 30 percent of the acreage of this unit; Bonham loam or Bonham silt loam, about 25 percent; and Bates and Bonham soils that have profiles similar to those representative of their respective series except that part or all of the surface layer has been removed by erosion, about 25 percent.

The soils in this mapping unit are on uplands and are very gently sloping and gently sloping. Mapped areas generally are either mostly Bates fine sandy loam or Bates loam, or they are mostly Bonham loam or Bonham silt loam. The degree of erosion varies.

Included with these soils in mapping, and making up about 10 percent of the mapped areas, are Carytown silt loam and Carytown loam, Collinsville fine sandy loam and Collinsville loam, and Steedman clay loam. Gullies that are 18 to 60 inches deep and 15 to 160 feet apart make up about 10 percent of the mapped areas.

These Bates and Bonham soils are well suited to tame pasture and native range. Intensive management is needed for protection against erosion. Such management should include control of grazing, use of plant cover and fertilizer, protection from fire, and control of brush. Other practices that improve soil structure and fertility also are needed. Capability unit VIe-1; pasture and hayland suitability group 8F; Eroded Prairie range site; woodland suitability group 5o0.

Bates-Collinsville complex, 1 to 5 percent slopes (BcC).—Bates fine sandy loam and Bates loam make up about 45 percent of the acreage of this complex, and Collinsville fine sandy loam and Collinsville loam make up about 40 percent. These very gently sloping and gently sloping soils are on uplands. The Bates soils have a profile similar to that described as representative for the series, but the surface layer and subsoil are thinner. The Collinsville fine sandy loam has the profile described as representative for the Collinsville series.

Included with this soil in mapping, and making up about 5 percent of the mapped areas, are Steedman clay loam, silty clay loam, silt loam, and loam. Also included are soils similar to the representative Bates soil, except that they have a sandy loam subsoil. A few small areas of sandstone rock outcrop are also included.

These soils are used dominantly for tame pasture and range but are also suitable for grain sorghum and small grain. Management is needed that maintains fertility and soil structure and protects against erosion and loss of moisture. It should include terracing, contour farming, fertilizing, and returning crop residue to the soil. Both soils are in capability unit IVe-2; Bates soil is in pasture and hayland suitability group 8A, and the Collinsville soil is in pasture and hayland suitability group 14A; Bates soil is in Loamy Prairie range site, and the Collinsville soil is Shallow Prairie range site; both soils are in woodland suitability group 5o0.

Bonham Series

The Bonham series consists of moderately well drained, very gently sloping and gently sloping soils on uplands. These soils formed under a cover of tall grasses in material weathered from shaly clay.

In a representative profile the surface layer is 11 inches of very dark grayish-brown loam. The upper part of the subsoil, to a depth of 15 inches, is dark-brown clay loam. The middle part, to a depth of 23 inches, is dark yellowish-brown clay. The lower part, to a depth of 65 inches, is a yellowish-brown clay.

Permeability in Bonham soils is slow. Available water capacity is high.

Representative profile of Bonham loam, 1 to 3 percent slopes, 1,780 feet east and 165 feet south of the NW. corner of sec. 2, T. 1 N., R. 11 E.:

A1—0 to 11 inches, very dark grayish-brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak, medium, granular structure; friable, hard; few earthworm casts; few iron-manganese concretions; medium acid; gradual, smooth boundary.

B1—11 to 15 inches, dark-brown (10YR 3/3) clay loam, dark grayish brown (10YR 4/2) dry; common, fine, faint, brown and dark yellowish-brown mottles; weak, medium, subangular blocky structure; firm, very hard; few earthworm casts; few iron-manganese concretions; medium acid; gradual, wavy boundary.

B21t—15 to 23 inches, dark yellowish-brown (10YR 4/4) clay, light yellowish brown (10YR 6/4) dry; common, medium, distinct, yellowish-red (5YR 5/6) and strong-brown (7.5YR 5/6) mottles; weak, medium, blocky structure; very firm, very hard; thin clay films of manganese oxide; medium acid; gradual, smooth boundary.

B22t—23 to 35 inches, yellowish-brown (10YR 5/4) clay, light yellowish brown (10YR 6/4) dry; many, medium, distinct, strong-brown (7.5YR 5/6) or yellowish-red (5YR 4/6) mottles and common, medium, faint, dark grayish-brown (10YR 4/2) mottles; weak, medium, blocky structure; very firm, extremely hard; thin clay films on faces of peds; few iron-manganese concretions; common spots and films of manganese oxide; medium acid; gradual, smooth boundary.

B23t—35 to 50 inches, yellowish-brown (10YR 5/4) clay, brownish yellow (10YR 6/6) dry; common, medium, faint and distinct, strong-brown (7.5YR 5/6) and gray (10YR 5/1) mottles; weak, coarse, blocky structure; very firm, extremely hard; thin clay films on faces of most peds; few iron-manganese concretions, some in clusters; slightly acid; gradual, smooth boundary.

B3—50 to 65 inches, yellowish-brown (10YR 5/4) clay, brownish yellow (10YR 6/6) dry; few, medium and coarse, faint, gray (10YR 5/1) and light olive-brown (2.5Y 5/6) mottles; weak, coarse, blocky structure; very firm; extremely hard; few iron-manganese concretions, some in clusters; mildly alkaline.

The A1 horizon is dominantly loam but in places is silt loam. The A and B1 horizons are very dark grayish brown to dark brown. Reaction in these horizons is slightly acid to strongly acid. The B2t horizon ranges in texture from silty clay loam to clay. Reddish, yellowish, and brownish mottles in these horizons are few to common and fine to medium. The B21t horizon is dark yellowish brown to pale brown. Reaction is slightly acid to strongly acid. The B22t, B23t, and B3 horizons have matrix colors of olives to browns or a matrix mottled with olives, grays, yellows, reds, or browns. These horizons are medium acid to mildly alkaline. Depth to weathered shale or shaly clay is more than 60 inches.

The Bonham soils are more clayey in the B2t horizon than the associated Bates soils. They have a thicker A1 horizon and a thicker solum than Steedman soils, and they lack the thick A2 horizon of the similar Choteau soils. The boundary of the A horizon in Bonham soils is less abrupt than that of associated Parsons soils. Bonham soils have a thicker A1 horizon than that of the similar Crockett soils.

Bonham loam, 1 to 3 percent slopes (BoB).—This very gently sloping soil is on uplands. It has the profile described as representative for the series.

Included with this soil in mapping are areas of Bates loam and fine sandy loam and areas of Parsons silt loam. These inclusions make up about 10 percent of the mapped areas.

Also included are small areas of soil that is similar to Bonham loam but has a more reddish subsoil.

This Bonham soil is used dominantly for tame pasture, hay, or range, but it is suited to alfalfa, cotton, corn, grain sorghum, peanuts, and small grain. Contour farming, returning crop residue to the soil, and using terraces help to reduce erosion, conserve moisture, and maintain soil structure. Terracing or contour farming are required where row crops are grown. Sown crops can be grown continuously if fertilizer is added and crop residue is used. Excessive tillage should be avoided. Capability unit IIe-2; pasture and hayland suitability group 8A; Loamy Prairie range site; woodland suitability group 5o0.

Bonham loam, 3 to 5 percent slopes (BoC).—This gently sloping soil is on uplands. Included in mapping are areas of soils that are similar to Bonham loam but are 40 to 60 inches deep to weathered shale. These inclusions make up about 10 percent of the mapped areas. Also included is a small acreage of Bates fine sandy loam and loam.

This soil is used mainly for range, hay, and tame pasture but is suited to cotton, corn, grain sorghum, peanuts, and small grain. Contour farming, terracing, returning crop residue to the soil, and using fertilizer help to reduce erosion, conserve moisture, and maintain soil structure. Excessive tillage should be avoided. Capability unit IIIe-4; pasture and hayland suitability group 8A; Loamy Prairie range site; woodland suitability group 5o0.

Bonham loam, 2 to 5 percent slopes, eroded (BoC2).—This moderately eroded, very gently sloping and gently sloping soil is on uplands. It has a profile similar to the one described as representative for the series, but part of the original surface layer has been removed by erosion in about 40 percent of the mapped areas. Few to many crossable gullies are on the surface of this soil. Sheet erosion occurs in these gullied areas, and the surface layer and subsoil have become mixed where such areas are cultivated.

Included with this soil in mapping, and making up about 10 percent of the mapped areas, are shallow, crossable gullies. Also included is an occasional deeper gully 5 to 45 feet wide, areas where all of the original surface layer has been lost through erosion, and minor eroded areas of Parsons silt loam and Steedman clay loam.

This soil is used dominantly for tame pasture and range but is suited to cotton, corn, grain sorghum, peanuts, and small grain. Intensive management is needed for protection from erosion. Terracing, contour farming, and use of crop residue and fertilizer improve the suitability of this soil for cultivation. Plant cover is needed to protect this soil from erosion in winter and spring. Capability unit IIIe-2; pasture and hayland suitability group 8A; Loamy Prairie range site; woodland suitability group 5o0.

Burleson Series

The Burleson series consists of moderately well drained, nearly level and gently sloping soils on uplands. These soils formed under a cover of tall and mid grasses in material weathered from clayey sediment.

In a representative profile the surface layer is 20 inches of very dark gray clay. Below, to a depth of 60 inches, is dark-gray clay.

Permeability in Burleson soils is very slow. Available water capacity is high.

Representative profile of Burleson clay, 0 to 1 percent slopes, 350 feet east and 60 feet north of the SW. corner of sec. 1, T. 1 S., R. 8 E.:

Ap—0 to 6 inches, very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; weak, medium and fine, granular structure; firm, very hard; neutral; clear, smooth boundary.

A1—6 to 20 inches, very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; few, fine, faint, dark yellowish-brown mottles; weak, coarse, blocky structure; very firm, extremely hard; neutral; diffuse, wavy boundary.

AC1—20 to 48 inches, dark-gray (10YR 4/1) clay, gray (10YR 5/1) dry; common, fine and medium, distinct, reddish-yellow (5YR 6/6) mottles; weak, coarse, blocky structure; very firm, extremely hard; distinct intersecting slickensides; few iron-manganese concretions; few siltstone and chert fragments; mildly alkaline; diffuse, wavy boundary.

AC2—48 to 60 inches, dark-gray (10YR 4/1) clay, gray (10YR 5/1) dry; common, fine and medium, distinct, reddish-yellow (5YR 6/6) mottles; weak, coarse, blocky structure; very firm, extremely hard; few intersecting slickensides; few hard lime concretions; few iron-manganese concretions; few chert and siltstone fragments; moderately alkaline.

The A horizon is black to very dark gray. Reaction is medium acid to mildly alkaline. In places mottles are not in the A1 horizon. Thickness of the A horizon varies with microrelief, ranging from 12 inches on small knolls to 30 inches in small depressions. The representative profile was in a small depression, and such depressions are dominant in the microrelief of these soils. The AC horizon in small depressions is dark gray, but in small knolls it is olive gray. Mottles in these AC horizons are grayish, yellowish, and brownish. Reaction is mildly alkaline to moderately alkaline. Depth to calcareous clay ranges from 40 to 60 inches.

Burleson soils have a thicker A horizon than the associated Ferris soils. They have a more clayey A horizon than the associated Wilson soils.

Burleson clay, 0 to 1 percent slopes (BuA).—This nearly level soil is on uplands. It has the profile described as representative for the series.

Included with this soil in mapping are small areas of Wilson silt loam. This inclusion makes up about 10 percent of the mapped areas.

This Burleson soil is used dominantly as cropland. It is suited to alfalfa, cotton, grain, forage sorghum, small grain, tame pasture, and native range.

Management is needed that improves soil structure, reduces crusting, increases the water-intake rate, controls surface wetness, and reduces erosion. Crops that produce large amounts of residue are needed in the cropping system. Returning the residue to the soil improves soil structure, increases water intake, and prevents surface crusting. This soil is difficult to till because the surface layer is clayey. Tillage should be timely and kept to a minimum. Large cracks form in the surface when these soils dry. Surface drainageways generally control wetness. Sown crops can be grown continuously if fertilizer is used and crop residue is returned to the soil. Capability unit IIw-3; pasture and hayland suitability group 7A; Blackclay Prairie range site; woodland suitability group 5o0.

Burleson clay, 1 to 3 percent slopes (BuB).—This very gently sloping soil is on uplands. Included in mapping are Wilson silt loam, which makes up about 5 percent of the mapped areas, and Ferris silty clay, acid surface variant, which makes up 10 percent.

This Burleson soil is suited to and used for cotton, grain sorgum, small grain, alfalfa, range, and tame pasture. Management practices are needed that improve soil structure, reduce crusting, increase water intake, and protect against water erosion. The cropping system should include crops that produce large amounts of crop residue. The residue can be returned to the soil to improve soil structure, increase water intake, and prevent surface crusting. This soil is difficult to till because it is clayey. Tillage should be timely and kept to a minimum. Large cracks form in the surface of these soils when they are dry. If row crops are grown, terraces and contour tillage are needed. Sown crops can be grown continuously if fertilizer is used and crop residue is returned to the soil. Capability unit IIe-3; pasture and hayland suitability group 7A; Blackclay Prairie range site; woodland suitability group 5o0.

Carytown Series

The Carytown series consists of poorly drained, nearly level soils on flood plains and uplands. These soils formed under a cover of tall and mid grasses in material weathered from shale or old clayey alluvium enriched with sodium. Some areas of these soils are subject to flooding.

In a representative profile the surface layer is 6 inches of dark-gray silt loam. The upper part of the subsoil, to a depth of 40 inches, is very dark gray silty clay. The lower part is dark grayish-brown silty clay loam and extends to a depth of 55 inches. The underlying material is mottled gray, yellowish-brown, and dark grayish-brown, and dark grayish-brown silty clay loam.

Permeability of Carytown soils is very slow. Available water capacity is high.

Representative profile of Carytown silt loam, thin surface, 525 feet east and 2,580 feet north of the SW. corner of sec. 27, T. 1 N., R. 10 E.:

Ap—0 to 6 inches, dark-gray (10YR 4/1) silt loam, light gray (10YR 6/1) dry; few, fine, faint, yellowish-brown mottles; weak, fine and medium, granular structure; friable, hard; medium acid; abrupt, smooth boundary.

B21t—6 to 22 inches, very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; common, medium, faint, very dark grayish-brown (10YR 3/2) mottles; moderate, coarse, columnar structure parting to moderate, medium and coarse, blocky; very firm, extremely hard; patchy clay films on faces of peds and patchy very dark gray films on sides of columns; neutral; gradual, smooth boundary.

B22t—22 to 40 inches, very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; few, fine, faint, very dark brown mottles; moderate, medium and coarse, blocky structure; very firm, extremely hard; thin clay films and a few lenses of salt crystals on faces of peds; neutral; gradual, smooth boundary.

B3—40 to 55 inches, dark grayish-brown (10YR 4/2) silty clay loam, grayish brown (10YR 5/2) dry; common, medium, distinct, strong-brown (7.5YR 5/6) mottles; weak, medium and coarse, blocky structure; very firm, very hard; patchy clay films and common lenses of salt crystals on faces of peds; a few, fine, iron-manganese concretions; neutral; gradual, smooth boundary.

C—55 to 70 inches, coarsely mottled gray (10YR 5/1), yellowish-brown (10YR 5/6), and dark grayish-brown (10YR 4/2) silty clay loam; massive; very firm, very hard; few, fine and medium, iron-manganese concretions; moderately alkaline.

The Ap horizon is dark-gray to dark grayish-brown silt loam and loam. Reaction in this horizon is strongly acid to medium acid. The B2t horizon is silty clay loam, silty clay, or clay that ranges from very dark gray to dark grayish brown. Mottles in this horizon are brownish, grayish, or yellowish. Reaction ranges from medium acid in the upper part of the B2t horizon to neutral to moderately alkaline in the lower part. In the C horizon reaction is neutral to moderately alkaline.

Carytown soils have a thinner A horizon than similar Parsons soils, and they contain more sodium than associated Lightning soils and similar Wilson soils.

Carytown silt loam, thin surface (Ca).—This nearly level soil is on uplands. Included in mapping are areas of Parsons silt loam and areas of circular mounds that are 6 inches to 3 feet high and 25 to 100 feet in diameter. In some mapped areas as much as 10 percent is Parsons silt loam, and about 3 percent is circular mounds. Soil in the mound areas has a profile similar to that described as representative of Carytown soils, but the surface layer is thicker.

This Carytown soil is used dominantly for tame pasture, hay, and range but is also suitable for peanuts, small grain, grain sorghum, and cotton. Management practices are needed that maintain soil structure, reduce crusting, and increase water intake. The cropping system should include crops that produce large amounts of residue for return to the soil annually. Tillage should be timely and kept to a minimum. In places gypsum applications are beneficial. Capability unit IVs-1; pasture and hayland suitability group 8D; Shallow Claypan range site; woodland suitability group 5o0.

Chaney Series

The Chaney series consists of moderately well drained, gently sloping soils on uplands. These soils formed in material weathered from shaly clay and shale under a cover of oak forest and an understory of tall grasses.

In a representative profile the surface layer is 6 inches of very dark gray and dark grayish-brown loam. The upper part of the subsoil, to a depth of 20 inches, is yellowish-red clay. The lower part, which extends to a depth of 70 inches, is yellowish-brown clay and clay loam.

Permeability in Chaney soils is slow. Available water capacity is high.

Representative profile of Chaney loam, 3 to 5 percent slopes, 1,050 feet east and 2,580 feet south of the NW. corner of sec. 16, T. 1 S., R. 9 E.:

A1—0 to 3 inches, very dark gray (10YR 3/1) loam, grayish brown (10YR 5/2) dry; weak, medium, granular structure; friable, hard; some mixing of underlying colors by earthworms; slightly acid; clear, wavy boundary.

A2—3 to 6 inches, dark grayish-brown (10YR 4/2) loam, light brownish gray (10YR 6/2) dry; few, medium, faint, yellowish-brown (10YR 5/4) mottles; weak, coarse, subangular blocky structure; friable, hard; some mixing of overlying colors by earthworms; medium acid; clear, wavy boundary.

B21t—6 to 20 inches, yellowish-red (5YR 5/6) clay, reddish yellow (5YR 6/6) dry; common, fine, faint, yellowish-brown mottles; moderate, medium, blocky structure; very firm, very hard; clay films on faces of peds; coating of dark grayish-brown (10YR 4/2) loam on faces of peds; many grooved pressure faces; few, medium, iron-manganese concretions; medium acid; gradual, wavy boundary.

B22t—20 to 40 inches, yellowish-brown (10YR 5/6) clay, brownish yellow (10YR 6/6) dry; common, medium and fine, distinct, yellowish-red (5YR 4/6) and gray (10YR 5/1) mottles; weak, medium, blocky structure; extremely firm, extremely hard; clay films on faces of peds; many grooved pressure faces; few, medium, iron-manganese concretions; medium acid; gradual, wavy boundary.

B23t—40 to 54 inches, yellowish-brown (10YR 5/4) clay, light yellowish brown (10YR 6/4) dry; common, medium, distinct, olive (5Y 4/4) mottles and few, medium, distinct, dark-gray (10YR 4/1) and grayish-brown (10YR 5/2) mottles; weak, coarse, blocky structure; extremely firm, extremely hard; patchy clay films on faces of peds; few grooved pressure faces; few, medium iron-manganese concretions; few, fine, hard and soft lime nodules near lower boundary; mildly alkaline; gradual, wavy boundary.

B3—54 to 70 inches, yellowish-brown (10YR 5/6) clay loam, brownish yellow (10YR 6/6) dry; many, coarse, distinct, gray (10YR 5/1) mottles; massive; extremely firm, extremely hard; few, medium, iron-manganese concretions; few pockets of hard and soft lime nodules; moderately alkaline.

The A1 horizon is very dark gray to dark brown, and the A2 horizon is dark grayish brown to light brownish gray. Reaction in these horizons is slightly acid to medium acid. In cultivated areas these horizons generally are mixed. The B2t horizon is reddish-brown to brownish-yellow clay to clay loam. Reaction of the B21t and B22t horizons is slightly acid to medium acid. The B23t and B3 horizons are mildly alkaline to moderately akaline in reaction. They are mottled with gray, yellow, brown, and red. Depth of shaly clay or weathered shale ranges from 60 to more than 72 inches.

These soils contain a few spots of soft lime at depths below 40 inches, and they are mildly alkaline to moderately alkaline in the lower part of the Bt horizon. They are enough like the Chaney series in morphology, composition, and behavior that a new series is not warranted.

Chaney soils have a less clayey B2t horizon than the similar Homa soils and a more clayey B2t horizon than associated Konawa soils.

Chaney loam, 3 to 5 percent slopes (CeC).—This gently sloping soil is on uplands. Included in mapping, and making up about 15 percent of the mapped areas, are soils that have an eroded surface layer. They are otherwise similar to Chaney soils. Small areas of Konawa fine sandy loam are also included.

This Chaney soil is used dominantly for tame pasture but is also suitable for small grain, grain sorghum, and range. Management is needed that maintains soil fertility, increases water intake, and reduces erosion. Terracing, contour farming, and stripcropping help to control erosion. Applying fertilizer and returning crop residue to the soil annually help to maintain soil structure and improve fertility. Capability unit IVe-1; pasture and hayland suitability group 8B; Sandy Savannah range site; woodland suitability group 5o0.

Choteau Series

The Choteau series consists of moderately well drained, very gently sloping soils on uplands. These soils formed under a cover of tall and mid grasses in deeply weathered shale or shaly clay.

In a representative profile the surface layer is 11 inches of very dark grayish-brown loam. The subsurface layer extends to a depth of 20 inches and is brown loam. The subsoil, which extends to a depth of 65 inches, is brown clay loam in the upper 7 inches and yellowish-brown clay below.

Permeability in Choteau soils is slow. Available water capacity is high.

Representative profile of Choteau loam, 1 to 3 percent slopes, 1,380 feet south and 120 feet west of the NE. corner of sec. 34, T. 1 N., R. 10 E.:

Ap—0 to 11 inches, very dark grayish-brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; few, fine, faint, dark-brown and dark yellowish-brown mottles; weak, fine, granular structure; very friable, hard; few, fine, iron-manganese concretions; strongly acid; clear, smooth boundary.

A2—11 to 20 inches, brown (10YR 4/3) loam, pale brown (10YR 6/3) dry; common, medium, faint, dark grayish-brown (10YR 4/2) and dark yellowish-brown (10YR 4/4) mottles; weak, coarse, subangular blocky structure parting to weak, fine, granular; very friable, hard; few very dark grayish-brown (10YR 3/2) coatings on faces of peds; few, fine, iron-manganese concretions; strongly acid; gradual, wavy boundary.

B1—20 to 27 inches, brown (10YR 5/3) clay loam, pale brown (10YR 6/3) dry; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, coarse, subangular blocky structure; friable, hard; few iron-manganese concretions; strongly acid; gradual, smooth boundary.

B2t—27 to 42 inches, yellowish-brown (10YR 5/4) clay, light yellowish brown (10YR 6/4) dry; common, medium, faint, brown (10YR 5/3) mottles and common, medium, distinct, light brownish-gray (10YR 6/2) and reddish-brown (5YR 4/4) mottles; weak, medium, blocky structure; very firm, very hard; few patchy clay films on faces of peds; few, fine, iron-manganese concretions; slightly acid; diffuse, smooth boundary.

B3—42 to 65 inches, yellowish-brown (10YR 5/6) clay, brownish yellow (10YR 6/6) dry; many, coarse, distinct, light-gray (10YR 6/1), strong-brown (7.5YR 5/6), and dark reddish-brown (5YR 3/4) mottles; weak, coarse, blocky structure; very firm, very hard; few patchy clay films on faces of peds; gray brown and light-gray strata have less clay than the rest of the mass; few, medium, iron-manganese concretions; mildly alkaline.

The Ap horizon is very dark grayish brown to dark brown, and it is medium acid to strongly acid in reaction. The A2 horizon is dark grayish-brown to pale-brown loam or silt loam. It is medium acid to very strongly acid in reaction. The B2t horizon is brown to yellowish-brown clay loam to clay. Common to many grayish, brownish, or reddish mottles are in the upper part of the B2t horizon. Reaction in this horizon is slightly acid to strongly acid. Depth of shaly clay or weathered shale is more than 60 inches.

Choteau soils have a thicker A horizon than the similar Bonham soils. Their solum is thicker, and they have a more clayey B2t horizon than associated Bates soils.

Choteau loam, 1 to 3 percent slopes (ChB).—This very gently sloping soil is on uplands. Included in mapping, and making up about 5 percent of the mapped areas, are small areas of Bonham loam and other small areas of circular mounds 6 inches to 3 feet high and 25 to 75 feet in diameter. The mounds make up about 2 percent of the mapped areas. The soil in the mounds has a profile similar to that of this soil, but the surface layer is thicker. Also included are minor areas of Parsons silt loam.

This Choteau soil is used dominantly for tame pasture and hay but is also suited to alfalfa, cotton, corn, grain sorghum, peanuts, small grain, and range. Management is needed that maintains fertility and soil structure and protects the soil against erosion. Use of terraces, contour farming practices, and fertilizer and returning crop residue to the soil help to reduce erosion, conserve moisture, and maintain soil structure. Tillage should be timely, and it should be kept to a minimum. Fertilizer is needed to maintain a high level of production and to improve the soil. Capability unit IIe-2; pasture and hayland suitability group 8A; Loamy Prairie range site; woodland suitability group 5o0.

Collinsville Series

The Collinsvile series consists of well-drained to somewhat excessively drained, very gently sloping to moderately steep soils on uplands. These soils formed under a cover of tall and mid grasses in material weathered from sandstone. Collinsville soils in Coal County are mapped only in a complex with Bates or Steedman soils.

In a representative profile the surface layer is 7 inches of very dark grayish-brown fine sandy loam. The next layer is 5 inches of very dark grayish-brown gravelly fine sandy loam. The underlying material is sandstone.

Permeability in Collinsville soils is moderately rapid. Available water capacity is low to moderate.

Representative profile of Collinsville fine sandy loam, in an area of Bates-Collinsville complex, 1 to 5 percent slopes, 1,380 feet east and 75 feet north of the SW. corner of sec. 22, T. 2 N., R. 10 E.:

A1—0 to 7 inches, very dark grayish-brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; moderate, fine, granular structure; very friable, soft; strongly acid; gradual, wavy boundary.

C—7 to 12 inches, very dark grayish-brown (10YR 3/2) gravelly fine sandy loam, grayish brown (10YR 5/2) dry; massive; very friable, soft; 30 percent, by volume, soft and hard sandstone fragments; strongly acid; abrupt, wavy boundary.

R—12 inches +, yellowish-brown, hard sandstone bedrock, fractured at intervals of 1 to 3 feet.

The A horizon generally is very dark brown, very dark grayish-brown, or dark-brown fine sandy loam but in places is loam. The B horizon is weakly developed in places. It is dark brown or brown to dark yellowish brown. This horizon has weak or moderate granular structure. The C horizon lacks structure. Colors in this horizon are similar to those in the B horizon. Depth to sandstone is 4 to 20 inches. Reaction is strongly acid to slightly acid throughout the profile.

Collinsville soils have a less clayey A horizon than similar Talpa soils. They are shallower and lack the B2t horizon of sandy clay loam of associated Bates soils. They are less clayey throughout the A and B horizons than associated Steedman soils.

Crockett Series

The Crockett series consists of moderately well drained, very gently sloping and gently sloping soils on uplands. These soils formed under a cover of tall and mid grasses in material weathered from clay beds or deeply weathered shale.

In a representative profile the surface is 8 inches of very dark grayish-brown loam. The upper part of the subsoil, to a depth of 20 inches, is dark-brown clay. The lower part is yellowish-brown clay. It extends to a depth of 65 inches.

Permeability in Crockett soils is very slow. Available water capacity is high.

Representative profile of Crockett loam, 1 to 4 percent slopes, 1,850 feet north and 350 feet east of the SW. corner of sec. 4, T. 1 S., R. 9 E.:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak, medium, granular structure; friable, slightly hard; few, fine, iron-manganese concretions; slightly acid; clear, wavy boundary.

B21t—8 to 20 inches, dark-brown (10YR 4/3) clay, brown (10YR 5/3) dry; common, medium, faint, dark yellowish-brown (10YR 4/4) mottles and common, fine, distinct, reddish-brown and gray (10YR 5/1) mottles; moderate, medium, blocky structure; very firm, extremely hard; nearly continuous clay films on faces of peds; some peds coated with very dark grayish-brown (10YR 3/2) loam; medium acid; gradual, wavy boundary.

B22t—20 to 42 inches, yellowish-brown (10YR 5/6) clay, brownish yellow (10YR 6/6) dry; common, medium, distinct, grayish-brown (10YR 5/2) mottles and few, medium, distinct, gray (10YR 5/1) mottles; moderate, medium, blocky structure; very firm, extremely hard; nearly continuous clay films on peds; few slickensides; few peds are coated with very dark grayish-brown (10YR 3/2) loam; few, fine, iron-manganese concretions; slightly acid; gradual, wavy boundary.

B23t—42 to 58 inches, yellowish-brown (10YR 5/6) clay, brownish yellow (10YR 6/6) dry; many, medium and coarse, distinct, gray (10YR 5/1) mottles; weak, coarse, blocky structure; very firm, extremely hard; thin, patchy clay films on faces of peds; few, fine, iron-manganese concretions; few, fine and medium, hard, lime concretions; mildly alkaline; gradual, wavy boundary.

B3—58 to 65 inches, yellowish-brown (10YR 5/6) clay, brownish yellow (10YR 6/6) dry; many medium and few, coarse, distinct, gray (10YR 5/1) and strong brown (7.5YR 5/6) mottles; weak, coarse, blocky structure; very firm, extremely hard; patchy clay films on faces of peds; few, fine, iron-manganese concretions; few, medium and coarse, hard, lime nodules; mildly alkaline.

The A horizon is very dark grayish brown to dark brown. Reaction is medium acid to neutral. The Bt horizon is dark-brown to olive clay or silty clay. Reaction in the B21t horizon is slightly acid to medium acid. The Bt horizon has few to many grayish, brownish, and reddish mottles. Reaction in the B22t and B23t horizons is medium acid to mildly alkaline. Calcareous clay beds or deeply weathered calcareous shale is at a depth of 60 inches or more.

Crockett soils have a thinner A horizon than similar Bonham soils and a thicker solum than associated Steedman soils. They have a browner B2t horizon and are better drained than associated Wilson soils.

Crockett loam, 1 to 4 percent slopes (CrB).—This very gently sloping and gently sloping soil is on uplands.

Included with this soil in mapping are soils that are similar to this Crockett loam except the surface layer is eroded. These soils make up about 5 percent of the mapped areas. Inclusions of Parsons silt loam and Wilson silt loam make up about 5 percent of the mapped areas, and small areas of Steedman clay loam are present in places.

This Crockett soil is used dominantly for tame pasture and range, but it is also suitable for cotton, corn, sorghum, peanuts, and small grain. Management practices are needed that help to maintain fertility and soil structure and protect the soil against erosion. Terracing, contour farming, fertilizing, and returning crop residue to the soil reduce erosion, conserve moisture, and improve soil structure. Tillage should be timely and should be kept to a minimum. Capability unit IIIe-4; pasture and hayland suitability group 8A; Loamy Prairie range site; woodland suitability group 5o0.

Dougherty Series

The Dougherty series consists of well-drained, gently sloping to sloping soils on uplands. These soils formed in material weathered from sandy or loamy sediment under a cover of oaks and an understory of tall and mid grasses.

In a representative profile the surface layer is 7 inches of dark grayish-brown loamy fine sand. The subsurface layer, which extends to a depth of 28 inches, is brown loamy fine sand. The upper part of the subsoil, to a depth of 40 inches, is yellowish-red sandy clay loam. The lower part is yellowish-red sandy loam and extends to a depth of 65 inches. The underlying material is yellowish-red loamy fine sand.

Permeability in Dougherty soils is moderate. Available water capacity is high.

Representative profile of Dougherty loamy fine sand, 3 to 8 percent slopes, 795 feet south and 45 feet east of the NW. corner of sec. 13, T. 3 N., R. 11 E.:

A1—0 to 7 inches, dark grayish-brown (10YR 4/2) loamy fine sand, light brownish gray (10YR 6/2) dry; weak, fine, granular structure; very friable, soft; slightly acid; clear, smooth boundary.

A2—7 to 28 inches, brown (10YR 4/3) loamy fine sand, very pale brown (10YR 7/3) dry; single grain; very friable, soft; medium acid; clear, smooth boundary.

B2t—28 to 40 inches, yellowish-red (5YR 4/6) sandy clay loam, yellowish red (5YR 5/6) dry; common, medium, distinct, brown (10YR 5/3) mottles; moderate, medium, subangular blocky structure; friable, hard; patchy clay films on faces of peds and clay films bridging sand grains; common brown (10YR 4/3) coatings on faces of peds; few smooth pebbles; strongly acid; diffuse, smooth boundary.

B3—40 to 65 inches, yellowish-red (5YR 4/6) sandy loam, yellowish red (5YR 5/6) dry; weak, coarse, subangular blocky structure; friable, soft; few smooth pebbles; strongly acid; diffuse, smooth boundary.

C—65 to 84 inches, yellowish-red (5YR 5/6) loamy fine sand, reddish yellow (5YR 6/6) dry; massive; very friable, soft; 5 percent smooth gravel; strongly acid.

The A1 horizon is dark grayish brown to brown. The A2 horizon is brown to very pale brown. Reaction in the A horizon is medium acid to slightly acid. Combined thickness of the A1 and A2 horizons ranges from 20 to 35 inches. The B and C horizons are red, reddish brown, yellowish red, or reddish yellow. Reaction in these horizons is strongly acid to medium acid.

Dougherty soils differ from similar Konawa soils by having an A horizon that is more than 20 inches thick. They have a more reddish B2t horizon than associated Stidham soils, and they are deeper than similar Hartsells soils.

Dougherty loamy fine sand, 3 to 8 percent slopes (DoD).—This gently sloping to sloping soil is on uplands.

Included with this soil in mapping are small areas of Stidham loamy fine sand and Konawa fine sandy loam. Also included are areas of soils similar to this Dougherty soil except the subsoil is more clayey. The Stidham inclusion makes up about 10 percent of the mapped areas, and the other soils, 5 percent.

This Dougherty soil is used dominantly for tame pasture and range but is also suitable for peanuts, rye, and sorghum. Management practices are needed that maintain or improve fertility and reduce erosion. The cropping system should include plant cover to protect against soil blowing and water erosion in winter and spring. Plant cover is needed if low-residue crops are grown. Stripcropping, keeping tillage to a minimum, returning crop residue to the soil, and fertilizing help to reduce erosion and maintain fertility. Diversion terraces are needed in some areas. Capability unit IVe-3; pasture and hayland suitability group 9A; Deep Sand Savannah range site; woodland suitability group 5o0.

Ennis Series

The Ennis series consists of well-drained, nearly level soils on flood plains. These soils formed under a cover of mixed hardwoods and an understory of tall grasses in alluvium from limestone, shale, sandstone, and loess. They are subject to flooding.

In a representative profile the surface layer is 6 inches of dark grayish-brown loam. The upper part of the subsoil, to a depth of 24 inches, is dark yellowish-brown loam. The lower part is brown silt loam and loam and extends to a depth of 40 inches. The underlying material is very dark gray silty clay loam.

Ennis soils are moderately permeable. Available water capacity is high.

Representative profile of Ennis loam, 270 feet south and 355 feet west of the NE. corner of sec. 20, T. 1 N., R. 9 E.:

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) loam, grayish brown (10YR 5/2) dry; weak, medium, granular structure; friable, hard; few bodies of dark yellowish brown (10YR 4/4); slightly acid; clear, smooth boundary.

B1—6 to 24 inches, dark yellowish-brown (10YR 4/4) loam, light yellowish brown (10YR 6/4) dry; weak, coarse, subangular blocky structure; very friable, hard; medium acid; gradual, smooth boundary.

B21—24 to 31 inches, brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; few, medium, faint, dark yellowish-brown (10YR 4/4) mottles; weak, medium, subangular blocky structure; friable, very hard; medium acid; gradual, smooth boundary.

B22—31 to 40 inches, brown (10YR 4/3) loam, pale brown (10YR 6/3) dry; common, medium and fine, faint, dark grayish-brown (10YR 4/2) and dark yellowish-brown (10YR 4/4) mottles; weak, medium, subangular blocky structure; friable, very hard; medium acid; gradual, smooth boundary.

Cg—40 to 60 inches, very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; common, medium, faint, dark-gray (10YR 4/1) mottles and common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; massive; firm, extremely hard; few, fine, iron-manganese concretions; medium acid.

The A1 or Ap horizon is dark grayish brown to dark yellowish brown. It is less than 10 inches thick. Reaction in this horizon is slightly acid to strongly acid. The B horizon is brown to dark yellowish-brown loam or silt loam. Reaction in the B1 horizon is strongly acid to medium acid. The B2 horizon is very fine sandy loam, loam, silt loam, or sandy clay loam. Mottles are brownish, reddish, and grayish. Grayish mottles are below a depth of 24 inches. Reaction is strongly acid to medium acid in the B2 horizon. The Cg horizon is very dark gray to strong-brown loam to silty clay loam. Reaction is strongly acid to medium acid. Mottles in this horizon are brownish, grayish, or yellowish.

Ennis soils are more sandy and have better internal drainage than associated Lanton or Lightning soils. They lack the distinct stratification of similar Robinsonville soils.

Ennis loam (0 to 1 percent slopes) (En).—This nearly level soil is on flood plains. It is subject to flooding once every 1 to 5 years.

Included with this soil in mapping are small areas of Robinsonville soils that range in texture from silt loam to fine sandy loam and small areas of Lanton silt loam. Also included are areas of soils that have a profile similar to that of Ennis loam, except that they have gray colors at depths above 40 inches.

This Ennis soil is used dominantly for tame pasture and range but is also suitable for alfalfa, cotton, corn, grain sorghum, peanuts, small grain, and trees. Management practices are needed that maintain soil structure and fertility and protect the soil from the overflow of streams. To maintain production and improve soil structure, it is necessary to return crop residue to the soil, keep tillage to a minimum, and apply fertilizer. Terraces for diverting water flowing from adjacent uplands are also necessary. Capability unit IIw-1; pasture and hayland suitability group 2A; Loamy Bottomland range site; woodland suitability group 3o7.

Ferris Series, Acid Surface Variant

This acid surface variant from the normal Ferris series is on uplands and is gently sloping. It is somewhat excessively drained. This variant formed under a cover of tall and mid grasses in material weathered from clayey sediment, shaly clay, or massive clay beds. It is noncalcareous to a depth of 40 inches.

In a representative profile the surface layer is 7 inches of very dark grayish-brown silty clay. Below, to a depth of 65 inches, is olive-brown clay.

Permeability is very slow in this soil. Available water capacity is high.

Representative profile of Ferris silty clay, acid surface variant, 3 to 5 percent slopes, 120 feet south and 1,675 feet west of the NE. corner of sec. 18, T. 1 S., R. 9 E.:

Ap—0 to 7 inches, very dark grayish-brown (2.5Y 3/2) silty clay, grayish brown (2.5Y 4/2) dry; weak, coarse, blocky structure; very firm, extremely hard; few, fine, iron-manganese concretions; slightly acid; clear, smooth boundary.

AC1—7 to 15 inches, olive-brown (2.5Y 4/4) clay, light olive brown (2.5Y 5/4) dry; few, fine and medium, distinct, yellowish-brown (10YR 5/6) mottles; most ped interiors are slightly darker in color; weak, coarse, blocky structure; very firm, extremely hard; many cracks coated with dark grayish-brown (2.5Y 4/2) and very dark grayish-brown (2.5Y 3/2) silty clay; few slickensides; few, fine and medium, iron-manganese concretions; few smooth pebbles slightly acid; gradual, wavy boundary.

AC2—15 to 30 inches, olive-brown (2.5Y 4/4) clay, light olive brown (2.5Y 5/4) dry; ped interiors are slightly darker in color; weak, coarse, blocky structure; very firm, extremely hard; many cracks coated with very dark grayish-brown (2.5Y 3/2) and dark grayish-brown (2.5Y 4/2) silty clay; few intersecting slickensides; few, fine and medium, iron-manganese concretions; few smooth pebbles; neutral; gradual, wavy boundary.

AC3—30 to 43 inches, olive-brown (2.5Y 4/4) clay, light olive brown (2.5Y 5/4) dry; most ped interiors are slightly darker in color; weak, coarse, blocky structure; very firm, extremely hard; few cracks coated with dark grayish-brown (2.5Y 4/2) silty clay; few intersecting slickensides; few, fine and medium, iron-manganese concretions; few smooth pebbles; moderately alkaline; gradual, wavy boundary.

C—43 to 65 inches, olive-brown (2.5Y 4/4) clay, light olive brown (2.5Y 5/4) dry; few, fine, distinct, olive-yellow mottles; ped interiors are slightly darker in color; massive; very firm, extremely hard; few slickensides; few pockets of soft powdery calcium carbonate and gypsum; few, fine and medium, iron-manganese concretions; few smooth gravel fragments; moderately alkaline.

The A1 or Ap horizon is very dark gray to very dark grayish brown and is less than 10 inches thick. Reaction in this horizon is slightly acid to moderately alkaline. The AC horizon ranges in color from brown to olive. The upper part of the AC horizon is slightly acid to neutral but ranges to moderately alkaline as depth increases. In places the lower part of the AC horizon is calcareous. Calcareous shaly clay or massive calcareous claybeds are at a depth of 40 inches or more.

This soil has a thinner and generally browner A horizon than associated Burleson soils.

Ferris silty clay, acid surface variant, 3 to 5 percent slopes (FeC).—This gently sloping soil is on uplands. Included in mapping, and making up about 15 percent of the mapped areas, are soils that have a silty clay loam surface layer but are otherwise similar to this variant of the Ferris series.

This soil is presently used for tilled crops and grass but is suited to cotton, grain sorghum, small grain, tame pasture, and range.

Management practices are needed that improve soil structure, reduce crusting, increase water intake, and reduce erosion. A cropping system that includes crops that produce large amounts of residue is needed. The crop residue should be returned to the soil to improve structure, increase water intake, and prevent surface crusting. Use of terraces and contour tillage is necessary, but tillage should be timely and kept to a minimum. Large cracks form in the surface when this soil is dry. Capability unit IIIe-3; pasture and hayland suitability group 7A; Blackclay Prairie range site; woodland suitability group 5o0.

Hartsells Series

The Hartsells series consists of well-drained, very gently sloping to sloping soils on uplands. These soils formed under a cover of oaks and an understory of tall grasses in material weathered from sandstone.

In a representative profile the surface layer is 7 inches of dark grayish-brown fine sandy loam. The subsurface layer extends to a depth of 11 inches and is brown fine sandy loam. The upper part of the subsoil that extends to a depth of 17 inches is yellowish-brown sandy loam. The lower part is yellowish-brown sandy clay loam to a depth of 36 inches. The underlying material is sandstone.

Permeability in Hartsells soils is moderately rapid. Available water capacity is moderate to high.

Representative profile of Hartsells fine sandy loam, 3 to 5 percent slopes, 270 feet south and 60 feet east of the NW. corner of sec. 14, T. 2 N., R. 9 E.:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) fine sandy loam, light brownish gray (10YR 6/2) dry; weak, fine, granular structure; very friable, soft; strongly acid; clear, smooth boundary.

A2—7 to 11 inches, brown (10YR 4/3) fine sandy loam, pale brown (10YR 6/3) dry; weak, fine, granular structure; very friable, soft; strongly acid; clear, wavy boundary.

B1—11 to 17 inches, yellowish-brown (10YR 5/4) sandy loam, light yellowish brown (10YR 6/4) dry; weak, medium, subangular blocky structure; friable, hard; many peds coated with brown (10YR 4/3) siftings from the A2 horizon; very strongly acid; gradual, smooth boundary.

B21t—17 to 30 inches, yellowish-brown (10YR 5/6) sandy clay loam, brownish yellow (10YR 6/6) dry; weak to moderate, medium, subangular blocky structure; friable, hard; clay films bridging sand grains and patchy clay films on faces of peds; very strongly acid; gradual, smooth boundary.

B22t—30 to 36 inches, yellowish-brown (10YR 5/6) sandy clay loam, brownish yellow (10YR 6/6) dry; few, fine and medium, distinct, strong-brown (7.5YR 5/6) mottles; weak, medium, subangular blocky structure; friable, hard; patchy clay films on faces of peds, few sandstone fragments; very strongly acid; abrupt, wavy boundary.

R—36 inches, yellowish-brown (10YR 5/6) and yellowish-red (5YR 4/6) sandstone.

The Ap horizon is dark grayish-brown to grayish-brown fine sandy loam or sandy loam. Reaction in this horizon is strongly acid to very strongly acid. The A2 horizon is pale brown to yellowish brown, and reaction is strongly acid to very strongly acid. The B2t horizon is strong-brown, yellowish-brown, or dark yellowish-brown sandy clay loam or loam. The lower part of the B horizon has few to common brownish or reddish mottles. In places a gradational B3 horizon that is similar to the B2t horizon but slightly less clayey is immediately above the sandstone. Depth to the sandstone is 20 to 40 inches.

Hartsells soils are not so deep as associated Konawa soils and similar Stidham or Dougherty soils. They have B2t horizons that are less clayey and are yellower than associated Homa soils.

Hartsells fine sandy loam, 1 to 3 percent slopes (HaB).—This very gently sloping soil is on uplands. It has a profile similar to the one described as representative for the series, but the combined thickness of the surface layer and subsoil in this soil is about 5 inches thinner.

Included with this soil in mapping are areas of Homa fine sandy loam. Also included are areas of soils in which the surface layer and subsoil combined are 10 to 20 inches thick or more than 40 inches thick. The soils in the latter areas are otherwise similar to the soil described as representative of the Hartsells series. The Homa inclusions make up about 5 percent of the mapped areas, and the other inclusions make up about 10 percent.

This Hartsells soil is used dominantly for tame pasture and range but is also suitable for cotton, corn, grain sorghum, peanuts, and small grain.

Management practices are needed that maintain fertility and soil structure and provide protection against erosion. The erosion hazard can be reduced by terracing, contour farming, and stripcropping and by the proper use of crop residue and fertilizer. Plant cover helps to control soil blowing and water erosion in winter and spring. Sown crops can be grown continuously if fertilizer is used and crop residue is returned to the soil annually.

Terracing, contour farming, and keeping tillage to a minimum are required where row crops are grown. Capability unit IIe-1; pasture and hayland suitability group 8B; Sandy Savannah range site; woodland suitability group 4o1.

Hartsells fine sandy loam, 3 to 5 percent slopes (HaC).—This gently sloping soil is on uplands. It has the profile described as representative of the series.

Included with this soil in mapping, and making up about 10 percent of the mapped areas, are soils similar to this Hartsells soil except that the combined thickness of the surface layer and subsoil is more than 40 inches. Also included, and making up about 5 percent of the mapped areas, are soils similar to this Hartsells soil except that the combined thickness of the surface layer and subsoil is 10 to 20 inches. In addition, small areas of Homa soils were included in mapping.

This Hartsells soil is used for tame pasture and range but is also suitable for cotton, corn, grain sorghum, peanuts, and small grain.

Management practices that maintain fertility, maintain soil structure, and provide protection against erosion are needed. The hazard of erosion can be reduced by terracing, contour farming, stripcropping, and returning crop residue to the soil. Plant cover is needed to help control soil blowing and water erosion in winter and spring. The use of crop residue and fertilizer help to conserve moisture and maintain soil structure. Capability unit IIIe-1; pasture and hayland suitability group 8B; Sandy Savannah range site; woodland suitability group 4o1.

Hartsells fine sandy loam, 2 to 5 percent slopes, eroded (HaC2).—This moderately eroded, very gently sloping and gently sloping soil is on uplands. It has a profile similar to the one described as representative for the series except that part of the surface layer has been removed by erosion. In some areas there are crossable gullies where sheet erosion occurs, and the surface layer and subsoil have been mixed by tillage.

Included with this soil in mapping are minor uncrossable gullies, areas of eroded Homa fine sandy loam that make up about 5 percent of the mapped areas, and small areas of rock outcrop. Also included, making up about 5 percent of the mapped areas, are areas of soils similar to Hartsells soils except that the thickness of the surface layer and subsoil combined is more than 40 inches.

This Hartsells soil is used dominantly for tame pasture and range, but is also suitable for cotton, corn, grain sorghum, peanuts, and small grain. Intensive management is needed for protection against erosion. Terracing, contour farming, returning crop residue to the soil, and applying fertilizer are needed practices. Plant cover helps protect against soil blowing and water erosion in winter and spring. Deterioration of soil structure and loss of fertility can be controlled by the foregoing practices. Capability unit IIIe-2; pasture and hayland suitability group 8B; Sandy Savannah range site; woodland suitability group 4o1.

Hartsells soils, 2 to 6 percent slopes, severely eroded (HeC3).—This severely eroded, very gently sloping to sloping soils are on uplands. They have a profile similar to the one described as representative for the series, but about 40 percent of the mapped area has lost the surface layer through erosion or has many uncrossable gullies. The surface layer in uneroded areas is fine sandy loam and sandy loam. Uncrossable gullies are 2 to 5 feet deep and are at intervals of 25 to 150 feet.

Included with these soils in mapping are areas of a soil that has a profile similar to the representative Hartsells soil, but the thickness of the surface layer and subsoil combined is 10 to 20 inches. This inclusion makes up about 10 percent of the mapped areas. Also included in some mapped areas are areas of severely eroded Homa soils. These areas make up about 5 percent of the mapped areas.

These Hartsells soils are so severely eroded that they are not suitable for cultivation and should be returned to permanent vegetation. Tame pasture and range can be established if the banks of gullies are sloped, runoff from higher areas is diverted, critical areas are mulched with plant residue, and fertilizer is applied. The quality of grasses can be maintained or improved by controlling brush, using suitable grazing practices, and providing protection from fire. These soils are suitable for use as woodland but the native hardwood trees are of poor quality and grow slowly. Capability unit VIe-2; pasture and hayland suitability group 8F; Eroded Sandy Savannah range site; woodland suitability group 5c3e.

Homa Series

The Homa series consists of moderately well drained, very gently sloping to steep soils on uplands. These soils formed under a cover of oaks and an understory of tall grasses in material weathered from shale and clay.

In a representative profile the surface layer is 5 inches of very dark grayish-brown and brown fine sandy loam. The subsoil, which extends to a depth of 40 inches, is clay, and color ranges from yellowish red in the upper part to strong brown and light olive brown in the lower part. The underlying material is a mottled, gray, light olive-brown, and pale-olive clay.

Permeability is slow in Homa soils. Available water capacity is high.

Representative profile of Homa fine sandy loam, in an area of Homa soils and Rock outcrop, moderately steep, 450 feet south and 360 feet east of the NW. corner of sec. 3, T. 1 N., R. 11 E.:

A1—0 to 2 inches, very dark grayish-brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; moderate, fine and medium, granular structure; very friable, slightly hard; few, coarse, sandstone fragments; medium acid; clear, wavy boundary.

A2—2 to 5 inches, brown (10YR 4/3) fine sandy loam, pale brown (10YR 6/3) dry; weak, medium, granular structure; very friable, slightly hard; few, coarse, sandstone fragments, few bodies of very dark grayish-brown (10YR 3/2) fine sandy loam; strongly acid; clear, wavy boundary.

B21t—5 to 20 inches, yellowish-red (5YR 4/6) clay, yellowish red (5YR 5/6) dry; common, fine and medium, distinct, brown (10YR 5/3) mottles that have gray (10YR 5/1) centers; moderate, medium, blocky structure; extremely firm, extremely hard; clay films or pressure faces on peds; very strongly acid; gradual, wavy boundary.

B22t—20 to 32 inches, strong-brown (7.5YR 5/6) clay, reddish yellow (7.5YR 6/6) dry; common, medium, distinct, pale-brown (10YR 6/3) and gray (10YR 5/1) mottles; moderate, medium and coarse, blocky structure; extremely firm, extremely hard; clay films or pressure faces on peds; few iron-manganese concretions; strongly acid; gradual, wavy boundary.

B3—32 to 40 inches, light olive-brown (2.5YR 5/4) clay, light yellowish brown (2.5Y 6/4) dry; common, medium and coarse, distinct, gray (10YR 5/1) and olive-gray (5Y 5/2) mottles; weak, medium, blocky structure; extremely firm, extremely hard; patchy clay films or pressure faces on peds; few, fine, iron-manganese concretions; slightly acid; gradual, wavy boundary.

C—40 to 60 inches, coarsely mottled gray (10YR 5/1), light olive-brown (2.5Y 5/6), and pale-olive (5Y 6/4) clay; massive; extremely firm, extremely hard; bedding planes that have strata of hard shale evident; neutral.

The A1 horizon is very dark grayish-brown to brown loam or fine sandy loam. Reaction is strongly acid to slightly acid. The A2 horizon is dark grayish-brown to light yellowish-brown sandy loam, very fine sandy loam, or loam. Reaction in the A2 horizon is very strongly acid to medium acid. The upper part of the B2t horizon is dark reddish-brown to strong-brown, and mottles are grayish and brownish. Reaction is very strongly acid to medium acid. The lower part of the B2t horizon is dark reddish brown to yellowish brown. Few to many grayish, brownish, and reddish mottles are present. Reaction is strongly acid to slightly acid. The B3 horizon is dark gray to light olive brown, and reaction is strongly acid to mildly alkaline. The C horizon is dark gray to olive, and reaction is slightly acid to moderately alkaline. Bedding planes are evident in the weathered clayey shale or shaly clay. The solum is 30 to 55 inches thick.

Homa soils have a more clayey B2t horizon than associated Hartsells soils or similar Chaney soils.

Homa-Hartsells complex, 2 to 5 percent slopes (HhC).—About 65 percent of this unit is Homa loam and Homa fine sandy loam, and about 25 percent is Hartsells fine sandy loam and Hartsells sandy loam. These very gently sloping soils are on uplands.

The profile of the Hartsells soil is similar to that described as representative for the series, but the surface layer and subsoil combined are about 5 inches thinner (fig. 3).

Included with this soil in mapping are areas of a soil that has a profile similar to that described as representative for the Hartsells series, but the thickness of the surface layer and subsoil combined is 10 to 20 inches. Also included are small areas of Rock outcrop.

This Homa-Hartsells complex is used dominantly for tame pasture and range but is also suitable for sorghum and small grain.

Management practices are needed that maintain fertility and soil structure, reduce erosion, and conserve moisture. Intensive erosion-control practices are needed. Terracing, contour farming, fertilizing, using close-growing crops, returning crop residue to the soil annually, and using minimum tillage help to control erosion, conserve moisture, and

Figure 3.—Profile of Hartsells fine sandy loam in the Homa-Hartsells complex, 2 to 5 percent slopes.

maintain fertility and soil structure. Capability unit IVe-4; pasture and hayland suitability group 8B; Sandy Savannah range site; woodland suitability group 4o1.

Homa soils and Rock outcrop, moderately steep (HoE).—Homa soils make up about 65 percent of the acreage of this mapping unit and Rock outcrop about 12 percent. The mapped areas are on uplands. The Homa soils have the profile described as representative for the Homa series. The Rock outcrop is sandstone bedrock.

Included with this soil in mapping, and making up 7 percent of the mapped areas, are areas of Hartsells fine sandy loam. Also included are areas of soils that have a profile similar to the one described as representative for the Hartsells series except that the combined thickness of the surface layer and subsoil is 10 to 20 inches. The latter inclusions make up 9 percent of the mapped areas. Additional inclusions, and making up 7 percent of the mapped areas, are areas of soil that has a profile similar to the one described as representative for the Homa series except that the combined thickness of the surface layer and subsoil is less than 30 inches, or the upper part of the subsoil is yellowish brown.

This undifferentiated soil group is suited to range and woodland. The less sloping, less stony areas of the Homa soils are suited to tame pasture. Quality of the native grass can be maintained or improved by controlling brush and grazing and by providing protection against fire. The native hardwood trees are of poor quality and grow slowly. Capability unit VIIs-1; pasture and hayland suitability group 8B; Sandy Savannah range site; woodland suitability group 5x9.

Homa soils and Rock outcrop, steep (HoF).—Homa loam and Homa fine sandy loam make up about 55 percent of the acreage of this mapping unit and Rock outcrop about 15 percent. The areas are on uplands. The Homa soils have a profile similar to the one described as representative for the Homa series, but the combined thickness of the surface layer and subsoil is about 5 inches thinner. The Rock outcrop is sandstone bedrock.

Included with these soils in mapping, and making up about 25 percent of the mapped areas, are areas of soils that have a profile similar to the one described as representative for the Homa series. In these soils, however, the combined thickness of the surface layer and subsoil is less than 30 inches, or the upper part of the subsoil is yellowish brown. Also included, and making up 5 percent of the mapped areas, are areas of soil where the combined thickness of the fine sandy loam surface layer and subsoil is 6 to 15 inches.

This undifferentiated soil group is suited to range and woodland. The quality of native grass can be maintained or improved by controlling brush and grazing and by providing protection against fire. Native hardwood trees are of poor quality and grow slowly. Capability unit VIIs-2; not in a pasture and hayland suitability group; Savannah Breaks range site; woodland suitability group 5x9.

Kaufman Series

The Kaufman series consists of somewhat poorly drained, nearly level soils on flood plains. These soils formed in material weathered from clayey sediment under a cover of various kinds of trees and an understory of tall grasses. They are subject to flooding.

In a representative profile the surface layer is very dark gray silty clay and extends to a depth of 30 inches. The subsoil, which extends to a depth of 50 inches, is very dark gray silty clay. The underlying material is very dark gray silty clay.

Kaufman soils are very slowly permeable. Available water capacity is high.

Representative profile of Kaufman silty clay, 375 feet west and 1,320 feet north of the SE. corner of sec. 9, T. 1 S., R. 9 E.:

Ap—0 to 5 inches, very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; weak, medium and fine, blocky structure; very firm, very hard; mildly alkaline; clear, smooth boundary.

A11—5 to 17 inches, very dark gray (N 3/0) silty clay, dark gray (N 3/0) dry; common, medium, distinct, strong-brown (7.5YR 5/6) mottles; weak, coarse, blocky structure; extremely firm, extremely hard; common slickensides; few lime concretions; few, medium, iron-manganese concretions; mildly alkaline; gradual, wavy boundary.

A12—17 to 30 inches, very dark gray (N 3/0) silty clay, dark gray (N 3/0) dry; common, medium, distinct, strong-brown (7.5YR 5/6) mottles; weak, coarse, blocky structure; extremely firm, extremely hard; common slickensides; few lime concretions; few, medium, iron-manganese concretions; mildly alkaline; gradual, wavy boundary.

Bg—30 to 50 inches, very dark gray (N 3/0) silty clay, gray (N 4/0) dry; common, medium and coarse, distinct, strong-brown (7.5YR 5/6) mottles; weak, coarse, blocky structure; extremely firm, extremely hard; common lime concretions; few, medium, iron-manganese concretions; moderately alkaline; gradual, wavy boundary.

Cg—50 to 75 inches very dark gray (N 3/0) silty clay, dark gray (N 4/0) dry; few, medium, distinct, dark-brown (7.5YR 3/2) mottles; massive; very firm, extremely hard; calcareous; moderately alkaline.

The A horizon is black to very dark gray . Reaction is slightly acid to mildly alkaline. The Bg and Cg horizons are gray to very dark gray silty clay or clay that has grayish, brownish, or yellowish mottles. Reaction is mildly alkaline to moderately alkaline, and pockets, lenses, or concretions of lime are below a depth of 24 inches. Thickness of the solum ranges from 40 to 70 inches.

The Kaufman soils are more clayey throughout than associated Lanton soils. They have a more clayey A horizon than similar Lightning soils.

Kaufman silty clay (0 to 1 percent slopes) (Ka).—This nearly level soil is on flood plains. It has the profile described as representative for the series (fig. 4). This soil is subject to damaging floods and is wet in spring.

Figure 4.—Profile of Kaufman silty clay. Note the numerous cracks in the dry soil material.

Included with this soil in mapping, and making up 10 percent of the mapped areas, are areas of Lanton silty clay loam. Also included, and making up 5 percent of the mapped areas, are areas of soils that have a profile similar to the one described as representative of Kaufman series but that have brown colors.

This Kaufman soil is used dominantly for small grain, pecans, tame pasture, range, and woodland but is also suitable for alfalfa, cotton, corn, grain sorghum, and soybeans. Management is needed that controls wetness, maintains soil structure, and protects the soil from overflowing streams. Returning crop residue to the soil helps to improve soil structure. Surface drains generally are sufficient for controlling wetness. Water often remains on the surface for several days after rains. This clayey soil is difficult to till, and tillage should be timely and kept to a minimum. Capability unit IIIw-1; pasture and hayland suitability group 1A; Heavy Bottomland range site; woodland suitability group 2w6.

Konawa Series

The Konawa series consists of well-drained, very gently sloping and gently sloping soils on uplands. These soils formed under a cover of oaks and an understory of tall grasses in material weathered from sandy or loamy sediment.

In a representative profile the surface layer is dark-brown fine sandy loam and extends to a depth of 7 inches. The next layer, to a depth of 13 inches, is dark yellowish-brown fine sandy loam. The upper part of the subsoil, to a depth of 42 inches, is yellowish-red sandy clay loam. The lower part is yellowish-red fine sandy loam. It extends to a depth of 65 inches.

Konawa soils are moderately permeable. Available water capacity is high.

Representative profile of Konawa fine sandy loam, 2 to 5 percent slopes, 105 feet east and 735 feet north of the SW. corner of sec. 29, T. 2 N., R. 11 E.:

Ap—0 to 7 inches, dark-brown (10YR 4/3) fine sandy loam, pale brown (10YR 6/3) dry; weak, fine, granular structure; very friable, soft; slightly acid; clear, smooth boundary.

A2—7 to 13 inches, dark yellowish-brown (10YR 4/4) fine sandy loam, light yellowish brown (10YR 6/4) dry; weak, fine, granular structure; very friable, slightly hard; few bodies of brown (10YR 4/3) and very dark brown (10YR 3/3); slightly acid; clear, wavy boundary.

B21t—13 to 32 inches, yellowish-red (5YR 4/6) sandy clay loam, yellowish red (5YR 5/6) dry; weak, coarse, prismatic structure parting to weak, coarse, blocky; firm, hard; clay films bridging sand grains of faces of peds; few, fine, iron-manganese concretions; medium acid; diffuse, smooth boundary.

B22t—32 to 42 inches, yellowish-red (5YR 4/6) sandy clay loam, reddish yellow (5YR 6/6) dry; weak, coarse, subangular blocky structure; firm, hard; clay films bridging grains and coating some peds; few, medium, iron-manganese concretions; medium, acid; diffuse, smooth boundary.

B3—42 to 65 inches, yellowish-red (5YR 5/6) fine sandy loam, reddish yellow (5YR 6/6) dry; weak, coarse, subangular blocky structure; friable, hard; medium acid.

The Ap or A1 horizon is dark grayish brown to pale brown. Reaction is medium acid to slightly acid. The A2 horizon has slightly lighter colors than the Ap horizon. Reaction in this horizon is medium acid to slightly acid. The B2t horizon is reddish-brown to strong-brown fine sandy loam or sandy clay loam.

The Konawa soils are thinner and have a more loamy A horizon than similar Stidham or Dougherty soils. They have a thicker solum and a more reddish B2t horizon than associated and similar Hartsells soils. They are less clayey in the B2t horizon than associated Chaney soils.

Konawa fine sandy loam, 2 to 5 percent slopes (KoC).—This very gently sloping and gently sloping soil is on uplands.

Included with this soil in mapping, and making up 10 percent of the mapped areas, are areas of soils that have a profile similar to the one described as representative for the Konawa series except that the subsoil is more clayey. Also included are small areas of Dougherty loamy fine sand and Stidham loamy fine sand.

This Konawa soil is used primarily for tame pasture but is also suitable for corn, cotton, grain sorghum, peanuts, range, and small grain. Management practices are needed that maintain fertility and soil structure and protect against erosion. Terracing, contour farming, stripcropping, and returning crop residue to the soil help to control erosion. Plant cover protects against soil blowing and water erosion in winter and spring. Applying fertilizer and returning crop residue to the soil conserve moisture, maintain soil structure, and reduce erosion. Capability unit IIIe-1; pasture and hayland suitability group 8B; Sandy Savannah range site; woodland suitability group 5o0.

Lanton Series

The Lanton series consists of poorly drained, nearly level to gently sloping soils on flood plains. These soils formed under a cover of different kinds of trees and an understory of tall grasses. The material in which they formed was weathered from clayey or loamy sediment. Soils of this series are subject to flooding.

In a representative profile the surface layer is very dark grayish-brown and very dark gray silt loam to a depth of 20 inches. Below this, to a depth of 38 inches, is very dark gray silty clay loam. The underlying material is dark-gray clay

Permeability is slow in Lanton soils. Available water capacity is high.

Representative profile of Lanton silt loam, 155 feet south and 1,055 feet east of the NW. corner of sec. 17, T. 3 N., R. 11 E.:

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak, medium and fine, granular structure; friable, very hard; few dark grayish-brown (10YR 4/2) earthworm casts; slightly acid; clear, smooth boundary.

A11—7 to 20 inches, very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; few, medium and fine, faint, dark-brown (10YR 3/3) mottles; weak, medium, subangular blocky structure; friable, very hard; few dark grayish-brown (10YR 4/2) earthworm casts; many ped faces have coatings of very dark grayish-brown (10YR 3/2) silt loam; few, fine, iron-manganese concretions; slightly acid; gradual, smooth boundary.

A12—20 to 38 inches, very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; common, medium and fine, distinct, strong-brown (7.5YR 5/6) mottles and common, medium and fine, faint, gray (10YR 5/1) mottles; weak, medium, subangular blocky structure; firm, very hard; few earthworm casts; few, fine and medium, iron-manganese concretions; slightly acid; diffuse, smooth boundary.

Cg—38 to 62 inches, dark-gray (10YR 4/1) clay, gray (10YR 6/1) dry; common, medium and coarse, faint, very dark gray (10YR 3/1) mottles and distinct, brown (7.5YR 5/4) mottles; massive; firm, very hard; patchy films and thin silt coatings on faces of cracks; few, fine and medium, iron-manganese concretions; slightly acid.

The A horizon is very dark grayish-brown to black silt loam and silty clay loam. In places the Ap horizon is dark brown in color. The Ap or A11 horizon has common, brownish, grayish, and, in places, reddish mottles. Reaction in the A horizon is slightly acid to neutral. Thickness of the dark A horizon exceeds 24 inches. The Cg horizon is variable in color, ranging from very dark gray to grayish brown, and it has faint and distinct grayish and brownish mottles. Reaction in this horizon is slightly acid to neutral.

Soils in mapping unit Lc near stream channels are outside the defined range for the Lanton series. These soils have better surface drainage than Lanton soils, and carbonate concretions generally are between depths of 30 and 60 inches. They are enough like the Lanton series in morphology, composition, and behavior, however, so that a new series is not warranted.

Lanton soils are less clayey than associated Kaufman soils. They have a thicker A horizon than associated Robinsonville, Lightning, and Ennis soils.

Lanton silt loam (0 to 1 percent slopes) (La).—This soil is on flood plains. It has the profile described as representative for the series. This soil is subject to damaging floods and is wet in spring.

Included with this soil in mapping, and making up 10 percent of the mapped areas, are areas of soils that have a profile similar to the one described as representative for the series except that the surface layer is less than 24 inches thick. Also included, and making up 5 percent of the mapped areas, are areas of Ennis loam.

This Lanton soil is used dominantly for tame pasture and range but is also suitable for alfalfa, corn, cotton, grain sorghum, peanuts, small grain, and woodland. Management practices are needed that control wetness, maintain soil structure, and protect the soil from overflowing streams. Crop residue should be returned to the soil to improve the soil structure. Tillage should be timely and kept to a minimum. Surface drainage is sufficient for controlling soil wetness. Capability unit IIIw-2; pasture and hayland suitability group 2A; Loamy Bottomland range site; woodland suitability group 2w6.

Lanton silty clay loam, moderately wet (0 to 1 percent slopes) (Lc).—This soil is on flood plains. It has a profile similar to the one described as representative for the series except that it has a silty clay loam surface layer, and it has a higher concentration of calcium carbonate at depths between 30 and 60 inches. Also, this soil has better surface drainage. It is subject to damaging floods.

Included with this soil in mapping, and making up 5 percent of the mapped areas, are areas of soils that have a profile similar to the one described as representative for the Lanton series except that the surface layer is less than 24 inches thick. Also included, and making up 10 percent of the mapped areas, are areas of soils that have a texture of loam and sandy loam. Small areas of Kaufman silty clay also are included.

This Lanton soil is used dominantly for crops and tame pasture but is suitable for alfalfa, corn, cotton, grain sorghum, peanuts, range, soybeans, tame pasture, and small grain. Management practices are needed that protect this soil from overflowing streams, control wetness, and maintain soil structure. Crop residue should be returned to the soil to improve soil structure. Tillage should be timely and kept to a minimum. Surface drainage is sufficient for controlling soil wetness. Capability unit IIw-2; pasture and hayland suitability group 2A; Loamy Bottomland range site; woodland suitability group 5o0.

Lightning Series

The Lightning series consists of poorly drained and somewhat poorly drained, nearly level soils on flood plains. These soils formed under a cover of different kinds of trees and an understory of tall grasses. The material in which they formed was weathered from loamy or clayey alluvium. These soils are subject to flooding.

In a representative profile the surface layer is dark-gray silt loam that extends to a depth of 6 inches. The upper part of the subsoil, to a depth of 25 inches, is very dark gray silty clay. The lower part, to a depth of 45 inches, is dark-gray silty clay loam. The underlying material is dark grayish-brown silty clay loam.

Permeability is very slow in Lightning soils. Available water capacity is high.

Representative profile of Lightning silt loam, 650 feet east and 2,440 feet south of the N. W. corner of sec. 4, T. 2 N., R. 10 E.:

Ap—0 to 6 inches, dark-gray (10YR 4/1) silt loam, gray (10YR 6/1) dry; weak, medium and fine, granular structure; friable, hard; slightly acid; clear, smooth boundary.

B2t—6 to 25 inches, very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; moderate, medium, blocky structure; very firm, extremely hard; clay films on most faces of peds; slightly acid; gradual, smooth boundary.

B3—25 to 45 inches, dark-gray (10YR 4/1) silty clay loam, gray (10YR 5/1) dry; common, medium, faint, dark grayish-brown (10YR 4/2) and brown (10YR 4/3) mottles; weak, medium, blocky structure; very firm, very hard; few lenses of powdery gypsum on faces of peds; few, fine and medium, iron-manganese concretions; slightly acid; gradual, smooth boundary.

C—45 to 70 inches, dark grayish-brown (10YR 4/2) silty clay loam, light brownish gray (10YR 6/2) dry; few, medium and fine, faint, dark yellowish-brown (10YR 4/4) and gray (10YR 5/1) mottles; weak, coarse, blocky structure; very firm, very hard; few calcium carbonate concretions; slightly acid.

The A horizon is dominantly gray to dark-gray silt loam, but in places it is loam and silty clay loam. Reaction is strongly acid to neutral. The Bt horizon is very dark gray to dark gray with brownish mottles in places in the upper part and grayish, brownish, and yellowish mottles in the lower part. Texture is silty clay loam to clay, and reaction is medium acid to slightly acid. The B3 horizon has color and texture similar to the B2t horizon, and reaction is medium acid to slightly acid. The C horizon is very dark gray to light brownish-gray silty clay loam to clay, and reaction is slightly acid to medium acid.

Lightning soils are more clayey in the B horizon than associated Lanton and Ennis soils, and they lack the columnar structure and high sodium content of associated Carytown soils. They are less clayey in the A horizon than similar Kaufman soils.

Lightning-Carytown complex (0 to 1 percent slopes) (Lt).—About 75 percent of the acreage in this complex is Lightning silt loam, Lightning loam, or Lightning silty clay loam, and about 25 percent is Carytown silt loam. These soils are on flood plains. They are wet in spring and are subject to damage by flooding. The Lightning soil has the profile described as representative for the Lightning series (fig. 5).

Figure 5.—Profile of Lightning silt loam.

Included with this soil in mapping are areas of Lanton silt loam that make up about 5 percent of the mapped areas and small areas of a soil similar to Lightning soils except that the surface layer is darker in color.

These soils are used principally for tame pasture and range. They are also suitable for corn, alfalfa, cotton, grain sorghum, small grain, and woodland. Management practices are needed that control wetness, maintain soil structure, reduce crusting, increase water intake, and provide protection from overflowing streams. Returning crop residue to the soil improves structure and reduces crusting. Surface drainage generally is sufficient for controlling soil wetness. Tillage should be timely and kept to a minimum. In places gypsum applications are beneficial. Both soils are in capability unit IIIw-3; both are in pasture and hayland suitability group 2B; Lightning soil is in Heavy Bottomland range site, and the Carytown soil is in Shallow Claypan range site; both soils are in woodland suitability group 3w6.

Mine Pits and Dumps

Mine pits and dumps (Mp) consists of dumps and trenches that remain after coal has been mined. The pits are 10 to 60 feet deep, have nearly vertical sides, and are partly filled with water. The dump areas are undulating to very steep, and they consist of various combinations of weathered shale, coal residue, gravel, clay loam, and clay. Reaction of this material is mostly alkaline to neutral.

Most of the dump areas have a sparse cover of bermudagrass or annual and perennial native grasses (fig. 6).

Figure 6.—An area of Mine pits and dumps.

Included with this land type in mapping are minor areas of gravel and limestone quarries.

This land type is suited to range and wildlife habitat and is used for these purposes. Minor areas are suitable for post lots. Capability unit VIIs-4; not placed in pasture and hayland suitability group; Coal Strip Mines range site; woodland suitability group 5o0.

Parsons Series

The Parsons series consists of somewhat poorly drained, nearly level and very gently sloping soils on uplands. These soils formed under a cover of tall and mid grasses in material weathered from loamy or clayey sediment.

In a representative profile the surface layer is a very dark grayish-brown silt loam to a depth of 8 inches. The subsurface layer extends to a depth of 12 inches and is dark-gray silt loam. The upper part of the subsoil is very dark gray and dark gray clay to a depth of 32 inches; the lower part is dark-gray clay loam mottled with gray and yellowish brown. It extends to a depth of 62 inches.

Permeability is very slow in Parsons soils. Available water capacity is high.

Representative profile of Parsons silt loam, 0 to 1 percent slopes, 180 feet west and 2,110 feet south of the NE. corner of sec. 8, T. 1 N., R. 8 E.:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak, fine, granular structure; friable, hard; few, fine, iron-manganese concretions; neutral (limed); clear, smooth boundary.

A2—8 to 12 inches, dark-gray (10YR 4/1) silt loam; light gray (10YR 6/1) dry; few, fine, faint, gray mottles and few, fine, distinct, yellowish-brown mottles; weak, medium, granular structure; friable hard; few, fine, iron-manganese concretions; medium acid; abrupt, smooth boundary.

B21t—12 to 24 inches, very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; few, medium, faint, dark-brown (10YR 3/3) mottles; weak, coarse, blocky structure; very firm, extremely hard; patchy clay films on faces of peds; many peds have thin gray (10YR 5/1) silt loam coatings; medium acid; gradual, smooth boundary.

B22t—24 to 32 inches, dark-gray (10YR 4/1) clay, gray (10YR 5/1) dry; common, medium, distinct, dark yellowish-brown (10YR 3/4) mottles; weak, coarse, blocky structure; friable firm, extremely hard; patchy clay films on faces of peds; many peds have thin gray (10YR 5/1) silt loam coatings; medium acid; gradual, smooth boundary.

B23t—32 to 42 inches, dark-gray (10YR 4/1) clay loam, gray (10YR 5/1) dry; many medium and a few coarse, distinct, strong-brown (7.5YR 5/6) mottles; weak, coarse, blocky structure; very firm, extremely hard; few thin clay films on faces of peds; few, fine, iron-manganese concretions; medium acid; diffuse, smooth boundary.

B3—42 to 62 inches, coarsely mottled gray (10YR 6/1) and yellowish-brown (10YR 5/8) clay loam; weak, coarse, blocky structure; very firm, extremely hard; few, medium, iron-manganese concretions; mildly alkaline.

The Ap or A1 horizon ranges from very dark gray to very dark grayish brown. Where the soil is not limed, reaction ranges from strongly acid to slightly acid. The A2 horizon is dark gray to grayish brown, and reaction is medium acid to strongly acid. The B2t horizon is very dark gray to dark grayish brown, and mottles are brownish, grayish, and, in places, reddish. Texture ranges from clay to clay loam. Reaction is medium acid to strongly acid in the B2t horizon. The B3 horizon is dark gray to yellowish brown or is coarsely mottled gray and yellowish brown. Texture ranges from clay to clay loam. Reaction in the B3 horizon is mildly alkaline to neutral.

Parsons soils have a thicker A horizon than similar Carytown soils, and they have a more abrupt boundary between the A and B horizons than associated Bonham soils. They lack the soft lime concretions in the lower part of the B horizon of similar Wilson soils, and they have a distinct A2 horizon, which is lacking in the Wilson soils.

Parsons silt loam, 0 to 1 percent slopes (PaA).—This soil is on uplands. It has the profile described as representative for the series.

Included with this soil in mapping, and making up about 10 percent of the mapped areas, is Carytown silt loam. Also included, and making up about 5 percent of the mapped areas, are soils that have a brown subsoil but are otherwise similar to this Parsons soil. Other inclusions are small areas of Bonham loam and Wilson silt loam.

This soil is used dominantly for tame pasture, hayland, and range. It is also suitable for corn, cotton, grain sorghum, peanuts, and small grain. Management practices are needed that improve soil structure and reduce crusting. The cropping system should include crops that produce large amounts of residue, which can be returned to the soil to improve soil structure, increase water intake, and reduce crusting. Capability unit IIs-1; pasture and hayland suitability group 8C; Claypan Prairie range site; woodland suitability group 5o0.

Parsons silt loam, 1 to 3 percent slopes (PaB).—This very gently sloping soil is on uplands. It has a profile (fig. 7) similar to the one described as representative for the series, but the lower part of the subsoil is brown.

Figure 7.—Profile of Parsons silt loam.

Included with this soil in mapping, and making up about 15 percent of the mapped areas, are soils that have a profile similar to that described as representative of the Parsons series except for a yellowish-brown subsoil or a combined thickness of surface layer and subsoil that is less than 8 inches. Also included are small areas of Steedman clay loam and Bonham loam.

This soil is used dominantly for range, hay, and tame pasture, but it is also suitable for corn, cotton, grain sorghum, peanuts, and small grain. Management practices are needed that improve soil structure, reduce surface crusting, and reduce erosion. Crops that produce large amounts of residue need to be grown in the cropping system. Returning the residue to the soil improves soil structure, increases water intake, and reduces crusting and erosion. Terraces and contour tillage help to reduce erosion. Sown crops can be grown without the use of terraces if fertilizer is used and crop residue is returned to the soil. Capability unit IIIe-6; pasture and hayland suitability group 8C; Claypan Prairie range site; woodland suitability group 5o0.

Robinsonville Series

The Robinsonville series consists of well-drained, nearly level to gently sloping soils on floods plains. These soils formed in material weathered from loamy alluvium under a cover of different kinds of trees and an understory of tall grasses. They are subject to flooding.

In a representative profile the surface layer is very dark grayish-brown loam 3 inches thick. Below, to a depth of 33 inches, is brown loam and brown fine sandy loam. Between depths of 33 and 60 inches is dark-brown fine sandy loam.

Permeability is moderately rapid in Robinsonville soils. Available water capacity is high.

Representative profile of Robinsonville loam, 665 feet west and 2,640 feet south of the NE. corner of sec. 13, T. 3 N., R. 10 E.:

A1—0 to 3 inches, very dark grayish-brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak, medium, granular structure; friable, hard; few peds and pores that have a brown (10YR 4/3) coating; medium acid; clear, smooth boundary.

C1—3 to 18 inches, brown (10YR 6/4) loam, pale brown (10YR 6/3) dry; structureless; friable, slightly hard; dark yellowish-brown (10YR 4/4) coatings on faces of peds and in pores; 5-inch strata of dark yellowish-brown loam; strongly acid; gradual, smooth boundary.

C2—18 to 33 inches, brown (10YR 4/3) fine sandy loam, pale brown (10YR 6/3) dry; common, medium, faint, yellowish-brown (10YR 5/4) and dark-brown (10YR 3/3) mottles; structureless; friable, slightly hard; bedding planes and thin strata of very dark-gray silt loam; strongly acid; diffuse, smooth boundary.

Bb—33 to 60 inches, dark-brown (10YR 3/3) fine sandy loam, pale brown (10YR 6/3) dry; common, medium and coarse, faint, dark grayish-brown (10YR 4/2) and yellowish-brown (10YR 5/4) mottles; weak, medium, subangular blocky structure; friable, hard; medium acid.

The A1 horizon is very dark grayish-brown to brown silt loam to fine sandy loam. The C1 horizon is brown to yellowish-brown silt loam to fine sandy loam. Reaction in the A1 and C1 horizons is slightly acid to strongly acid. The C2 horizon is brown to yellowish-brown loam to fine sandy loam. Bedding planes and stratification are common in the C horizon. The Bb horizon is at a depth of 30 to 50 inches and is dark brown to brown. Reaction in the C2 and Bb horizons is medium acid to strongly acid.

These soils are outside the defined range for the series in that they are more acid between depths of 10 to 40 inches and have a buried B horizon at a depth of less than 40 inches. They are enough like the Robinsonville soils in morphology, composition, and behavior so that a new series is not warranted.

These Robinsonville soils have a thinner A1 horizon than associated Lanton soils. They are slightly sandier than similar Ennis soils.

Robinsonville and Lanton soils, channeled (0 to 5 percent slopes) (Ra).—About 40 percent of the mapped areas in this unit is Robinsonville soils that range in texture from silt loam to fine sandy loam, and about 30 percent is Lanton silt loam and Lanton silty clay loam. Channels make up about 18 percent of the mapped areas. The Lanton soils have a profile similar to that described as representative of their series, but the surface layer is thinner and they have stratified layers throughout.

Soils in this unit are nearly level to gently sloping. They are on flood plains that are 125 to 500 feet wide. Meandering streams are partly clogged by debris, and areas are damaged by flooding more than once a year. Most mapped areas contain either Robinsonville or Lanton soils, but some areas are made up of soils in both of these series.

Included with these soils in mapping, and making up about 12 percent of the mapped acreage, are areas of Ennis loam.

These soils are used dominantly for tame pasture, range, and woodland, and they are suited to these uses. They are not suited to cultivated crops because of the presence of stream channels and the hazard of flooding. Production of tame pasture, native grasses, and trees can be improved under good management. Capability unit Vw-1; pasture and hayland suitability group 2A; Loamy Bottomland range site; woodland suitability group 3w6.

Rock Outcrop

Rock outcrop occurs in this county as exposed sandstone and limestone bedrock. It is not practical to map it separately. Rock outcrop occurs as a part of the following mapping units: Homa soils and Rock outcrop, moderately steep; Homa soils and Rock outcrop, steep; and Talpa-Rock outcrop complex, 5 to 30 percent slopes.

Steedman Series

The Steedman series consists of well-drained, very gently sloping to steep soils on uplands. These soils formed under a cover of tall and mid grasses in material weathered from shale.

In a representative profile the surface layer is 6 inches of very dark grayish-brown clay loam. The upper part of the subsoil, to a depth of 16 inches, is olive-brown clay; the lower part, which extends to a depth of 35 inches, is olive clay. The underlying material is shale.

Permeability is slow in Steedman soils. Available water capacity is high.

Representative profile of Steedman clay loam, 2 to 5 percent slopes, 1,320 feet east and 2,640 feet south of the NW. corner of sec. 25, T. 1 N., R. 10 E.:

A1—0 to 6 inches, very dark grayish-brown (10YR 3/2) clay loam, grayish brown (10YR 5/2) dry; moderate, medium, granular structure; friable, hard; medium acid; clear, smooth boundary.

B21t—6 to 16 inches, olive-brown (2.5Y 4/4) clay, light olive brown (2.5Y 5/4) dry; moderate, medium, blocky structure; very firm, very hard; distinct clay films on faces of peds; some peds have very dark grayish-brown (10YR 3/2) coatings of clay loam; medium acid; gradual, wavy boundary.

B22t—16 to 25 inches, olive (5Y 4/4) clay, olive (5Y 5/4) dry; few, medium, faint, pale-olive (5Y 6/3) mottles; weak, medium and coarse, blocky structure; extremely firm; extremely hard; distinct clay films on many peds; few distinct slickensides; few peds have very dark grayish-brown (10YR 3/2) coatings of clay loam; few, fine, iron-manganese concretions; neutral; gradual, wavy boundary.

B3—25 to 35 inches, olive (5Y 5/4) clay, pale olive (5Y 6/4) dry; few, fine and medium, faint, dark olive-gray (5Y 3/2) and olive-gray (5Y 5/2) mottles; weak, coarse, blocky structure; extremely firm, extremely hard; few distinct slickensides; few, fine, iron-manganese concretions; calcareous; moderately alkaline; gradual, wavy boundary.

R—35 to 44 inches, olive-gray (5Y 5/2) and olive (5YR 5/3) weathered shale that has laminated seams of hard unweathered shale; calcareous; moderately alkaline.

The A horizon is very dark brown to very dark gray in color and is dominantly clay loam, but in places it is silty clay loam, silt loam, or loam. It is less than one-third the thickness of the solum. Reaction in the A horizon is strongly acid to slightly acid. The B horizon is dark grayish-brown to olive clay loam, silty clay, or clay. Mottles are brownish, grayish, and, in places, reddish. Reaction is medium acid and slightly acid near the upper boundary of the B horizon but ranges with depth to moderately alkaline at the lower boundary. Thickness of the solum ranges from 25 to 40 inches.

Steedman soils have a thinner solum than associated Crockett and Bonham soils. They are more clayey than associated Bates and Collinsville soils.

Steedman clay loam, 2 to 5 percent slopes (SdC).—This soil is on uplands. It has the profile described as representative for the series.

Included with this soil in mapping, and making up 15 percent of the mapped areas, are areas of soils that have a profile similar to the one described as representative for the Steedman series except that the surface layer is thicker, or the combined thickness of the surface layer and subsoil is 20 to 25 inches. Also included are small areas of Rock outcrop and Collinsville fine sandy loam.

This Steedman soil is used dominantly for hay and tame pasture but is also suitable for grain sorghum and small grain.

Management is needed that maintains soil fertility, improves soil structure, increases water intake, and reduces erosion. Erosion can be controlled by terraces and contour farming. Crop residue should be returned to the soil to help maintain fertility, improve water intake, improve soil structure, and reduce erosion. Capability unit IVe-1; pasture and hayland suitability group 8A; Loamy Prairie range site; woodland suitability group 5o0.

Steedman-Collinsville complex, 5 to 20 percent slopes (SeE).—About 70 percent of the acreage of this complex is Steedman clay loam, Steedman silty clay loam, Steedman silt loam, or Steedman loam, and about 15 percent is Collinsville fine sandy loam and Collinsville loam. These sloping to moderately steep soils are on uplands.

Included with these soils in mapping are areas of soils that have a profile similar to the one described as representative for the Steedman series except that the surface layer is thicker, or the combined thickness of the surface layer and the subsoil is less than 25 inches. Also included are small areas of Bates fine sandy loam and of Bonham loam. These included areas make up about 15 percent of the total mapped acreage.

These soils are used for range, but some are also suitable for tame pasture. The quality of grasses can be maintained or improved by using suitable grazing practices, providing protection against fire, and controlling brush. Both soils are in capability unit VIe-4; Steedman soil is in pasture and hayland suitability group 8A, and the Collinsville soil is in pasture and hayland suitability group 14A; Steedman soil is in Loamy Prairie range site, and the Collinsville soil is in Shallow Prairie range site; both soils are in woodland suitability group 5o0.

Steedman-Robinsonville complex, 5 to 30 percent slopes (SrE).—About 35 percent of the acreage in this complex is Steedman clay loam, Steedman silty clay loam, Steedman silt loam, or Steedman loam, and about 35 percent is Robinsonville soils. These soils are on the upper parts of prairie drainageways. The sides of the drainageways are dominantly Steedman clay loam, and the floor is dominantly Robinsonville soils that range in texture from silt loam to fine sandy loam.

Included with these soils in mapping are areas of Carytown silt loam, Lanton silt loam, and Lanton silty clay loam. Each of these soils makes up about 10 percent of the mapped areas. Also included are areas of Parsons silt loam, Bonham loam, and Ennis loam that make up about 10 percent of the mapped acreage.

These soils are used for range and tame pasture and are suited to these uses. The quality of grasses can be maintained or improved by using suitable grazing practices, providing protection from fire, and controlling brush. Both soils are in capability unit VIe-3; Steedman soil is in pasture and hayland suitability group 8A, and the Robinsonville soil is in pasture and hayland suitability group 2A; Steedman soil is in the Loamy Prairie range site, and Robinsonville soil is in Loamy Bottomland range site; both soils are in woodland suitability group 5o0.

Stidham Series

The Stidham series consists of well-drained, very gently sloping soils on uplands. These soils formed under a cover of oaks and an understory of tall and mid grasses in material weathered from sandy or loamy sediment.

In a representative profile the surface layer is 7 inches of brown loamy fine sand. The subsurface layer, which extends to a depth of 26 inches, is pale-brown loamy fine sand. The upper part of the subsoil, to a depth of 46 inches, is yellowish-brown sandy clay loam; the lower part, which extends to a depth of 60 inches, is yellowish-brown fine sandy loam. The underlying material is strong-brown loamy fine sand.

Permeability is moderate in Stidham soils. Available water capacity is high.

Representative profile of Stidham loamy fine sand, 1 to 3 percent slopes, 2,040 feet south and 90 feet east of the NW. corner of sec. 13, T. 3 N., R. 11 E.:

Ap—0 to 7 inches, brown (10YR 5/3) loamy fine sand, pale brown (10YR 6/3) dry; single grain; very friable, soft; medium acid; clear, smooth boundary.

A2—7 to 26 inches, pale-brown (10YR 6/3) loamy fine sand, very pale brown (10YR 7/3) dry; single grain; very friable, soft; medium acid; clear, wavy boundary.

B2t—26 to 46 inches, yellowish-brown (10YR 5/6) sandy clay loam, brownish yellow (10YR 6/6) dry; common, medium and fine, faint, brown (10YR 5/3) mottles and distinct strong-brown (7.5YR 5/6) mottles; moderate, coarse, prismatic structure; patchy clay films; friable, hard; strongly acid; diffuse, smooth boundary.

B3—46 to 60 inches, yellowish-brown (10YR 5/6) fine sandy loam, brownish yellow (10YR 6/6) dry; many, coarse, distinct, gray (10YR 5/1) and dark-red (2.5YR 3/6) mottles; weak, coarse, subangular blocky structure; friable, slightly hard; strongly acid; diffuse, smooth boundary.

C—60 to 80 inches, strong-brown (7.5YR 5/6) loamy fine sand, reddish yellow (7.5YR 6/6) dry; common, medium, distinct, brown (10YR 5/3) mottles; massive; very friable, soft; strongly acid.

The A1 horizon is dark grayish brown to brown, and the A2 horizon is pale brown to brown. Reaction in the A horizon is strongly acid to slightly acid. The B2t horizon is brown to yellowish brown and has few to many brownish mottles. In the B3 horizon colors are similar to those of the B2t horizon, but texture is lighter. The C horizon grades from loamy fine sand to sandy clay loam as depth increases. Reaction in the B and C horizons is medium acid to strongly acid.

Stidham soils differ from similar Konawa and Hartsells soils by having a thicker A horizon. They have a less reddish B2t horizon than Konawa or Dougherty soils.

Stidham loamy fine sand, 1 to 3 percent slopes (StB).—This very gently sloping soil is on uplands. Included in mapping, and making up 10 percent of the mapped areas, are areas of Dougherty loamy fine sand. Also included, and making up 5 percent of the mapped areas, are areas of soils that have a profile similar to the one described as representative for the Stidham series except that the combined thickness of the surface and subsurface layers is less than 20 inches.

This Stidham soil is presently used for tame-pasture range, but it is also suitable for cotton, peanuts, rye, and sorghum.

Management practices are needed that maintain or improve fertility and reduce soil erosion. The cropping system should include a plant cover to protect against soil blowing and water erosion in winter and spring. Cover plants are needed where low-residue crops are grown. Stripcropping, minimum tillage, and the return of crop residue to the soil annually help to reduce erosion and improve fertility. Capability unit IIIe-5; pasture and hayland suitability group 9A; Deep Sand Savannah range site; woodland suitability group 5o0.

Talpa Series

The Talpa series consists of well-drained, sloping to steep soils on uplands. These soils formed under a cover of mid and short grasses in material weathered from limestone.

In a representative profile the surface layer is 4 inches of very dark grayish-brown silty clay loam. Below, to a depth of 8 inches, it is very dark grayish-brown gravelly silty clay loam. The underlying material is limestone.

Permeability is moderate in Talpa soils. Available water capacity is low to moderate.

Representative profile of Talpa silty clay loam in an area of Talpa-Rock outcrop complex, 5 to 30 percent slopes, 1,915 feet east and 90 feet north of SW. corner of sec. 4, T. 1 S., R. 8 E.:

A11—0 to 4 inches, very dark grayish-brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate, medium, granular structure; firm, hard; few angular limestone pebbles; calcareous; moderately alkaline; gradual, wavy boundary.

A12—4 to 8 inches, very dark grayish-brown (10YR 3/2) gravelly silty clay loam, dark grayish brown (10YR 4/2) dry; weak, medium, granular structure; firm, hard; 25 percent, by volume, limestone gravel; calcareous; moderately alkaline.

R—8 to 12 inches, hard, fractured limestone bedrock that has few, thin, discontinuous coatings of calcium carbonate on upper surfaces and in crevices.

The A horizon is very dark grayish brown to dark brown. It generally is silty clay loam but in places is silt loam and clay loam. Reaction in the A horizon ranges from neutral to moderately alkaline. Depth to limestone bedrock ranges from 5 to 20 inches, but in most places is less than 12 inches.

Talpa soils are more clayey, and they have higher reaction than similar Collinsville soils.

Talpa-Rock outcrop complex, 5 to 30 percent slopes (TrE). —About 55 percent of this complex is Talpa silty clay loam, Talpa silt loam, or Talpa clay loam, and 25 percent is Rock outcrop. The areas (fig. 8) are on uplands, and the soils are sloping to steep.

Figure 8.—Typical area of Talpa-Rock outcrop complex, 5 to 30 percent slopes.

The Talpa silty clay loam has the profile described as representative of the Talpa series. The Rock outcrop is limestone bedrock. It commonly extends less than one foot above the surface of surrounding Talpa soils.

Included with this complex in mapping, and making up about 20 percent of the mapped areas, are soils that have a profile similar to that described as representative of the Talpa series except for a limestone content of more than 35 percent or a soil depth of less than 5 inches.

This complex is suited to range and is used for that purpose. In places limestone bedrock is excavated and crushed and then is calcined for farm use or is used for road surfacing.

The quality of grasses can be maintained or improved by controlling grazing, providing protection from fire, and by controlling brush. Capability unit VIIs-3; not in a pasture and hayland suitability group; Very Shallow range site; woodland suitability group 5o0.

Wilson Series

The Wilson series consists of somewhat poorly drained, nearly level soils on uplands. These soils formed under a cover of tall grasses in material weathered from clayey old alluvium.

In a representative profile the surface layer is 8 inches of very dark gray silt loam. The upper part of the subsoil, to a depth of 36 inches, is dark-gray clay. The lower part extends to a depth of 55 inches and is olive-gray clay. The underlying material is gray clay.

Permeability is very slow in Wilson soils. Available water capacity is high.

Representative profile of Wilson silt loam, 2,565 feet north and 150 feet west of the SE. corner of sec. 35, T. 1 S., R. 8 E.:

Ap—0 to 8 inches, very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak, medium, granular structure moist and massive dry; friable, hard; few dark-gray (10YR 4/1) coatings near lower boundary; slightly acid; clear, smooth boundary.

B21tg—8 to 18 inches, dark-gray (10YR 4/1) clay, gray (10YR 5/1) dry; moderate, medium, blocky structure; extremely firm, extremely hard; distinct clay films on faces of peds; few, fine, iron-manganese concretions; medium acid; gradual, wavy boundary.

B22tg—18 to 36 inches, dark-gray (10YR 4/1) clay, gray (10YR 5/1) dry; few, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, coarse, blocky structure; extremely firm, extremely hard; distinct clay films on faces of peds; few distinct slickensides; few, medium and fine, iron-manganese concretions; medium acid; diffuse, wavy boundary.

B3—36 to 55 inches, olive-gray (5Y 4/2) clay, olive gray (5Y 5/2) dry; few, fine, distinct, brown (10YR 4/3) mottles; weak, coarse, blocky structure; extremely firm, extremely hard; patchy clay films on faces of peds; few distinct slickensides; few pockets of hard and soft calcium carbonate and gypsum crystals; few, medium and fine, iron-manganese concretions; moderately alkaline; diffuse, smooth boundary.

C—55 to 75 inches, gray (10YR 5/1) clay, gray (10YR 6/1) dry; common, coarse, distinct strong-brown (7.5YR 5/6) mottles; massive; very firm, extremely hard; few hard and soft nodules of calcium carbonate; few angular chert fragments; few, medium and fine, iron-manganese concretions; moderately alkaline.

The Ap horizon is very dark gray to very dark grayish brown in color, and reaction is medium acid to slightly acid. The upper part of the B2t horizon is black to dark gray and in places has brownish or reddish mottles. The lower part of the B2t horizon is very dark gray to dark grayish brown and has few to common brownish or yellowish mottles. Reaction is medium acid to neutral in this horizon. The B3 horizon is similar to the B2t horizon but is dark gray to light olive gray. Slickensides and calcium carbonate nodules or concretions are at depths between 20 and 60 inches. Solum thickness is 50 to 75 inches.

Wilson soils have a less clayey A horizon than associated Burleson soils and a more grayish B2t horizon than associated Crockett soils. They have lower sodium concentrations than similar Carytown soils.

Wilson soils have soft lime accumulations in the lower part of the B horizon that are lacking in similar Parsons soils.

Wilson silt loam (0 to 1 percent slopes) (Ws).—This nearly level soil is on uplands. Included in mapping, and making up 15 percent of the mapped areas, are areas of soils that have a profile similar to the one described as representative for the Wilson series except that the subsoil is brown to yellowish brown. Also included are small areas of Burleson clay.

This soil is presently used for crops or pasture. It is suitable for alfalfa, corn, cotton, grain sorghum, peanuts, and small grain and is suitable as range and tame pasture. Management practices are needed that improve soil structure and reduce crusting. The cropping system should include crops that produce large amounts of residue. Returning residue to the soil improves soil structure, increases water intake, and reduces crusting. Capability unit IIs-1; pasture and hayland suitability group 8C; Claypan Prairie range site; woodland suitability group 5o0.

Use and Management of the Soils

This section explains the system of capability classification used by the Soil Conservation Service and gives estimated yields of the principal crops grown in the county under two levels of management. The capability classification of each soil mapped in the county can be learned by referring to the "Guide to Mapping Units." Information about management needs of a particular soil is given in the section "Descriptions of the Soils."

This section also contains information about management of the soils for cultivated crops and tame pasture, use of the soils for range and for woodland, use of the soils for wildlife habitat, and uses of soils for engineering.

Management for Cultivated Crops [2]

This section contains information about the use and management of the soils for cultivated crops. Alfalfa, cotton, grain sorghum, forage sorghum, wheat, peanuts, oats, and corn are the principal crops grown in Coal County. Only a small percentage of the suitable cropland is used for tilled crops.

The major management needs in the production of the principal cultivated crops are fertilization, erosion control, and preservation of good tilth.

Fertilizer should be applied in accordance with the needs of the crop and the soil as determined by soil tests.

Effective measures for reducing the erosion hazard include management of crop residue or cover crops, terracing, and contour farming (fig. 9). The management practices needed depend upon the properties of the soil and on the cropping system used.

Tilth is preserved by proper management of residue and cover crops, by avoiding unnecessary tillage, and by tilling only when the soils are within the proper range of moisture content.

An essential of management is a cropping system that provides an ample amount of crop residue that can be returned to the soil. In Coal County, at least 3,000 pounds of residue per acre is needed to maintain soil structure and tilth and to replenish the supply of organic matter. Corn, sorghum, oats, and wheat leave large amounts of residue. Cotton and peanuts leave small amounts of residue and should be grown in a cropping system along with high-residue crops, or they should be followed by cover crops.

[2]By ERNEST O. HILL, conservation agronomist, Soil Conservation Service.

Figure 9.—Residue of grain sorghum protects a contour-farmed area of Crockett loam, 1 to 4 percent slopes.

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. In class I are soils that have few limitations, the widest range of use, and the least risk of damage when they are used. The soils in the other classes have progressively greater natural limitations. In class VIII are soils and landforms so rough, so shallow, or otherwise so limited that they do not produce worthwhile yields of crops, forage, or wood products.

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, II*e*. 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, IIIe-3 or IIIe-6. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

The eight classes in the capability system and the subclasses and units in Coal County are described in the list that follows. The unit designation for each soil in the county can be found in the "Guide to Mapping Units."

Class I. Soils having few limitations that restrict their use. (None in Coal County.)

Class II. Soils having moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Subclass IIe. Soils subject to moderate erosion if not protected.

Unit IIe-1. Moderately deep, very gently sloping, well-drained soils that are loamy throughout; on uplands.

Unit IIe-2. Deep, very gently sloping, moderately well drained, loamy soils that have a clayey and loamy subsoil; on uplands.

Unit IIe-3. Deep, very gently sloping, moderately well drained soils that are clayey throughout; on uplands.

Subclass IIw. Soils having moderate limitations because of seasonal overflow or surface wetness.

Unit IIw-1. Deep, nearly level, well-drained soils that are loamy throughout; on flood plains.

Unit IIw-2. Deep, nearly level, poorly drained, loamy soils over clayey or loamy sediment; on flood plains.

Unit IIw-3. Deep, nearly level, moderately well drained soils that are clayey throughout; on uplands.

Subclass IIs. Soils that have moderate limitations because of very slow permeability.

Unit IIs-1. Deep, nearly level, somewhat poorly drained, loamy soils that have a clayey or loamy subsoil; on uplands.

Class III. Soils having severe limitations that reduce the choice of plants, require special conservation practices, or both.

Subclass IIIe. Soils subject to severe erosion if they are not protected.

Unit IIIe-1. Moderately deep and deep, very gently sloping and gently sloping, well-drained soils that are loamy throughout; on uplands.

Unit IIIe-2. Moderately deep and deep, very gently sloping and gently sloping, moderately well drained and well drained, eroded, loamy soils that have a loamy or clayey subsoil; on uplands.

Unit IIIe-3. Deep, gently sloping, somewhat excessively drained soils that are clayey throughout; on uplands.

Unit IIIe-4. Deep, very gently sloping and gently sloping, moderately well drained, loamy soils that have a loamy or clayey subsoil; on uplands.

Unit IIIe-5. Deep, very gently sloping, well-drained, sandy soils that have a loamy subsoil; on uplands.

Unit IIIe-6. Deep, very gently sloping, somewhat poorly drained, loamy soils that have a clayey and loamy subsoil; on uplands.

Subclass IIIw. Soils that have severe limitations because of excess water.

Unit IIIw-1. Deep, nearly level, somewhat poorly drained soils that are clayey throughout; on flood plains.

Unit IIIw-2. Deep, nearly level, poorly drained, loamy soils over clayey sediment; on flood plains.

Unit IIIw-3. Deep, nearly level, somewhat poorly drained and poorly drained, loamy soils that have a loamy or clayey subsoil; on flood plains.

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

Subclass IVe. Soils subject to very severe erosion if they are cultivated and not protected.

Unit IVe-1. Moderately deep and deep, very gently sloping and gently sloping, moderately well-drained and well-drained, loamy soils that have a loamy and clayey subsoil; on uplands.

Unit IVe-2. Very shallow to moderately deep, very gently sloping and gently sloping, well-drained to somewhat excessively drained soils that are loamy throughout; on uplands.

Unit IVe-3. Deep, gently sloping and sloping, well-drained, sandy soils that have a loamy subsoil; on uplands.

Unit IVe-4. Moderately deep and deep, very gently sloping and gently sloping, moderately well drained and well drained, loamy soils that have a loamy or clayey subsoil; on uplands.

Subclass IVs. Soils that have very severe limitations because of high sodium content or other soil features.

Unit IVs-1. Deep, nearly level, poorly drained, loamy soils that have a loamy and clayey subsoil high in content of sodium; on uplands.

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

Subclass Vw. Soils subject to flooding.
Unit Vw-1. Deep, nearly level to gently sloping, well-drained and poorly drained, loamy soils over loamy or clayey sediment; on flood plains.

Class VI. Soils having severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife.
Subclass VIe. Soils limited chiefly by hazard of erosion, if protective cover is not maintained.
Unit VIe-1. Moderately deep and deep, very gently sloping and gently sloping, moderately well drained and well drained, severely eroded, loamy soils that have a loamy or clayey subsoil; on prairie uplands.
Unit VIe-2. Moderately deep, very gently sloping to sloping, well-drained, severely eroded soils that are loamy throughout; on wooded uplands.
Unit VIe-3. Moderately deep and deep, sloping to steep, well-drained loamy soils that have a loamy or clayey subsoil; on wooded flood plains and prairie uplands.
Unit VIe-4. Very shallow to moderately deep, sloping to moderately steep, well-drained to somewhat excessively drained, loamy soils that have a loamy or clayey subsoil; on prairie uplands.

Class VII. Soils having very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife.
Subclass VIIs. Soils that are very severely limited by moisture capacity, stones, or other soil features.
Unit VIIs-1. Deep, moderately steep, moderately well drained, loamy soils that have a clayey subsoil, are on wooded uplands, and have rock outcrops.
Unit VIIs-2. Deep, steep, moderately well drained, loamy soils that have a clayey subsoil, are on wooded uplands, and have rock outcrops.
Unit VIIs-3. Very shallow and shallow, sloping to steep, well-drained soils that are loamy throughout, are on prairie uplands, and have rock outcrops.
Unit VIIs-4. Mine pits and dumps that remain after coal has been mined. The dumps consist of a mixture of loamy and clayey soil material mixed with weathered shale and coal residue. The slopes are undulating to very steep.

Class VIII. Soils and landforms having limitations that preclude their use for commercial plant production and restrict their use to recreation, wildlife, water supply, or to esthetic purposes. (None in Coal County.)

Estimated Yields

Estimated yields for important crops in Coal County are listed in table 2, under two levels of management.

The A columns show the estimated yields that can be expected under common management followed by a substantial number of farmers in the county. This management includes (1) proper rates of seeding, dates of planting, and efficient harvesting methods; (2) sufficient control of weeds, insects, and disease to insure normal plant growth; (3) terraces and contour farming where necessary; and (4) use of lime and fertilizer in small amounts.

The B columns show the estimated yields for soils under improved management. This management includes the first three practices listed under common management, plus (1) use of lime and fertilizer according to soil tests in amounts needed for high production; (2) the use of adapted improved varieties; (3) surface drainage where required; (4) residue management and those tillage methods that prevent erosion, maintain soil structure, increase water infiltration, and aid seedling emergence; and (5) a cropping system fitted to the operator's goals and the specific needs of the soils.

Yields are not listed for soils that are normally considered unsuitable for crops. Crop failures (zero yields) are included in the yield estimates. Yields at specific management levels were estimated by the soil scientists making the soil survey in the county, through consultations with farmers, and by observation during the progress of the survey. These estimates were further corroborated by personnel of Oklahoma State University and from research information applicable to the crops and soils of Coal County.

Management for Pasture and Hay

This section contains information about use and management of soils for tame pasture and hay. Many soils presently used as cropland and woodland are being converted to tame pasture. Most of the soils are suited to tame pasture and hay.

The principal grasses used are bermudagrass, bahiagrass, and fescue. These are generally overseeded with legumes. A bermudagrass-legume mixture is the main summer pasture. Under good management, improved varieties of bermudagrass produce more forage than common bermudagrass (fig. 10). Many of the soils of the county are suited to small grain and are used for fall, winter, and spring grazing. Rye and vetch, when overseeded on bermudagrass, provide for grazing late in fall and early in spring. Annual lespedeza is suited to most soils and is grown with bermudagrass, mainly to provide more palatable forage in July and August. Sudan and sorghum hybrids are suited to the arable soils

Figure 10.—Mid bermudagrass on Bates fine sandy loam, 1 to 3 percent slopes.

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

[Yields in columns A can be expected under common management; yields in columns B can be expected under improved management. Absence of a yield indicates that the crop is not commonly grown on the soil at the level of management specified]

Soil	Alfalfa		Cotton		Grain sorghum		Peanuts		Wheat	
	A	B	A	B	A	B	A	B	A	B
	Tons	Tons	Lbs.	Lbs.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.
Bates fine sandy loam, 1 to 3 percent slopes	1.2	2.2	230	390	28	43	25	42	18	30
Bates fine sandy loam, 3 to 5 percent slopes	---	---	200	300	26	38	22	35	16	25
Bates fine sandy loam, 2 to 5 percent slopes, eroded	---	---	150	265	22	35	15	28	14	20
Bates and Bonham soils, 2 to 5 percent slopes, severely eroded	---	---	---	---	---	---	---	---	---	---
Bates-Collinsville complex, 1 to 5 percent slopes	---	---	---	---	22	35	---	---	14	20
Bonham loam, 1 to 3 percent slopes	2.0	3.0	235	400	32	50	25	45	20	33
Bonham loam, 3 to 5 percent slopes	---	---	200	340	30	42	22	38	19	30
Bonham loam, 2 to 5 percent slopes, eroded	---	---	150	275	25	38	18	32	17	28
Burleson clay, 0 to 1 percent slopes	1.8	2.8	220	420	32	50	---	---	23	32
Burleson clay, 1 to 3 percent slopes	1.8	2.8	215	415	30	48	---	---	23	32
Carytown silt loam, thin surface	---	---	125	225	18	26	15	26	13	21
Chaney loam, 3 to 5 percent slopes	---	---	---	---	22	35	---	---	12	19
Choteau loam, 1 to 3 percent slopes	2.0	3.0	235	400	30	45	25	45	20	33
Crockett loam, 1 to 4 percent slopes	---	---	150	290	26	42	18	30	15	26
Dougherty loamy fine sand, 3 to 8 percent slopes	---	---	---	---	22	35	15	30	---	---
Ennis loam	2.5	3.5	230	400	30	45	28	45	18	30
Ferris silty clay, acid surface variant, 3 to 5 percent slopes	---	---	150	275	22	40	---	---	15	26
Hartsells fine sandy loam, 1 to 3 percent slopes	---	---	225	385	26	42	25	40	17	28
Hartsells fine sandy loam, 3 to 5 percent slopes	---	---	180	300	22	35	22	35	15	25
Hartsells fine sandy loam, 2 to 5 percent slopes, eroded	---	---	135	275	20	32	16	28	14	20
Hartsells soils, 2 to 6 percent slopes, severely eroded	---	---	---	---	---	---	---	---	---	---
Homa-Hartsells complex, 2 to 5 percent slopes	---	---	---	---	20	32	---	---	---	17
Homa soils and Rock outcrop, moderately steep	---	---	---	---	---	---	---	---	---	---
Homa soils and Rock outcrop, steep	---	---	---	---	---	---	---	---	---	---
Kaufman silty clay	2.0	3.8	225	435	30	50	---	---	24	32
Konawa fine sandy loam, 2 to 5 percent slopes	---	---	200	300	26	38	25	43	16	26
Lanton silt loam	2.8	3.8	250	450	40	60	30	48	22	36
Lanton silty clay loam, moderately wet	3.2	4.4	350	500	45	65	32	52	25	40
Lightning-Carytown complex	1.2	2.6	150	275	20	35	---	---	15	22
Mine pits and dumps	---	---	---	---	---	---	---	---	---	---
Parsons silt loam, 0 to 1 percent slopes	---	---	150	280	25	38	20	30	18	28
Parsons silt loam, 1 to 3 percent slopes	---	---	140	250	22	35	16	28	17	26
Robinsonville and Lanton soils, channeled	---	---	---	---	---	---	---	---	---	---
Steedman clay loam, 2 to 5 percent slopes	---	---	---	---	20	32	---	---	12	20
Steedman-Collinsville complex, 5 to 20 percent slopes	---	---	---	---	---	---	---	---	---	---
Steedman-Robinsonville complex, 5 to 30 percent slopes	---	---	---	---	---	---	---	---	---	---
Stidham loamy fine sand, 1 to 3 percent slopes	---	---	150	275	25	38	22	40	---	---
Talpa-Rock outcrop complex, 5 to 30 percent slopes	---	---	---	---	---	---	---	---	---	---
Wilson silt loam	1.5	2.8	225	300	35	45	20	30	20	30

and are used for summer pasture. Tall fescue is suited to the wetter soils and provides for grazing early in spring and late in fall.

Management needed for tame pasture includes proper grazing, application of fertilizer according to soil tests, and protection from fire.

Pasture and hayland suitability groups

The soils of Coal County have been grouped according to their ability to produce similar kinds and amounts of tame pasture and hay. Each group consists of soils that are suitable for similar kinds of plants, require about the same management, and have about the same potential productivity.

In table 3 average acre yields of principal pasture and hay plants are estimated for each pasture and hay group. The soils in each group are indicated by the representative mapping unit symbol. Yields are estimated for two levels of management. The "A" level of management is the customary or prevailing management, and the "B" level is that under improved management. Monthly grazing data and yearly totals are given in animal-unit-months per acre. Dry hay production is shown in tons per acre.

Use of the Soils for Range[3]

Raising beef cattle is the major livestock enterprise in Coal County, and more than two-thirds of the acreage in the county is native range that is used for that purpose. A few large ranches are in the county, but most of the rangeland is in livestock farms. Native range generally is grazed the year around, but during the dormant season forage for the cattle is supplemented by protein cubes and hay.

Range sites and condition classes

For the purpose of classifying range resources, soils are placed in groups called range sites. Each range site has a distinctive potential plant community or climax vegetation. This vegetation is the stabilized plant community on the particular site; it reproduces itself and does not change so long as the environment does not change.

Effective range management requires knowledge of the different kinds of soil and the kinds and amounts of herbage that can be produced. It also requires the ability to evaluate the condition of the vegetation in relation to its potential for production.

On a given range site the plants are grouped as decreasers, increasers, or invaders, according to their response to prolonged heavy grazing. Decreasers are plants in the potential plant community that tend to die out if they are heavily grazed. They are generally the most palatable and most productive perennials. Increasers are plants in the potential plant community that become more abundant as the decreasers decline. These are generally the shorter, less productive, less palatable plants. Under prolonged heavy grazing, the increasers become dominant. Invaders are plants that are not part of the potential plant community but that become established if both the decreasers and the increasers decline. They may be either woody plants, perennials, or annuals, and they may come from other nearby sites or from great distances.

Range condition refers to the composition of the existing native vegetation on a given site in relation to what the site is capable of producing. It is expressed in terms of condition classes. The condition class represents the degree to which the existing plant community is different from that of the potential plant community. It is determined by estimating the relative production, by weight, of the species making up the plant community.

A range site is in excellent condition if 76 to 100 percent of the present vegetation is of the same kind as the potential plant community for the site. It is in good condition if the percentage is between 51 and 75, in fair condition if the percentage is between 26 and 50, and in poor condition if the percentage is 25 or less.

A range site in excellent condition is at or near its maximum productivity. It has a plant cover that adequately protects the soil, encourages the absorption of moisture, and helps to maintain fertility.

A site in good condition has lost some of its decreaser plants, but it is still productive and can be maintained and improved by good management.

A site in fair condition has a severely altered plant community in which increasers are dominant and invaders are becoming prominent. Generally, the mulch is inadequate for protection against compaction and erosion. The exclusion of grazing animals for an entire season is usually necessary to bring about rapid improvement in condition of the range.

A site in poor condition has lost almost all of the desirable forage plants. Few, if any, of the original range plants are left, and invaders are numerous.

Potential forage production depends upon the soil, kinds of plants, condition of plants, and the current moisture condition.

Conservation treatment of rangeland involves planning and applying range management and conservation practices that are in three broad groups: plant management practices, accelerating practices, and livestock control practices. Such range practices as proper grazing use, deferred grazing, and rotation-deferred grazing relate to plant management. Range seeding, brush control, and other practices specifically designed to speed up improvement of range cover by other means than grazing management alone are accelerating practices. Livestock control facilitates handling of livestock by fencing, establishing stock watering facilities, and using other practices to get better livestock distribution.

Grazing systems should be scheduled so that enough cover remains to protect the soil and maintain the quality of desirable plants. Repeated or prolonged overuse of a range site reduces the ability of the plants to produce the deep roots, seeds, and new shoots that are necessary for reproduction and maintenance of the stand.

Operators should become familiar with their range sites and with the main grasses growing in them generally, and they should understand signs of improvement or decline in range condition. They should then adjust their management practices to fit the conditions.

One of the main objectives of good range management is to maintain the range sites in excellent or good condition. Where this is accomplished, moisture is conserved, yields are maintained or improved, and the soils are protected against deterioration. A major concern is being able to recognize important changes in the kind of vegetative cover on a range site. The changes are so gradual that they are often overlooked or misunderstood. Lush growth, encouraged by heavy rainfall, can lead to the conclusion that the range site is in good condition and improving. Actually this type of cover is often weedy, and the long trend is toward a poorer condition that will afford less production. In contrast, some range sites in excellent condition that are being closely grazed under the supervision of a careful manager may, for short periods of time, have a degraded appearance that conceals their quality.

Specific information about the stocking of range sites is not included in this survey. Technical personnel of the local agricultural agencies will assist ranchers in classifying range sites, estimating the condition of the range, and the determining number of animals to stock.

[3] By NEAL STIDHAM, range conservationist, Soil Conservation Service.

Descriptions of range sites

The descriptions that follow give the significant soil characteristics pertinent to range productivity, names of the principal native plants where the site is in good condition, and the species to be expected on a site that has declined to a poor condition.

The annual herbage yields are estimates based upon clippings made near the end of the growing season. The weights given are for air-dry herbage clipped at ground level. The shrub and tree yields were not included.

BLACKCLAY PRAIRIE RANGE SITE

This range site consists of deep, nearly level to very gently sloping soils on uplands. These soils have a loamy surface layer and a loamy or clayey subsoil.

Where this site is in excellent condition, about 80 percent of the vegetation is a mixture of decreasers, such as little bluestem, big bluestem, indiangrass, switchgrass, and eastern gamagrass. There are a few woody plants, such as leadplant, prairie rose, and osageorange. About 20 percent of the climax vegetation consists of increasers, such as sideoats grama, Texas wintergrass, and buffalograss.

Prolonged overgrazing generally thins the decreasers and increasers and allows the invaders to become prominent. Some common invaders are silver bluestem, windmillgrass, tumblegrass, annual three-awn, Japanese brome, western ragweed, common broomweed, basketflower, and leavenworth eryngo.

Annual air-dried herbage yield is about 7,000 pounds per acre in favorable years and 3,500 pounds per acre in unfavorable years.

CLAYPAN PRAIRIE RANGE SITE

This range site consists of deep, nearly level to very gently sloping soils on uplands. These soils have a loamy surface layer and a loamy or clayey subsoil.

Where this site is in excellent condition, decreasers make up about 70 percent of the plant vegetation. These species are little bluestem, big bluestem, indiangrass, switchgrass, purpletop, grayfeathers, sunflowers, and blacksamson. The remaining 30 percent consists of a mixture of increaser plants, among which are meadow dropseed, Scribner panicum, wild-indigo, slimflower scurf-pea, and goldenrod.

Under prolonged overuse invaders become abundant. Among these are broomsedge, annual three-awns, narrowleaf sumpweed, lanceleaf ragweed, bitter sneezeweed, common persimmon, and hawthorns.

Annual air-dried herbage yield is about 5,000 pounds per acre in favorable years and about 2,500 pounds per acre in unfavorable years.

COAL STRIP MINES RANGE SITE

This range site consists of areas that have been strip mined for coal. The mine dumps are made up of a mixture of loamy and clayey soil material, weathered shale, and coal residue. Slopes are undulating to steep.

Following mine operations, revegetation of the site is slow unless it is encouraged. Land owners have been successful in sowing a mixture of native grass and sweetclover seed from airplanes during favorable seasons. Proper grazing management is essential in establishing vegetative cover on mine dumps. Areas that are properly seeded and managed are restored to a good cover of native grasses that is similar to that of the adjacent prairies.

In Coal County none of this site is in excellent or good condition, therefore yield data are not available.

When this site is in fair condition, the estimated annual yield of air-dried herbage is about 2,000 pounds per acre in years of favorable moisture and 1,000 pounds per acre in years of unfavorable moisture.

DEEP SAND SAVANNAH RANGE SITE

This range site consists of deep, very gently sloping to sloping soils on uplands. These soils have a sandy surface layer and a loamy subsoil.

Where this site is in excellent condition, about 65 percent of the vegetation consists of a mixture of grasses and forbs, and about 35 percent is woody plants. The decreasers are little bluestem, big bluestem, indiangrass, switchgrass, tall dropseed, Scribner panicum, bearded skeletongrass, and Texas bullnettle.

Proper grazing use, deferred grazing, range seeding, and fire control are generally needed to restore a productive cover of native grasses in areas that were formerly cropped.

Under prolonged heavy grazing, decreaser plants lose their vigor and allow such invader plants as broomsedge, splitbeard bluestem, annual three-awn, showy partridgepea, ragweed, camphorweed, and white snakeroot to become prominent.

Annual air-dried herbage yield is about 4,000 pounds per acre in favorable years and about 2,000 pounds per acre in unfavorable years.

ERODED PRAIRIE RANGE SITE

This range site consists of moderately deep and deep, very gently sloping to gently sloping soils on uplands. These soils have a loamy surface layer and a loamy or clayey subsoil. In places erosion has removed some of the surface layer, leaving the clayey subsoil exposed.

Generally, this range site has been cultivated and then abandoned. Revegetation has taken place naturally, or the land has been reseeded to grasses. The site is capable of producing a mixture of tall grasses, such as indiangrass, little bluestem, and big bluestem.

Maximum production on this site is about 50 percent of that of the same soils in native vegetation that have not been cultivated. Annual air-dried herbage yield is about 3,000 pounds per acre in favorable years and about 1,500 pounds per acre in unfavorable years.

ERODED SANDY SAVANNAH RANGE SITE

This range site consists of moderately deep, very gently sloping to sloping, severely eroded soils on uplands. These soils are loamy throughout.

This site produces types of climax vegetation that are similiar to those of the Sandy Savannah range site, but in lesser amounts. Decreaser grasses are big bluestem, indiangrass, and little bluestem. Invaders are broomsedge, splitbeard bluestem, three-awn, and ragweed. This site is limited to formerly cultivated soils and therefore generally needs reseeding to restore production within a reasonable number of years.

Annual air-dried herbage yield, where the site has been restored to good condition, is about 3,000 pounds per acre in favorable years and about 1,500 pounds per acre in unfavorable years.

HEAVY BOTTOMLAND RANGE SITE

This range site consists of deep, nearly level soils on flood plains. These soils are loamy or clayey throughout, or they have a loamy surface layer and a loamy or clayey subsoil.

TABLE 3.—Pasture and hay groups and estimated average

[Not included in this table, because they are not suitable for

Pasture and hayland suitability group	Plants	Level of management	Animal-unit-months 1/ per acre			
			January	February	March	April
Group 1A: Ka. Deep, clayey soils that have a very slowly permeable subsoil; on bottom lands; subject to flooding; control of wetness and protection from damage by overflow needed.	Common bermudagrass.	A	---	---	---	0.4
		B	---	---	---	.4
	Improved bermudagrass.	A	---	---	---	.4
		B	---	---	---	.4
	Fescue	A	---	0.2	0.5	.7
		B	---	.3	.6	1.0
Group 2A: En, La, Lc, Ra, Robinsonville part of SrE. Deep, loamy soils that have a moderately rapid to slowly permeable subsoil; on bottom lands; subject to flooding; brush control, use of fertilizer, and protection from damage by overflow needed.	Common bermudagrass.	A	---	---	---	.4
		B	---	---	---	.5
	Improved bermudagrass.	A	---	---	---	.4
		B	---	---	---	.6
	Fescue	A	---	.3	.6	.9
		B	---	.4	.7	1.1
Group 2B: Lt. Deep, loamy soils that have a very slowly permeable subsoil; on bottom lands; subject to flooding; brush control, use of fertilizer, drainage, and protection from damage by overflow needed.	Common bermudagrass.	A	---	---	.2	.4
		B	---	---	.3	.6
	Improved bermudagrass.	A	---	---	.3	.5
		B	---	---	.4	.9
	Fescue	A	---	.3	.6	.7
		B	---	.3	.6	.7
Group 7A: BuA, BuB, FeC. Deep, clayey soils that have a very slowly permeable subsoil; on uplands; increase of water intake and use of fertilizer needed.	King Ranch bluestem only.	A	---	---	---	.2
		B	---	---	---	.4
Group 8A: BaB, BaC, BaC2, BcC, BoB, BoC, BoC2, ChB, CrB, SdC, SeE, SrE. Moderately deep and deep, loamy soils that have moderately slow to very slow permeability in the subsoil; on uplands; increase of water intake and use of fertilizer needed. For Collinsville part of BcC and SeE, refer to group 14A; for Robinsonville part of SrE, refer to group 2A.	Common bermudagrass.	A	---	---	.2	.5
		B	---	---	.4	.9
	Improved bermudagrass.	A	---	---	.3	.7
		B	---	---	.4	1.0
	Fescue	A	---	.2	.3	.5
		B	---	.3	.5	.8

acre yields of principal pasture and hay plants

pasture or hay, are the mapping units HoF, Mp, and TrE]

Animal-unit-months 1/ per acre—Con.									
May	June	July	August	September	October	November	December	Total	Hay
									Tons
0.7	0.7	0.6	0.5	0.5	0.4	0.2	---	4.0	1.6
.9	.9	.8	.7	.6	.6	.3	---	5.2	2.1
1.0	1.0	.9	.8	.8	.4	.2	---	5.5	1.8
1.2	1.2	1.0	.9	.9	.6	.3	---	6.5	2.2
.6	.5	---	---	.6	.7	.6	.2	4.5	1.8
1.0	.8	---	---	.9	1.0	.6	.3	6.5	2.2
.8	.9	.7	.7	.6	.6	.3	---	5.0	2.1
1.2	1.2	1.1	1.0	.9	.8	.5	---	7.2	2.9
.9	1.0	.9	.8	.8	.7	.5	---	6.0	2.4
1.2	1.3	1.2	1.0	.9	.7	.5	---	7.4	3.0
.9	.6	---	---	.7	.9	.8	.3	6.0	2.4
1.1	.7	---	---	.9	1.1	1.0	.4	7.4	3.0
.5	.4	.4	.3	.3	.2	---	---	2.7	1.1
.8	.6	.6	.5	.5	.3	---	---	4.2	1.7
.6	.5	.4	.4	.3	.2	---	---	3.2	1.4
.8	.8	.5	.5	.6	.5	---	---	5.0	2.5
.7	.6	---	---	.5	.6	.6	.4	5.0	2.1
.8	.7	---	---	.6	.7	.6	.4	5.5	2.6
.4	.6	.6	.4	.4	.3	.1	---	3.0	1.2
.9	1.0	1.0	.8	.7	.5	.3	---	5.6	2.3
.6	.4	.4	.4	.3	.2	---	---	3.0	1.2
1.0	.8	.7	.7	.7	.3	---	---	5.5	2.3
.7	.5	.4	.4	.3	.2	---	---	3.5	1.4
1.1	.9	.8	.8	.7	.6	---	---	6.2	2.5
.5	.3	---	---	.3	.4	.3	.2	3.0	1.2
.8	.4	---	---	.6	.8	.6	.2	5.0	2.1

TABLE 3.—*Pasture and hay groups and estimated average*

Pasture and hayland suitability group	Plants	Level of management	Animal-unit-months 1/ per acre January	February	March	April
Group 8B: CeC, HaB, HaC, HaC2, HhC, HoE, KoC. Moderately deep and deep, loamy soils that have a slowly to moderately rapidly permeable subsoil; on uplands; brush control, use of fertilizer, and liming of acid soils needed.	Common bermudagrass.	A	---	---	---	0.2
		B	---	---	---	.4
	Improved bermudagrass.	A	---	---	---	.3
		B	---	---	---	.5
	Lovegrass	A	---	---	---	.2
		B	---	---	---	.4
	Bahiagrass	A	---	---	---	.2
		B	---	---	---	.4
Group 8C: PaA, PaB, Ws. Loamy soils that have a very slowly permeable dense subsoil of clay; somewhat droughty; on uplands; drainage of level areas, brush control, use of fertilizer, and reduction of surface compaction needed.	Common bermudagrass.	A	---	---	.2	.5
		B	---	---	.4	.8
	Improved bermudagrass.	A	---	---	.3	.6
		B	---	---	.5	1.0
	Fescue	A	---	.2	.3	.5
		B	---	.3	.5	.8
Group 8D: Ca. Deep, loamy, thin-surfaced soils that have a very slowly permeable dense subsoil of clay; high in sodium; droughty; on uplands; drainage of level areas, use of fertilizer, and improvement of soil structure needed.	Fescue only	A	---	.1	.2	.3
		B	---	.2	.3	.5
Group 8F: BbC3, HeC3. Deep, loamy soils that have a slowly permeable to moderately rapidly permeable subsoil; severely eroded; on uplands; brush control, use of fertilizer, and shaping of gullies needed.	Common bermudagrass.	A	---	---	---	.1
		B	---	---	---	.4
	Improved bermudagrass.	A	---	---	---	.2
		B	---	---	---	.4
	Lovegrass	A	---	---	---	.2
		B	---	---	---	.4
Group 9A: DoD, StB. Deep, sandy soils that have a moderately permeable subsoil; on uplands; use of fertilizer and brush control needed.	Common bermudagrass.	A	---	---	---	.2
		B	---	---	---	.4
	Improved bermudagrass.	A	---	---	---	.2
		B	---	---	---	.3
	Lovegrass	A	---	---	---	.2
		B	---	---	---	.4
	Bahiagrass	A	---	---	---	.2
		B	---	---	---	.4

acre yields of principal pasture and hay plants—Continued

Animal-unit-months 1/ per acre—Con.									Hay
May	June	July	August	September	October	November	December	Total	
									Tons
0.5	0.5	0.5	0.4	0.4	0.3	0.2	---	3.0	1.2
.9	1.0	.9	.8	.8	.7	.5	---	6.0	2.4
.7	.7	.5	.4	.4	.3	.2	---	3.5	1.4
1.1	1.2	1.0	.9	.8	.7	.4	---	6.7	2.7
.5	.5	.5	.4	.4	.3	.2	---	3.0	1.2
.9	1.0	.9	.8	.8	.7	.5	---	6.0	2.4
.5	.5	.5	.4	.4	.3	.2	---	3.0	1.2
.9	1.0	.9	.8	.8	.7	.5	---	6.0	2.4
.6	.4	.4	.4	.3	.2	---	---	3.0	1.2
.9	.7	.7	.5	.5	.3	---	---	4.8	2.0
.7	.5	.5	.4	.4	.2	---	---	3.6	1.5
1.0	.8	.8	.7	.6	.3	---	---	5.7	2.4
.5	.3	---	---	.4	.5	.4	---	3.1	1.4
.8	.4	---	---	.6	.8	.6	---	5.0	2.1
.3	.2	---	---	.2	.3	.3	.1	2.0	.8
.5	.3	---	---	.3	.4	.3	.2	3.0	1.3
.3	.4	.3	.3	.2	.1	.1	---	1.8	.7
.7	.7	.6	.5	.5	.4	.2	---	4.0	1.6
.3	.4	.3	.3	.2	.2	.1	---	2.0	.8
.8	.8	.7	.6	.6	.5	.2	---	4.0	1.8
.4	.4	.3	.3	.2	.2	---	---	2.0	.8
.8	.8	.7	.6	.5	.4	---	---	4.2	1.6
.5	.5	.3	.3	.2	.2	.1	---	2.3	.9
.7	.7	.6	.5	.5	.4	.2	---	4.0	1.6
.4	.5	.4	.3	.3	.3	.1	---	2.5	1.0
.9	1.2	1.0	.8	.6	.4	.3	---	5.5	1.9
.5	.5	.3	.3	.2	.2	.1	---	2.3	.9
.7	.7	.6	.5	.5	.4	.2	---	4.0	1.6
.5	.5	.3	.3	.2	.2	.1	---	2.3	.9
.7	.7	.6	.5	.5	.4	.2	---	4.0	1.6

TABLE 3.—*Pasture and hay groups and estimated average*

Pasture and hayland suitability group	Plants	Level of management	Animal-unit-months 1/ per acre			
			January	February	March	April
Group 14A: Collinsville part of BcC and SeE. Shallow and very shallow, loamy soils that have a moderately rapidly permeable subsoil; on uplands; conserving moisture and use of fertilizer needed.	Common bermudagrass.	A	---	---	---	0.2
		B	---	---	---	.3
	Improved bermudagrass.	A	---	---	---	.2
		B	---	---	---	.4
	Lovegrass	A	---	---	---	.2
		B	---	---	---	.3

1/ Animal-unit-month—the amount of forage or feed required to maintain one animal unit (one cow, one horse, one

A large part of the climax vegetation in this site grows during periods of cool weather. Mainly these plants are wildryes, uniolas, sedges, and rushes. Where the site is in excellent range condition, other plants in abundance on the well-drained areas are switchgrass, prairie cordgrass, big bluestem, and Florida paspalum. American elm, pecan, walnut, poison-ivy, and indigobush make up 30 to 40 percent of the vegetation, and herbaceous plants make up about 60 to 70 percent.

Plants in abundance where the site is in poor condition are seacoast sumpweed, buffalograss, meadow dropseed, ragweeds, windmillgrass, hawthorn, elm, persimmon, ash, pecan sprouts, and trumpetvine.

Annual air-dried herbage yield when the site is in excellent condition is about 7,000 pounds per acre in a series of favorable years and about 3,500 pounds per acre in unfavorable years.

LOAMY BOTTOMLAND RANGE SITE

This range site consists of deep, nearly level to gently sloping soils on flood plains. These soils are loamy throughout, or they have a loamy surface layer and a loamy or clayey subsoil. Most soils in this site are used for crops or tame pasture. Areas of soils used for native grasses are suitable for either native hay or range.

Where this site is in excellent range condition, it has a mixture of tall grasses, among which are eastern gamagrass, prairie cordgrass, big bluestem, switchgrass, broadleaf uniola, and wildryes. These grasses make up about 65 percent of the vegetation. Woody plants, such as pecan, walnut, indigobush, passiovine, and trumpetvine make up the remaining 35 percent.

If the range condition deteriorates to poor, which generally occurs in areas that were formerly cultivated and abandoned because of overflow, the plant mixture in places is a combination of johnsongrass, bermudagrass, pecan sprouts, trumpetvine, seacoast sumpweed, marestail, ragweed, white snakeroot, hawthorn, persimmon, and a few plants of indiangrass, big bluestem, and switchgrass. Because this site has the highest production potential of any in the country, it is valuable cropland. If it is used for native pasture, it should be kept in excellent condition.

Annual air-dried herbage yield is about 8,500 pounds per acre in favorable years and 4,250 pounds per acre in unfavorable years.

LOAMY PRAIRIE RANGE SITE

This range site consists of moderately deep and deep, very gently sloping to steep soils on uplands. These soils have a loamy surface layer and a loamy or clayey subsoil.

Where this site is in excellent condition, about 80 percent of the vegetation is a mixture of decreasers, such as big bluestem, little bluestem, indiangrass, and switchgrass. About 15 percent of the vegetation consists of increasers, among which are tall dropseed, purpletop, jointtail, sideoats grama, wild-indigo, goldenrod, and health aster. Legumes and forbs, such as tickclover, leadplant, gayfeather, and blacksamson, make up the other 5 percent of the vegetation.

Invaders become common on this site following prolonged overuse. These are broomsedge, splitbeard bluestem, annual three-awn, ragweed, common broomweed, hawthorn, prairie crabapple, and winged elm.

Annual air-dried herbage yield is about 6,500 pounds per acre in favorable years and about 4,000 pounds per acre in unfavorable years.

SAVANNAH BREAKS RANGE SITE

This range site (fig. 11) consists of deep, steep soils and Rock outcrop and escarpments on uplands. Stones and boulders commonly are on the surface. Runoff is common during high, intense rainfall or during prolonged rainy periods.

Where this site is in excellent condition, about 60 percent of the vegetation is grasses, legumes, and other forbs, and 40 percent is woody plants. Forage plants are little bluestem, big bluestem, indiangrass, and switchgrass. The primary woody plants are post oak, blackjack oak, and shortleaf pine.

Prolonged heavy grazing, fire, and heavy use have thinned out the grasses and released space for sprouts. Where this has occurred, the range condition has deteriorated to poor, and the plant cover is almost a solid stand of scrubby post oak, blackjack oak, elm, hawthorn, and per-

acre yields of principal pasture and hay plants—Continued

Animal-unit-months 1/ per acre—Con.									
May	June	July	August	September	October	November	December	Total	Hay
									Tons
0.3	0.4	0.3	0.3	0.2	0.2	0.1	---	2.0	0.8
.6	.7	.6	.5	.5	.4	.2	---	3.8	1.6
.4	.5	.4	.3	.3	.2	.1	---	2.4	1.0
.7	.8	.7	.6	.5	.5	.3	---	4.5	1.9
.3	.4	.3	.3	.2	.2	.1	---	2.0	.8
.6	.7	.6	.5	.5	.4	.2	---	3.8	1.6

mule, five sheep or goats) for a period of 30 days.

simmon trees. This overstory of woody plants shades the grasses and contributes to the development of a thin, weak stand of little bluestem, broomsedge, annual three-awns, poverty oatgrass, ragweed, and croton.

Herbage yield is about 2,000 pounds per acre in favorable years and about 1,000 pounds in unfavorable years.

Figure 11.—Savannah Breaks range site in an area of Homa soils and Rock outcrop, steep.

SANDY SAVANNAH RANGE SITE

This range site consists of moderately deep to deep, very gently sloping to moderately steep soils on uplands. These soils have a loamy surface layer and a loamy or clayey subsoil.

Where this site is in excellent condition, it has a mixture of tall grasses and trees (fig. 12). Where it is in poor condition it has almost solid stands of scrub oaks.

Hardwood trees make up about 25 percent of the climax vegetation. The major species of trees are post oak and blackjack oak, and the minor species are red oak, shortleaf

Figure 12.—Sandy Savannah range site on Homa fine sandy loam. Grasses are little bluestem, big bluestem, and indiangrass.

pine, and hickory. Principal decreasers are little bluestem, big bluestem, indiangrass, tephrosia, and slender lespedeza.

Annual fires followed by overgrazing weaken the grasses, and the area is invaded by oaks. The space once occupied by grasses thus becomes a filled-in-savannah which supports essentially the same species but in a much thicker stand. This enviromental change results in a range class of poor for this site

Annual herbage yield is about 5,000 pounds per acre in favorable years and about 2,500 pounds in unfavorable years.

SHALLOW CLAYPAN RANGE SITE

This range site consists of deep,nearly level soils on uplands and flood plains. These soils have a loamy surface layer and a loamy or clayey subsoil that contains significant amounts of exchangeable sodium.

The plant composition of this range site, where in excellent condition, is about 50 percent decreasers, among which are switchgrass, little bluestem, indiangrass, and gayfeathers. The other 50 percent consists of increaser species, such as meadow dropseed, silver bluestem, fall witchgrass, Scribner panicum, heath aster, goldenrod, and slimflower scurf-pea.

As the condition class deteriorates, invader plants that become prominent are ragweed, bitter sneezeweed, narrowleaf sumpweed, croton, broomweed, annual dropseed, and three-awn.

Annual air-dried herbage yield is about 3,000 pounds per acre in favorable years and about 1,500 pounds per acre in unfavorable years.

SHALLOW PRAIRIE RANGE SITE

This range site consists of very shallow to shallow, very gently sloping to moderately steep soils on uplands. These soils are loamy throughout.

Where this range site is in excellent condition, decreaser plants make up about 70 percent of the vegetation. They are little bluestem, big bluestem, indiangrass, tephrosia, sensitivebrier, and perennial sunflowers (fig. 13). Increaser plants make up about 30 percent of the vegetation. These are sideoats grama, meadow dropseed, hairy grama, purpletop, jointtail, ashy sunflower, sticky goldenrod, and coralberry.

Overuse weakens the decreaser plants and allows other species to invade the vacant areas. Where a poor range condition develops, plants that are abundant are annual brome, annual three-awn, and such increasers as persimmon, coralberry, sticky goldenrod, hairy grama, and silver bluestem.

Annual air-dried herbage yield is about 4,500 pounds per acre in favorable years and about 2,000 pounds per acre in unfavorable years.

Figure 13.—Loamy Prairie range site on Bates fine sandy loam, foreground. Cattle in background are grazing on Shallow Prairie range site in an area of Bates-Collinsville complex, 1 to 5 percent slopes.

VERY SHALLOW RANGE SITE

This range site consists of very shallow and shallow, sloping to steep soils on uplands. These soils are loamy throughout. Stones are frequently on or near the surface and throughout the soil.

Where this range site is in excellent condition, the decreaser plants make up about 50 percent of the plant composition. They are little bluestem, big bluestem, indiangrass, and perennial sunflowers. Increasers make up the other half. They are side-oats grama, hairy grama, buffalograss, and silver bluestem.

Where the range condition deteriorates to poor, annual three-awn, silver bluestem, windmillgrass, common broomweed, and ragweed are prominent. In addition, brush, such as hawthorn, persimmon, and sumac, generally becomes much denser.

Air-dried herbage yields are about 2,000 pounds per acre in favorable years and about 1,000 pounds per acre in unfavorable years.

Use of the Soils as Woodland[4]

Natural stands of commercial woodland make up less than 25 percent of the acreage of Coal County. Soils capable of supporting commercial forest species make up about 55 percent. The principal commercial trees on bottom lands are elm, red oak, white oak, cottonwood, sycamore, water oak, ash, hackberry, and pecan. On uplands they are eastern redcedar, shortleaf pine, and southern red oak.

The soils of Coal County have been rated on the basis of their performance when used to produce wood crops. The ratings are a means of expressing information useful in managing wood crops according to the kinds of soil. Items rated in this soil survey and their importance to woodland use and management in Coal County are discussed in the following paragraphs.

Erosion hazard is the potential erodibility of the soil and the hazard it causes when the area is managed according to currently recognized acceptable standards. The rating is *slight* if no special techniques in management are required. It is *moderate* if some provision in management must be made to prevent accelerated erosion. Roads, skid trails, fire lanes, and land construction work and maintenance require some special techniques. The rating is *severe* if special techniques in management and special attention to roads, skid trails, fire lanes, and to land construction work and maintenance are necessary to minimize accelerated erosion.

Equipment limitation ratings are based on limits to operation of mechnical equipment normally used for woodland operations. The dominant factors are steepness of slope, wetness of the soil, clayey and sandy soil textures, and obstacles, such as rocks.

A soil rating of *slight* indicates that there are no particular limitations to the use of equipment.

A rating of *moderate* indicates that not all types of equipment can be used and that there are periods not in excess of three months when equipment cannot be used because of soil wetness or instability.

A rating of *severe* indicates that some kinds of equipment use are limited, that special equipment is needed in places, that the soil is wet more than three months, or soil texture limits equipment use.

Seedling mortality ratings refer to the expected degree of mortality of naturally occurring or planted tree seedlings as influenced by the kinds of soil and where plant competition is not a factor.

Potential productivity is expressed as site index for given tree species. Site index is a numerical means of expressing the quality of a forest site, based on the height of the dominant stand at an arbitrarily chosen age. The arbitrary ages used in this survey are 30 years for cottonwood, 35 years for sycamore, and 50 years for all other species. Height is the average height in feet of the dominant or codominant species.

Preferred species is shown by listing the principal commercial tree species that should be favored in existing stands, and by denoting the tree species that are suitable for planting. The selection of preferred species is influenced by their growth rates and by the quality, value, and general marketability of the products obtained from each species.

The rating is *slight*, if seedling survival ordinarily exceeds 75 percent, or if natural regeneration is suitable or an original planting can be expected to produce a satisfactory stand.

The rating is *moderate* if seedling survival is between 50 to 75 percent. In this case, natural regeneration cannot be relied upon always for adequate and immediate restocking, and planting may be a desirable alternative.

The rating is *severe* if the seedling survival is less than 50 percent and adequate restocking is not expected without additional management attention. For example, superior planting techniques and planting stock are needed, and replanting is required in places to assure adequate stands.

Woodland suitability groups

The soils of Coal County have been grouped on the basis of their performance in producing trees. The ratings of individual soil provide a basis for grouping soils according to their suitability for woodland use and management. Groupings of the soils simplify the presentation of information. A woodland suitability group consists of soils that have comparable potential productivity and comparable limitations, produce similar kinds of wood crops, and require similar management practices.

Important soil-related hazards or limitations in woodland use and management are a part of the definition of each woodland suitability group. The limitations or hazards are (1) potential erosion hazard, (2) equipment limitations, and (3) seedling mortality. The evaluation of these management items for the soils of each woodland group consists of ratings based on the severity of the hazard or limitation imposed on management. The ratings are *slight, moderate,* and *severe*.

Each group symbol consists of three elements. The first element in the symbol indicates the relative potential productivity of the soils in the group for growing wood crops. It expresses the site quality on the site index of one or more important forest types or species.

The numeral 1 indicates very high potential productivity. (Not applicable in Coal County.)

The numeral 2 indicates high potential productivity.

The numeral 3 indicates moderately high potential productivity.

The numeral 4 indicates moderate potential productivity.

The numeral 5 indicates low potential productivity.

The second element in the symbol indicates the soil or

[4]By NORMAN E. SMOLA, woodland conservationist, Soil Conservation Service.

physiographic characteristic that is the primary cause of hazards, limitations, or restrictions of the soils for woodland use or management. This element is x, w, c or o. The letter x means stoniness or rockiness; the letter w means excessive wetness; the letter c means there are limitations because of the kind or amount of clay in the surface layer; and the letter o indicates there are no significant soil-related limitations.

Some soils have more than one limiting characteristic; in this case, priority was assigned to the element in the order in which the characteristics are listed here.

The third element in the symbol indicates the degree of hazard or limitation and the general suitability of the soil for certain kinds of trees.

The numeral 1 indicates the soils have no significant management limitations and are best suited to needleleaf trees.

The numeral 2 indicates soils that have one or more moderate limitations and are best suited to needleleaf trees. (Not applicable in Coal County.)

The numeral 3 indicates one or more severe limitations and that needleleaf trees are the most suitable.

The numeral 4 indicates the soils have no significant limitations and broadleaf trees are the most suitable. (Not applicable in Coal County.)

The numeral 5 indicates one or more moderate limitations and that broadleaf trees are the most suitable. (Not applicable in Coal County.)

The numeral 6 indicates one or more severe limitations and that broadleaf trees are the most suitable.

The numeral 7 indicates soils that present no significant management concerns and are well suited to either needleleaf or broadleaf trees.

The numeral 8 indicates one or more moderate limitations and that the soils are well suited to either needleleaf or broadleaf trees. (Not applicable in Coal County.)

The numeral 9 indicates one or more severe limitations and that the soils are suited to either needleleaf or broadleaf trees.

The numeral 0 indicates the soils are not suited to any major commercial tree species for the production of wood products.

TABLE 4.—*Woodland suitability groups*

[Absence of entry in a column means

Woodland suitability group, map symbols, and descriptions of soils	Management concerns	
	Erosion hazard	Equipment limitation
Group 2w6: Ka, La. Deep, nearly level, clayey to loamy soils that are best suited to southern hardwoods; on flood plains.		Severe: seasonally wet and subject to flooding.
Group 3o7: En. Deep, nearly level, loamy soils that are suitable for southern pines or hardwoods; on flood plains.	Slight	Slight: subject to flooding
Group 3w6: Lt, Ra. Deep, nearly level to gently sloping, loamy soils that are best suited to water-tolerant hardwoods; on flood plains.		Severe: seasonally wet and subject to flooding.
Group 4o1: HaB, HaC, HaC2, HhC. Moderately deep and deep, very gently sloping and gently sloping, loamy soils that are suitable for southern pines and Eastern redcedar; on uplands	Slight	Slight
Group 5c3e: HeC3. Moderately deep, very gently sloping to sloping, severely eroded, loamy soils that are best suited to needleleaf trees; on uplands.	Moderate to severe	Moderate to severe
Group 5x9: HoE, HoF. Deep, moderately steep and steep, loamy soils that are suitable for southern pines or upland hardwoods; on uplands.	Slight to severe	Severe
Group 5o0: BaB, BaC, BaC2, BbC3, BcC, BoB, BoC, BoC2, BuA, BuB, Ca, CeC, ChB, CrB, DoD, FeC, KoC, Lc, Mp, PaA, PaB, SdC, SeE, SrE, StB, TrE, Ws. Soils that are not suitable for the production of major commercial wood products.		

A fourth element, e, has been added to the three element group symbols to designate severely eroded soils.

The woodland group assigned to each soil can be determined by referring to the "Guide to Mapping Units." Soils unsuitable for the production of the major commercial trees for wood crops have been placed in woodland suitability group 5o0.

Table 4 includes a brief description of each woodland suitability group in Coal County and rates the groups according to the method discussed in this section.

Use of the Soils for Wildlife Habitat[5]

The wildlife population of any area depends upon the availability of food, cover, and water in a suitable combination. Habitat is established, improved, or maintained by establishing desirable vegetation and developing water supplies in suitable places.

[5]By JEROME F. SYKORA, biologist, Soil Conservation Service.

In table 5 each of the soils in Coal County is rated according to the suitability for the elements of wildlife habitat. Ratings are for three classes of wildlife. These ratings refer only to the limitations of the soil and do not take into account the climate, the use of the soil, or the distribution of wildlife and human population. The limitations of individual sites has to be determined by onsite inspection.

The meanings of the numerical ratings used in table 5 are as follows:

Well suited means that habitat generally is easily established, improved, or maintained; that the soil has few or no limitations that affect management; and that satisfactory results can be expected. *Suited* means that habitat can be established, improved, or maintained in most places; that the soil has moderate limitations that affect management; and that moderate intensity of management and fairly frequent attention is required for satisfactory results. *Poorly suited* indicates that habitats can be established, improved, or maintained in most places; that the soil has rather severe limitations; that habitat management is difficult and expensive and requires intensive effort; and that results are not

and factors in woodland management

information was not available]

Management concerns—Con.	Potential productivity		
Seedling mortality	Selected species	Site index	Preferred species for planting
Severe: seasonally wet and subject to flooding.	Cottonwood Green ash Sycamore	100 --- ---	Cottonwood, sycamore, water oak, cherrybark oak.
Slight: subject to flooding	Shortleaf pine Red oak Black walnut	70 --- ---	Loblolly pine, shortleaf pine, black walnut, northern red oak.
Moderate to severe: seasonally wet and subject to flooding.	Water oak Green ash Hackberry	80 --- ---	Water oak, green ash.
Slight	Shortleaf pine Eastern redcedar	60 ---	Shortleaf pine, loblolly pine, Eastern redcedar.
Moderate to severe	Shortleaf pine Red oak Eastern redcedar	55 --- ---	Shortleaf pine, Eastern redcedar.
Slight to severe	Shortleaf pine Eastern redcedar Red oak	55 --- ---	Not recommended for planting.
---	---	---	Not recommended for planting.

TABLE 5.—*Suitability of the soils for elements*

Soil series and map symbols	Elements of wildlife habitat			
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood woody plants
Bates:				
BaB, BaC, BaC2	Suited	Well suited	Well suited	Suited
BbC3, BcC	Poorly suited	Suited	Suited	Poorly suited
Bonham: BoB, BoC, BoC2	Well suited	Well suited	Well suited	Suited
Burleson: BuA, BuB	Well suited	Suited	Suited	Poorly suited
Carytown: Ca	Poorly suited	Suited	Suited	Poorly suited
Chaney: CeC	Suited	Suited	Suited	Suited
Choteau: ChB	Well suited	Well suited	Well suited	Suited
Crockett: CrB	Suited	Well suited	Well suited	Suited
Dougherty: DoD	Suited	Well suited	Well suited	Well suited
Ennis: En	Well suited	Well suited	Well suited	Well suited
Ferris, acid surface variant FeC.	Suited	Well suited	Suited	Poorly suited
Hartsells:				
HaB, HaC, HaC2	Suited	Well suited	Well suited	Well suited
HeC3	Unsuited	Suited	Suited	Suited
Homa:				
HhC	Poorly suited	Suited	Suited	Well suited
HoE	Unsuited	Poorly suited	Suited	Suited
HoF	Unsuited	Poorly suited	Poorly suited	Suited
Kaufman: Ka	Well suited	Well suited	Well suited	Suited
Konawa: KoC	Well suited	Well suited	Well suited	Well suited
Lanton: La, Lc	Well suited	Well suited	Well suited	Well suited
Lightning: Lt	Suited	Suited	Suited	Suited
Mine pits and dumps: Mp	Unsuited	Poorly suited	Poorly suited	Poorly suited
Parsons: PaA, PaB	Well suited	Well suited	Well suited	Poorly suited
Robinsonville: Ra	Poorly suited	Suited	Well suited	Well suited
Steedman:				
SdC	Poorly suited	Suited	Suited	Poorly suited
SeE	Unsuited	Suited	Suited	Poorly suited
SrE	Unsuited	Suited	Suited	Suited

of wildlife habitat and kinds of wildlife

Elements of wildlife habitat—Con.				Kinds of wildlife		
Coniferous woody plants	Wetland food and cover plants	Waterfowl shallow-water developments	Ponds	Open-land wildlife	Woodland wildlife	Wetland wildlife
Suited	Unsuited	Unsuited	Poorly suited	Well suited	Suited	Unsuited.
Poorly suited	Unsuited	Unsuited	Poorly suited	Suited	Poorly suited	Unsuited.
Suited	Unsuited	Poorly suited	Suited	Well suited	Suited	Poorly suited.
Poorly suited	Poorly suited	Suited	Well suited	Suited	Poorly suited	Poorly suited.
Poorly suited	Poorly suited	Suited	Poorly suited	Suited	Poorly suited	Suited.
Suited	Unsuited	Unsuited	Suited	Suited	Suited	Unsuited.
Suited	Poorly suited	Poorly suited	Suited	Well suited	Suited	Poorly suited.
Suited	Poorly suited	Poorly suited	Suited	Well suited	Suited	Poorly suited.
Well suited	Unsuited	Unsuited	Unsuited	Well suited	Well suited	Unsuited.
Well suited	Suited	Unsuited	Poorly suited	Well suited	Well suited	Unsuited.
Poorly suited	Unsuited	Unsuited	Well suited	Suited	Poorly suited	Unsuited.
Well suited	Unsuited	Unsuited	Poorly suited	Well suited	Well suited	Unsuited.
Poorly suited	Unsuited	Unsuited	Unsuited	Suited	Suited	Unsuited.
Suited	Unsuited	Unsuited	Suited	Suited	Well suited	Unsuited.
Suited	Unsuited	Unsuited	Poorly suited	Poorly suited	Suited	Unsuited.
Suited	Unsuited	Unsuited	Poorly suited	Poorly suited	Suited	Unsuited.
Suited	Well suited	Well suited	Well suited[1/]	Well suited	Suited	Well suited.
Well suited	Unsuited	Unsuited	Poorly suited	Well suited	Well suited	Unsuited.
Suited	Well suited	Well suited	Suited[1/]	Well suited	Well suited	Well suited.
Suited	Well suited	Well suited	Suited[1/]	Suited	Suited	Well suited.
Poorly suited	Poorly suited	Poorly suited	Unsuited	Poorly suited	Poorly suited	Poorly suited.
Poorly suited	Poorly suited	Suited	Suited[1/]	Well suited	Poorly suited	Poorly suited.
Suited	Suited	Poorly suited	Poorly suited	Suited	Well suited	Suited.
Poorly suited	Unsuited	Unsuited	Well suited	Suited	Poorly suited	Unsuited.
Poorly suited	Unsuited	Unsuited	Poorly suited	Suited	Poorly suited	Unsuited.
Poorly suited	Poorly suited	Poorly suited	Suited	Suited	Suited	Poorly suited.

TABLE 5.—*Suitability of soils for elements*

Soil series and map symbols	Elements of wildlife habitat			
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood woody plants
Stidham: StB	Suited	Well suited	Well suited	Well suited
Talpa: TrE	Unsuited	Suited	Suited	Suited
Wilson: Ws	Suited	Suited	Suited	Poorly suited

1/ Rating applies to suitability of soils for pond reservoirs.

always satisfactory. *Unsuited* indicates that it is impractical or impossible to establish, improve, or maintain habitat and that unsatisfactory results are probable.

The column heading *Grain and seed crops* refers to grain-producing or seed-producing annual plants, such as corn, sorghum, millets, and soybeans.

Grasses and legumes refers to domestic grasses and legumes that are established by planting and which furnish food and cover for wildlife. The grasses include bahiagrass, weeping lovegrass, johnsongrass, ryegrass, and panicgrasses. Legumes include species of clover, annual lespedezas, and bush lespedezas.

Wild herbaceous upland plants refers to native or introduced perennial grasses, forbs, and weeds that provide food and cover for upland wildlife. Examples of these are beggarweed, perennial lespedezas, wild bean, pokeberry, and cheatgrass.

Hardwood woody plants refers to nonconiferous trees, shrubs, and woody vines that produce fruits, nuts, buds, catkins, or foliage (browse) that are used extensively as food by wildlife. These plants commonly become established through natural process, but they can be planted. They include species of oak, cherry, dogwood, huckleberry, viburnum, black locust, sand plum, sumac, maple, grape, honeysuckle, greenbrier, bois d'arc, mulberry, hackberry, pecan, hickory, and black and red hawthorne.

Coniferous woody plants are cone-bearing trees and shrubs that are used mainly as cover, but some also furnish food in the form of browse, seeds, or fruit-like cones. They become established through natural process or are planted. Included are pines, cedars, and ornamentals.

Wetland food and cover plants are annual and perennial wild herbaceous plants that grow on moist to wet sites. They do not include submersed or floating aquatics. These plants furnish food or cover mostly for wetland wildlife. Some examples are smartweed, wild millet, spikerush, and other rushes, sedges, and burreed.

Waterfowl shallow-water developments are those areas in which low dikes and water-control structures are established to create habitat principally for waterfowl. They are designed so that they can be drained, planted, and flooded, or used as permanent impoundments for growing submersed aquatics. Both freshwater and brackish water situations are included.

Ponds refers to sites where water of suitable depth and quality can be impounded mainly for fish production.

Open-land wildlife are quail, doves, cottontail rabbits, foxes, meadowlarks, field sparrows, and other birds and mammals. These open-land wildlife generally live on cropland, pastures, meadows, lawns, and other upland areas where grasses, herbs, and shrubby plants grow.

Woodland wildlife are woodcock, thrush, vireo, squirrel, deer, raccoon, wild turkey, and other birds and mammals. These wildlife generally live in wooded areas where hardwood trees, shrubs, and coniferous trees grow.

Wetland wildlife are ducks, geese, rails, herons, shore birds, mink, beavers, muskrats, and other birds and mammals that normally live in wet areas, marshes and swamps.

Engineering Uses of the Soils[6]

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

Among the properties of soils most important in engineering are permeability, strength, compaction characteristics, drainage, shrink-swell potential, grain size, plasticity, and reaction. Also important are slope and depth to the water table and to bedrock. 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.

[6]By FOREST McCLUNG, engineer, Soil Conservation Service.

of wildlife habitat and kinds of wildlife—Continued

Elements of wildlife habitat—Con.				Kinds of wildlife		
Coniferous woody plants	Wetland food and cover plants	Waterfowl shallow-water developments	Ponds	Open-land wildlife	Woodland wildlife	Wetland wildlife
Suited	Unsuited	Unsuited	Poorly suited	Well suited	Well suited	Unsuited.
Poorly suited	Unsuited	Unsuited	Unsuited	Suited	Suited	Unsuited.
Poorly suited	Suited	Suited	Suited[1/]	Suited	Poorly suited	Suited.

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 6, 7, and 8. Tables 6 and 7 show, respectively, several estimated soil properties significant to engineering and interpretations for various engineering uses. Table 8 gives engineering test data for four representative soils. This information, along with the soil maps and other information from parts of this survey, can be used to make interpretations in addition to those given in the tables. 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 soils 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 limitations that can be expected.

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 (7) used by the Soil Conservation Service 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 organic-matter content. Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes; for example, ML-CL.

The 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 the 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 AASHO classification for tested soils, with group index numbers in parentheses, is shown in table 8; the estimated classification, without group index numbers, is given in table 6 for all soils mapped in Coal County.

Estimated soil properties significant to engineering

In table 6 the soil series of the county, and their map symbols, are listed, and certain physical and chemical properties significant to engineering are described. The estimates in columns titled "Depth from surface" and "USDA texture" are based on a modal profile, or a profile typical for the soil series. The estimates in the remaining columns are for the series of the county. For the soils in the county that were tested, estimates in table 6 are based on the test data listed in table 8. For the other soils, estimates are based on test data obtained from similar soils in the county and in other counties, and on past experience in engineering.

TABLE 6.—*Estimated soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or reason it is necessary to follow carefully the instructions for

Soil series and map symbols	Hydro-logic soil group	Depth to—		Depth from surface (typical profile)	Classification		
		Bedrock	Seasonal high water table		USDA texture	Unified	AASHO
		Inches	Feet	Inches			
*Bates: BaB, BaC, BaC2, BbC3, BcC. For Bonham part of unit BbC3 and Collinsville part of unit BcC, see Bonham and Collinsville series, respectively.	B	20-40	> 6	0-13	Fine sandy loam.	SM or ML	A-4
				13-17	Loam	ML or CL	A-4
				17-32	Sandy clay loam.	ML, SC, or CL	A-4 or A-6
				32	Sandstone.		
Bonham: BoB, BoC, BoC2	C	> 72	2-3	0-11	Loam	ML or CL-ML	A-4
				11-15	Clay loam	CL or CH	A-6 or A-7
				15-65	Clay	CL or CH	A-7
Burleson: BuA, BuB	D	> 72	1-2	0-60	Clay	CL, MH or CH	A-7
Carytown: Ca	D	> 72	0-1	0-6	Silt loam	ML or ML-CL	A-4
				6-40	Silty clay	MH or CH	A-7
				40-70	Silty clay loam.	ML or CL	A-6
Chaney: CeC	C	> 72	2-3	0-6	Loam	ML or CL	A-4
				6-54	Clay	CL or CH	A-6 or A-7
				54-70	Clay loam	CL or ML-CL	A-6 or A-7
Choteau: ChB	C	> 72	2-3	0-20	Loam	ML or CL	A-4
				20-27	Clay loam	CL or ML-CL	A-6 or A-7
				27-65	Clay	CL or CH	A-7
Collinsville. Mapped only in complex with Bates and Steedman soils.	C	4-20	> 6	0-7	Fine sandy loam.	SM or ML	A-2 or A-4
				7-12	Gravelly fine sandy loam.	SM	A-2
				12	Sandstone.		
Crockett: CrB	D	> 72	1-2	0-8	Loam	ML or CL	A-4
				8-65	Clay	CL or CH	A-7
Dougherty: DoD	A	>84	> 6	0-28	Loamy fine sand.	SM	A-2
				28-40	Sandy clay loam.	SC or CL	A-4
				40-65	Sandy loam	SM or SM-SC	A-2 or A-4
				65-84	Loamy fine sand.	SM	A-2
Ennis: En	B	> 72	4-6	0-24	Loam	ML or CL	A-4
				24-31	Silt loam	ML or CL	A-4
				31-40	Loam	ML or CL	A-4
				40-60	Silty clay loam.	ML or CL	A-6
Ferris, acid surface variant: FeC.	D	> 72	> 6	0-7	Silty clay	CH	A-7
				7-65	Clay	CH	A-7
Hartsells: HaB, HaC, HaC2, HeC3.	B	20-40	> 6	0-11	Fine sandy loam.	SM or ML	A-2 or A-4
				11-17	Sandy loam	SM or SM-SC	A-2 or A-4
				17-36	Sandy clay loam.	SC or CL	A-4 or A-6
				36	Sandstone.		
*Homa: HhC, HoE1/, HoF1/. For Hartsells part of unit HhC, see Hartsells series.	C	> 72	1-2	0-5	Fine sandy loam.	SM, ML, or ML-CL	A-2 or A-4
				5-60	Clay	CL or CH	A-7
Kaufman: Ka	D	>75	0-1	0-75	Silty clay	CL or CH	A-7

significant to enginering

more kinds of soil. The soils in such mapping units may have different properties and limitations, and for this referring to other series that appear in the first column of this table]

Percentage passing sieve—				Permeability	Available water capacity	Reaction	Corrosivity		Shrink-swell potential
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 0.42 mm.)	No. 200 (0.074 mm.)				Uncoated steel	Concrete	
				Inches per hour	Inches per inch of soil	pH value			
100	100	85-100	45-65	2.0-6.3	0.09-0.13	5.6-6.5	Low	Moderate	Low.
100	100	85-100	55-85	0.63-2.0	0.12-0.16	5.2-6.5	Low	Moderate	Low.
100	100	90-100	40-75	0.63-2.0	0.12-0.16	5.1-6.5	Low	Moderate	Low.
100	100	90-100	60-75	0.63-2.0	0.12-0.16	5.1-6.5	Moderate	Moderate	Low.
100	100	95-100	75-98	0.06-0.63	0.15-0.19	5.1-6.5	Moderate	Moderate	Moderate to high.
100	100	90-100	90-98	0.06-0.20	0.14-0.18	5.1-7.8	High	Moderate	High.
100	100	90-100	75-95	< 0.06	0.14-0.18	5.6-8.4	High	Moderate	High.
100	100	90-100	70-90	0.63-2.0	0.14-0.18	5.1-6.0	High	Moderate	Low.
100	100	95-100	90-98	< 0.06	0.14-0.18	5.6-8.4	High	High	High.
100	100	95-100	80-90	0.20-0.63	0.15-0.19	6.6-8.4	High	High	Moderate.
100	100	85-95	55-85	0.63-2.0	0.12-0.16	5.6-6.5	Moderate	Moderate	Low.
100	100	90-100	90-98	0.06-0.20	0.14-0.18	5.6-8.4	High	Moderate	High.
100	100	95-100	75-95	0.20-0.63	0.15-0.19	7.4-8.4	High	Low	Moderate.
100	100	85-95	55-85	0.63-2.0	0.12-0.16	4.5-6.0	Moderate	High	Low.
100	100	95-100	75-95	0.20-0.63	0.15-0.19	5.1-6.0	High	Moderate	Moderate.
100	100	90-100	90-98	0.06-0.20	0.14-0.18	5.1-7.8	High	Moderate	High.
100	100	85-98	30-60	2.0-6.3	0.09-0.13	5.1-6.5	Low	Moderate	Low.
70-80	50-60	50-60	20-40	2.0-6.3	0.07-0.10	5.1-6.5	Low	Moderate	Low.
98-100	98-100	85-100	55-85	0.63-2.0	0.12-0.16	5.6-7.3	Moderate	Moderate	Low.
98-100	98-100	90-100	90-98	< 0.06	0.14-0.18	5.6-7.8	High	Moderate	High.
100	100	90-98	13-30	2.0-6.3	0.06-0.09	5.6-6.5	Low	Moderate	Low.
100	100	96-100	40-60	0.63-2.0	0.12-0.16	5.1-6.0	Low	Moderate	Low.
100	100	50-70	15-40	2.0-6.3	0.09-0.13	5.1-6.0	Low	Moderate	Low.
100	100	90-98	13-30	2.0-6.3	0.06-0.09	5.1-6.0	Low	Moderate	Low.
100	100	90-100	55-85	0.63-2.0	0.12-0.16	5.1-6.5	Low	Moderate	Low.
100	100	90-100	70-90	0.63-2.0	0.14-0.18	5.1-6.0	Low	Moderate	Low.
100	100	90-100	50-90	0.63-2.0	0.12-0.16	5.1-6.0	Low	Moderate	Low.
100	100	95-100	85-95	0.63-2.0	0.15-0.19	5.1-6.0	Moderate	Moderate	Low to moderate.
100	100	95-100	90-98	< 0.06	0.14-0.18	6.1-7.8	High	Low	High.
95-100	95-100	90-100	80-95	< 0.06	0.14-0.18	6.1-8.4	High	Low	High.
100	100	70-100	30-55	2.0-6.3	0.09-0.13	4.5-5.5	Moderate	High	Low.
100	100	50-70	15-40	2.0-6.3	0.09-0.13	4.5-5.0	Moderate	High	Low.
100	100	90-100	36-55	2.0-6.3	0.12-0.16	4.5-5.0	Moderate	High	Low.
100	100	85-100	30-60	2.0-6.3	0.09-0.13	4.5-6.5	Moderate	High	Low.
100	100	90-100	90-98	0.06-0.20	0.14-0.18	4.5-8.4	High	High	High.
100	100	94-100	90-98	< 0.06	0.14-0.18	6.1-8.4	High	Low	High.

TABLE 6.—*Estimated soil properties*

Soil series and map symbols	Hydro-logic soil group	Depth to— Bedrock	Seasonal high water table	Depth from surface (typical profile)	Classification USDA texture	Unified	AASHO
		Inches	Feet	Inches			
Konawa: KoC	B	> 72	> 6	0-13	Fine sandy loam.	SM or ML	A-2 or A-4
				13-42	Sandy clay loam.	SM, SC, ML or CL	A-2 or A-4
				42-65	Fine sandy loam.	SM or ML	A-2 or A-4
Lanton: La, Lc	D	> 72	0-1	0-20	Silt loam	ML or CL-ML	A-4
				20-38	Silty clay loam.	ML or CL	A-6
				38-62	Clay	CL or CH	A-7
*Lightning: Lt For Carytown part of unit Lt, see Carytown series.	D	> 72	0-1	0-6	Silt loam	ML or ML-CL	A-4
				6-25	Silty clay	CL or CH	A-6 or A-7
				25-70	Silty clay loam.	CL or CH	A-6 or A-7
Mine pits and dumps: Mp[2].							
Parsons: PaA, PaB	D	> 72	0-1	0-12	Silt loam	ML or ML-CL	A-4
				12-32	Clay	CL or CH	A-7
				32-62	Clay loam	CL or CH	A-6 or A-7
*Robinsonville: Ra For Lanton part of unit Ra, see Lanton series.	B	> 72	> 6	0-18	Loam	ML or ML-CL	A-4
				18-60	Fine sandy loam.	SM or ML-CL	A-2 or A-4
*Steedman: SdC, SeE, SrE For Collinsville part of SeE and Robinsonville part of SrE, see Collinsville and Robinsonville series.	D	25-40	1-2	0-6	Clay loam	CL or ML-CL	A-6 or A-7
				6-35	Clay	CL or CH	A-7
				35	Shale.		
Stidham: StB	A	> 72	4-5	0-26	Loamy fine sand.	SM	A-2
				26-46	Sandy clay loam.	SC or ML-CL	A-4
				46-60	Fine sandy loam.	SM or ML	A-2 or A-4
				60-80	Loamy fine sand.	SM	A-2
Talpa: TrE[1]	D	5-20	> 6	0-4	Silty clay loam	CL or ML-CL	A-6
				4-8	Gravelly silty clay loam.	CL or ML-CL	A-6
				8	Limestone.		
Wilson: Ws	D	> 72	0-1	0-8	Silt loam	ML or CL-ML	A-4
				8-75	Clay	CL or CH	A-7

1/ Properties of Rock outcrop not estimated.

significant to engineering—Continued

Percentage passing sieve—				Permeability	Available water capacity	Reaction	Corrosivity		Shrink-swell potential
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 0.42 mm.)	No. 200 (0.074 mm.)				Uncoated steel	Concrete	
				Inches per hour	Inches per inch of soil	pH value			
100	100	85-98	30-60	2.0-6.3	0.09-0.13	5.6-6.5	Low	Low to moderate.	Low.
100	100	90-100	30-60	0.63-2.0	0.12-0.16	5.1-6.0	Low	Moderate	Low.
100	100	85-98	30-60	2.0-6.3	0.09-0.13	5.1-6.0	Low	Moderate	Low.
100	100	90-100	75-90	0.63-2.0	0.14-0.18	6.1-7.3	High	Low	Low.
100	100	95-100	85-95	0.06-0.2	0.15-0.19	6.1-7.3	High	Low	Moderate.
100	100	94-100	90-98	0.06-0.2	0.14-0.18	6.1-7.3	High	Low	High.
100	100	90-100	75-90	0.06-0.2	0.14-0.18	5.1-7.3	High	Moderate	Low.
100	100	95-100	85-98	< 0.06	0.14-0.18	5.6-6.5	High	Moderate	High.
100	100	90-100	85-99	< 0.06	0.15-0.19	5.6-6.5	High	Moderate	Moderate to high.
100	100	90-100	75-90	0.63-2.0	0.14-0.18	5.1-6.5	High	Moderate	Low.
100	100	90-100	90-100	< 0.06	0.14-0.18	5.1-6.0	High	Moderate	High.
100	100	90-100	75-95	< 0.06-0.20	0.15-0.19	5.1-7.8	High	Moderate	Moderate to high.
100	100	85-95	50-90	2.0-6.3	0.12-0.16	5.1-6.5	Low	Moderate	Low.
100	100	85-100	30-60	2.0-6.3	0.09-0.13	5.1-6.0	Low	Moderate	Low.
100	100	95-100	75-95	0.20-0.63	0.15-0.19	5.1-6.5	Moderate	Moderate	Moderate.
100	100	90-100	95-100	0.06-0.20	0.14-0.18	5.6-8.4	High	Moderate	High.
100	100	90-98	15-35	2.0-6.3	0.06-0.09	5.1-6.5	Low	Moderate	Low.
100	100	90-100	40-60	0.63-2.0	0.12-0.16	5.1-6.0	Moderate	Moderate	Low.
100	100	85-98	30-60	2.0-6.3	0.09-0.13	5.1-6.0	Low	Moderate	Low.
100	90-100	65-80	15-35	2.0-6.3	0.06-0.09	5.1-6.0	Low	Moderate	Low.
100	100	95-100	65-95	0.63-2.0	0.15-0.19	6.6-8.4	Moderate	Low	Moderate.
70-80	70-80	70-80	65-75	0.63-2.0	0.13-0.17	6.6-8.4	Moderate	Low	Low to moderate.
100	100	90-100	75-90	0.63-2.0	0.14-0.18	5.6-6.5	High	Moderate	Low.
100	100	94-100	90-98	< 0.06	0.14-0.18	5.6-8.4	High	Moderate	High.

2/ Properties not estimated because the material is too variable to classify.

TABLE 7.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or reason it is necessary to follow carefully the instructions for

Soil series and map symbols	Suitability as a source of—		Soil features affecting—			
				Farm ponds		
	Topsoil	Road fill	Highway location	Reservoir area	Embankment	Agricultural drainage
*Bates: BaB, BaC, BaC2, BbC3, BcC. For Bonham part of BbC3 and Collinsville part of unit BcC, see Bonham and Collinsville series.	Good	Fair: moderate traffic-supporting capacity.	Depth to bedrock is 20 to 40 inches.	Depth to bedrock is 20 to 40 inches.	Limited volume of material.	Well drained.
Bonham: BoB, BoC, BoC2	Fair: limited quantity of suitable material.	Poor: high shrink-swell potential.	High shrink-swell potential; low traffic-supporting capacity.	Features favorable.	Clayey material; poor compaction.	Moderately well drained; slow permeability.
Burleson: BuA, BuB	Poor: clayey textures.	Poor: high shrink-swell potential.	High shrink-swell potential.	Features favorable.	Unstable when wet.	Moderately well drained; very slow permeability.
Carytown: Ca	Poor: limited quantity of suitable material.	Poor: high shrink-swell potential.	High shrink-swell potential; low traffic-supporting capacity; dispersed subsoil is high in sodium.	Features favorable except for dispersed soil.	Clayey material; poor compaction; dispersed soil.	Poorly drained; very slow permeability.
Chaney: CeC	Poor: limited quantity of suitable material.	Poor: high shrink-swell potential.	High shrink-swell potential; low traffic-supporting capacity.	Features favorable.	Clayey material; poor compaction.	Moderately well drained; slow permeability.
Choteau: ChB	Good	Fair: moderate traffic-supporting capacity.	Moderate to high shrink-swell potential; moderate traffic-supporting capacity.	Features favorable.	Fair slope stability.	Moderately well drained; slow permeability.
Collinsville. Mapped only in complex with Bates and Steedman soils.	Poor: limited quantity of suitable material.	Poor: limited quantity of suitable material.	Depth to bedrock is 4 to 20 inches.	Depth to bedrock is 4 to 20 inches.	Depth to bedrock is 4 to 20 inches.	Well drained.
Crockett: CrB	Poor: limited quantity of suitable material.	Poor: high shrink-swell potential.	High shrink-swell potential; low traffic-supporting capacity.	Features favorable.	High compressibility.	Moderately well drained; very slow permeability.
Dougherty: DoD	Poor: sandy texture.	Good	Slope	High seepage potential.	Fair slope stability; erosion.	Well drained.
Ennis: En	Good	Good to fair: moderate traffic-supporting capacity.	Low shrink-swell potential; subject to flooding.	Seepage potential; subject to flooding.	Fair slope stability; resistance to piping.	Subject to flooding; well drained.

interpretations of the soils

more kinds of soil. The soils in such mapping units may have different properties and limitations, and for this referring to other series that appear in the first column of this table]

Soil features affecting—Continued				Soil limitations for sewage disposal	
Irrigation	Terraces and diversions	Grassed waterways	Foundations for low buildings	Septic tank filter fields	Sewage lagoons
Limited root zone; high available water capacity.	Features favorable.	Features favorable.	Features favorable.	Severe: depth to bedrock is 20 to 40 inches.	Severe: depth to bedrock is 20 to 40 inches.
Slow permeability; high available water capacity.	Features favorable.	Features favorable.	High shrink-swell potential.	Severe: slow permeability.	Slight to moderate: slope.
Very slow permeability; high available water capacity.	Very slow permeability.	Features favorable.	High shrink-swell potential.	Severe: very slow permeability; water table at a depth of 1 to 2 feet.	Slight to moderate.
Very slow permeability; high sodium content; high available water capacity.	Very slow permeability; high sodium content; dispersed soil.	Thin surface layer; very slow permeability; high sodium content; dispersed soil.	High shrink-swell potential; poorly drained; water table at a depth of 0 to 1 foot.	Severe: very slow permeability; water table at a depth of 0 to 1 foot.	Slight except for dispersed soil on embankments.
Slow permeability; high available water capacity.	Features favorable.	Slow permeability.	High shrink-swell potential.	Severe: slow permeability.	Moderate: slope.
Features favorable; high available water capacity; slow permeability.	Features favorable.	Features favorable.	Moderate to high shrink-swell potential; water table at a depth of 2 to 3 feet.	Severe: slow permeability.	Slight.
Depth to bedrock is 4 to 20 inches; low to moderate available water capacity.	Depth to bedrock is 4 to 20 inches.	Depth to bedrock is 4 to 20 inches; low to moderate available water capacity.	Depth to bedrock is 4 to 20 inches.	Severe: depth to bedrock is 4 to 20 inches.	Severe: depth to bedrock is 4 to 20 inches; moderately rapid permeability.
Very slow permeability; high available water capacity.	Features favorable.	Features favorable.	High shrink-swell potential; water table at a depth of 1 to 2 feet.	Severe: very slow permeability; water table at a depth of 1 to 2 feet.	Slight to moderate: slope.
Features favorable for sprinkler irrigation.	Sandy surface layer.	Features favorable.	Slight to moderate; slope.	Slight to moderate: moderate permeability.	Severe: slope; moderate permeability.
Subject to flooding; high available water capacity.	Nearly level; subject to flooding.	Features favorable.	Subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding; moderate permeability.

TABLE 7.—*Engineering*

Soil series and map symbols	Suitability as a source of—		Soil features affecting—			
	Topsoil	Road fill	Highway location	Farm ponds: Reservoir area	Farm ponds: Embankment	Agricultural drainage
Ferris, acid surface variant: FeC.	Poor: clayey texture; limited quantity of suitable material.	Poor: high shrink-swell potential.	High shrink-swell potential; low traffic-supporting capacity.	Features favorable.	High compressibility; moderate stability.	Somewhat excessively drained; very slow permeability.
Hartsells: HaB, HaC, HaC2, HeC3.	Good	Fair: limited quantity of suitable material.	Sandstone at a depth of 20 to 40 inches.	Sandstone at a depth of 20 to 40 inches; seepage potential.	Limited quantity of borrow material; compressibility.	Well drained.
*Homa: HhC, HoE[1]/, HoF[1]/ For Hartsells part of HhC, see Hartsells series.	Poor: limited quantity of suitable material.	Poor: low traffic-supporting capacity; high shrink-swell potential.	High shrink-swell potential.	Features favorable.	Fair slope stability; high compressibility.	Moderately well drained; slow permeability.
Kaufman: Ka	Poor: clayey texture.	Poor: low traffic-supporting capacity; high shrink-swell potential.	Subject to flooding; high shrink-swell potential; very slow permeability.	Features favorable.	Fair slope stability; high compressibility.	Somewhat poorly drained; very slow permeability; subject to flooding.
Konawa: KoC	Fair: limited quantity of suitable material.	Good	Moderate: moderate traffic-supporting capacity.	High seepage potential at a depth below 42 inches.	Fair slope stability; resistance to piping.	Well drained.
Lanton: La, Lc	Good	Poor: low traffic-supporting capacity.	Subject to flooding.	Features favorable.	Fair slope stability.	Poorly drained; slow permeability; subject to flooding.
*Lightning: Lt For Carytown part of Lt, see Carytown series.	Poor: limited quantity of suitable material.	Poor: moderate to high shrink-swell potential.	Moderate to high shrink-swell potential; subject to flooding.	Features favorable.	Fair slope stability.	Poorly or somewhat poorly drained; very slow permeability; subject to flooding.
Mine pits and dumps: Mp[2]/.						
Parsons: Pa, PaB	Fair: limited quantity of suitable material.	Poor: moderate to high shrink-swell potential.	Moderate to high shrink-swell potential.	Features favorable.	Fair slope stability; high compressibility.	Somewhat poorly drained; very slow permeability.
*Robinsonville: Ra For Lanton part of Ra, see Lanton series.	Good	Good	Subject to flooding.	Moderately rapid permeability.	Resistance to piping and erosion; fair slope stability.	Well drained; subject to flooding.

interpretations of the soils—Continued

Soil features affecting—Continued				Soil limitations for sewage disposal	
Irrigation	Terraces and diversions	Grassed waterways	Foundations for low buildings	Septic tank filter fields	Sewage lagoons
Very slow permeability; high available water capacity.	Features favorable.	Vegetation difficult to establish.	High shrink-swell potential.	Severe: very slow permeability.	Moderate: slope.
Features favorable	Features favorable.	Features favorable.	Sandstone at a depth of 20 to 40 inches.	Moderate: rippable sandstone at a depth of 20 to 40 inches.	Severe: moderately rapid permeability; slope.
Slopes; high available water capacity; slow permeability.	Slopes; slow permeability.	Slopes	High shrink-swell potential; slopes.	Severe: slow permeability; water table at a depth of 1 to 2 feet.	Severe: slope.
Subject to flooding; very slow permeability; high available water capacity.	Nearly level; subject to flooding.	Features favorable.	High shrink-swell potential; subject to flooding.	Severe: very slow permeability; subject to flooding; water table at a depth of 0 to 1 foot.	Severe if subject to flooding; slight if protected from flooding.
Features favorable	Features favorable.	Features favorable.	Features favorable.	Slight	Severe: moderate permeability; slope.
Slow permeability; subject to flooding; high available water capacity.	Subject to flooding.	Subject to flooding.	Subject to flooding.	Severe: slow permeability; subject to flooding; water table at a depth of 0 to 1 foot.	Severe if subject to flooding; slight if protected from flooding.
Very slow permeability; subject to flooding; high available water capacity.	Subject to flooding.	Subject to flooding.	Subject to flooding; moderate to high shrink-swell potential.	Severe: very slow permeability; subject to flooding; water table at a depth of 0 to 1 foot.	Severe if subject to flooding; slight if protected from flooding.
Very slow permeability; high available water capacity.	Features favorable.	Features favorable.	Moderate to high shrink-swell potential; water table at a depth of 0 to 1 foot.	Severe: very slow permeability; water table at a depth of 0 to 1 foot.	Slight if slope is less than 2 percent; moderate if slope is more than 2 percent.
Subject to flooding; high available water capacity.	Subject to flooding.	Subject to flooding.	Subject to flooding.	Severe: subject to flooding.	Severe: moderately rapid permeability; subject to flooding.

TABLE 7.—*Engineering*

Soil series and map symbols	Suitability as a source of—		Soil features affecting—			
	Topsoil	Road fill	Highway location	Farm ponds: Reservoir area	Farm ponds: Embankment	Agricultural drainage
*Steedman: SdC, SeE, SrE. For Collinsville part of SeE, and Robinsonville part of SrE, see Collinsville and Robinsonville series.	Poor: limited quantity of suitable material.	Poor: high shrink-swell potential; low traffic-supporting capacity.	High shrink-swell potential; depth to shale is 25 to 40 inches.	Shale is at a depth of 25 to 40 inches.	Fair slope stability; high compressibility.	Well drained; slow permeability.
Stidham: StB	Poor: sandy texture.	Good	Features favorable except for slope stability.	High seepage potential at a depth below 46 inches.	Fair slope stability.	Well drained.
Talpa: TrE[1]	Poor: limited quantity of suitable material.	Poor: limited quantity of suitable material.	Depth to bedrock is 5 to 20 inches.	Depth to bedrock is 5 to 20 inches.	Limited quantity of borrow material.	Well drained.
Wilson: Ws	Fair: limited quantity of suitable material.	Poor: high shrink-swell potential; low traffic-supporting capacity.	High shrink-swell potential; low traffic-supporting capacity.	Features favorable.	Fair slope stability.	Somewhat poorly drained; very slow permeability.

1/ Properties of Rock outcrop not estimated.

Following are explanations of the columns in table 6.

Permeability, as used in the table, refers only to the downward movement of water through undisturbed soil material. The estimates are based on structure and porosity of the soil as it occurs in place. Such features as plowpans and surface crust were not considered.

Available water capacity, given in terms of inches per inch of soil, is the capacity of the soil 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. The amount of water shown in the table will wet the soil material described to a depth of 1 inch without further percolation.

Reaction is expressed in terms of pH values. A pH of 4.5 to 5.0 indicates very strong acidity, and a pH of 9.1 or higher indicates very strong alkalinity.

Corrosivity is the process of deterioration. Uncoated steel pipe when buried in the soil will deteriorate as a result of an electrochemical process converting iron into its ions. Soil moisture forms solutions with soluble salts in the soil and becomes electrolytes. Concrete deterioration is caused by a chemical reaction between the base (the concrete) and a weak acid (the soil solution). Texture, salts, and fluctuating soil moisture are properties that influence corrosivity.

The *shrink-swell potential* is the amount that a soil will expand when wet or contract when dry. It is estimated primarily on the basis of the amount and kind of clay in a soil.

For the *hydrologic soil group*, the entire thickness of the soil profile shown in the table is considered. The soils are classified in four hydrologic groups—A, B, C, and D. The basis of the grouping is intake of water at the end of a long-duration storm, after prior wetting and opportunity for swelling, but without consideration of the protective effect of vegetation. Group A consists mostly of sandy soils that have the lowest runoff potential. Group D consists mostly of clays that have the highest runoff potential.

Engineering interpretations

Table 7 gives engineering interpretations of the soils and estimates of their suitability for engineering uses. The data apply to the soil considered representative of the series. A detailed profile typical of each series is described in the section "Descriptions of the Soils." Some soil features are favorable for certain kinds of engineering work but unfavorable for others. Among the soil features for which suitability ratings are given are the following:

Topsoil is the soil material used to cover or resurface an area where vegetation is to be established and maintained. Properties considered are those that affect the productivity and workability of the soil material and the amount of suitable material available.

Road fill or subgrade is the soil material on which a subbase is laid and the pavement is built. Suitability ratings are based on the performance of the soil material as subgrade when excavated and compacted or compacted and used in place.

Highway location refers to trafficways that consist of the underlying local soil material called the subgrade; the base material of gravel, crushed rock, soil, or cement-stabilized *interpretations of the soils—Continued*

Soil features affecting—Continued				Soil limitations for sewage disposal	
Irrigation	Terraces and diversions	Grassed waterways	Foundations for low buildings	Septic tank filter fields	Sewage lagoons
Slow permeability; high available water capacity.	Features favorable, except for slopes over 5 percent.	Features favorable.	High shrink-swell potential.	Severe: slow permeability; water table at a depth of 1 to 2 feet; depth to shale is 25 to 40 inches.	Severe: shale is at a depth of 25 to 40 inches.
Features favorable for sprinkler irrigation.	Fair slope stability.	Sandy surface layer is easily eroded.	Features favorable except in surface layer.	Slight	Moderate: moderate permeability; high seepage.
Limited rooting zone; low to moderate available water capacity.	Depth to bedrock is 5 to 20 inches.	Limited rooting zone; depth to bedrock is 5 to 20 inches.	Depth to bedrock is 5 to 20 inches.	Severe: depth to bedrock is 5 to 20 inches.	Severe: depth to bedrock is 5 to 20 inches; moderate permeability.
Very slow permeability; high available water capacity.	Very slow permeability.	Features favorable.	High shrink-swell potential.	Severe: very slow permeability; water table at a depth of 0 to 1 foot.	Slight.

2/ Interpretations not estimated because the material is too variable to classify.

soil called the subbase; and the actual road surface or pavement, either flexible or rigid.

Reservoir areas (farm ponds) are areas behind a dam or embankment where water is collected and stored for use. The floor of the reservoir area is normally undisturbed except where soil material is borrowed for embankment construction.

Embankments (farm ponds) are raised structures of soil material constructed across drainageways to impound water. These embankments are generally less than 20 feet high, are constructed of "homogeneous" soil material, and compacted to medium density.

Agricultural drainage is the removal of excess water from the soil. The factors considered are those features and qualities of the soil that affect the installation and performance of surface and subsurface drainage practices.

Irrigation is the artificial application of water to cropland by a sprinkler system or by overland flow.

Terraces and diversions are low ridges or channels constructed on the approximate contour to divert runoff water to a safe disposal area.

A *waterway* is a constructed or natural drainageway that has suitable cover of vegetation. It is established to convey excess water.

Foundations for low buildings are footings and shallow piers for houses and other low buildings of no more than three stories.

Septic tank filter fields are the subsurface tile systems that distribute effluent from a septic tank into the natural soil. The properties that affect absorption are permeability, depth to water table or rock, and flooding.

Sewage lagoons are shallow ponds constructed to hold sewage within a depth of 2 to 5 feet for the time required for the bacterial decomposition of solids. The lagoon consists of a nearly level floor and an embankment or dike that forms the sides of the pond.

Engineering test data

Table 8 gives test data for samples of four of the soil series of the county. Selected layers of the soils were sampled, and the samples were tested by the Oklahoma Department of Highways. The samples tested were taken from profiles considered modal for the series. They do not represent all of the soils of Coal County or even the maximum range of characteristics of each series sampled.

Shrinkage limit is the moisture content at which a soil ceases to decrease in volume, even though additional moisture is removed.

Shrinkage ratio is the volume change, expressed as the percentage of the volume of dry soil material, divided by the loss of moisture caused by drying. This ratio is expressed numerically.

Mechanical analysis shows the percentages, by weight, of soil particles that would pass through sieves of specified sizes. Silt and clay pass through the No. 200 sieve. Sand and other coarser material do not. Silt is that material larger than 0.002 millimeter in diameter that passes through the No. 200 sieve, and clay is that fraction passing through the No. 200 sieve that is smaller than 0.002 millimeter in diameter. The

TABLE 8.—*Engineering*

[Tests performed by the Oklahoma Department of Highways in accordance with standard

Soil name and location	Parent material	Oklahoma Report No.	Depth from surface	Shrinkage— Limit	Shrinkage— Ratio	Volume change from field moisture equivalent
		S.O.	Inches			Percent
Bates fine sandy loam, 1 to 3 percent slopes. 435 feet south and 2,535 feet east of the NW. corner of sec. 19, T. 2 N., R. 11 E. (modal profile)	Sandstone.	3593	0-13	---	---	---
		3594	22-28	14	1.85	22
		3595	28-32	14	1.83	22
Burleson clay, 0 to 1 percent slopes. 350 feet east and 60 feet north of the SW. corner of sec. 1, T. 1 S., R. 8 E. (modal profile)	Clayey sediment.	3613	6-20	9	2.06	67
		3614	20-48	8	2.09	91
		3615	48-60	8	2.10	78
Hartsells fine sandy loam, 3 to 5 percent slopes. 270 feet south and 60 feet east of the NW. corner of sec. 14. T. 2 N., R. 9 E. (modal profile)	Sandstone.	3608	0-7	---	---	---
		3609	17-30	14	1.90	11
		3610	30-36	14	1.90	18
Lightning silt loam from an area of Lightning-Carytown complex. 650 feet east and 2,440 feet south of the NW. corner sec. 4, T. 2 N., R. 10 E. (modal profile)	Loamy or clayey alluvium.	3616	0-6	21	1.68	6
		3617	6-25	9	2.02	57
		3618	45-70	10	2.04	47

1/ Mechanical analyses according to the AASHO Designation T88-57(1). Results by this procedure frequently may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method, and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes for soil.

2/ The Oklahoma Department of Highways classification procedure further subdivides the AASHO A-2-4 subgroup in

clay fraction was determined by the hydrometer method, rather than the pipette method that most soil scientists use in determining the clay in soil samples.

Liquid limit and *plasticity index* indicate the effect of water on the strength and consistence of soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from a solid to a plastic state. If the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material passes from solid to plastic. The liquid limit is the moisture content at which the material changes from plastic to liquid. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material remains plastic.

Formation and Classification of Soils

This section contains information about the five major factors of soil formation, some of the common processes that take place in the soils of Coal County, and the classification of the soils by higher categories.

Factors of Soil Formation

The properties of the soil at any given place result from the integrated effects of five major factors of soil formation —parent material, climate, plant and animal life, relief, and time. Few generalizations can be made regarding the effect of any one factor because the effect of each is modified by the other four.

Parent material.—Parent material is one of the most influential factors of soil formation in the county. It sets the limits of the chemical and mineralogical composition of the soil as well as influences the rate of soil development. Parent material is the unconsolidated material from which soil is formed.

Coal County has several kinds of parent material, all producing different soils.

Soils formed in shale, such as Homa soils, have a clayey subsoil. Those formed in sandstone, such as Bates, have a loamy subsoil. Soils formed from limestone, such as Talpa, have an adequate supply of bases. Examples of soils formed in clayey, loamy, or sandy sediment are Burleson, Robinsonville, and Stidham soils.

test data

procedures of the American Association of State Highway Officials (AASHO) (1)]

Mechanical analysis1/						Liquid limit	Plasticity index	Classification	
Percentage passing sieve—			Percentage smaller than—						
No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.005 mm.	0.002 mm.			AASHO2/	Unified3/
						Percent			
100	100	52	35	9	7	4/ NP	--	A-4(3)	ML
100	100	72	54	33	28	28	5	A-4(7)	ML
100	100	64	46	33	28	29	11	A-6(6)	CL
100	100	91	85	48	43	49	25	A-7-6(16)	CL
100	100	92	88	59	50	57	28	A-7-6(18)	CH-MH
100	100	92	83	57	49	59	33	A-7-6(20)	CH
100	99	32	20	5	2	NP	--	A-2-4(0)	SM
100	99	44	37	21	18	22	8	A-4(2)	SC
100	100	48	40	25	14	26	11	A-6(3)	SC
100	98	90	79	16	8	24	3	A-4(8)	ML
100	100	98	97	50	40	43	20	A-7-6(13)	Cl
100	100	99	97	55	38	39	19	A-6(12)	CL

the following: A-2-3(0) if PI=nonplastic; A-2(0) if PI=NP to 5; and A-2-4(0) if PI=5 to 10.

3/ Based on the Unified Soil Classification System, Technical Memorandum No. 3-357, volume 1, Waterways Experiment Station, Corps of Engineers, March 1953. Soil Conservation Service and Bureau of Public Roads have agreed to consider that all soils having plasticity indexes within 2 points from A-line are to be given a borderline classification. Examples are CL and CH-MH.

4/ NP=Nonplastic.

Climate.—The moist, subhumid continental climate of Coal County is characterized by rains of high intensity. Moisture and warm temperatures have been sufficient to promote the formation of distinct horizons in many of the soils. Differences in soils, however, cannot be attributed to climate, because the climate is uniform throughout the county. Heavy rains have caused rapid runoff that has eroded many of the soils. This erosion is an indirect effect of climate.

Plants and animals.—Plants, burrowing animals, insects and soil micro-organisms have a direct influence on the formation of soil. Native vegetation, such as trees, grasses, or a combination of both, has a bearing on the amount of organic matter, amounts and kinds of plant nutrients, and the type of soil structure and consistence. The Bates, Bonham, Choteau, and Steedman soils formed under native grasses. The fibrous roots of these native grasses promote a good granular structure that is high in organic-matter content. This type of vegetation reduces loss of soil nutrients by the recycling and by the feeding ability of the deep grass roots. Consequently, the soils that developed under grass in Coal County tend to have more bases and organic matter than the soils that formed under trees. The Homa and Hartsells soils developed under trees and are therefore lower in plant nutrients and organic matter than those that developed under grasses.

During the past century man has altered this soil-forming process by removing the native vegetation over much of the county. Lack of adequate conservation measures has resulted in much soil loss through sheet and gully erosion. Where most of the surface layer has been removed or many gullies have formed, eroded phases of soils are mapped. An example is Bates and Bonham soils, 2 to 5 percent slopes, severely eroded.

Relief.—Relief affects soil formation through its influence on moisture, drainage, erosion, temperature, and plant cover. The relief of Coal County is determined largely by the resistance of underlying parent material to weathering and geological erosion. In about 19 percent of the Coal County area, the soils are on flood plains, and in about 81 percent they are on uplands.

The effect of relief on soil formation is illustrated by the two different soils, Bates and Collinsville, both of which formed in material weathered from sandstone. The Bates soils generally are in areas of less sloping relief. They have less surface runoff, and more water percolates through these soils to influence the loss, gain, or transfer of soil constituents. The Collinsville soils typically are in areas of more sloping relief and have a less clearly defined profile than Bates soils. On the more sloping soils, more of the rainwater runs off instead of moving through the soil to help in the formation of a deeper solum.

Time.—Time is a factor of soil formation that cannot be measured strictly in years. The length of time needed for the development of genetic horizons depends on the intensity and interreactions of the soil-forming factors in promoting the losses, gains, transfers, or transformations of soil constitutents that are necessary for forming soil horizons. Soils that have no definite horizon are young or immature. Mature soils have approached equilibrium with their environment and tend to have a well-defined horizon.

The soils of Coal County range from young to old. Some of the mature soils are those of the Bonham, Parsons, and Carytown series on uplands. The Stidham and Konawa soils are younger soils but have clearly defined horizons. The Collinsville and Talpa soils are considered young soils. They have had sufficient time to develop clearly defined horizons, but because they are sloping, geological erosion has taken away soil material almost as fast as it has formed. Ennis and Robinsonville soils on flood plains have been developing for such a short time that they show little horizon development.

Active processes of soil formation

Active processes that have influenced the formation of horizons in the soils of Coal County are (1) accumulation of organic matter, (2) leaching of calcium carbonates and bases, and (3) translocation of silicate clay minerals. In most soils, more than one of these processes have been active in the development of horizons.

The additions of organic matter to the surface layer by native grasses have contributed to the granular structure. The granular surface layer is high in organic matter in soils such as Bonham and is called a mollic epipedon in the soil classification system (*6*). The Hartsells soils formed under native woods in material weathered from sandstone and contain less organic matter than Bonham soils. Their surface layer is called an ochric epipedon in the classification system.

Leaching of carbonates and bases is active in the formation of soils. The accumulation of calcium carbonates and bases in the lower part of the B horizon of the Crockett soils indicates the depth to which water has percolated. The Bonham and Choteau soils have been leached to the extent that they have no accumulation of calcium carbonates. Konawa, Dougherty, and Stidham soils have a distinct A2 horizon that has been leached of bases. The B horizon of these soils has had much leaching of bases, and this is reflected by their base saturation.

Soils on flood plains, such as Lanton, moderately wet, and Kaufman, are recharged with bases when flooding occurs. The more acid Robinsonville soils have not been leached, but their sediment comes from leached, acid soils. The moderately deep Steedman soils formed over weathered shale beds and are high in carbonates. Calcium carbonates in Steedman soils are related to the nature of the parent material and to the soil-forming processes.

The translocation of silicate clay minerals is a very important factor in establishing the properties and classification of soils. Argillic horizons are diagnostic for classification. Clay films on ped surfaces, bridging sand grains, and increases in total clay are used in the field as evidence of argillic horizons. The argillic horizon occurs in many soils, such as Bonham, Crockett, and Hartsells. The varying degree of translocation of silicate clay minerals and the parent material have resulted in wide variation in the texture and other properties of the argillic horizons of the soils. The Hartsells, Konawa, Dougherty, and Stidham soils have a subsurface layer that is more intensely leached of silicate clay minerals than the surface layer of other soils in the county.

The grasses on the soils bring bases to the surface, and this retards leaching and formation of an A2 horizon. Geological erosion on soils, such as Talpa and Collinsville, hinders horizon development through soil losses. The sediment of Robinsonville, Ennis, and other soils on flood plains was deposited so recently that there has not been enough time for the formation of horizons.

Classification of the Soils

Classification consists of an orderly grouping of soils according to a system designed to make it easier to remember soil characteristics and interrelationships. Classification is useful in organizing and applying the results of experience and research. Soils are placed in narrow classes for discussion in detailed soil surveys and for application of knowledge within farms and fields. The many thousands of narrow classes are then grouped into progressively fewer and broader classes in successively higher categories, so that information can be applied to large geographic areas.

Two systems of classifying soils have been used in the United States in recent years.The older system was adopted in 1938 (*2*) and revised later (*4*). The system currently used by the National Cooperative Soil Survey was developed in the early sixties (*3*) and was adopted in 1965 (*6*). It is under continual study.

The current system of classification has six categories. Beginning with the most inclusive, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. The criteria for classification are soil properties that are observable or measurable, but the properties are selected so that soils of similar genesis are grouped together. The placement of some soil series in the current system of classification, particularly in families, may change as more precise information becomes available.

Table 9 shows the classification of each soil series of Coal County by family, subgroup, and order, according to the current system.

Order.—Ten soil orders are recognized in the current system. These are the Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate the soil orders are those than tend to give broad climatic groupings of soils. Two exceptions, the Entisols and Histosols, are in many different climates. Six of the ten soil orders are represented in Coal County. These are the Entisols, Vertisols, Inceptisols, Mollisols, Alfisols, and Ultisols.

Entisol means recent and includes young soils without genetic horizons, or ones that have only the beginning of such horizons. Included in this group are loamy soils on flood plains, such as Robinsonville soil.

Vertisol is taken from *verto* or vertical mixing. This order is characterized by soils that have high montmorillonite clay content. The high swelling and shrinking nature of the clay in the soils belonging to this order render them as special

TABLE 9.—*Soil series classified according to the current system of classification*

Series	Family	Subgroup	Order
Bates	Fine-loamy, siliceous, thermic (mixed)	Typic Argiudolls	Mollisols.
Bonham	Fine, mixed, thermic	Aquic Argiudolls	Mollisols.
Burleson	Fine, montmorillonitic, thermic	Udic Pellusterts	Vertisols.
Carytown	Fine, mixed, thermic	Albic Natraqualfs	Alfisols.
Chaney1/	Fine, mixed, thermic	Aquic Paleustalfs	Alfisols.
Choteau	Fine, mixed, thermic	Aquic Paleudolls	Mollisols.
Collinsville	Loamy, siliceous, thermic (mixed)	Lithic Hapludolls	Mollisols.
Crockett	Fine, montmorillonitic, thermic	Udertic Paleustalfs	Alfisols.
Dougherty	Loamy, mixed, thermic	Arenic Haplustalfs	Alfisols.
Ennis	Fine-loamy, siliceous, thermic	Fluventic Dystrochrepts	Inceptisols.
Ferris acid surface variant2/	Fine, montmorillonitic, thermic	Udorthentic Chromusterts	Vertisols.
Hartsells	Fine-loamy, siliceous, thermic	Typic Hapludults	Ultisols.
Homa	Very-fine, mixed, thermic	Albaquic Hapludalfs	Alfisols.
Kaufman	Fine, montmorillonitic, noncalcareous, thermic.	Vertic Haplaquolls	Mollisols.
Konawa	Fine-loamy, mixed, thermic	Ultic Haplustalfs	Alfisols.
Lanton3/	Fine-silty, mixed, noncalcareous, thermic	Cumulic Haplaquolls	Mollisols.
Lightning	Fine, mixed, thermic	Typic Ochraqualfs	Alfisols.
Parsons	Fine, mixed, thermic	Mollic Albaqualfs	Alfisols.
Robinsonville4/	Coarse-loamy, mixed, nonacid, thermic	Typic Udifluvents	Entisols.
Steedman	Fine, montmorillonitic, thermic	Vertic Haplustalfs	Alfisols.
Stidham	Loamy, mixed, thermic	Arenic Haplustalfs	Alfisols.
Talpa	Loamy, mixed, thermic	Lithic Haplustolls	Mollisols.
Wilson	Fine, montmorillonitic, thermic	Vertic Ochraqualfs	Alfisols.

1/ Soils correlated as Chaney are taxadjuncts to that series. These soils have a few spots of soft lime at depths below 40 inches and are moderately alkaline in reaction. Solums are slightly thicker. They are enough like the Chaney series in morphology, composition, and behavior so that a new series is not warranted.

2/ The Ferris acid surface variant in Coal county is noncalcareous to a depth of 40 inches. The acreage is not sufficient to warrant a new series.

3/ Mapping unit Lc is a taxadjunct to the Lanton series. It generally has carbonate concretions at depths between 30 and 60 inches, is near stream channels, and has better surface drainage than Lanton soils. It is enough like the Lanton series in morphology, composition, and behavior so that a new series is not warranted.

4/ These soils are taxadjuncts to the Robinsonville series. They differ by being more acid at depths between 10 and 40 inches and having a buried B horizon at a depth of less than 40 inches. They are enough like the Robinsonville series in morphology, composition, and behavior that a new series is not warranted.

concerns in management. The Burleson soils are representative of Vertisols in the county.

Inceptisol is coined from the Latin word *inceptum* meaning the beginning. Inceptisols include young soils that have some diagnostic horizons but reflect weak eluviation or illuviation. Ennis soils that have weakly expressed horizons represent Inceptisols of the area.

Mollisol means soft and is derived from the Latin word *mollis*. Mollisols have a dark surface layer and a high percentage of bases. Bates soils are typical mollisols of the county.

Alfisol is taken from the word Pedalfer, a general term that has been applied to aluminum-iron soils of the eastern United States. Alfisol soils lack the dark surface layer of the Mollisols and have a medium amount of bases. Alfisols soils such as Parsons and Konawa are characterized by a leached A2 horizon and argillic horizons.

Ultisol is taken from the word "ultimate." Ultisols are soils that are strongly weathered. They lack a dark surface layer and have a well-expressed soil horizon. They are low in bases. The Hartsells is the only Ultisol in the county.

Suborder.—Each order is divided into suborders based on characteristics that seem to produce classes that have the greatest genetic homogeneity, such as drainage, climate and vegetation, or physical and chemical properties that reflect these. The prefix *Ud*, meaning humid climate, forms the suborder Udolls, but soils formed in dryer moisture regimes are identified by the *Ust* from the word "combustion" that is used in the order Ustolls.

Great Group.—The Great Group is based on the presence, absence, or arrangement of diagnostic horizons. Diagnostic subsurface horizons, commonly used at the Great Group level, are argillic and cambic. The argillic horizon is an illuvial horizon in which silicate clay has accumulated to a significant extent. Bonham, Bates, Steedman, and Konawa are soils that have argillic horizons. The cambic horizon, in contrast to the argillic, has little or no accumulation of silicate clay and is usually identified in the field by colors that have higher chroma than those of the surface layer. Alb is a prefix that is modified from Albus and used for soils that have an albic or highly leached horizon. This prefix is used at the Great Group level to signify diagnostic characteristics of Parsons soils.

Subgroup.—The Subgroup is a category of soils that reflects the central concept of the Great Group (typic) and categories of soils that represent intergrades to other Great Groups. For example, *cumulic* is an adjective used to denote a thick surface layer and *lithic* is connotative of shallow soils.

Family.—The family is a grouping of soils into a category on the basis of properties important to plant growth or to behavior of soils when used for engineering. Some properties used as family differentia include texture, mineralogy, reaction, soil temperature, and permeability.

Series.—The series is the lowest level of classification. It is a grouping of individual soils that are uniform in differentiating characteristics and in arrangement of horizons. The soil series name is the name most frequently used in describing soils. The series is frequently given the name of a geographic location near the place where it was first observed and mapped. An example is the Steedman series. Each series represents a particular kind of soil.

The terminology used in the classification system tells much about the physical, chemical, and mineralogical properties of each soil. The classification of the Bonham series at each category reflects specific soil characteristics common to the Bonham series. The order Mollisols reflects a dark surface layer that is high in organic-matter content. The suborder Udolls is derived from *Ud* meaning humid climate, and *oll* is from Mollisol. Thus, Udolls have all the properties defined for Mollisol and are located mostly in humid climates. The Great Group classification of the Bonham series is Argiudolls. The *argi* signifies an argillic horizon and the Udolls include all properties defined for the suborder Udolls. The Subgroup of Bonham classification is Aquic Argiudolls. *Aquic* means that Bonham soils have some characteristics associated with wetness, and are typical Argiudolls. The fine, mixed thermic family typifies the clayey Bonham profile that has mixed clay mineralogy, and thermic designates the warm temperate climate of Bonham areas that is important to the choice of crops to be grown.

General Nature of the County

Additional information about the survey area is given in this section. This information will be most useful to persons not familiar with Coal County. Briefly discussed are early history, industry and transportation, mineral resources, climate, physiography, drainage, relief, and farming.

Coal County was formerly a part of the Choctaw Nation of Indian Territory and the area was called Tobucksy, the Chocktaw Indian word for coal. When Oklahoma became a State the translated name was retained because of the vast deposits of coal that underlie the area. The town of Lehigh was originally designated the county seat, but soon after statehood the seat was transferred to Coalgate. Most of the people who lived in the county were coal miners, and when the mines were closed the population began to decrease rapidly. The population dwindled from about 12,800 in 1940 to 5,546 in 1960. Other towns and communities are Tupelo, Centrahoma, Lehigh, Cottonwood, Olney, Bromide, Clarita, and Phillips.

Industry in Coal County is limited but is greatly needed to improve the economy. There is a clothing factory in Coalgate, a charcoal processing plant in Phillips, and a limestone quarry near Bromide.

Coal County has a well-distributed system of highways that includes U.S. Highway No. 75 and several State highways. An important railroad artery crosses the western part of the county. Coal County has a fairly good network of all-weather roads that are maintained by the county.

The main mineral resource of the county is bituminous coal. The coal fields are now inactive, having reached their peak prior to 1945. A large supply of coal remains, however, in the event the market for coal is reactivated.

In recent years oil and natural gas wells have been drilled in four small fields. High-grade limestone is abundant in the southwestern corner of the county. It is quarried and crushed for gravel and for agricultural lime. Water is sufficient in most of the county, and there are about 40 small watershed lakes. Small quantities of shale, sand, and gravel are taken from shallow pits and used in road construction.

Climate[7]

The location of Coal County within the Sandstone Hills region of southeastern Oklahoma provides a temperate, continental climate. Gradual changes between the definite seasons are occasionally marked by quick changes in the weather. The most changeable conditions occur in spring and provide the greatest number of severe local storms and heaviest rains. Summers are long and hot, but the heat is made more bearable by occasional rain and moderate wind. The cooler weather in fall is accompanied by heavy rain in September followed by an increasing number of sunny days. Winters are generally short and mild and have only brief periods of low temperature and snow cover. Table 10 summarizes the records of temperature and precipitation at Coalgate.

Records for Coalgate show that January is the coldest month, having an average temperature below freezing 1 year out of 30. The coldest day each winter averages 6° F., while the coldest low of -5° F. occurred on January 8, 1940. The mildest winters were in 1931 and 1941, when the temperature failed to drop below 20° F. Summer temperatures rise to 90° or higher 97 days per year, but only 20 days per year average 100° or higher. The average hottest day each year is 105°, and only in one year out of 30 does the temperature fail to reach 100°. Table 11 gives probabilities, by specified dates, for last freezing temperature in spring and first freezing temperature in fall.

The gently rolling terrain of Coal County provides localized cold air drainage areas and frost pockets where first freezes in fall sometimes occur a few days earlier than usual, and last freezes in spring are a few days later than usual. First fall freezes have varied from October 7, in 1948, to November 21, 1944. The last spring freezes have varied from February 23, 1946, to April 20, 1953.

Variable annual precipitation has ranged from 23.93 inches in 1963 to 63.22 inches in 1957. Coalgate records show that 17 percent of the moisture is received in winter, 33 percent in spring, 27 percent in summer, and 23 percent in fall. Greatest monthly totals have ranged from 5.39 inches in November 1957 to 15.75 inches in April 1967. Daily totals of 0.5 inch or more occur on an average of 27 days per year and totals of 1.0 inch or more on 14 days per year. Days with 3 to 5 inches of rain occur in 2 years out of 3, and 5 such days occurred in 1967. The greatest daily rain, 9.54 inches, was on July 20, 1953.

Measurable snowfall occurs in four out of five years and accounts for only 3 percent of the winter moisture. Seasonal snowfall averages from 2.5 inches in the southern part of the county to 4.5 inches in the northern part. The greatest monthly total was 9 inches, which fell on January 8, 1944. This also stands as the greatest daily snowfall and as a record depth. Ground cover of snow normally melts within a day or so.

Percent of possible sunshine received ranges from 57 percent in January to 78 percent in August. An average year has 140 clear days, 93 partly cloudy days, and 132 cloudy days. Annual lake evaporation averages 54.5 inches, and 70

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[7]By STANLEY G. HOLBROOK, climatologist for Oklahoma, National Weather Service, U.S. Department of Commerce.

TABLE 10.—*Temperature and precipitation data*

[All Data from Coalgate; period of record, 1938-67]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	Average maximum	Average minimum	Average total	One year in 10 will have— Less than—	One year in 10 will have— More than—	Days that have snow cover of 1 inch or more	Average depth of snow on days that have snow cover
	°F.	°F.	°F.	°F.	Inches	Inches	Inches	Number	Inches
January	53	29	73	9	1.6	0.3	2.9	2	2
February	58	34	77	16	3.0	.4	6.5	1	2
March	66	41	83	23	3.1	.2	6.0	(1/)	2
April	76	52	88	33	5.2	2.1	11.6	0	---
May	83	60	91	45	5.2	2.4	8.5	0	---
June	90	68	98	56	4.4	1.2	9.0	0	---
July	96	71	103	62	3.6	.9	7.6	0	---
August	96	70	104	59	2.7	.3	5.4	0	---
September	90	62	100	47	4.1	.6	10.1	0	---
October	80	52	92	32	3.1	.2	6.5	0	---
November	65	39	81	21	2.3	.1	5.2	0	---
December	56	32	74	15	2.3	.7	4.3	(1/)	1
Year	76	51	2/105	3/ 6	40.6	29.8	55.0	3	2

1/ Less than one-half day.

2/ Average annual maximum temperature.

3/ Average annual minimum temperature.

percent of this total occurs during the period of May to October.

Thunderstorms average 52 per year, and an occasional storm produces localized surface winds of 60 to 80 mph. Severe hailstorms occur one year out of five. About half of these storms cause damage exceeding $50,000. Only 12 tornadoes have been documented in Coal County. They occurred in 10 different years of the 94 that were recorded. Two tornadoes caused three deaths and 79 injuries, and three other tornadoes injured an additional 15 persons. Property damage has averaged about $50,000 per tornado.

Physiography, Drainage, and Relief

Coal County contains 336,640 acres and is 55 percent woodland and 45 percent prairie. The trees in wooded uplands are mostly oak, hickory, redcedar, and a scattering of shortleaf pine and elm. In wooded bottom lands they are mostly oak, elm, ash, cottonwood, sycamore, hackberry, pecan, and bois d'arc. The prairie areas originally had a cover of big bluestem, little bluestem, indiangrass, switchgrass, and a scattering of forbs.

The major streams of the county enter from the northwest and generally flow southeastward to the Red River. Most flood plains in the county are along the major streams. They consist of nearly level to gently sloping soils and are well drained to poorly drained. The flood plains range about 600 feet in width along the smaller creeks to 2 miles in width along the larger ones. Elevation at Coalgate, the county seat, is 623 feet.

The extreme southwestern corner of the county is sloping to steep limestone escarpment that extends northward about 5 miles. The area is dissected by drainageways and is sloping to steep. It ranges from 1 to 3 miles in width. The rest of the county is characterized by sandstone hills and ridges that have mostly narrow summits and deep, narrow drainageways. Shale valleys are between the hills or ridges. Soils in the valley are mostly nearly level to gently sloping. They too are dissected by many narrow drainageways. The valley areas support tall grasses, and the ridges support trees and a scattered understory of grasses.

TABLE 11.—*Probabilities of last freezing temperatures in spring and first in fall*

[All Data from Coalgate; period of record, 1921-50]

Probability	Dates for given probability and temperature				
	16° F.	20° F.	24° F.	28° F.	32° F.
Spring:					
1 year in 10, later than	February 27	March 11	March 24	April 5	April 17
2 years in 10, later than	February 19	March 3	March 15	March 28	April 11
5 years in 10, later than	February 2	February 16	February 27	March 13	March 31
Fall:					
1 year in 10, earlier than	November 26	November 11	October 29	October 26	October 18
2 years in 10, earlier than	December 4	November 21	November 5	October 31	October 23
5 years in 10, earlier than	December 20	December 10	November 18	November 10	November 1

Two broad, smooth valley areas are in the county. One is in the southeastern part, south of Coalgate to the county line. The other is in the southwestern part, south of Clarita to the county line.

Small acreages of very gently sloping to sloping, old alluvial terrace remnants in the form of mantles are present on ridge crests in the extreme northeastern corner of the county.

Farming

Farming in Coal County began with a few early settlers in the latter part of the nineteenth century. Small farms made up most of the county until about 1940. During that period cotton was the major cash crop, and only enough other crops were grown to provide feed for hogs, dairy cows, and work stock.

The trend toward larger farms began after 1940. The average size of a farm in 1940, according to the U.S. Agricultural Census, was 169.5 acres. In 1945 it was 218.9 acres, and in 1959 it was 450.3 acres. The 1964 U.S. Agricultural Census indicated that the average farm in the county was 465.4 acres in size.

The lay of the land and the kinds of soil did not favor large-scale cropping systems. As a result, the raising of livestock and the producing of livestock products expanded. The census reports indicate that crop acreages harvested in the period of 1940 to 1964 decreased by almost 70 percent, and the sale of livestock and livestock products increased nearly five times during this period. In 1940 about 1,558 farms were in the county. In 1964 only 650 farms remained.

The trend is toward an increase in tame-pasture acreage and better range management that will increase cattle production. Most of the crops grown in the county are used as feed for livestock.

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Glossary

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.

Base saturation. The degree to which material that has base-exchange properties is saturated with exchangeable cations other than hydrogen, expressed as a percentage of the cation-exchange capacity.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Channery soil. A soil that contains thin, flat fragments of sandstone, limestone, or schist, as much as 6 inches in length along the longer axis. A single piece is called a fragment.

Chiseling. Tillage of soil with an implement that has one or more soil-penetrating points that loosen the subsoil and brings *clods* to the surface. A form of emergency tillage to control soil blowing.

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.

Climax vegetation. The stabilized plant community on a particular site; it reproduces itself and does not change so long as the environment does not change.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Contour farming. Plowing, cultivating, planting, and harvesting in rows that are at right angles to the natural direction of the slope or that are parallel to terrace grades.

Depth, soil. In this survey the following descriptions of depth are used for corresponding numerical range.

Deep	40 inches or more
Moderately deep	20 to 40 inches
Shallow	10 to 20 inches
Very shallow	10 inches or less

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.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

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

Erosion pavement. A layer of gravel or stones on the ground surface that remains after the fine particles are removed by wind or water. Desert pavements result from exposure to dry winds.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

Gleization. The reduction, translocation, and segregation of soil compounds, notably of iron, usually in the lower horizons, as a result of waterlogging with poor aeration and drainage; expressed in the soil by mottled colors dominated by gray. The soil-forming processes leading to the development of a gley soil.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rains. The distinction between gully and rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by normal tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage. V-shaped gullies result if the material is more difficult to erode with depth; whereas U-shaped gullies result if the lower material is more easily eroded than that above it.

Gypsum. Calcium suphate.

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 sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

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

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.

Permeability. The quality of a soil horizon that enables water or air to move through it. 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 series, 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 relatively weak acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value, acidity.

Poorly graded. A soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles in poorly graded soil material, density can be increased only slightly by compaction.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		pH
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Sand. Individual rock or mineral fragments in soils having diameters ranging 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.

Savannah. Dry grassland that contains isolated or scattered trees or shrubs.

Series, soil. A group of soils developed from a particular type of parent material and having genetic horizons that, except for texture of the surface layer, are similar in differentiating characteristics and in arrangement in the profile.

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.

Slick spots. Small areas in a field that are slick when wet because they contain excess exchangeable sodium, or alkali.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles, less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *Very coarse sand* (2.0 to 1.0 millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter). The separates recognized by the International Society of Soil Science are as follows: I (2.0 to 0.2 millimeter); II (0.2 to 0.02 millimeter); III (0.02 to 0.002 millimeter); IV (less than 0.002 millimeter).

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

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 (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together with any regular cleavage, as in many claypans and hardpans.

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

Substratum. Technically the part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surplus runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Type, soil. A subdivision of the soil series that is made on the basis of differences in the texture of the surface layer.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

Well-graded soil. A soil or soil material consisting of particles that are well distributed over a wide range in size or diameter. Such a soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

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