SOIL SURVEY

Pratt County, Kansas

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
KANSAS AGRICULTURAL EXPERIMENT STATION

Issued September 1968

Major fieldwork for this soil survey was done in the period 1958–62. Soil names and descriptions were approved in 1965. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1962. This survey was made cooperatively by the Soil Conservation Service and the Kansas Agricultural Experiment Station. It is a part of the technical assistance furnished to the Pratt County Soil and Water Conservation District.

HOW TO USE THIS SOIL SURVEY

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

Locating Soils

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

On each sheet of the detailed map, soil areas are outlined and are identified by symbol. 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 in the survey. This guide lists all of the soils of the county in alphabetic order by map symbol. It shows the page where each kind of soil is described, and also the page for the capability unit, windbreak group, range site, or any other group in which the soil has been placed.

Interpretations not included in the text can be developed by grouping the soils according to their suitability or limitations for a particular use. 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 in the soil descriptions and in the discussions of the capability units.

Foresters and others can refer to the section "Management of Windbreaks," where the soils of the county are grouped according to their suitability for trees.

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

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

Engineers and builders will find, under "Engineering Uses of the Soils," tables that give engineering descriptions of the soils in the county and that name soil features that affect engineering practices and structures.

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

Newcomers in Pratt 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 section "General Facts About the County."

Cover picture: Stripcropping of wheat and grain sorghum on a Pratt loamy fine sand.

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SOIL SURVEY OF PRATT COUNTY, KANSAS

BY MARCELLUS L. HORSCH, BRUCE R. HOFFMAN, AND DONALD A. GIER, SOIL CONSERVATION SERVICE

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

PRATT COUNTY, in the south-central part of Kansas (fig. 1), occupies 466,560 acres. The county had a population of 12,122 in 1960, according to records of the U.S. Bureau of the Census. In that year Pratt, the county seat, had a population of 8,156. In 1964 about 349,726 acres was used for field crops, mainly wheat and sorghum, and about 90,480 acres was in grass. The rest was in woodland, roads, towns, and lakes.

Farming is the main enterprise in this county. About 60 percent of the income is derived from that source, and about 40 percent is derived from the production of oil and gas, manufacturing, and the tourist trade. Beef cattle, wheat, and grain sorghum are the main sources of income on the farms. The kinds of crops that can be grown are limited by the small amount of rainfall.

Most of the soils in the county are slightly or moderately eroded and are subject to further erosion. Water has caused erosion in a large acreage, and wind has caused erosion in most of the remaining acreage, especially where the soils have a sandy surface layer.

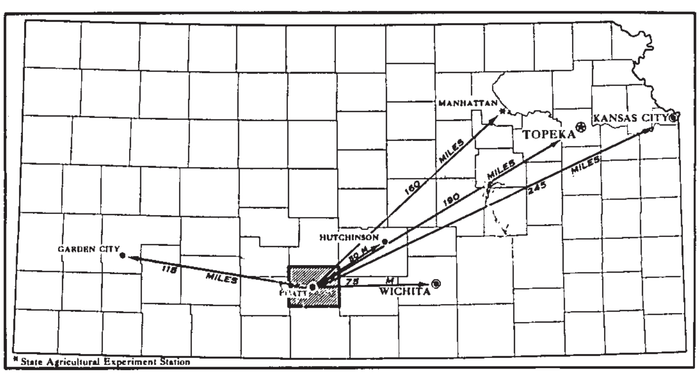

Figure 1.—**Location of Pratt County in Kansas.**

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soils are in Pratt County, where they are located, and how they can be used. They went into the county knowing they likely would find many soils they had already seen, and perhaps some they had not. As they traveled over the county, they observed steepness, length, and shape of slopes; size and speed of streams; kinds of native plants or crops; 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 roots of plants.

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. To use this survey efficiently, it is necessary to know the kinds of groupings most used in a local soil classification.

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. Pratt and Bethany, 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 go with their behavior in the natural, untouched landscape. Soils of one series can differ somewhat in texture of their surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man.

Many soil series contain soils that differ in texture of their surface layer. According to such differences in texture, separations called soil types are made. Within a series, all the soils having a surface layer of the same texture belong to one soil type. Naron fine sandy loam and Naron loam are two soil types in the Naron series. The difference in texture of their surface layers is apparent from their names.

Some types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use, that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into phases. The name of a soil phase indicates a feature that affects management. For example, Farnum loam, 1 to 3 percent slopes, is one of several phases of Farnum loam, a soil type that ranges from nearly level to moderately sloping.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew soil boundaries on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that greatly 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 management of farms and fields, a mapping unit is nearly equivalent to a soil type or a phase of a soil type. 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 type or soil phase.

In preparing some detailed maps, the soil scientists have a problem of delineating areas where different kinds of soils are so intricately mixed and so small in size that it is not practical to show them separately on the map. Therefore, they show this mixture of soils as one mapping unit and call it a soil complex. Ordinarily, a soil complex is named for the major kinds of soil in it, for example, Pratt-Carwile complex. Also, in some places two or more soils are mapped in a single unit if the differences between the soils are too small to justify separation, though these soils occur separately. This unit is called an undifferentiated soil group or undifferentiated unit. An example of such a unit is Albion and Shellabarger soils, 7 to 15 percent slopes. Furthermore, most surveys include areas where the soil material is so rocky, so shallow, or so frequently worked by wind and water that it cannot be classified by soil series. These areas are shown on the map like other mapping units, but they are given descriptive names, such as Broken alluvial land and Wet alluvial land, are called land types.

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 soils 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 soils. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in a way that it is readily useful to different groups of readers, among them farmers, ranchers, managers of woodland, engineers, and homeowners. Grouping soils that are similar in suitability for each specified use is the method of organization commonly used in soil surveys. On the basis of yield and practice tables and other data, the soil scientists set up trial groups, and then test them by further study and by consultation with farmers, agronomists, engineers, and others. Then, the scientists 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 Pratt County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of farming or other land use. Such a map is not suitable for planning the management of a farm or field, because the soils in any one association ordinarily differ in slope, depth, drainage, or other characteristics that affect management. The nine soil associations in Pratt County are described in the following paragraphs.

1. Tivoli-Pratt Association

Duny and hummocky, loose fine sands and loamy fine sands that have a sandy subsoil

This soil association consists of deep, sandy, duny and hummocky soils in the northwestern part of the county south of Hopewell. The association occupies about 8 percent of the county. Tivoli soils are dominant, but Pratt soils are also extensive. In addition, the association contains minor areas of Carwile soils.

Tivoli soils have developed in loose sand that has been blown by wind so that it forms steep-sided dunes (fig. 2). In many areas of these soils, blowouts have occurred between the dunes or near the crests of the dunes. The surface layer of the Tivoli soils is loose fine sand slightly darkened by organic matter. Beneath the surface layer is light-colored fine sand. Tivoli soils are low in content of organic matter and are highly susceptible to wind erosion if they are not protected. They occupy about 55 percent of this association.

Pratt soils are intermingled with Tivoli soils in hummocky areas that surround the Tivoli soils on the sand dunes. Like the Tivoli soils, Pratt soils have formed in windblown sand. They have a somewhat thicker surface layer and a more clayey, more coherent subsoil than the Tivoli soils. Their content of organic matter is low. Pratt soils make up about 40 percent of this association.

Nearly level Carwile soils occupy small areas between the sand dunes and the hummocks. They have formed in old, clayey alluvium and in windblown sand. Carwile soils make up about 5 percent of this association.

The soils of this association absorb nearly all of the moisture from rainfall, but they are subject to wind erosion if they are not protected by a cover of plants. Because the content of organic matter is low and susceptibility to wind erosion is high, these soils can be safely cultivated in only a small part of the acreage. If grazing is well managed, however, and if other management is good, tall grasses grow well.

About 40 percent of this association is in native grasses and is used for pasture. The areas in native grasses consist mainly of Tivoli soils and of rougher areas of Pratt soils. The rest of the acreage of Pratt soils and small acreages of Carwile soils are in wheat and sorghum or have been seeded to rye or sudangrass and used as pasture.

2. Pratt-Carwile Association

Undulating loamy fine sands that have a sandy subsoil, and nearly level or gently sloping fine sandy loams that have a clayey subsoil

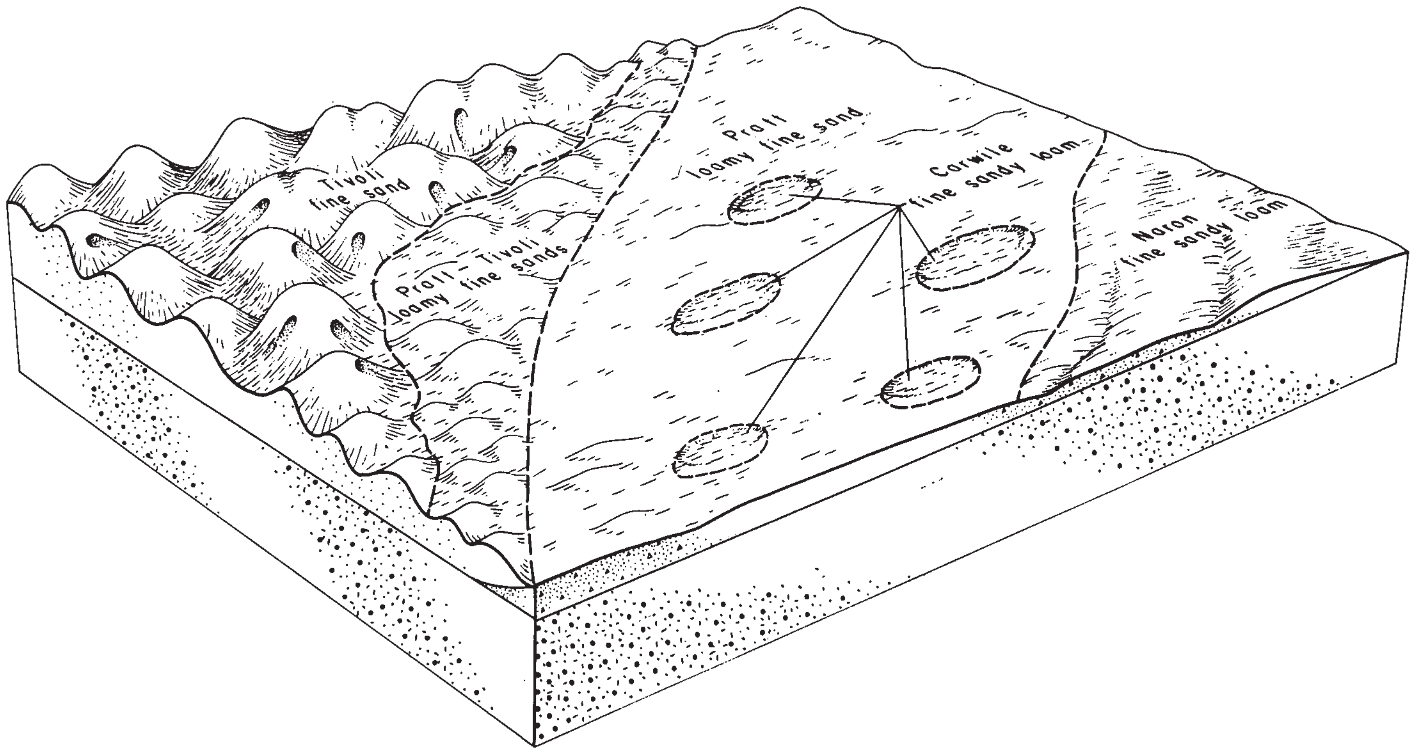

Figure 2.—**Major soils of associations 1 and 2 and the positions they normally occupy on the landscape.**

This association is marked by many small depressions. Except for a small area north of Preston, it consists of a strip, 2 to 10 miles wide, along the northern edge of the county. Some of the areas are undulating or gently undulating, but the low areas are nearly level. The association makes up about 19 percent of the county. Well-drained Pratt and somewhat poorly drained Carwile soils are dominant (see fig. 2).

Pratt soils, in the higher places throughout the undulating areas, make up about 75 percent of the acreage. They have formed in windblown sand and have a surface layer and a subsoil of loamy fine sand. The Pratt soils absorb nearly all of the moisture from rainfall. They are low in content of organic matter and plant nutrients and are subject to severe wind erosion if they are not protected.

Nearly level Carwile soils, which in some places occur in slight depressions, make up about 20 percent of the acreage. They have a surface layer of fine sandy loam and a subsoil of mottled sandy clay loam to clay. Water frequently stands on the surface of the Carwile soils during wet periods.

Gently undulating Naron soils and undulating or hummocky, closely intermingled Pratt and Tivoli soils occupy about 5 percent of this association. The Pratt and Tivoli soils occur in isolated areas on hills or hummocks that are somewhat higher and steeper than the rest of the landscape.

Most of this association is used to grow wheat and grain sorghum, but a small part is in pasture of native grasses. Wind erosion is a serious hazard when the soils are not protected by crop residue or by a cover of plants. Most of the soils are deficient in nitrogen.

3. Pratt-Naron-Clark Association

Gently sloping and undulating loamy fine sands and fine sandy loams, and nearly level to strongly sloping, calcareous clay loams

This association consists of areas of gently sloping to undulating soils dissected by a few narrow drainageways. One area is in the southeastern corner of the county, and the other lies south of Preston in the northeastern part. The association occupies about 8 percent of the county. It consists of about equal proportions of well-drained Pratt, Naron, and Clark soils and of minor acreages of other soils.

Pratt soils, which have formed in sandy windblown deposits, are on hummocks throughout the association. They have a surface layer and a subsoil of loamy fine sand. The Pratt soils absorb moisture readily and therefore lose little water through runoff. They are susceptible to wind erosion, however, and are low in content of organic matter.

Naron soils have smooth, gentle slopes or are undulating. They have formed in moderately sandy material deposited by wind. Their surface layer is fine sandy loam or loam, and their subsoil is sandy clay loam. Naron soils are deep, well drained, and moderately permeable, and they are also moderately fertile.

Clark soils generally occur near drainageways, at a lower elevation than Pratt and Naron soils. They are highly calcareous and have formed in highly calcareous outwash. The Clark soils are less sandy than the Pratt and Naron. They have a surface layer of fine sandy loam to clay loam, and a subsoil of clay loam.

Nearly all of the acreage in this association is in wheat and sorghum, but a small acreage is in grass. The soils are low in content of organic matter and plant nutrients. Wind erosion is the most serious hazard, but water erosion is also a hazard in the areas of sloping, less sandy soils.

4. Naron-Farnum Association

Nearly level to moderately sloping fine sandy loams and loams that have a subsoil of sandy clay loam or clay loam

Nearly level to moderately sloping areas dissected by intermittent streams make up this association. The largest area consists of a strip, 2 to 6 miles wide, that runs from the county line north of Preston diagonally southwestward to the county line on the western side. Another area consists of a strip, about 3 miles wide, in the southeastern part of the county. The association occupies about 16 percent of the county.

Naron soils occupy about 50 percent of this association. They have formed in windblown material at a higher elevation than the other soils. The Naron soils are deep and well drained. They have a surface layer of fine sandy loam to loam, and a subsoil of sandy clay loam.

Farnum soils occupy about 40 percent of the association. They have formed in windblown material and in moderately fine textured outwash. The Farnum soils are nearly level or gently sloping in most places, but they are moderately sloping in areas around intermittent streams. Like the Naron soils, they are deep and well drained. The surface layer of the Farnum soils is loam, and their subsoil is clay loam.

Nearly level Carwile and Clark soils, and undulating to hummocky Pratt soils, occupy most of the rest of the association, but small acreages are occupied by other soils. The Pratt soils are on some of the higher hummocks.

Nearly all of this association is in wheat and sorghum, but a few small areas of moderately sloping soils along intermittent streams are used as pasture. The soils are well drained, and, in general, they are moderately fertile and easily tilled. Water erosion and wind erosion are the most serious hazards, but lack of water can also cause damage to crops.

5. Clark-Ost Association

Nearly level to moderately sloping clay loams that have a subsoil of clay loam

This soil association is on uplands in the eastern part of the county. One area lies between Natrona and Preston in the northeastern part, and the other is south of Cairo in the southeastern part. The association occupies about 3 percent of the county. About 55 percent of the acreage is Clark soils that are not intermingled with Case soils to any extent, about 20 percent is Ost soils, about 15 percent is intermingled soils of the Case and Clark series, and about 10 percent is minor soils.

Clark soils are mainly gently sloping or moderately sloping but are slightly hummocky in places. They have formed in highly calcareous outwash sediment and are deep, dark colored, and highly calcareous. In many places erosion has removed much of the original dark-colored surface layer. In those areas tillage has mixed part of the limy subsoil with the soil material in the remaining surface layer, and as a result, the present surface layer has a light-gray cast. The present surface layer has a texture of fine sandy loam to clay loam, and the subsoil is clay loam.

Ost soils are deep and dark colored. They have a surface layer of clay loam, and a subsoil and substratum of calcareous clay loam. The Ost soils have formed in calcareous outwash.

Case soils are similar to the Clark but are light colored throughout. They have a highly calcareous surface layer and subsoil.

About 85 percent of this association is used to grow wheat and sorghum. Some of the more sloping areas of Clark soils are in native grasses, and some areas of the Case and Clark soils that are intermingled have been reseeded to grass. Water erosion is a serious hazard throughout most of the association.

6. Farnum-Ost-Clark Association

Nearly level to moderately sloping loams, and nearly level to strongly sloping, calcareous clay loams that have a subsoil of clay loam

This soil association occupies a strip, 3 to 4 miles wide and about 10 miles long, west and southwest of the town of Pratt. It makes up about 4 percent of the county.

Farnum soils make up about 40 percent of the acreage. They are deep and well drained and have a loam surface layer and a clay loam or sandy clay loam subsoil. The Farnum soils have formed in windblown sand and in moderately fine textured outwash. They are mainly nearly level or gently sloping but have stronger slopes in areas along drainageways.

Ost soils, downslope from the Farnum soils, occupy about 30 percent of this association. They have smooth, gentle slopes, and like the Farnum soils, they are deep and well drained. The Ost soils have a surface layer of dark-colored clay loam; a subsoil, also of clay loam; and a substratum that contains a large amount of lime. The Ost soils have formed in calcareous outwash.

Clark soils, downslope from the Ost soils, occupy about 20 percent of the association. They are gently sloping or moderately sloping and are deep, dark colored, and highly calcareous. The surface layer of the Clark soils is fine sandy loam to clay loam, and their subsoil is clay loam. In some of the more sloping areas, these soils are moderately eroded and have a surface layer that has a light-gray cast.

Moderately sloping Shellabarger and Albion soils make up most of the rest of this association. They are mainly around drainageways.

Most of this association is used to grow wheat and sorghum, but some of the moderately sloping areas have been reseeded to native grasses. Water erosion is a serious hazard in the sloping areas, and lack of moisture can damage crops in all the areas.

7. Bethany-Ost Association

Nearly level or gently sloping silt loams to clay loams that have a subsoil of clay loam to silty clay

This association consists of a broad area of nearly level or gently sloping soils on uplands that are dissected in places by intermittent streams (fig. 3). It makes up about

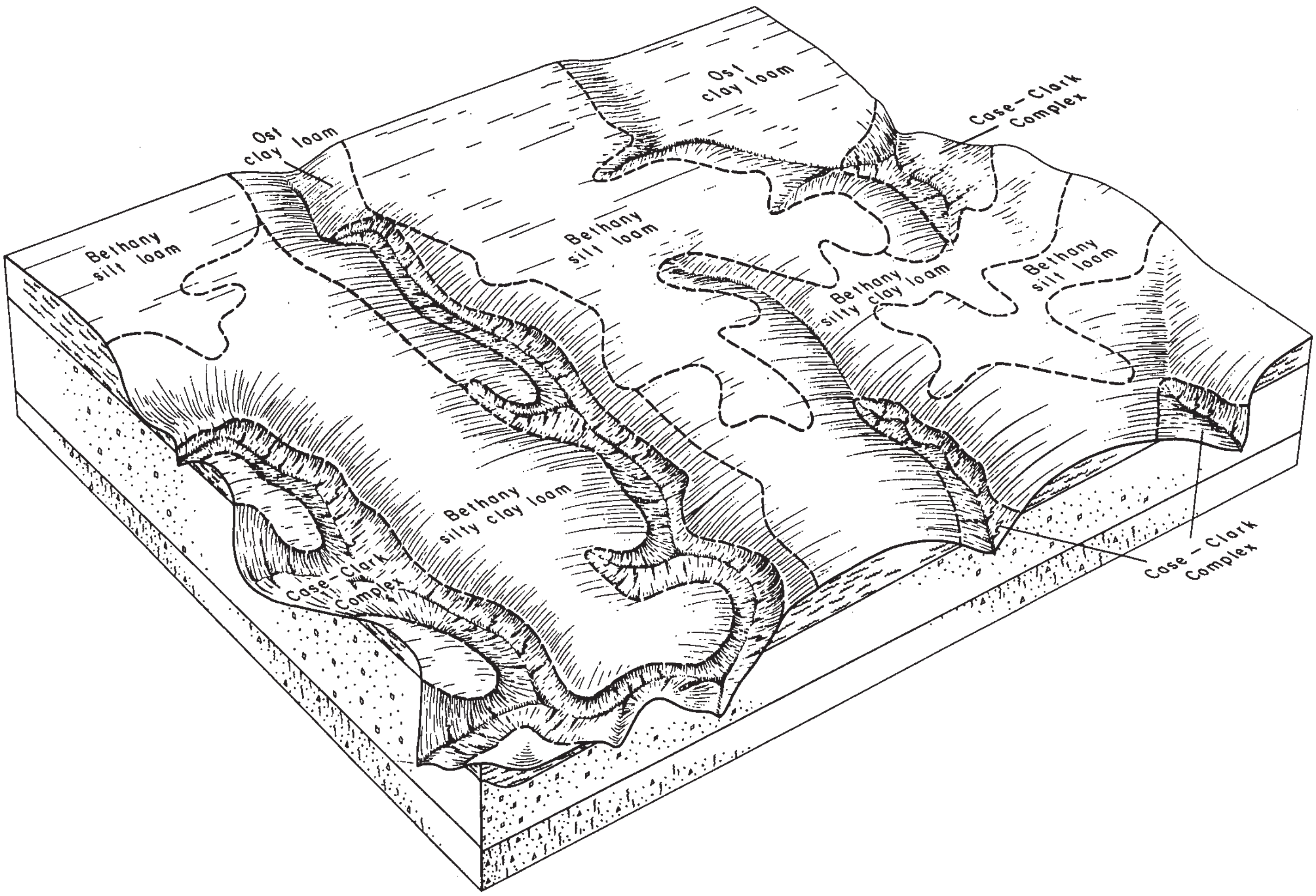

***Figure 3.*—Major soils of association 7 and the position they normally occupy on the landscape.**

22 percent of the total acreage in the county and occupies most of the south-central and southwestern parts.

Bethany soils occupy about 60 percent of the association. They are at higher elevations than the other soils and are deep and well drained. In some places these soils are nearly level, and in others they have long, gentle slopes. They have a surface layer of silt loam to silty clay loam and a very firm, clayey subsoil. The material in which they formed is fine-textured old alluvium or loess.

Ost soils, which lie downslope from the Bethany soils, make up about 25 percent of the association. They are deep, well drained, and gently sloping. The Ost soils have a surface layer of clay loam and a subsoil of calcareous clay loam. They have formed in calcareous, moderately fine textured sediment from outwash.

Tabler, Farnum, Clark, Case, and Kaw soils occupy minor acreages in this association. Tabler soils occur in low spots, and Farnum soils occur throughout the association. Clark soils are on the side slopes of intermittent streams, and Case soils are on the side slopes of drainageways. In many places the areas of Clark soils are intermingled with areas of Case soils. Kaw soils occupy a minor acreage in small valleys and in the beds of intermittent streams, where they are frequently flooded by runoff from the uplands.

The soils of this association are among the most desirable for crops in the county. Nearly all of the acreage is in wheat and sorghum, but some areas of strongly sloping, intermingled Case and Clark soils are in native grasses. Water erosion is a hazard in the sloping areas, and wind erosion is a hazard in fields left bare during dry seasons. On all of the soils, crops are subject to damage caused by lack of water.

8. Shellabarger-Albion-Farnum Association

Nearly level to strongly sloping sandy loams to loams that are deep and moderately deep and have a subsoil of sandy clay loam to clay loam; underlain by gravel in places

This association consists of areas of nearly level to strongly sloping soils dissected in several places by well-entrenched streams (fig. 4). The largest area consists of a belt, 1 to 5 miles wide, that extends on either side of the Ninnescah River from the town of Pratt to the Kingman County line. Other areas are along Painter Creek in the southeastern part of the county and along the county line between Pratt and Barber Counties. The association occupies about 18 percent of the county.

Gently sloping or moderately sloping, well-drained

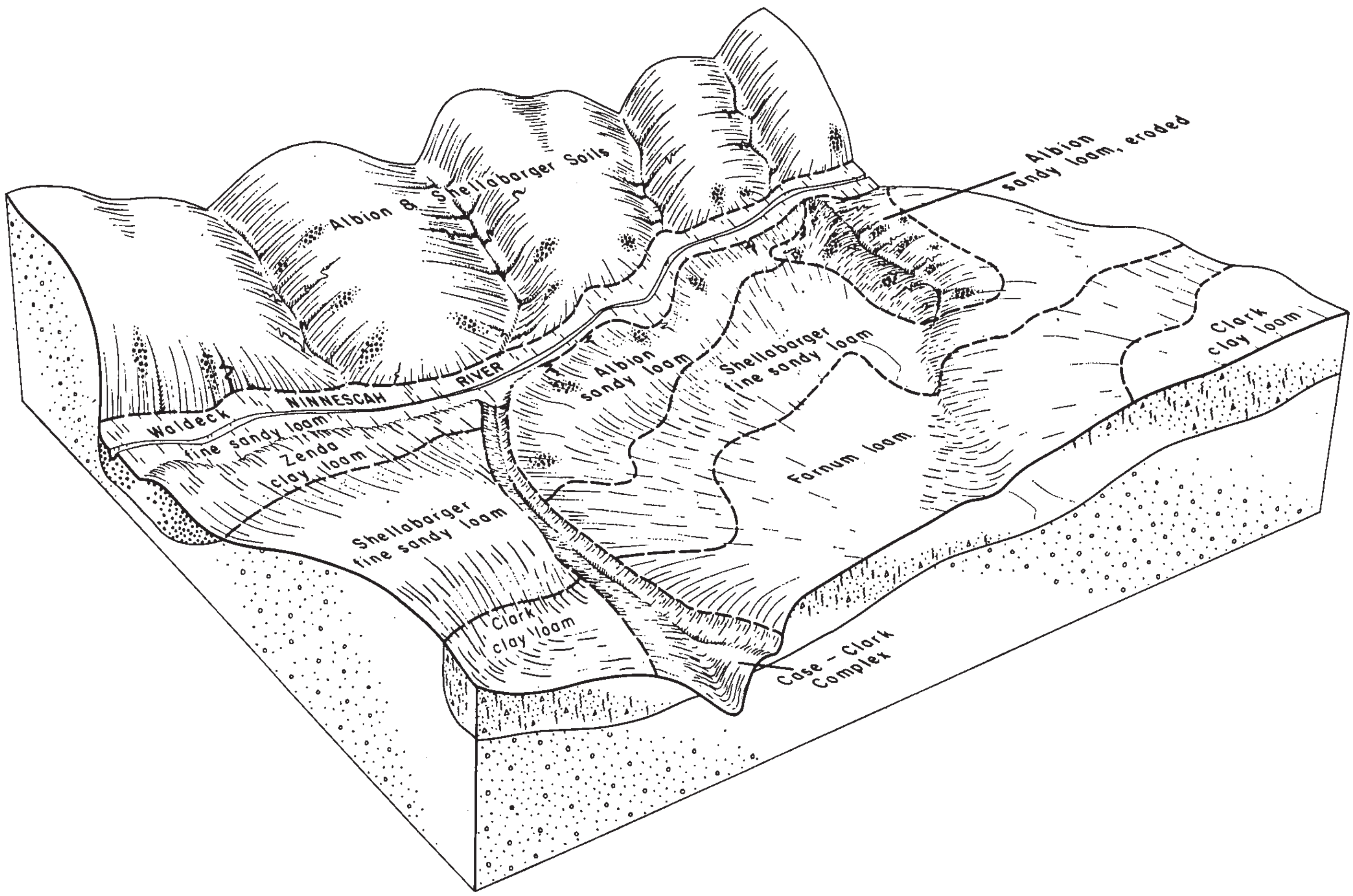

***Figure 4.*—Major soils in associations 8 and 9 and the positions they normally occupy on the landscape.**

Shellabarger soils make up about 40 percent of this association. They are deep soils that formed in reddish, moderately sandy outwash sediment, and they are at nearly the highest elevations in the association. The Shellabarger soils have a surface layer of fine sandy loam, a subsoil of sandy clay loam, and a substratum of sand and gravel. The sand and gravel are at some depth between 36 and 50 inches.

Moderately sloping to strongly sloping, somewhat excessively drained Albion soils make up about 35 percent of the association. They occur mostly around drainageways, downslope from Shellabarger soils. The Albion soils are moderately deep and have formed in moderately sandy outwash sediment. They have a surface layer of sandy loam and a subsoil of sandy clay loam. At some depth below about 25 to 36 inches, the underlying material is sand and gravel.

Deep, well-drained, nearly level or gently sloping Farnum soils, on low ridgetops, make up about 15 percent of the association. They have formed in moderately sandy, wind-deposited material and in moderately fine textured outwash sediment. The Farnum soils have a loam surface layer and a clay loam or sandy clay loam subsoil.

Minor acreages in this association are occupied by Clark and Croft soils. The Clark soils occupy small areas on knobs throughout the association. The Croft soils occur on low terraces along streams.

About three-fourths of the association is used to grow wheat and sorghum, but the Croft soils and the strongly sloping areas of Albion and Shellabarger soils are mostly in grass. Water erosion is a severe hazard in most of the sloping areas, and wind erosion is a hazard in all the areas. Also the soils are low in natural fertility.

9. Zenda-Waldeck Association

Nearly level soils that have a sandy to loamy surface layer and a loamy subsoil

This soil association is on flood plains and low terraces along the meandering Ninnescah River. It consists of a nearly level plain (see fig. 4) that gradually slopes toward the river. The association occupies about 2 percent of the county. Zenda and Waldeck soils, and areas of Broken alluvial land and Wet alluvial land, are dominant.

Zenda soils are deep, dark colored, and somewhat poorly drained. They have formed in moderately fine textured alluvium and have a clay loam surface layer and a subsoil of mottled clay loam. The water table is only about 4 feet beneath the surface. In places Zenda soils occur with areas of Slickspot soils that have been adversely affected by salts. They make up about 50 percent of the association.

Waldeck soils are somewhat poorly drained. They have formed in moderately sandy, calcareous alluvium on low terraces next to the Ninnescah River. The surface layer and the subsoil of these soils have a texture of fine sandy loam. The water table is generally at a depth of only 2 to 5 feet, but it rises to the surface during periods when water in the river is high. Waldeck soils make up about 40 percent of the association.

Broken alluvial land occupies the channel of the Ninnescah River and banks along the river. Wet alluvial land consists of loamy, wet soil material that has a texture of sandy loam to clay loam. It is poorly drained and has a seasonal high water table that rises to the surface during some periods of the year. From 10 to 15 percent of the acreage is covered with cattails, rushes, and sedges. These land types make up about 5 percent of the association.

Minor acreages throughout the association are occupied by Kanza, Plevna, and Croft soils, and those soils make up about 5 percent of the association. The Kanza and Plevna soils are in narrow valleys along the Ninnescah River or along tributaries of that river. The Croft soils are on terraces along the Ninnescah River.

About half of this association is used to grow wheat, sorghum, alfalfa, and some corn. In the rest of the acreage, the soils are unsuitable for cultivation. They are subirrigated, however, and support a good stand of grass that is used for grazing. The areas of Broken alluvial land and of Wet alluvial land are desirable for wildlife habitat and for recreation.

Wetness and occasional flooding are the main hazards to crops. Wind erosion is also a hazard if the cultivated soils are left bare or the sandy soils are overgrazed.

Descriptions of the Soils

This section describes the soil series and mapping units of Pratt County. The acreage and proportionate extent of each mapping unit are given in table 1.

The procedure is first to describe the soil series, and then the mapping units in that series. Thus, to get full information on any one mapping unit, it is necessary to read the description of that unit and also the description of the soil series to which it belongs. As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Broken alluvial land and Wet alluvial land, for example, are miscellaneous land types that do not belong to a soil series. They are listed, nevertheless, in alphabetic order along with the soil series.

In comparing a mapping unit with a soil series, many will prefer to read the short description in paragraph form. It precedes the technical description that identifies layers by A, B, and C horizons and depth ranges. The technical profile descriptions are mainly for soil scientists and others who want detailed information about soils. Unless otherwise indicated, the colors given in the descriptions are those of a moist soil. Some of the terms used to describe the soils are defined in the Glossary at the back of this soil survey.

Following the name of each mapping unit, there 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 are the capability unit and range site in which the mapping unit has been placed. The pages on which each capability unit and range site are described can be found by referring to the "Guide to Mapping Units" at the back of this survey.

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

Soil	Area	Extent	Soil	Area	Extent
	Acres	*Percent*		*Acres*	*Percent*
Albion sandy loam, 1 to 4 percent slopes	10, 473	2. 2	Naron loam, 0 to 1 percent slopes	571	0. 1
Albion sandy loam, 3 to 7 percent slopes, eroded	1, 855	. 4	Naron loam, 1 to 3 percent slopes	6, 643	1. 4
Albion and Shellabarger soils, 7 to 15 percent slopes	29, 840	6. 4	Naron-Farnum complex	2, 419	. 5
Bethany silty clay loam, 1 to 4 percent slopes, eroded	8, 751	1. 9	Ost clay loam, 0 to 1 percent slopes	858	. 2
Bethany silt loam, 0 to 1 percent slopes	22, 975	5. 0	Ost clay loam, 1 to 4 percent slopes	17, 926	3. 8
Bethany silt loam, 1 to 3 percent slopes	33, 077	7. 1	Pratt loamy fine sand, undulating	58, 436	12. 5
Broken alluvial land	440	. 1	Pratt loamy fine sand, hummocky	15, 056	3. 2
Carwile fine sandy loam	17, 501	3. 8	Pratt-Carwile complex	9, 865	2. 1
Case-Clark complex, 3 to 7 percent slopes	14, 575	3. 1	Pratt-Tivoli loamy fine sands	19, 927	4. 3
Case-Clark complex, 7 to 15 percent slopes	3, 143	. 7	Sandy breaks-Alluvial land complex	9, 304	2. 0
Clark clay loam, 1 to 4 percent slopes	26, 331	5. 6	Shellabarger fine sandy loam, 0 to 1 percent slopes	659	. 1
Clark fine sandy loam, 1 to 3 percent slopes	6, 108	1. 3	Shellabarger fine sandy loam, 1 to 4 percent slopes	13, 616	3. 0
Clark-Ost clay loams, 0 to 1 percent slopes	4, 596	1. 0	Shellabarger fine sandy loam, 3 to 7 percent slopes, eroded	1, 978	. 4
Croft soils	3, 478	. 8	Tabler clay loam	6, 648	1. 4
Farnum clay loam, 3 to 6 percent slopes, eroded	1, 437	. 3	Tivoli fine sand	10, 058	2. 2
Farnum fine sandy loam, 0 to 1 percent slopes	7, 380	1. 6	Waldeck fine sandy loam	1, 562	. 3
Farnum loam, 0 to 1 percent slopes	12, 711	2. 7	Wet alluvial land	1, 019	. 2
Farnum loam, 1 to 3 percent slopes	33, 117	7. 1	Zenda clay loam	1, 527	. 3
Farnum loam, 3 to 6 percent slopes	661	. 1	Zenda-Slickspots complex	764	. 2
Farnum-Carwile complex	538	. 1	Intermittent lakes	1, 049	. 2
Kanza-Plevna complex	3, 927	. 8	Gravel pits	136	(1)
Kaw silt loam	172	(1)	Water	427	. 1
Kaw silt loam, frequently flooded	2, 021	. 4	Total	466,560	100. 0
Naron fine sandy loam, 0 to 1 percent slopes	6, 063	1. 3			
Naron fine sandy loam, 1 to 3 percent slopes	33, 763	7. 3			
Naron fine sandy loam, 3 to 6 percent slopes	1, 179	. 3			

[1] Less than 0.5 percent.

285-493—68——2

Albion Series

The Albion series consists of moderately deep or deep, gently sloping to strongly sloping soils that are moderately sandy and somewhat excessively drained. These soils occur on uplands in the eastern half of the county, mostly within a few miles of a stream. They have formed in moderately sandy, noncalcareous old alluvium that is underlain by gravel at some depth between 25 and 36 inches.

The surface layer, about 8 inches thick, is mainly brown sandy loam but in places contains some coarse sand and fine gravel. It has weak granular structure, is slightly hard when dry and friable when moist, and is medium acid to strongly acid. The subsoil, which is about 21 inches thick, consists of reddish-brown sandy clay loam to sandy loam. It has subangular blocky structure and is hard when dry and friable when moist. The substratum is very pale brown, loose sand and gravel.

Permeability is moderate throughout the profile but is rapid in the underlying sand and gravel. Internal drainage is rapid, and the water-holding capacity is low. Erosion by water and wind is a hazard, and natural fertility is low.

The Albion soils are used mostly for cultivated crops, mainly wheat. Some of the strongly sloping areas are in grass.

Typical profile of Albion sandy loam in a cultivated field (2,220 feet south and 100 feet east of the northwest corner of sec. 17, T. 27 S., R. 12 W.):

A1—0 to 8 inches, brown (7.5YR 4/2) sandy loam, dark brown (7.5YR 3/2) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; pH 5.5; clear, wavy boundary.

B2t—8 to 18 inches, reddish-brown (5YR 5/4) sandy clay loam, dark reddish brown (5YR 3/4) when moist; moderate, medium, subangular blocky structure; hard when dry, friable when moist; few worm casts; pH 6.8; gradual, wavy boundary.

B3—18 to 29 inches, reddish-brown (5YR 5/4) sandy loam, reddish brown (5YR 4/4) when moist; weak, fine, subangular blocky structure; slightly hard when dry, very friable when moist; pH 7.0; gradual, irregular boundary.

IIC—29 to 60 inches, very pale brown (10YR 7/4) sand and gravel, yellowish brown (10YR 5/6) when moist; single grain; loose both when dry and when moist; pH 7.3.

The A horizon ranges from 4 to 14 inches in thickness. In most places it has a texture of fine sandy loam or sandy loam, but in some places the uppermost 2 to 4 inches is loamy fine sand as a result of winnowing by wind. When dry, the A horizon is brown to dark grayish brown. The B horizons range from 12 to 28 inches in combined thickness. Depth to sand and gravel ranges from 25 to 36 inches.

The Albion soils occur with Shellabarger, Farnum, and Naron soils. They are shallower over sand and gravel than the Shellabarger soils, have a less clayey subsoil than the Farnum soils, and have a thinner A horizon and a more sandy substratum than the Naron soils.

Albion sandy loam, 1 to 4 percent slopes (Ab).—This soil is mainly on uplands that border the valley of the Ninnescah River. It also occupies small areas on uplands adjacent to other streams. Slight erosion has taken place. This soil has the profile described as typical for the series. In places, however, wind has sifted out the particles of clay from the surface layer or has deposited sand on the surface. In those areas the surface layer is loamy fine sand to a depth of 2 to 4 inches.

Included with this gently sloping soil in mapping were small areas of Shellabarger fine sandy loam, 1 to 4 percent slopes; Clark fine sandy loam, 1 to 3 percent slopes; and Albion sandy loam that is underlain by sand and gravel at some depth between 15 and 25 inches. Also included were spots, as large as 1 acre in size, that have gravel on the surface.

The content of organic matter and the water-holding capacity are low. In cultivated areas where this soil is not protected, the hazards of wind erosion and water erosion are severe.

This soil is not well suited to cultivation. For about 3 years out of 4, it needs to be kept in legumes or other crops that help to maintain the content of organic matter and that increase the water-holding capacity. Wheat is a suitable crop if this soil is cultivated, and most of the acreage is now in wheat. In some years the supply of moisture is too low and the weather is too hot and dry for sorghum and other crops grown in summer to mature. Good management of crop residue is needed to conserve moisture, to help maintain the supply of plant nutrients, and to protect this soil from wind erosion. Terraces and contour farming help to control water erosion. Growing a cover crop and practicing stubble-mulch tillage help to control wind erosion. Fertilizer is needed to increase the supply of plant nutrients. If enough moisture is available for crops, good response is generally obtained from applications of a nitrogen fertilizer and phosphate. (Capability unit IVe–2, Sandy range site)

Albion sandy loam, 3 to 7 percent slopes, eroded (Ao).—This soil is mainly on side slopes adjacent to streams in the eastern half of the county. In places, however, it is on knobs that protrude from areas of less sloping Albion soils. Moderate erosion has taken place.

The surface layer is generally about 5 inches thick. In places it contains material from the subsoil that has been mixed into it by tillage, and the texture in those areas is finer than sandy loam. The subsoil is heavy sandy loam or sandy clay loam and is about 20 inches thick. It is underlain by sand and gravel.

Included with this soil in mapping were small areas of an Albion sandy loam in which sand and gravel are within 25 inches of the surface. Also included were small areas that have gravel on the surface.

The low water-holding capacity, sand and gravel near the surface, and susceptibility to further erosion make this Albion soil unsuitable for cultivation. Nevertheless, cultivated crops are grown. Nearly all of the acreage is in wheat, but some areas have been reseeded to native grasses. Reseeding to suitable native grasses and using the areas for range would be desirable. (Capability unit VIe–3, Sandy range site)

Albion and Shellabarger soils, 7 to 15 percent slopes (As).—The soils of this mapping unit occupy areas adjacent to the major streams in the roughest parts of the county. Some of the areas are along the Ninnescah River and along Turkey, Sand, and Silver Creeks.

The mapping unit consists primarily of somewhat excessively drained Albion and Shellabarger soils that occur together in such an intricate pattern it was not practical to map them separately. About 40 percent of the mapping unit is Albion sandy loam, about 30 percent is Shellabarger fine sandy loam, and about 10 percent is Albion gravelly sandy loam. The rest consists of about equal acreages of Albion sandy loam underlain by sand

and gravel at a depth of less than 20 inches; gravelly outcrop; Naron fine sandy loam; and Clark fine sandy loam. The proportions of Albion and Shellabarger soils are fairly consistent throughout each area, but the proportions of the other soils vary. Some areas do not contain all of these soils.

The texture of the surface layer ranges from gravelly sand to clay loam, but it is dominantly sandy loam. The texture of the subsoil ranges from sandy clay loam to sand and gravel.

Nearly all of the acreage is used for range, but a few small areas have been cultivated. The cultivated areas are severely eroded and are being reseeded to native grasses. Only a small amount of runoff occurs in the grass-covered areas that are properly grazed. The hazard of water erosion is severe if cultivated crops are grown. (Capability unit VIe-3, Sandy range site)

Bethany Series

The Bethany series consists of deep, dark-colored soils that are well drained and nearly level or gently sloping. These soils are on uplands in the central and southwestern parts of the county. They have formed in alkaline or calcareous, silty and clayey loess or old alluvium.

In most places the surface layer is dark grayish-brown heavy silt loam that is about 13 inches thick and is medium acid. It is hard when dry and friable when moist, and it is easily tilled. The subsoil is dark grayish-brown or brown silty clay loam to clay about 37 inches thick. It has blocky or subangular blocky structure and is very hard when dry and very firm when moist. The upper part of the subsoil is slightly acid to neutral. The lower part is calcareous and contains a few nodules or concretions of lime. Beneath the subsoil in some areas is friable loess that has a texture of silty clay loam. In other places the underlying material is old alluvium. The underlying material contains many fine nodules or concretions of lime. It has weak blocky structure and is easily penetrated by roots.

Permeability is moderate, and these soils have high water-holding capacity. They are susceptible to water erosion and wind erosion, however, and they shrink and crack during dry seasons.

The Bethany soils are well suited to the dryland crops and native grasses commonly grown in the county. Most of the acreage is in wheat and sorghum.

Typical profile of a cultivated Bethany silt loam that has slopes of about 1 percent (1,470 feet north and 125 feet west of the southeast corner of sec. 36, T. 28 S., R. 14 W.):

A1—0 to 13 inches, dark grayish-brown (10YR 4/2) heavy silt loam, very dark brown (10YR 2/2) when moist; moderate, medium, granular structure; hard when dry, friable when moist; pH 6.0; clear, smooth boundary.

B1—13 to 18 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine, subangular blocky structure; hard when dry, firm when moist; pH 6.5; clear, smooth boundary.

B21t—18 to 30 inches, dark grayish-brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) when moist; moderate, medium, blocky structure; very hard when dry, very firm when moist; thick, continuous clay films; pH 7.0; gradual, irregular boundary.

B22t—30 to 46 inches, brown (10YR 5/3) silty clay, dark grayish brown (10YR 4/2) when moist; weak, medium, blocky structure; extremely hard when dry, very firm when moist; few patchy clay films; calcareous, and contains a few concretions of soft lime; diffuse, irregular boundary.

B3ca—46 to 50 inches, brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) when moist; weak, coarse, subangular blocky structure; hard when dry, friable when moist; calcareous, and contains many fine concretions of soft lime.

The A horizon ranges from 6 to 16 inches in thickness and from heavy silt loam to light silty clay loam in texture. When that horizon is dry, its color ranges from dark brown to dark grayish brown. The B horizons range from 15 to 37 inches in combined thickness. When they are dry, their color ranges from brown to dark grayish brown. In most places lime is at some depth between 16 and 33 inches, but it is below a depth of 36 inches in places.

Bethany soils occur with Ost, Clark, Farnum, and Tabler soils. They have a more clayey subsoil than the Ost and Clark soils and are leached of lime to a greater depth than those soils. Bethany soils are lighter colored and have a thicker surface layer than the Tabler soils. They have more silt and less sand in their subsoil than the Farnum soils.

Bethany silt loam, 0 to 1 percent slopes (Be).—This nearly level soil is on smooth uplands in the south-central and southwestern parts of the county. It is slightly eroded. In most places the surface layer is about 14 inches thick and has a texture of silt loam, but the texture is light silty clay loam in some places. The subsoil is about 35 inches thick and contains lime at some depth between 27 and 33 inches.

Included with this soil in mapping were a few small areas of Tabler clay loam. Also included were areas of Ost clay loam, 0 to 1 percent slopes.

A crust forms on this Bethany soil after hard rains, and blowing is likely to occur when this soil is dry unless the areas are protected by a growing crop or crop residue. Leaving crop residue near the surface when the soil is tilled increases the amount of rainfall that is absorbed.

This soil is well suited to all the dryland crops and native grasses commonly grown in the county, and it is also suited to leveling for flood irrigation. The crops respond to applications of phosphate and a fertilizer high in nitrogen. (Capability unit IIc-3, Loamy Upland range site)

Bethany silt loam, 1 to 3 percent slopes (Bh).—This gently sloping soil is mainly in the south-central and southwestern parts of the county. It is slightly eroded. The profile is similar to the one described for the series, but the surface layer is only about 12 inches thick and has a texture of light silty clay loam in places. Lime is at some depth between 27 and 33 inches.

Included with this soil in mapping were a few small areas of Bethany silty clay loam, 1 to 4 percent slopes, eroded. Also included were minor areas of Farnum loam, 1 to 3 percent slopes, and of Ost clay loam, 1 to 4 percent slopes.

This Bethany soil is suited to all the dryland crops and native grasses commonly grown in the county. Nearly all of the acreage is in wheat and sorghum. The crops respond to applications of nitrate and phosphate. Water erosion is a hazard unless practices are used to control it. Terracing, farming on the contour, and managing crop residue properly help to control erosion and to increase the absorption of water. (Capability unit IIe-2, Loamy Upland range site)

Bethany silty clay loam, 1 to 4 percent slopes, eroded (Bc).—This soil occurs throughout the south-central and southwestern parts of the county. It is mostly on rounded hills and along drainageways in the uplands, mainly near areas of other Bethany soils. Moderate erosion has taken place. Water erosion has removed most of the original surface layer of silt loam, and the present surface layer has a texture of silty clay loam and is about 8 inches thick. In places tillage has mixed part of the subsoil with the remaining surface soil. Lime is at some depth between about 16 and 30 inches.

Small areas of Bethany silt loam, 1 to 3 percent slopes, were included with this soil in mapping. Also included were small areas of Ost clay loam, 1 to 4 percent slopes.

This Bethany soil is well suited to the dryland crops and native grasses commonly grown in the county, and most of the acreage is in wheat and sorghum. Severe water erosion is a hazard unless this soil is protected by a cover of plants or by crop residue. Terracing, farming on the contour, and managing crop residue properly all help to control erosion. Good response is obtained from applications of nitrate and phosphate. (Capability unit IIIe-5, Loamy Upland range site)

Broken Alluvial Land

Broken alluvial land (0 to 20 percent slopes) (Br) is a miscellaneous land type that consists of the channel and the banks of the Ninnescah River. The areas in which it occurs range from 100 to 300 feet in width. Where they occur, the stream channel is generally less than 100 feet wide, and it is only 30 to 75 feet wide in most places. The areas on the banks of the river are gently sloping to steep and consist of overfalls 100 to 200 feet wide and 5 to 10 feet above the stream channel. They consist of sandbars and of scoured-out pockets that are exposed during periods of normal streamflow. The areas are flooded when the water is high.

This land type is not suitable for cultivation and has little value for grazing. It is used chiefly for recreation and as habitat for wildlife. (Capability unit VIIw-1, Unstable range site)

Carwile Series

The Carwile series consists of deep, dark-colored, somewhat poorly drained soils that have developed in old clayey alluvium and in moderately sandy material deposited by wind. These soils are nearly level and are in slight depressions in some places. They occur in small patches throughout the county but are mainly in the northern half.

In most places the surface layer is grayish-brown fine sandy loam that is about 12 inches thick and has a few strong-brown mottles in places. It has weak granular structure and is soft when dry and friable when moist. The subsoil is generally dark grayish-brown or grayish-brown heavy sandy clay loam to clay mottled with strong brown or gray. It is about 35 inches thick, has blocky or subangular blocky structure, and is very hard when dry and firm when moist. The substratum is distinctly mottled, massive sandy clay loam that is very hard when dry and firm when moist. It is frequently wet because of the perched water table, and it is neutral in reaction.

Permeability is slow. During wet seasons the water table is within the root zone of crops, and crops are occasionally drowned unless surface drainage is provided. Wind erosion is a hazard if these soils are not protected by a cover of plants or by crop residue.

The Carwile soils are suited to all the dryland crops and native grasses commonly grown in the county. Nearly all of the acreage is in wheat and sorghum, but a few small areas are still in native pasture.

Typical profile of a cultivated Carwile fine sandy loam (1,840 feet south and 250 feet west of the northeast corner of sec. 15, T. 26 S., R. 14 W.):

A1—0 to 12 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; a few, fine, faint, strong-brown mottles; weak, fine, granular structure; soft when dry, friable when moist; pH 6.0; clear, smooth boundary.

B1—12 to 20 inches, dark grayish-brown (10YR 4/2) sandy clay loam, very dark grayish brown (10YR 3/2) when moist; common, fine, distinct, strong-brown mottles; weak, medium, subangular blocky structure; very hard when dry, firm when moist; pH 6.5; gradual, wavy boundary.

B2t—20 to 33 inches, grayish-brown (10YR 5/2) clay, very dark grayish brown (10YR 3/2) when moist; common, fine, distinct, strong-brown mottles; moderate, medium, blocky structure; extremely hard when dry, extremely firm when moist; thick, continuous clay films; pH 7.0; gradual, irregular boundary.

B3—33 to 47 inches, pale-brown (10YR 6/3) heavy sandy clay loam, grayish brown (10YR 5/2) when moist; common, fine, distinct, strong-brown mottles; weak, fine, angular blocky structure; very hard when dry, very firm when moist; pH 7.5; gradual, irregular boundary.

C—47 to 60 inches, light brownish-gray (10YR 6/2) sandy clay loam, dark grayish brown (10YR 4/2) when moist; common, fine, distinct mottles; massive; very hard when dry, firm when moist; pH 7.0.

The A horizon ranges from 8 to 14 inches in thickness. In some places wind has deposited a layer of loamy fine sand, 2 to 4 inches thick, on the surface. In others it has sifted out the finer particles from the fine sandy loam of the surface layer and has left a layer of loamy fine sand 2 to 4 inches thick. The B horizons range from 25 to 40 inches in combined thickness. Depth to the B2t horizon ranges from 16 to 25 inches. When this soil is dry, the color of the B horizons ranges from dark grayish brown to gray. The B3 horizon and the C horizon are calcareous in places.

The Carwile soils occur with Pratt, Naron, and Farnum soils. Unlike the Pratt soils, they have a subsoil of mottled sandy clay loam to clay. The Carwile soils have a profile somewhat similar to those of the Naron and Farnum soils, but their subsoil is more clayey and is compact and mottled. They are more sandy than the Tabler soils, but they occur in low spots like those soils.

Carwile fine sandy loam (0 to 2 percent slopes) (Ca).—This nearly level soil occurs in low areas or slight depressions, generally with Pratt and Naron soils. It is slightly eroded. The profile is similar to the one described for the series. The compact layer is at some depth between 16 and 25 inches.

Included with this soil in mapping were a few small areas of Pratt loamy fine sand, undulating; Naron fine sandy loam, 0 to 1 percent slopes; and Farnum fine sandy loam, 0 to 1 percent slopes. The areas also contain many potholes, or small depressions, that are shown on the soil map by a spot symbol.

This soil is well suited to all the dryland crops commonly grown in the county. Nearly all of the acreage is in wheat and grain sorghum. Natural fertility is moderate, but the crops, especially small grains, respond to applications of fertilizer. In most places the soils are more deficient in nitrogen than in phosphorus. Response is greater, however, where both kinds of fertilizer are applied than where nitrate alone is added. Stubble-mulch tillage and stripcropping help to control wind erosion and to maintain the content of organic matter. In places surface drainage is also needed to drain the potholes. This soil can be leveled and is suited to flood irrigation if good surface drainage can be established. (Capability unit IIw–2, Sandy range site)

Case Series

The Case series consists of loamy, light-colored, calcareous soils that are well drained and have formed in highly calcareous outwash sediment. These soils are moderately to strongly sloping. They occur around upland drainageways in the southwestern and eastern parts of the county. In Pratt County the Case soils are not mapped separately but are mapped with Clark soils.

In most places the surface layer is pale-brown clay loam that has granular structure. This layer is about 6 inches thick. It is hard when dry and friable when moist. It is calcareous and contains many small, hard concretions of lime. Beneath the surface layer is a layer of very pale brown clay loam that has granular structure and is about 14 inches thick. This layer is hard when dry and friable when moist, is strongly calcareous, and contains many hard and soft concretions of lime. The underlying material is light-colored, highly calcareous clay loam that is massive and is very hard when dry and friable when moist. From 30 to 80 percent of the underlying material, by volume, consists of soft and hard concretions of lime.

These soils are moderately permeable and are low in content of organic matter. They are susceptible to serious water erosion and wind erosion when the surface is not protected by a cover of plants. Response is good to applications of a complete fertilizer.

The moderately sloping areas of Case soils are suited to wheat, sorghum, and legumes. In those areas nearly all of the acreage is in wheat and sorghum. The areas that have stronger slopes are in native grass and are used as range.

Typical profile of a cultivated Case clay loam (2,150 feet north and 450 feet west of the southeast corner of sec. 31, T. 28. S., R. 15 W.):

Ap—0 to 6 inches, pale-brown (10YR 6/3) clay loam, brown (10YR 4/3) when moist; moderate, medium, granular structure; hard when dry, friable when moist; calcareous, and contains many small, hard concretions of calcium carbonate; gradual boundary.

C1ca—6 to 20 inches, very pale brown (10YR 7/3) clay loam, brown (10YR 5/3) when moist; moderate, medium, granular structure; hard when dry, friable when moist; strongly calcareous; about 40 percent, by volume, is soft and hard masses of segregated calcium carbonate; gradual boundary.

C2ca—20 to 50 inches +, brownish-yellow (10YR 6/6) light clay loam, yellowish brown (10YR 5/6) when moist; massive; very hard when dry, friable when moist; calcareous; about 30 percent, by volume, is masses of segregated calcium carbonate.

The A horizon ranges from pale brown to light gray in color and from 3 to 8 inches in thickness. Its texture is dominantly clay loam, but it is fine sandy loam in some places where these soils occur near sandy soils.

In Pratt County the Case soils are mapped only in complexes with Clark soils. They have a lighter colored surface layer (fig. 5) than the Clark soils, but their profile is somewhat similar in other respects.

Case-Clark complex, 3 to 7 percent slopes (Cc).—The soils of this complex occur mainly on knolls in the eastern part of the county and around drainageways in the southwestern part. The complex consists of areas of Case and Clark soils that occur in too intricate a pattern to be separated on the soil map. About 70 percent of the complex consists of Case clay loam; 25 percent, of Clark clay loam; and 5 percent, of Clark and Case fine sandy loams.

Figure 5.—**A cultivated field of soils of Case-Clark complex, 3 to 7 percent slopes. The light-colored areas are the Case soil, and the dark-colored ones are the Clark.**

The Case soils have a profile similar to the one described for the Case series. The Clark soil has a profile similar to the one described for the Clark series, but the surface layer ranges from pale brown to dark grayish brown in color. It is about 6 inches thick and is highly calcareous. The surface layer is underlain by very pale brown, limy soil material.

In some places small areas of Albion sandy loam were included with these soils in mapping.

Because the soils of this complex are highly susceptible to erosion, they are not well suited to cultivated crops grown year after year. Also, the surface layer seals over and crusts easily after rains and the rate of water absorption is low.

Legumes and grasses grown 3 years out of 4 help to maintain the content of organic matter and increase the supply of plant nutrients and the rate of water absorption. Nearly all of the acreage is in wheat and sorghum. Wheat is a suitable crop, but sorghum is sometimes affected by chlorosis, a yellowing of the leaves, because of the high content of lime in these soils. Installing terraces, farming on the contour, and managing crop residue will help to control water erosion. Phosphate and a fertilizer high in nitrogen are both needed to maintain the supply of plant nutrients. (Capability unit IVe–4, Limy Upland range site)

Case-Clark complex, 7 to 15 percent slopes (Ck).—About 60 percent of this soil complex is Case clay loam, and 25 percent is Clark clay loam. An additional 5 percent is Albion sandy loam, another 5 percent is Clark and Case fine sandy loams, and still another 5 percent is Kaw silt loam, frequently flooded. The Kaw soil is on the bottoms of narrow drainageways. The other soils occur around drainageways, mainly in the east-central and southwestern parts of the county. Except for the stronger slopes, the soils are similar to the soils of Case-Clark complex, 3 to 7 percent slopes.

Because of their strong slopes and susceptibility to water erosion, the soils of this complex are not suitable for cultivated crops but are well suited to range. Nearly all of the acreage is in range, but a few small areas are cultivated. The cultivated areas are moderately to severely eroded, but the areas used for range are only slightly eroded. A large amount of forage is produced where good range management is practiced. (Capability unit VIe-1, Limy Upland range site)

Clark Series

The Clark series consists of deep, well-drained, nearly level to strongly sloping soils that contain a large amount of lime. These highly calcareous soils are mainly on uplands in the eastern half of the county, but the steeper areas are on the side slopes of drainageways in the southwestern part. The soils have formed in calcified, highly calcareous old alluvium that has a texture of loam to clay loam.

In most places the surface layer is grayish-brown clay loam about 8 inches thick. It is calcareous and is slightly hard when dry and friable when moist. Beneath the surface layer is a layer of pale-brown clay loam that is calcareous and is about 6 inches thick. This layer contains many concretions of soft lime. It has granular structure and is slightly hard when dry and sticky when moist. The substratum is light-colored, highly calcareous clay loam. It has subangular blocky structure and is hard when dry and friable when moist. About 30 to 80 percent of the substratum, by volume, consists of soft and hard concretions of lime.

These soils are moderately permeable but are susceptible to erosion by water and wind. The moderately sloping soils are subject to severe sheet erosion when they are not protected by a cover of plants.

The Clark soils are suited to wheat, sorghum, and grass, and they are also suited to sweetclover if enough moisture is available. Nearly all of the acreage is in wheat and sorghum, but the yields of sorghum are sometimes low because the lime in the soils causes chlorosis. The strongly sloping Clark soils are used as range, and some of the eroded areas that were formerly cultivated have been reseeded to grass.

Typical profile of a cultivated Clark clay loam (2,540 feet south and 100 feet west of the northeast corner of sec. 24, T. 28 S., R. 12 W.):

A1—0 to 8 inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, granular structure; slightly hard when dry, friable when moist; calcareous; clear, wavy boundary.

AC—8 to 14 inches, pale-brown (10YR 6/3) clay loam, dark brown (10YR 4/3) when moist; strong, medium, granular structure; slightly hard when dry, friable when moist; calcareous; contains many concretions of soft lime; gradual, wavy boundary.

C1ca—14 to 22 inches, very pale brown (10YR 7/4) clay loam, yellowish brown (10YR 5/4), when moist; hard when dry, friable when moist; weak, coarse, subangular blocky structure; calcareous; about 50 percent, by volume, is hard to soft masses of calcium carbonate; gradual, irregular boundary.

C2ca—22 to 50 inches, brownish-yellow (10YR 6/6) light clay loam, yellowish brown (10YR 5/6) when moist; massive; porous; calcareous; about 30 percent, by volume, consists of masses of calcium carbonate.

The A horizon ranges from clay loam to fine sandy loam in texture, from 4 to 14 inches in thickness, and from dark grayish brown to grayish brown in color. The AC horizon ranges from 4 to 10 inches in thickness. In some places these soils are noncalcareous to a depth of about 12 inches, but they are typically calcareous to the surface.

The Clark soils occur mainly with Ost, Bethany, and Case soils. Unlike the Ost soils, they have a calcareous surface layer, and they lack a B2t horizon. They have a less clayey subsoil than the Bethany soils and are calcareous closer to the surface. Clark soils have a darker colored surface layer than Case soils.

Clark clay loam, 1 to 4 percent slopes (Cm).—This is a gently sloping soil on uplands, mainly in the east-central part of the county. It is slightly eroded and has a surface layer that is sticky when wet. The profile is similar to the one described for the series.

Included with this soil in mapping were small areas of Case-Clark complex, 3 to 7 percent slopes, and of Ost clay loam, 1 to 4 percent slopes. Also included were small areas of Clark fine sandy loam, 1 to 3 percent slopes.

Water erosion is a hazard when this soil is cultivated and is not protected by a cover of plants. The surface layer contains a large amount of lime, and in places lime pebbles are on the surface. When this soil is wet, implements used for tillage do not scour. Stubble-mulch tillage helps to prevent runoff, improves soil tilth, and keeps the surface soil porous. Terraces and contour farming help to control erosion.

This soil is suited to all the dryland crops and grasses commonly grown in the county, but it appears to be better suited to wheat than to other crops. Much of the acreage is in wheat and grain sorghum, but the high content of lime makes sorghum slightly susceptible to chlorosis. Sweetclover and alfalfa grow fairly well if enough moisture is available. The soils are low in nitrogen and phosphorus, and crops respond to applications of those elements. (Capability unit IIIe-3, Limy Upland range site)

Clark fine sandy loam, 1 to 3 percent slopes (Cn).—This soil is gently sloping in some places and gently undulating in others. It occurs mainly in the eastern part of the county, in most places with areas of Pratt loamy fine sand and Naron fine sandy loam. Slight erosion has taken place. In most places the profile is similar to the one described for the series, but the surface layer generally has a texture of fine sandy loam. In some places, however, wind has sifted out the finer particles and has left a layer of loamy fine sand, 2 to 5 inches thick, on the surface.

Included with this soil in mapping were small areas of Naron fine sandy loam, 1 to 3 percent slopes, and of Clark clay loam, 1 to 4 percent slopes. Also included were small areas of Pratt loamy fine sand, undulating.

Permeability is moderate, and this soil has good water-holding capacity. It is subject to water erosion and wind erosion, however, if it is not protected by a cover of plants or crop residue.

This soil is well suited to the dryland crops and grasses commonly grown in the county. It is also well suited to sweetclover and alfalfa if enough moisture is available for those crops. Installing terraces and farming on the contour help to control erosion in the gently sloping areas, and stripcropping and stubble-mulch tillage help to control erosion in the undulating areas not suitable for terracing. Crops grown on this soil respond to applications of phosphate and a fertilizer high in nitrogen. (Capability unit IIIe-3, Limy Upland range site)

Clark-Ost clay loams, 0 to 1 percent slopes (Co).—This soil complex consists mainly of nearly level Clark and Ost soils that occur in such an intricate pattern it was not practical to map them separately. About 70 percent of the acreage is Clark clay loam, and 25 percent is Ost clay loam. An additional 3 percent is Clark fine sandy loam, and 2 percent is Naron fine sandy loam. The soils occur mainly in the eastern part of the county near Preston and Isabel (in Barber County). Typical profiles are described under the Clark and Ost series.

The soils of this complex are well suited to all the dryland crops commonly grown in the county. They are also suited to legumes if enough moisture is available. Nearly all of the acreage is in wheat and grain sorghum (fig. 6). (Capability unit IIc-4, Limy Upland and Loamy Upland range sites)

Croft Series

The Croft series consists of sandy, somewhat excessively drained, nearly level soils that are moderately shallow over sand. These soils are on terraces along the major streams in the county. They have formed in coarse-textured alluvium that, in a few places, has been reworked by wind to a depth of a few inches.

In most places the surface layer is grayish-brown loamy fine sand about 13 inches thick. It is structureless, is loose when dry and very friable when moist, and is slightly acid. Beneath the surface layer is a layer of structureless, brown loamy fine sand that is about 12 inches thick, is loose both when dry and when moist, and is slightly acid. The substratum is light yellowish-brown sand that is structureless, is loose both when dry and when moist, and is neutral or moderately alkaline in reaction.

Permeability is rapid, and internal drainage is excessive. The water-holding capacity is low. Wind erosion is a severe hazard if these soils are not protected by a cover of plants or crop residue.

Figure 6.—**A new seeding of wheat on Clark clay loam. This soil is highly calcareous, and it has white pebbles of lime on the surface in many places.**

The Croft soils are not suitable for field crops and are mostly in native grasses. Some small areas are used for rye pasture.

Typical profile of Croft loamy fine sand in pasture (1,100 feet east and 850 feet north of the southwest corner of sec. 25, T. 27 S., R. 11 W.):

A1—0 to 13 inches, grayish-brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) when moist; single grain; loose when dry, very friable when moist; pH 6.5; clear, smooth boundary.

AC—13 to 25 inches, brown (10YR 5/3) loamy fine sand, dark brown (10YR 4/3) when moist; single grain; loose both when dry and when moist; pH 6.5; clear, irregular boundary.

C—25 to 40 inches +, light yellowish-brown (10YR 6/4) fine and medium sand, dark brown (10YR 4/3) when moist; single grain; loose both when dry and when moist; pH 7.8.

The A1 horizon ranges from 6 to 15 inches in thickness and from light fine sandy loam to loamy fine sand in texture. In places it contains a large amount of gravel. When the A1 horizon is dry, its color ranges from dark grayish brown to brown. The AC horizon ranges from 6 to 15 inches in thickness and grades to coarse sand and gravel at some depth between 15 and 30 inches.

The Croft soils are lighter colored and more sandy than the Waldeck soils, and they lack the fairly thick B2 horizon that is typical in the profile of the Waldeck soils. The Croft soils are lighter colored than the Kanza and Plevna soils, and they do not have a high water table like those soils.

Croft soils (0 to 2 percent slopes) (Cs).—These are the only Croft soils mapped in Pratt County. They are slightly eroded and are on terraces along the major streams in the county. The profile is similar to the one described for the series, but the surface layer is only about 10 inches thick in places and ranges from light fine sandy loam to loamy fine sand in texture. The underlying material is medium and coarse sand.

Included with these soils in mapping were small areas of Waldeck fine sandy loam. Also included were soils of the Kanza-Plevna complex.

If the Croft soils are well managed, they are suited to tall and mid grasses. They are suitable for range and for wildlife habitat, and nearly all of the acreage is in range. Soil blowing is a serious hazard, however, unless the soils are protected. Blowing is likely to start and cactus and other annual weeds quickly invade in areas that are overgrazed. (Capability unit VIe-2, Sands range site)

Farnum Series

The Farnum series consists of deep, dark-colored soils that are well drained and are nearly level to moderately sloping. These soils are on uplands in nearly all parts of the county. They have formed in moderately fine textured outwash sediment and moderately sandy windblown material.

In most places the surface layer is grayish-brown loam about 10 inches thick. It has weak granular structure, is soft when dry and very friable when moist, and is slightly acid. The upper part of the subsoil is dark grayish-brown light clay loam about 6 inches thick. It has moderate, coarse, granular structure, is hard when dry and friable when moist, and is neutral in reaction. The lower part of the subsoil is brown light clay loam about 26 inches thick. It has blocky structure, is hard or very hard when dry and firm when moist, and is neutral or mildly alkaline in reaction. The substratum is brown fine sandy loam that has weak granular structure. It is slightly hard when dry and friable when moist and is mildly alkaline.

Permeability is moderate, but these soils have slow internal drainage and good water-holding capacity. Water erosion and wind erosion are hazards.

The Farnum soils are well suited to all the dryland crops and grasses commonly grown in the county. Nearly all of the acreage is cultivated, but some of the sloping areas are in grass. Wheat and sorghum are the main crops.

Typical profile of a cultivated Farnum loam (550 feet west and 200 feet north of the southeast corner of sec. 7, T. 28 S., R. 14 W.):

A1—0 to 10 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; pH 6.5; clear, smooth boundary.

B1—10 to 16 inches, dark grayish-brown (10YR 4/2) light clay loam, dark brown (10YR 3/3) when moist; moderate, coarse, granular structure; hard when dry, friable when moist; pH 7.0; clear, wavy boundary.

B21t—16 to 30 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) when moist; moderate, medium, subangular blocky structure; very hard when dry, firm when moist; thin, continuous clay films; pH 7.0; gradual, irregular boundary.

B22t—30 to 42 inches, brown (7.5YR 5/4) light clay loam, dark brown (7.5YR 4/4) when moist; moderate, fine, subangular blocky structure; hard when dry, firm when moist; pH 7.5; gradual, irregular boundary.

C—42 to 56 inches, brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 5/4) when moist; weak, medium, granular structure; slightly hard when dry, friable when moist; pH 7.8.

The A horizon ranges from 7 to 14 inches in thickness and from loam or fine sandy loam to clay loam in texture. When dry, it ranges from brown to dark grayish brown in color. The B horizons range from 20 to 36 inches in combined thickness and from sandy clay loam to clay loam in texture. In places the B22t horizon is mottled. The C horizon ranges from fine sandy loam to clay loam in texture. It is calcareous in places.

The Farnum soils have a less clayey subsoil than the Bethany soils. They have a more clayey subsoil and more blocky subsoil structure than the Shellabarger and Naron soils. The Farnum soils have a less compact, less mottled subsoil than the Carwile soils.

Farnum loam, 0 to 1 percent slopes (Fm).—This is a slightly eroded soil, mainly in the central and west-central parts of the county. Its surface layer is about 12 inches thick, is soft when dry and friable when moist, and is slightly acid to neutral in reaction. The subsoil is about 36 inches thick. Its texture is sandy clay loam to clay loam, and its structure is subangular blocky. Included with this soil in mapping were small areas of Carwile fine sandy loam that were too small to be mapped separately.

Wind erosion is a hazard when this Farnum soil is not adequately protected by a cover of plants or crop residue. In some places surface drainage is needed during wet seasons.

This soil is well suited to all the dryland crops and grasses commonly grown in the county. Nearly all of the acreage is in wheat and grain sorghum. The crops respond to applications of phosphate and a fertilizer high in nitrogen. Good management of crop residue helps to control wind erosion and increases the absorption of water. This soil is suitable for leveling and flood irrigation. (Capability unit IIc–3, Loamy Upland range site)

Farnum loam, 1 to 3 percent slopes (Fn).—This soil is mainly in the central part of the county. It is gently sloping or gently undulating and is slightly eroded. In most respects the profile is similar to the one described for the series. The subsoil is slightly acid to neutral in reaction.

Included with this soil in mapping were small areas of Naron loam, 1 to 3 percent slopes, and Bethany silt loam, 1 to 3 percent slopes. Also included were small areas of soils that have some characteristics of both Shellabarger fine sandy loam and Farnum loam.

This Farnum soil is well suited to all the dryland crops and grasses commonly grown in the county. Nearly all of the acreage is in wheat and sorghum. The crops respond to applications of phosphate and a fertilizer high in nitrogen. Water erosion is a hazard unless this soil is protected by a cover of plants or crop residue, but terraces and contour farming help to control erosion. (Capability unit IIe–2, Loamy Upland range site)

Farnum loam, 3 to 6 percent slopes (Fu).—This moderately sloping soil is on knolls and around drainageways, mainly in the eastern half of the county. It is slightly eroded. In most respects the profile is similar to the one described for the series. Included with this soil in mapping were small areas of Shellabarger fine sandy loam, 1 to 4 percent slopes.

This Farnum soil is suited to all the dryland crops and grasses commonly grown in the county. Except for small areas that are adjacent to drainageways and in grass, nearly all of the acreage is in wheat. Water erosion is a severe hazard where this soil is cultivated. Installing terraces and farming on the contour help to control erosion. Stubble-mulch tillage decreases the amount of runoff and helps to conserve moisture. (Capability unit IIIe–4, Loamy Upland range site)

Farnum clay loam, 3 to 6 percent slopes, eroded (Fa).—This soil occurs on knolls and around drainageways with Farnum loam, 3 to 6 percent slopes. All of the acreage was formerly cultivated, but some areas have been reseeded to native grasses. The surface layer is about 7 inches thick. In many places it contains soil material from the subsoil that has been mixed into it by tillage. The subsoil is about 30 inches thick.

Because this soil is already moderately eroded and is subject to further erosion, it is not well suited to cultivated crops grown year after year. Seeding to legumes or similar crops is desirable. If cultivated crops are grown, this soil needs to be protected by installing terraces, farming on the contour, and managing plant residue properly. Crops grown on it respond to applications of phosphate and a fertilizer high in nitrogen. (Capability unit IVe–3, Loamy Upland range site)

Farnum fine sandy loam, 0 to 1 percent slopes (Fe).—This soil is slightly eroded. It occurs with Naron and Pratt soils, mainly in the northern part of the county. Its surface layer is fine sandy loam that has weak granular structure and is about 11 inches thick. The subsoil is sandy clay loam or clay loam that has blocky structure and is about 30 inches thick. The lower part of the subsoil contains brown mottles.

Included with this soil in mapping were small areas of Carwile fine sandy loam. Also included were small areas of Naron fine sandy loam, 0 to 1 percent slopes.

This Farnum soil absorbs moisture readily and has good water-holding capacity. It has a moderate supply of plant nutrients. Wind erosion is a severe hazard when this soil is not protected by a cover of plants or crop residue.

This soil is well suited to all the dryland crops commonly grown in the county. Most of the acreage is in wheat and sorghum. Stubble-mulch tillage and stripcropping can be used to give some protection from erosion, and those practices also help to conserve moisture. This is a suitable soil for leveling and irrigation. (Capability unit IIe–3, Sandy range site)

Farnum-Carwile complex (0 to 1 percent slopes) (Fw).—This soil complex consists primarily of Farnum and Carwile soils that occur in such an intricate pattern it was not feasible to separate them on the soil map. About 60 percent of the acreage is Farnum loam, 0 to 1 percent slopes; 30 percent is Carwile fine sandy loam; and 10 percent is Naron fine sandy loam, 1 to 3 percent slopes. The profile of the Farnum soil is similar to the one described for the Farnum series. A profile typical of the Carwile and Naron soils is described under the Carwile and Naron series. The soils are mainly in the northeastern part of the county. They are mostly nearly level and contain a few shallow depressions and low hummocks. The Farnum and Naron soils occupy the higher areas, and the Carwile soil is in the depressions.

Runoff and internal drainage are slow. During wet seasons, crops in some of the low areas are likely to be drowned. Stubble-mulch tillage conserves moisture and increases the absorption of moisture.

The soils of this complex are suited to all of the dryland crops and grasses commonly grown in the county. Most of the acreage is in wheat and grain sorghum. (Capability unit IIc–3, Loamy Upland and Sandy range sites)

Kanza Series

The Kanza series consists of dark-colored, somewhat poorly drained subirrigated soils that are nearly level. These soils are along streams throughout the county. They have formed in well-sorted windblown fine sands.

In most places the surface layer is dark grayish-brown loamy fine sand about 11 inches thick. It has weak granular structure, is slightly hard when dry and friable when moist, and is slightly acid. Beneath the surface layer is a layer of grayish-brown loamy fine sand that is 7 to 10 inches thick and is mottled with fine gray and brown spots. This layer is structureless, is soft when dry and very friable when moist, and is slightly acid. The substratum is light brownish-gray fine sand mottled with brown and gray spots. It is structureless, loose both when dry and when moist, and mildly alkaline.

Runoff and internal drainage are very slow. Permeability is rapid above the water table. The water table is at a depth of 1 to 3 feet during the cool seasons and at a depth of 5 to 7 feet during the warm seasons. During unusually wet seasons, it is occasionally near the surface.

The Kanza soils are well suited to range if they are properly managed. They are used mainly for range or for meadow from which hay is cut. The high water table and susceptibility to wind erosion make them unsuitable for cultivated crops.

Typical profile of Kanza loamy fine sand in range (700 feet south and 1,420 feet west of the northeast corner of sec. 31, T. 27 S., R. 11 W.):

A1—0 to 11 inches, dark grayish-brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) when moist; weak granular structure; slightly hard when dry, friable when moist; slightly acid; gradual boundary.

AC—11 to 18 inches, grayish-brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) when moist; common, fine, distinct, strong-brown (7.5YR 5/6) mottles; structureless; soft when dry, very friable when moist; slightly acid; gradual boundary.

C—18 to 40 inches, light brownish-gray (10YR 6/2) fine sand, grayish brown (10YR 5/2) when moist; common, coarse, distinct, strong-brown (7.5YR 5/6) and dark-gray (10YR 4/1) mottles; structureless; loose both when dry and when moist; mildly alkaline.

When the A1 horizon is dry, its color ranges from grayish brown to gray. In most places distinct mottles are within 15 inches of the surface. The reaction of the A1 horizon ranges from medium acid to slightly acid. The texture of the AC horizon ranges from sand to heavy loamy fine sand, and the texture of the C horizon ranges from fine sand to coarse sand and gravel.

In Pratt County the Kanza soils occur with Plevna soils and are mapped in soil complexes with those soils. They are at higher elevations and have a lower water table than the Plevna soils. The Kanza soils are noncalcareous and more sandy than the Waldeck soils, and they lack the subsoil of heavy clay that is typical of the Carwile soils. They are darker colored and have a higher water table than the Croft soils.

Kanza-Plevna complex (0 to 2 percent slopes) (Kp).—The soils of this complex occur mainly on second bottoms of permanent streams throughout the county. They are subirrigated and are somewhat poorly drained. The water table is normally at a depth of about 2 feet, but it rises to the surface during cool seasons. The complex consists mainly of areas of Kanza and Plevna soils that occur in such an intricate pattern it was impractical to separate them on the soil map. About 40 percent of the acreage consists of Kanza loamy fine sand; 35 percent, of Plevna fine sandy loam; and 15 percent, of soils similar to the Kanza but lighter colored and mottled at a greater depth. Another 10 percent consists of about equal parts of Waldeck fine sandy loam and Wet alluvial land. Profiles typical of the Plevna and Waldeck soils are described under their respective series.

Wetness caused by the high water table or by flooding makes these soils unsuitable for cultivation. Nearly all of the acreage is in range, but a few areas are in meadow from which hay is cut. The soils are the best in the county for range if they are properly grazed. The moisture supplied by subirrigation makes them well suited to meadow of native hay. (Capability unit Vw–1, Subirrigated range site)

Kaw Series

Deep, dark-colored, nearly level soils that are well drained make up the Kaw series. These soils are on narrow, smooth flood plains of intermittent streams in the uplands, mainly in the southern part of the county. They have formed in silty alluvium that is slightly acid to neutral.

In most places the surface layer is dark grayish-brown silt loam about 18 inches thick. It has granular structure, is slightly hard when dry and very friable when moist, and is slightly acid to neutral in reaction. Just beneath the surface layer is a layer of dark grayish-brown light silty clay loam that has granular structure and is about 22 inches thick. That layer, like the surface layer, is slightly hard when dry and very friable when moist, and it is slightly acid to neutral in reaction. The substratum is mainly brown heavy silt loam, but it contains thin layers of sand and clay in places. In some areas the substratum contains a few fine mottles. It has granular structure, is soft when dry and very friable when moist, and is neutral in reaction.

Kaw soils are moderately permeable and have good water-holding capacity. In the lower lying areas adjacent to intermittent streams, flooding is frequent. It is rare where these soils lie farther back from the streams.

The Kaw soils are well suited to all the dryland crops and grasses commonly grown in the county. About half of the acreage is in wheat and grain sorghum, and the rest is used for grazing or wildlife.

Typical profile of a Kaw silt loam that is cultivated (2,040 feet west and 1,000 feet north of the southeast corner of sec. 6, T. 29 S., R. 12 W.):

A11—0 to 18 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) when moist; strong, medium, granular structure; slightly hard when dry, very friable when moist; pH 6.5; clear, wavy boundary.

A12—18 to 40 inches, dark grayish-brown (10YR 4/2) light silty clay loam, very dark brown (10YR 2/2) when moist; strong, medium and coarse, granular structure; slightly hard when dry, very friable when moist; pH 6.5; clear, wavy boundary.

C—40 to 54 inches +, brown (10YR 5/3) heavy silt loam, dark brown (10YR 4/3) when moist; moderate, medium, granular structure; soft when dry, very friable when moist; pH 7.0.

The A11 horizon ranges from 15 to 25 inches in thickness. When that horizon is dry, its color ranges from dark gray to dark grayish brown. The texture is dominantly silt loam, but it is loam or light silty clay loam in places. The A12 horizon ranges from 15 to 25 inches in thickness. The soil material in the A12 horizon grades to that in the C horizon. The C horizon is at some depth between 30 and 50 inches.

Like the Zenda soils, the Kaw soils occur near streams, but they have a less clayey profile than the Zenda soils. Also, they are noncalcareous and are free of mottling.

Kaw silt loam (0 to 1 percent slopes) (Ks).—This is a nearly level soil on smooth flood plains, mainly in the southeastern part of the county along Sand Creek. It is slightly eroded, but its profile is similar to the one described for the series. Included in mapping were small areas of Tabler clay loam in small depressions.

Kaw silt loam has high natural fertility, is moderately permeable, and has good water-holding capacity. It has medium surface and internal drainage. In places occasional flooding occurs, but it is not extensive enough to cause severe damage.

This soil is well suited to all the dryland crops and grasses commonly grown in the county. Nearly all of the acreage is in wheat, grain sorghum, and alfalfa. Managing crop residue properly helps to keep the surface layer porous and increases the absorption of moisture. This soil is suitable for land leveling and flood irrigation. (Capability unit IIc–2, Loamy Terrace range site)

Kaw silt loam, frequently flooded (0 to 2 percent slopes) (Kw).—This soil occurs on flood plains, 150 to 300 feet wide, along intermittent streams throughout the southern half of the county. It occupies lower lying areas than Kaw silt loam and is more frequently flooded. The soil is nearly level and is slightly eroded. Its surface layer is about 16 inches thick, has weak granular structure, and is slightly acid to neutral in reaction. Just beneath the surface layer is a layer that is similar in most respects but generally has a texture of light silty clay loam.

Included with this soil in mapping were areas of soils that have thin layers of sandy and clayey soil material in the substratum. These included soils are in the beds of intermittent streams that have sloping banks as high as 3 to 6 feet in places.

About half of the acreage of this soil is in wheat and sorghum, and the rest is grazed or in meadow. This soil is suited to all the dryland crops and grasses commonly grown in the county. Flooding is the main hazard to growing crops, but it is beneficial to crops in years of low rainfall. When this soil is not protected by a cover of plants or crop residue, water erosion and wind erosion are minor hazards. Natural fertility is high, but crops grown on this soil respond to nitrogen fertilizer and phosphate. (Capability unit IIIw–2, Loamy Lowland range site)

Naron Series

The Naron series consists of deep, well-drained, moderately sandy soils of the uplands. These soils are mainly in the northern and eastern parts of the county. They are nearly level to moderately sloping or undulating and have formed in windblown material and old alluvium.

In most places the surface layer is dark grayish-brown fine sandy loam about 8 inches thick. It has granular structure, is soft when dry and friable when moist, and is generally medium acid. Beneath the surface layer is a layer of dark grayish-brown heavy fine sandy loam about 5 inches thick. The soil material in that layer has medium granular structure, is slightly hard when dry and very friable when moist, and is medium acid to slightly acid. The subsoil is brown light sandy clay loam about 25 inches thick. It has medium subangular blocky structure, is hard when dry and friable when moist, and is mildly alkaline. The substratum is brown fine sandy loam that is structureless, is slightly hard when dry and friable when moist, and is moderately alkaline.

These soils are moderately permeable and have good water-holding capacity. They are susceptible to wind erosion and water erosion when the surface is not protected by a cover of plants or crop residue.

The Naron soils are well suited to all the dryland crops and grasses grown in the county. They are mainly in wheat and grain sorghum.

Typical profile of a cultivated Naron fine sandy loam (1,065 feet north and 140 feet east of the southwest corner of sec. 34, T. 26 S., R. 13 W.):

A1—0 to 8 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; pH 6.0; clear, wavy boundary.

A3—8 to 13 inches, dark grayish-brown (10YR 4/2) heavy fine sandy loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, granular structure; slightly hard when dry, very friable when moist; pH 6.5; clear, wavy boundary.

B21t—13 to 23 inches, dark-brown (7.5YR 4/3) light sandy clay loam, dark brown (7.5YR 3/3) when moist; moderate, medium, subangular blocky structure; hard when dry, friable when moist; pH 7.5; gradual, wavy boundary.

B22t—23 to 38 inches, brown (7.5YR 5/3) light sandy clay loam, dark brown (7.5YR 4/3) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist; pH 7.5; gradual, wavy boundary.

C—38 to 60 inches, brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) when moist; single grain; slightly hard when dry, friable when moist; pH 8.0.

The A horizon ranges from fine sandy loam to loam in texture and from 6 to 12 inches in thickness. When that horizon is dry, its color ranges from dark brown to dark grayish brown. The texture of the B horizons ranges from heavy fine sandy loam to sandy clay loam. The B22t horizon is calcareous in places. In most places the C horizon has a texture of fine sandy loam, but its texture is more clayey in some places.

The Naron soils occur mainly with Pratt and Carwile soils, but they have a less sandy surface layer and subsoil than the Pratt soils. They have a less clayey subsoil than the Carwile and Farnum soils, and unlike those soils, they have a subsoil that is generally free of mottling. The Naron soils lack the reddish colors that are typical of the Shellabarger soils.

Naron fine sandy loam, 0 to 1 percent slopes (Nd).—This soil is mainly in the central part of the county. It is slightly eroded, but its surface layer is about 10 inches thick in most places. Wind has sifted out the finer particles in the surface layer in some areas and has left on the surface a layer of loamy fine sand 2 to 4 inches thick. The subsoil is heavy fine sandy loam or sandy clay loam that has faint mottles in places. Included with this soil in mapping were small areas of Farnum fine sandy loam, 0 to 1 percent slopes.

This Naron soil is subject to erosion by wind if it is not protected by a growing crop or crop residue. It is well suited to all of the dryland crops and grasses commonly grown in the county, and nearly all of the acreage is in wheat and sorghum. Stubble-mulch tillage conserves moisture and helps to prevent soil blowing by keeping plant residue near the surface. In places stripcropping is also needed to control soil blowing during dry seasons. This soil is suited to land leveling for flood irrigation. Crops grown on it respond to applications of nitrogen fertilizer and phosphate. (Capability unit IIe-3, Sandy range site)

Naron fine sandy loam, 1 to 3 percent slopes (Nf).—This soil is mainly in the north-central, northeastern, and southeastern parts of the county. It is gently sloping or gently undulating and is slightly eroded. The surface layer is generally about 8 inches thick and has a texture of fine sandy loam. In some areas, however, wind has sifted out the finer particles and the texture is now loamy fine sand to a depth of 2 to 5 inches. Included in mapping were small areas of Farnum loam, 1 to 3 percent slopes; Pratt loamy fine sand, undulating; and Carwile fine sandy loam.

This Naron soil is subject to erosion by water and wind if it is not protected by a cover of plants or crop residue. In many places terraces and contour farming are needed to help to control water erosion. The gently undulating areas, however, are not suitable for terraces. In those places stripcropping and stubble-mulch tillage can be used to help control erosion.

This soil is well suited to all the grasses and dryland crops commonly grown in the county. Nearly all of the acreage is in wheat and sorghum. The crops respond to applications of nitrogen fertilizer and phosphate. (Capability unit IIIe-2, Sandy range site)

Naron fine sandy loam, 3 to 6 percent slopes (Ng).—This soil is mainly in the north-central and northeastern parts of the county. It is moderately sloping or moderately undulating and is slightly eroded. The profile is similar to the one described for the series, but the surface layer is only 6 to 8 inches thick and is slightly acid.

If this soil is kept in good tilth, it readily absorbs water. Much of the water from rainfall is lost, however, because it runs off the steeper slopes. This soil is subject to erosion when the surface is bare. Needed practices are terracing and contour tillage. Contour tillage and tillage that leaves plant residue on or near the surface help to protect the soil from erosion and conserve moisture.

This soil is suited to all the dryland crops and grasses commonly grown in the county. Nearly all of the acreage is in wheat and sorghum. The crops respond to applications of nitrogen fertilizer and phosphate. (Capability unit IIIe-2, Sandy range site)

Naron loam, 0 to 1 percent slopes (Nk).—This nearly level soil is mainly in the west-central part of the county. It is slightly eroded. The surface layer is about 12 inches thick, has granular structure, and is friable and easily tilled. It is slightly acid. The subsoil has a texture of sandy clay loam and has weak blocky structure. Included with this soil in mapping were small areas of Farnum loam, 0 to 1 percent slopes, and Carwile fine sandy loam.

This Naron soil is used mainly for wheat and sorghum, but it is suited to all the dryland crops and grasses commonly grown in the county. The structure is favorable for cropping, and this soil contains a moderate amount of plant nutrients and responds well to good management. It is susceptible to wind erosion, however, when it is not protected by a cover of plants or crop residue. Stubble-mulch tillage that leaves ample crop residue on the surface is a good practice for conserving moisture and helping to control erosion. The crops respond to applications of nitrogen fertilizer and phosphate. The slopes are smooth and are suitable for leveling for irrigation. (Capability unit IIc-1, Loamy Upland range site)

Naron loam, 1 to 3 percent slopes (Nm).—This gently sloping or gently undulating soil is mainly in the west-central and central parts of the county. It is slightly eroded. The surface layer is about 11 inches thick and is slightly acid. The subsoil is neutral in reaction.

Included with this soil in mapping were small areas of Naron fine sandy loam, 1 to 3 percent slopes, and of Farnum loam, 1 to 3 percent slopes. Also included were minor areas of Carwile fine sandy loam.

This Naron soil is moderately permeable and has good water-holding capacity. It is subject to further erosion by water.

This soil is well suited to all the dryland crops and grasses commonly grown in the county. Nearly all of the acreage is in wheat and sorghum. Terraces, contour farming, and stubble-mulch tillage increase the rate of infiltration and help to control erosion. Where this soil contains enough moisture, crops grown on it respond to applications of nitrogen fertilizer and phosphate. (Capability unit IIe-1, Loamy Upland range site)

Naron-Farnum complex (0 to 3 percent slopes) (Nn).—This soil complex is composed primarily of Naron fine sandy loam, 1 to 3 percent slopes, and Farnum loam, 0 to 1 percent slopes. The Naron soil makes up about 55 percent of the acreage, and the Farnum soil, about 35 percent. Carwile fine sandy loam makes up an additional 7 percent, and Clark fine sandy loam, 1 to 3 percent slopes, makes up about 3 percent. Profiles typical of the Farnum, Carwile, and Clark soils are described under the respective series.

The soils of this complex are gently undulating and occur mainly in the northeastern part of the county near Preston. The Naron soil is on knolls, and the Farnum soil is in the areas between the knolls. The Carwile and Clark components occupy small patches throughout the complex. The soils are slightly eroded and are subject to further erosion by water and wind.

These soils are well suited to all the dryland crops and grasses commonly grown in the area. Nearly all of the acreage is in wheat and sorghum. Stripcropping and stubble-mulch tillage will help to control erosion and conserve moisture. In most places the crops respond to applications of nitrogen fertilizer and phosphate. (Capability unit IIIe-2, Sandy and Loamy Upland range sites)

Ost Series

Deep, well-drained, nearly level or gently sloping soils that have a dark-colored surface layer and a highly calcareous subsoil are in the Ost series. These soils occur mainly in the southwestern part of the county around drainageways. They have formed on uplands in highly calcareous outwash sediment.

The surface layer is dark-gray clay loam about 9 inches thick. It has granular structure, is hard when dry and friable when moist, and is slightly acid. The subsoil is brown to light yellowish-brown clay loam about 13 to 14 inches thick. It has subangular blocky structure and is very hard when dry and firm to friable when moist. The upper part of the subsoil is neutral in reaction. The lower part is calcareous and contains concretions of soft lime. The substratum is pale-brown clay loam that has weak subangular blocky structure and is hard when dry and friable when moist. It is strongly calcareous. From 15 to 75 percent of the substratum, by volume, is soft lime.

Permeability is moderately slow, and the water-holding capacity is good. Natural fertility is moderate or moderately high.

The Ost soils are well suited to all the dryland crops and grasses commonly grown in the county. Nearly all of the acreage is in wheat and sorghum, but some of the sloping areas have been reseeded to native grasses.

Typical profile of a cultivated Ost clay loam (2,345 feet south and 50 feet east of the northwest corner of sec. 22, T. 28 S., R. 15 W.):

A1—0 to 9 inches, dark-gray (10YR 4/1) light clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine, granular structure; hard when dry, friable when moist; pH 6.5; clear, wavy boundary.

B2t—9 to 14 inches, brown (10YR 5/3) clay loam, dark brown (10YR 3/3) when moist; strong, medium, subangular blocky structure; hard when dry, firm when moist; thin, patchy clay films; pH 7.0; clear, wavy boundary.

B22tca—14 to 23 inches, light yellowish-brown (10YR 6/4) clay loam, dark brown (10YR 4/3) when moist; strong, medium, subangular blocky structure; very hard when dry, friable when moist; thin, patchy clay films; calcareous, and contains a few soft concretions of calcareous material; gradual, wavy boundary.

C—23 to 60 inches, pale-brown (10YR 6/3) clay loam, dark brown (10YR 4/3) when moist; weak, coarse, subangular blocky structure to nearly massive; hard when dry, friable when moist; calcareous; about 25 percent, by volume, is soft calcium carbonate.

The A horizon ranges from 6 to 14 inches in thickness. When dry, it ranges from dark gray to brown in color. The B horizons range from 8 to 16 inches in combined thickness. When dry, they range from brown to dark grayish brown in color. Depth to the horizon where lime is concentrated ranges from 12 to 24 inches.

The Ost soils occur with Clark soils but have a thicker surface layer, and their surface layer is noncalcareous. They have a less clayey subsoil than the Bethany soils and also have lime nearer the surface.

Ost clay loam, 0 to 1 percent slopes (Oc).—This nearly level soil occurs in small patches throughout the southwestern part of the county. It is slightly eroded. Its surface layer is about 12 inches thick, has granular structure, and is slightly acid to neutral in reaction. The surface layer grades to the subsoil, which has a texture of clay loam and is about 16 inches thick. The subsoil has subangular blocky structure and has soft lime in the lower part. Included in mapping were small areas of Bethany silt loam, 0 to 1 percent slopes, and Clark clay loam, 0 to 1 percent slopes.

This Ost soil has good water-holding capacity, but it does not absorb water well when the surface is bare. Natural fertility is moderate.

Nearly all of the acreage is in wheat and grain sorghum. Stubble-mulch tillage should be practiced to keep the soil porous and to prevent crusting and sealing of the surface soil. The crops respond to applications of nitrogen fertilizer and phosphate if the amount of soil moisture is adequate. (Capability unit IIc-4, Loamy Upland range site)

Ost clay loam, 1 to 4 percent slopes (Os).—This soil is on uplands, mainly in the southwestern part of the county. It is slightly eroded. The profile is similar to the one described for the series.

Included with this soil in mapping were small areas of Clark clay loam, 1 to 4 percent slopes. Also included were areas of Bethany silt loam, 1 to 3 percent slopes, and Bethany silty clay loam, 1 to 4 percent slopes, eroded.

This Ost soil is susceptible to water erosion when it is not protected by a cover of plants or plant residue, but it is suited to all of the dryland crops and grasses commonly grown in the county. Nearly all of the acreage is in wheat and sorghum, but some of the stronger slopes have been reseeded to native grasses. The crops respond to applications of nitrogen fertilizer and phosphate. Terraces and contour farming are needed to conserve moisture and to help to control erosion. Stubble-mulch tillage is also needed to keep this soil porous and to increase the absorption of water. (Capability unit IIIe-3, Loamy Upland range site)

Plevna Series

The Plevna series consists of dark-colored, poorly drained, nearly level soils on low terraces along streams. In places these wet soils are in depressions. They have formed in alluvium that in many places is more sandy below a depth of about 3 feet than above that depth.

In most places the surface layer is dark-gray fine sandy loam about 10 inches thick. It has weak granular structure, is soft when dry and very friable when moist, and is mildly alkaline. Beneath the surface layer is a layer, about 7 inches thick, of dark-gray fine sandy loam that has moderate granular structure, is slightly hard when dry and very friable when moist, and is moderately alkaline. The subsoil is gray fine sandy loam, about 23 inches thick, that is mottled with brown or strong brown. It is massive (structureless), is hard when dry and very friable when moist, and is moderately alkaline. The substratum is pale-brown fine sand that is structureless and is loose both when dry and when moist. The upper part of the substratum is mottled with strong brown.

Runoff is slow or very slow. Permeability is moderately rapid, but the water table is only 1½ to 3 feet below the surface during much of the growing season. It rises to within a few inches of the surface during wet seasons, however, and drops to a depth of about 4 feet late in summer and early in fall.

The Plevna soils are used chiefly for range and for meadow from which hay is cut. If they are properly managed, they produce large amounts of forage.

Typical profile of Plevna fine sandy loam in range (600 feet west and 20 feet north of the southeast corner of sec. 30, T. 27 S., R. 11 W.):

A11—0 to 10 inches, dark-gray (10YR 4/1) fine sandy loam, black (10YR 2/1) when moist; weak, medium, granular structure; soft when dry, very friable when moist; abundant grass roots; mildly alkaline; clear, smooth boundary.

A12—10 to 17 inches, dark-gray (10YR 4/1) fine sandy loam, very dark gray (10YR 3/1) when moist; few, medium, distinct mottles of strong brown (7.5YR 5/6); moderate, fine, granular structure; slightly hard when dry, very friable when moist; abundant grass roots; moderately alkaline; gradual, smooth boundary.

Bg—17 to 40 inches, gray (10YR 6/1) fine sandy loam, dark gray (10YR 4/1) when moist; common, medium, distinct mottles of strong brown (7.5YR 5/6) and brown (10YR 5/3); massive; hard when dry, very friable when moist; roots plentiful to a depth of about 24 inches, but few below that depth; moderately alkaline; gradual boundary.

IIC—40 to 60 inches, pale-brown (10YR 6/3) fine sand, brown (10YR 5/3) when moist; few, fine, faint mottles of strong brown in uppermost 10 inches of soil material; single grain; loose both when dry and when moist; moderately alkaline.

When the A11 horizon is dry, its color ranges from gray through very dark grayish brown. The A11 horizon ranges from 4 to 12 inches in thickness. In most places its texture is fine sandy loam or sandy loam, but it is loamy fine sand in places. Reaction throughout the profile ranges from neutral to moderately alkaline. In some places where flooding has occurred, the soil material is calcareous to a depth of a few inches. Below a depth of about 20 inches, the soil material is moderately calcareous and contains a few concretions of lime in places. In some areas the porous, sandy material of the IIC horizon is at a depth of only 24 inches. In others, soil material of more clayey texture is below a depth of 40 inches.

The Plevna soils occur with Kanza soils but have a less sandy surface layer and subsoil than those soils. In Pratt County they are mapped only in a complex with Kanza soils. The Plevna soils have poorer drainage and are more mottled than the Waldeck soils and are less sandy and have poorer drainage than the Croft soils.

Pratt Series

The Pratt series consists of deep, sandy soils that are well drained and are undulating to hummocky. These soils have formed in windblown sands on uplands, mainly in the northern half of the county.

In most places the surface layer is grayish-brown loamy fine sand about 9 inches thick. It is structureless, is loose both when dry and when moist, and is medium acid. The subsoil is generally brown loamy fine sand that is about 32 inches thick. It contains more particles of clay than the surface layer and holds together better. It is soft when dry and very friable when moist and is slightly acid. The substratum is light yellowish-brown loamy fine sand that is structureless, is loose when dry and very friable when moist, and is slightly acid to neutral.

Runoff is slow, and internal drainage is medium. The content of organic matter is low. These soils are highly susceptible to wind erosion.

The Pratt soils are suited to all the dryland crops and grasses commonly grown in the county. About 80 percent of the acreage is in wheat and grain sorghum, and the rest is in range.

Typical profile of a cultivated Pratt loamy fine sand (2,260 feet west and 450 feet north of the southeast corner of sec. 29, T. 26 S., R. 14 W.):

A1—0 to 9 inches, grayish-brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) when moist; single grain; loose both when dry and when moist; pH 6.0; clear, wavy boundary.

B21t—9 to 22 inches, brown (10YR 5/3) heavy loamy fine sand, dark brown (10YR 3/3) when moist; weak, very fine, granular structure; soft when dry, very friable when moist; contains a few bands, about a quarter of an inch wide, of clay-coated sand grains; pH 6.5; gradual, irregular boundary.

B22t—22 to 41 inches, brown (10YR 5/3) loamy fine sand, dark brown (10YR 4/3) when moist; single grain; soft when dry, very friable when moist; pH 7.0; gradual, wavy boundary.

C—41 to 63 inches +, light yellowish-brown (10YR 6/4) loamy fine sand; yellowish brown (10YR 5/4) when moist; single grain; soft when dry, loose when moist; pH 7.0.

The A horizon ranges from 6 to 14 inches in thickness. When dry, it ranges from dark grayish brown to brown in color. The B horizons range from 20 to 35 inches in combined thickness and from light fine sandy loam to loamy fine sand in texture. When dry, the B horizons range from brown to yellowish brown in color. The texture of the C horizon ranges from loamy fine sand to fine sand.

The Pratt soils occur with Naron, Carwile, and Tivoli soils. They have a more sandy subsoil than the Naron and Carwile soils and have a darker and thicker surface layer and a less sandy subsoil than the Tivoli soils.

Pratt loamy fine sand, undulating (3 to 8 percent slopes) (Pm).—This soil is on the uplands. It is mainly in the northern half of the county, but some small areas are in the southeastern part. Erosion has been slight to moderate. The profile is similar to the one described for the series. The subsoil is light fine sandy loam or loamy fine sand.

Included with this soil in mapping were a few small areas of Pratt loamy fine sand, hummocky, and Carwile fine sandy loam. Also included were minor areas of Naron fine sandy loam, 1 to 3 percent slopes.

This Pratt soil is susceptible to severe wind erosion when it is not protected by a cover of plants or crop residue. Wind erosion damages the crops and causes the soil material to pile up along fence rows and to drift onto roads and into ditches. Natural fertility is moderately low. The content of available organic matter is low. The organic matter is soon depleted if this soil is not well managed.

This soil is suited to most of the dryland crops and grasses commonly grown in the county, and nearly all of the acreage is in wheat and grain sorghum. If enough moisture is available, the crops respond to applications of nitrogen fertilizer and phosphate. Stubble-mulch tillage (fig. 7) and stripcropping are practices that help to protect this soil from blowing. On several farms in the county, sorghum has been used to form a wind barrier, one row

Figure 7.—**Stubble-mulch tillage in a field of Pratt loamy fine sand, undulating.**

wide, that protects the soils. Growing vetch, peas, rye, and other crops for use as green manure increases the amount of crop residue and adds organic matter. (Capability unit IIIe-1, Sands range site)

Pratt loamy fine sand, hummocky (8 to 12 percent slopes) (Pn).—This is a sandy, slightly to moderately eroded soil on uplands, mainly in the northern half of the county. In most respects it is similar to Pratt loamy fine sand, undulating, but it is steeper and occurs in rougher areas on hummocks that are higher and more peaked. Because of wind erosion, the surface layer is thinner than that of Pratt loamy fine sand, undulating, and it is lighter colored in some places. In most places the surface layer is about 8 inches thick, but it is less than 6 inches thick in some places. The subsoil is about 25 inches thick. It has a texture of loamy fine sand but grades to the light yellowish-brown fine sand of the substratum. Included in mapping were small areas of Pratt loamy fine sand, undulating.

Because of the strong slopes and severe hazard of wind erosion, Pratt loamy fine sand, hummocky, is not well suited to cultivated crops. Cultivated crops can be grown, however, if careful management is used so that soil blowing is controlled. Even so, this soil should be kept in grasses or legumes most of the time. Nearly all of the acreage was formerly cultivated, but about 30 percent of it has been reseeded to grass. Where this soil is used for cultivated crops, stripcropping can be practiced and crop residue left near the surface. Wheat is the main crop, and this soil is well suited to it. Wheat can be rotated with vetch or peas that will provide cover and maintain the content of organic matter. Natural fertility is moderate, but crops respond to applications of nitrogen fertilizer and phosphate. (Capability unit IVe-1, Sands range site)

Pratt-Carwile complex (3 to 8 percent slopes) (Po).—This soil complex is composed mainly of Pratt loamy fine sand, undulating, and Carwile fine sandy loam. About 55 percent of the acreage consists of the Pratt soil, about 30 percent consists of the Carwile soil, and 15 percent consists of small areas of Naron fine sandy loam, 1 to 3 percent slopes. The Carwile soil is nearly level. The soils are on uplands, mainly in the northern half of the county. The Pratt soil is on hummocks, and the Carwile soil is in the low areas between the hummocks. The Naron soil occupies the lower ends of the slopes that border areas of the Pratt soil. All of the soils are slightly eroded.

The profiles of the soils in this complex are similar to the ones described for their respective series, but they are more variable in characteristics. In some fields the surface layer of the Pratt soil ranges from light fine sandy loam to loamy fine sand. Also, the soils in some areas have some characteristics of both the Carwile and Pratt soils.

Runoff is very slow. Excess water drains onto the low areas of Carwile soils and stands for long periods. Because the areas are undulating, draining the low spots is generally not feasible.

The soils of this complex are suited to all the dryland crops and grasses commonly grown in the area, and nearly all of the acreage is in wheat and sorghum. The soils are subject to wind erosion, and a cover of plants or of crop residue is needed to prevent soil blowing. Stubble-mulch tillage and stripcropping are effective practices for helping to control wind erosion. These soils are moderately fertile, but crops grown on them respond to applications of nitrogen fertilizer and phosphate. (Capability unit IIIe-1, Sands and Sandy range sites)

Pratt-Tivoli loamy fine sands (8 to 15 percent slopes) (Pt).—This soil complex consists mainly of areas of Pratt loamy fine sand, hummocky, and of Tivoli loamy fine sand. These soils occur in such an intricate pattern that it was not feasible to separate them on the soil map. The Pratt soil occupies about 50 percent of the acreage; the Tivoli soil, about 20 percent; and Tivoli fine sand, an additional 5 percent. The rest of the acreage consists of soils that have some characteristics of both the Pratt soil and of Tivoli fine sand. The Pratt soil is on the lower hummocks. The Tivoli soils, which are steeper than the Pratt, are on the peaks of the hummocks.

The Pratt soil and the Tivoli fine sand have profiles similar to the ones described for their respective series. Tivoli loamy fine sand has a grayish-brown surface layer that is about 6 inches thick, is structureless, and is loose both when dry and when moist. Beneath the surface layer is a layer of brown loamy fine sand that is about 12 inches thick and has structure and consistency like those of the surface layer. The substratum is pale-brown, structureless fine sand.

Because the soils of this complex occur in rough areas and are susceptible to severe wind erosion, they are not suited to cultivated crops. Most of the acreage is in range consisting of native grasses, but about 10 percent is in rye pasture, forage sorghum, and wheat. Erosion is difficult to control in the cultivated areas. Therefore, reseeding the cultivated areas to suitable native grasses is desirable. Good range management is needed. (Capability unit VIe-2, Sands range site)

Sandy Breaks-Alluvial Land Complex

Sandy breaks-Alluvial land complex (7 to 15 percent slopes) (Sa) consists of small valleys cut into smoother uplands along the upper reaches of intermittent streams. The valleys have moderately steep or broken side slopes.

The width of the valley floors ranges from 50 to 750 feet, but it is generally less than 100 feet. In fact, it is between 10 and 50 feet in most places.

The soils of the valley slopes have a surface layer of fine sandy loam to loamy sand and a subsoil of sandy loam to sandy clay loam. They make up about 70 percent of the soil complex. The rest of the complex consists of soils on the valley floors. Those soils formed in alluvium that ranges from sand to clay loam in texture.

If the soils of this complex are properly managed, they support good stands of native grass. The soils are well suited to use for range and wildlife areas, and nearly all of the acreage is used for those purposes. The meandering stream channels have isolated some areas that would be suitable for cultivated crops, except for their small size and inaccessibility. The soils of the valley side slopes are too steep for cultivation. In the areas used for range, good range management is needed. (Capability unit VIe-3, Sandy and Loamy Lowland range sites)

Shellabarger Series

Deep, reddish, moderately sandy soils that are well drained and nearly level to strongly sloping make up the Shellabarger series. These soils are on uplands, mainly in the eastern half of the county. They have formed from reddish, noncalcareous, moderately sandy outwash sediment.

In most places the surface layer is dark-brown fine sandy loam about 11 inches thick. It has weak granular structure, is slightly hard when dry and friable when moist, and is medium acid. The subsoil is reddish-brown to yellowish-red light sandy clay loam to sandy loam about 39 inches thick. It generally has subangular blocky structure, is hard when dry and friable when moist, and is medium acid to slightly acid. The substratum is slightly acid to neutral sandy loam or sand and gravel. It is loose both when dry and when moist.

These soils are moderately permeable but are underlain by rapidly permeable sand and gravel. They have good water-holding capacity but are susceptible to erosion by both water and wind if they are cultivated and are not protected.

The Shellabarger soils are well suited to all the dryland crops and grasses commonly grown in the county. Except for some of the strongly sloping areas, nearly all of the acreage is cultivated. Wheat and sorghum are the main crops.

Typical profile of a cultivated Shellabarger fine sandy loam (845 feet east and 75 feet north of the southwest corner of sec. 20, T. 27 S., R. 12 W.):

A1—0 to 11 inches, dark-brown (7.5YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, granular structure; slightly hard when dry, friable when moist; pH 5.8; clear, smooth boundary.

B21t—11 to 21 inches, reddish-brown (5YR 4/3) light sandy clay loam, dark reddish brown (5YR 3/3) when moist; weak, fine, subangular blocky structure; hard when dry, friable when moist; pH 6.0; gradual, wavy boundary.

B22t—21 to 34 inches, reddish-brown (5YR 5/4) light sandy clay loam, reddish brown (5YR 4/4) when moist; moderate, medium, subangular blocky structure; hard when dry, friable when moist; pH 6.5; gradual, wavy boundary.

B3—34 to 50 inches, yellowish-red (5YR 5/5) sandy loam, yellowish red (5YR 4/5) when moist; weak, fine, granular structure; soft when dry, very friable when moist; pH 7.4; gradual, wavy boundary.

IIC—50 to 60 inches, yellow (10YR 7/6) sand and some fine gravel, yellowish brown (10YR 5/6) when moist; single grain; loose both when dry and when moist; pH 7.0.

The A horizon ranges from 6 to more than 16 inches in thickness. When dry, it is dark grayish brown to brown. The B horizons range from 25 to 40 inches in combined thickness, from brown or reddish brown to yellowish red in color, and from heavy sandy loam to sandy clay loam in texture. Depth to sand and gravel ranges from 36 to 50 inches.

The Shellabarger soils occur with Albion and Farnum soils. They are deeper over sand and gravel than the Albion soils and have a less clayey subsoil than the Farnum soils. Shellabarger soils are somewhat similar to the Naron soils, but they have a more reddish, more acid subsoil and a coarser textured substratum.

Shellabarger fine sandy loam, 0 to 1 percent slopes (Sb).—This soil occupies small patches in the uplands, mainly in the eastern part of the county. It is slightly eroded. The profile is similar to the one described for the series, but the surface layer is slightly thicker. It is generally about 12 inches thick but is more than 16 inches thick in some places. The subsoil is heavy sandy loam to sandy clay loam about 36 inches thick. Included with this soil in mapping were a few small areas of Farnum loam, 0 to 1 percent slopes, and Naron fine sandy loam, 0 to 1 percent slopes.

This nearly level Shellabarger soil absorbs water well and has good water-holding capacity. It is well drained and has moderate natural fertility.

This soil is well suited to all the dryland crops and grasses commonly grown in the county. Nearly all of the acreage is in wheat and sorghum. Soil blowing is a hazard when the soil is not protected by a growing crop or crop residue. Stubble-mulch tillage and stripcropping are practices needed to help to control wind erosion. Good management of crop residue also helps to improve the soil structure, improves soil tilth, and reduces evaporation. The crops respond to applications of nitrogen fertilizer and phosphate. (Capability unit IIe-3, Sandy range site)

Shellabarger fine sandy loam, 1 to 4 percent slopes (Se).—This soil is on uplands, mainly in the eastern half of the county, but small areas occur around drainageways in the southern part. Slight erosion has taken place, but the profile is similar to the one described for the series. Included in mapping were small areas of Naron fine sandy loam, 1 to 3 percent slopes; Albion sandy loam, 1 to 4 percent slopes; and Farnum loam, 1 to 4 percent slopes.

This soil is mostly in wheat and sorghum, but it is well suited to all the dryland crops and grasses commonly grown in the area. Water erosion is a serious hazard when protection is not provided by a cover of plants or by crop residue. Terraces and contour farming can be used to help to control erosion when this soil is bare. Stubble-mulch tillage helps to increase the absorption of water and reduces evaporation. If this soil contains enough moisture, the crops grown on it respond to applications of fertilizer. (Capability unit IIIe-2, Sandy range site)

Shellabarger fine sandy loam, 3 to 7 percent slopes, eroded (Sf).—This moderately sloping soil is on uplands in the eastern and southern parts of the county. It is mainly on long side slopes bordering drainageways. Moderate water erosion has taken place. Therefore, the present surface layer is only about 8 inches thick in many places and is less than 6 inches thick in much of the acreage. Tillage has mixed material from the subsoil with that in the surface layer, and as a result, the texture of the present surface layer ranges from fine sandy loam to light sandy clay loam. Included with this soil in mapping were small areas of Albion sandy loam, 3 to 7 percent slopes, eroded, and of Shellabarger fine sandy loam, 1 to 4 percent slopes.

Shellabarger fine sandy loam, 3 to 7 percent slopes, eroded, is moderately low in natural fertility and is too eroded and sloping to be well suited to cultivated crops grown year after year. All of the acreage has been cultivated, but native grasses have been reseeded in about 25 percent of the acreage. Grasses or legumes should be seeded in the rest of the acreage. It would be desirable to keep this soil out of cultivation permanently or to cultivate it only 1 year out of 4. Where cultivated crops are grown, terraces, contour farming, and good management of crop residue are needed to increase the absorption of moisture and to help to control erosion. Crops grown on this soil respond to applications of nitrogen fertilizer and phosphate. (Capability unit IVe-2, Sandy range site)

Tabler Series

The Tabler series consists of deep, moderately well drained, nearly level soils that have a subsoil of heavy silty clay. These soils are on uplands and generally occur in small patches throughout the county. They have formed in outwash sediment of calcareous clay and heavy clay loam.

In most places the surface layer is dark-gray clay loam about 9 inches thick. It is slightly hard when dry and friable when moist. The subsoil is very dark gray silty clay about 30 to 32 inches thick. It has weak blocky structure in the upper part and is nearly structureless (massive) in the lower part. The subsoil is very firm when moist and extremely hard when dry and is slightly acid to neutral. The substratum is grayish-brown, calcareous silty clay that contains small concretions of lime. It is massive and is very firm when moist and extremely hard when dry.

Runoff is slow, and permeability is very slow. These soils have good water-holding capacity and high natural fertility.

The Tabler soils are suited to dryland crops and grasses. Nearly all of the acreage is cultivated and is used to grow wheat and grain sorghum.

Typical profile of a cultivated Tabler clay loam (2,440 feet north and 200 feet east of the southwest corner of sec. 31, T. 28 S., R. 12 W.):

A1—0 to 9 inches, dark-gray (10YR 4/1) clay loam, black (10YR 2/1) when moist; moderate, fine, granular structure; slightly hard when dry, friable when moist; pH 6.0; abrupt, smooth boundary.

B2t—9 to 31 inches, very dark gray (10YR 3/1) silty clay, black (10YR 2/1) when moist; weak, fine and medium, blocky structure; extremely hard when dry, very firm when moist; thick, continuous clay films; few concretions of manganese dioxide; pH 6.5; clear, smooth boundary.

B3t—31 to 41 inches, dark-gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) when moist; few, faint, brown mottles; weak, coarse, blocky structure to massive; extremely hard when dry, very firm when moist; thin, patchy clay films; pH 7.5; gradual, irregular boundary.

C—41 to 55 inches, grayish-brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) when moist; few, faint, strong-brown mottles; massive; extremely hard when dry, very firm when moist; calcareous, and contains a few hard concretions of lime.

The A horizon ranges from 6 to 12 inches in thickness. When it is dry, its color ranges from dark grayish brown to dark gray. The B horizons range from 20 to 40 inches in combined thickness and from very dark gray to gray in color. The texture of the C horizon ranges from clay or silty clay to heavy clay loam.

In most places the Tabler soils occur with Bethany soils, but they have a thinner surface layer and a grayer, more clayey subsoil than the Bethany soils. The Tabler soils are less sandy than the Carwile soils and have a more compact, less limy subsoil than the Ost soils.

Tabler clay loam (0 to 1 percent slopes) (Ta).—This is the only Tabler soil mapped in Pratt County. It is in low spots in the uplands throughout the county. The profile is the one described for the series. The surface layer is sticky when wet, and a crust forms when the soil dries. In places the subsoil has concretions of lime in the lower part. Included in mapping were small areas of Bethany silt loam, 0 to 1 percent slopes.

Permeability is very slow. At times, water stands on the surface for several weeks.

This soil is well suited to all the dryland crops and grasses commonly grown in the county. Nearly all of the acreage is in wheat and grain sorghum. Surface drainage is needed in places, and good management of crop residue is needed to keep the surface layer porous and to help to prevent crusting. Stubble-mulch tillage and plowing crops under as green manure help to improve the structure of the surface layer and increase the absorption of water. The crops respond to nitrogen fertilizer and phosphate if the normal amount of rainfall has been received. (Capability unit IIs-1, Clay Upland range site)

Tivoli Series

The Tivoli series consists of deep, sandy, excessively drained soils formed in sand that was deposited by wind. These soils are in duny areas in the northwestern part of the county.

The surface layer is brown fine sand about 6 inches thick. It is structureless, is loose both when dry and when moist, and is slightly acid. Beneath the surface layer is the substratum of light yellowish-brown fine sand. The substratum is structureless, is loose both when dry and when moist, and is slightly acid.

The Tivoli soils have very rapid permeability, very rapid internal drainage, and low water-holding capacity. They are susceptible to severe wind erosion. Blowouts are common.

These soils are mainly in range (fig. 8). A few small areas were formerly cultivated but have mostly been reseeded to native grasses.

Typical profile of Tivoli fine sand in native grass (400 feet west and 100 feet south of the northeast corner of sec. 9, T. 27 S., R. 15 W.):

A1—0 to 6 inches, brown (10YR 5/3) fine sand, dark brown (10YR 3/3) when moist; single grain; loose both when dry and when moist; pH 6.5; gradual, wavy boundary.

C—6 to 60 inches +, light yellowish-brown (10YR 6/4) fine sand, dark yellowish brown (10YR 4/4) when moist; single grain; loose both when dry and when moist; pH 6.5.

Figure 8.—**Cattle grazing on rangeland of Tivoli fine sand. The grasses are mainly sand bluestem and little bluestem.**

The texture of the A1 horizon ranges from fine sand to loamy fine sand. When dry, the A1 horizon is brown to yellowish brown.

The Tivoli soils occur mainly with Pratt soils. Their surface layer is thinner than that of the Pratt soils. Also, they lack a B horizon and have a more sandy substratum.

Tivoli fine sand (12 to 25 percent slopes) (Tf).—This is a sandy, moderately to severely eroded soil in duny areas in the northwestern part of the county. The areas contain blowouts that range from ½ acre to 3 acres in size. The profile is the one described for the series. The surface layer is only slightly darker than the substratum. Included in mapping were small areas of Tivoli loamy fine sand.

Tivoli fine sand is too steep and susceptible to wind erosion to be suitable for cultivated crops, and nearly all of the acreage is in range. Erosion cannot be controlled when the surface is bare. Therefore, the cover of range plants needs to be protected by use of good management practices that include proper grazing, stabilizing blowouts, and reseeding native grasses in some places. (Capability unit VIIe-1, Choppy Sands range site)

Waldeck Series

The Waldeck series consists of dark-colored, somewhat poorly drained soils that are nearly level and are moderately sandy. These soils are on low terraces along the Ninnescah River. They have formed in moderately sandy, calcareous alluvium and are calcareous throughout.

In most places the surface layer is dark grayish-brown fine sandy loam about 15 inches thick. It has granular structure and is soft when dry and very friable when moist. Just beneath the surface layer is a layer of grayish-brown fine sandy loam that contains some faint, brown mottles and is about 9 inches thick. This layer has granular structure and is slightly hard when dry and very friable when moist. The subsoil is light brownish-gray fine sandy loam about 22 inches thick. It is structureless and is hard when dry and very friable when moist. The subsoil contains many mottles that are strong brown or gray. The substratum is pale-brown fine sand that is structureless and is loose both when dry and when moist. It contains some thin layers of coarse sand.

Runoff and internal drainage are both slow, but permeability above the water table is moderately rapid. The water table is generally rather high.

The Waldeck soils are used mostly for wheat, sorghum, and alfalfa. A small acreage is in range or in meadow from which hay is cut.

Typical profile of a cultivated Waldeck fine sandy loam (2,540 feet north and 2,270 feet west of the southeast corner of sec. 34, T. 27 S., R. 11 W.) :

A1—0 to 15 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) when moist; weak granular structure; soft when dry, very friable when moist; calcareous; gradual boundary.

A3—15 to 24 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) when moist; a few, faint, brown mottles in the lower 2 inches of soil material; weak, medium, granular structure; slightly hard when dry, very friable when moist; calcareous; gradual boundary.

B2—24 to 46 inches, light brownish-gray (10YR 6/2) fine sandy loam, grayish brown (10YR 5/2) when moist; common, medium, distinct, strong-brown (7.5YR 5/6, dry) mottles and a few gray (10YR 6/1, dry) mottles; calcareous; diffuse boundary.

IIC—46 to 60 inches, pale-brown (10YR 6/3) fine sand, brown (10YR 5/3) when moist; single grain; loose both when dry and when moist; contains thin layers of coarse sand and gravelly sand; calcareous.

When dry, the A horizon ranges from dark brown to gray in color. In some places these soils are noncalcareous to a depth of no more than 12 inches, but they are generally calcareous throughout. Depth to mottling ranges from 15 to 24 inches, and depth to the fine sand in the substratum ranges from 24 to about 60 inches. In some places the texture of the subsoil is heavy fine sandy loam. Mottling is at some depth between 15 and 24 inches.

The Waldeck soils generally occur with Zenda soils, but they have a more sandy subsoil than the Zenda soils. Normally, the Waldeck soils have a lower water table than the Plevna soils. They have a less clayey subsoil than the Carwile soils, and unlike the Carwile soils, they are calcareous.

Waldeck fine sandy loam (0 to 2 percent slopes) (Wa).—This is the only Waldeck soil mapped in Pratt County. It is mainly on low terraces along the Ninnescah River, and it is occasionally flooded when the river overflows. Slight erosion has taken place.

In most places the profile is like the one described for the series, but the subsoil is heavy fine sandy loam in places and is only about 22 inches thick in some areas. In some areas the subsoil is underlain by a layer of mottled fine sandy loam that contains more sandy material in places. Included in mapping were small areas of Zenda clay loam and Plevna fine sandy loam.

The surface layer is porous and absorbs water easily. The water table is generally 2 to 5 feet beneath the surface, but it rises to the surface when the level of the stream is high. When the stream overflows, this soil is occasionally flooded.

This soil is well suited to all the field crops and grasses commonly grown in the county. Nearly all of the acreage is in wheat, sorghum, and alfalfa, and most of the crops, especially legumes, benefit from the high water table or subirrigation. Wind erosion is a hazard when this soil is not protected by a cover of plants or by crop residue. Stubble-mulch tillage helps to provide the necessary cover to prevent soil blowing when the surface is not protected by a growing crop. Natural fertility is moderately high, but good response is generally obtained if nitrogen fertilizer and phosphate are applied. This soil contains enough lime to meet the needs of crops. When this soil is not in cultivated crops, it supports good stands of native tall grasses. (Capability unit IIIw–1, Subirrigated range site)

Wet Alluvial Land

Wet alluvial land (0 to 1 percent slopes) (Wd) is a miscellaneous land type in low areas on the flood plains of the Ninnescah River and other permanent streams. The soil material is loamy and is dark gray. Near the surface it has a texture of fine sandy loam to clay loam, is calcareous, and is streaked in many places with lime or salts. Beneath this soil material is sand to heavy clay loam. The soil material is strongly mottled and is normally saturated with water. During some seasons, the water table rises to the surface.

This land type is too wet to be suitable for cultivated crops, but it is suited to use as range and for wildlife areas. In the main, it supports a good growth of tall grasses, but about 10 to 15 percent of the acreage is covered with cattails, rushes, and sedges. (Capability unit VIw–1, Wet Land range site)

Zenda Series

The Zenda series consists of dark-colored, calcareous soils that are somewhat poorly drained. These soils are on low terraces, mainly along the Ninnescah River and along branches of Elm Creek, which is mainly in Barber County. They have formed in moderately fine textured alluvium.

In most places the surface layer is dark-gray clay loam about 14 inches thick. It has granular structure, is hard when dry and friable when moist, and is neutral to calcareous in reaction. The subsoil is grayish-brown, calcareous clay loam to a depth of about 38 inches and is mottled with strong brown and gray. It has granular structure, is very hard when dry and firm when moist, and contains many fine concretions of soft lime. The lower part of the subsoil is light brownish-gray, calcareous, massive heavy clay loam that contains coarse or medium, strong-brown mottles and fine, gray spots. It is very hard when dry and very firm when moist and contains some concretions of soft lime.

Permeability is moderate. The water table is normally within about 4 feet of the surface, but it fluctuates and rises to within 2 feet of the surface during wet seasons. The roots of most crops extend downward to the water table.

The Zenda soils are well suited to wheat, sorghum, legumes, and grasses. They are chiefly in wheat and alfalfa.

Typical profile of a cultivated Zenda clay loam (1,840 feet north and 2,490 feet east of the southwest corner of sec. 36, T. 27 S., R. 12 W.):

A1—0 to 14 inches, dark-gray (10YR 4/1) clay loam, very dark brown (10YR 2/2) when moist; moderate, medium, granular structure; hard when dry, friable when moist; neutral; clear, smooth boundary.

B1—14 to 22 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) when moist; a few, fine, faint, yellowish-brown (10YR 5/6) mottles in the lower part; moderate, coarse, granular structure; hard when dry, friable when moist; many fine concretions of soft lime, and soil mass is calcareous throughout; gradual, smooth boundary.

B2ca—22 to 38 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) when moist; a few, fine, distinct, strong-brown (7.5YR 5/6) and gray (N 5/0) mottles; weak, coarse, granular structure; very hard when dry, firm when moist; calcareous and contains many fine masses of segregated lime; diffuse boundary.

B3—38 to 52 inches, light brownish-gray (10YR 6/2) heavy clay loam, grayish brown (10YR 5/2) when moist; common, medium, distinct, strong-brown (7.5YR 5/6) mottles, and a few, faint, gray (5Y 5/1) mottles; massive; very hard when dry, very firm when moist; calcareous, and contains a few concretions of soft lime.

The A horizon ranges from 10 to 20 inches in thickness. When it is dry, its color ranges from brown to dark gray. The texture of this horizon is normally clay loam, but it is fine sandy loam or loam in some spots. The texture of the B horizons ranges from sandy clay loam to clay loam. Depth to distinct mottling ranges from 18 to 30 inches.

In most places the Zenda soils occur with Waldeck soils. They have a more clayey profile and a lower water table than the Waldeck soils. Unlike the Kaw soils, the Zenda soils are calcareous and contain distinct mottles.

Zenda clay loam (0 to 1 percent slopes) (Ze).—This nearly level soil is on low terraces along branches of Elm Creek and the Ninnescah River. Its surface layer is about 10 inches thick and is dark gray when dry and very dark grayish brown when moist.

Included with this soil in mapping were a few small areas of Waldeck fine sandy loam. Also included were areas of a soil that has some characteristics both of this soil and of Waldeck fine sandy loam.

In local areas and small spots within some fields, this soil is moderately to strongly saline. Water puddles in some low areas.

This soil is well suited to small grains, sorghum, legumes, and grasses, but most of the acreage is in wheat and alfalfa. The large amount of lime and the high water table make this soil desirable for growing alfalfa and sweetclover. A good practice is to keep much of the crop residue near the surface when tilled crops are grown. The crop residue increases the absorption of moisture and keeps the surface porous to help prevent puddling. Small amounts of a nitrogen fertilizer and phosphate are needed in some fields that have been intensively cropped. The small amount of salts does little damage to crops that are commonly grown. (Capability unit IIw–1, Subirrigated range site)

Zenda-Slickspots complex (0 to 2 percent slopes) (Zs).—This soil complex consists primarily of Zenda clay loam and of Slickspot soils that have been affected by salts. About 50 percent of the acreage is Zenda clay loam, about 25 percent is Slickspot soils, and 5 percent is Waldeck fine sandy loam. The rest consists of soils that have some characteristics of both the Zenda and Slickspot soils. These soils are mainly gently sloping and are on terraces along the Ninnescah River and Rattlesnake Creek.

The Zenda soil has a profile similar to the one described for the series. The Slickspot soils have a surface layer 3 to 8 inches thick. Their surface layer ranges from sandy loam to silty clay loam in texture. It puddles when wet, and the uppermost 1 inch of soil material is light colored and is crusted when dry. The subsoil ranges from sandy clay loam to light silty clay in texture and is 8 to 12 inches thick. It has a grayish or brownish color, is mottled in places, and is massive or has weak blocky structure.

Sometimes the water table is at a depth of about 3 feet, but at other times it rises to the surface. In many places these soils occur in low spots where they receive water that seeps out from the side slopes. The content of salts is high, and internal drainage is slow.

Wheat, grain sorghum, and alfalfa are grown on much of the acreage, though these soils are not well suited to them. Alfalfa grows well, but establishing a good stand is difficult. Barley, sorghum, and rye, which are moderately tolerant of salts, grow fairly well, but wheat is less tolerant of salts and the stand is generally thin and spotty. Some areas of Slickspot soils are bare. Working crop residue into the surface layer of these soils is desirable because it improves the soil structure and helps to prevent puddling. (Capability unit IVs-1, Saline Subirrigated range site)

Use and Management of Soils

The soils of Pratt County are used mostly for dryland farming and range. This section explains how the soils can be managed for these main purposes and gives the predicted yields of the principal dryland crops. In addition, it describes irrigation in this county; explains how the soils can be managed as range, for windbreaks, and for wildlife habitat; and discusses suitability of the soils for building highways, dikes or levees, and other engineering structures.

In discussing management of the soils for dryland crops, range, and wildlife, the procedure is to describe groups of soils that have similar uses and that require similar management, and then to suggest management suitable for the group. The soils in each group are listed in the "Guide to Mapping Units" at the back of this soil survey.

Management of Soils for Crops [1]

In Pratt County erosion by wind and water have taken a heavy toll of the readily available plant nutrients in the soils. The content of organic matter has been reduced to about ½ to ⅓ of the original level, and many of the soil aggregates have been broken down into unstable units. A decrease in the amount of water that is absorbed by the soils, an increase in the amount and rapidity of runoff, and an increase in the requirements for power have resulted.

Where crops are grown, the amount of minerals has declined so much that nitrate and phosphate are required in all but a few areas of the soils. Grain sorghum and wheat that are grown on sandy soils, such as the Pratt, Naron, Shellabarger, and Albion, respond to applications of potash, and lime is also needed on some of the soils. In only small areas of poorly drained soils is alkalinity a limitation to growing crops. Probably more serious are the losses of soil material sustained by the soils themselves as the result of erosion. Those losses are mentioned in the descriptions of the individual mapping units.

Pratt, Naron, Shellabarger, Albion, and other sandy soils are generally more susceptible to wind erosion than are clayey soils, such as the Bethany, Farnum, Tabler, and Ost. They are less susceptible to water erosion, however, because they are more friable and open. They absorb more water from rainfall than clayey soils, and less water runs off to cause erosion. In Pratt County the soils in roughly one-third of the acreage used for crops, that is, in about 100,000 acres, have a sandy surface layer that is eroded.

[1] MILTON E. SAFFRY, conservation agronomist, Soil Conservation Service, Salina, Kans., assisted in the preparation of this section.

Wind is the main factor that has caused erosion in those areas. Water has been the primary factor that has caused erosion in about 252,000 acres.

Successful practices for controlling water erosion are terraces, contour farming, waterways, and diversions. Practices that help to control wind erosion are stripcropping, growing a cover crop, and emergency tillage. Managing crop residue by practicing stubble mulching and properly using crop residue; choosing a cropping system that conserves moisture and protects the soils; keeping tillage to a minimum; and applying the proper kinds and amounts of fertilizer all help to control both water erosion and wind erosion. They also help to improve the general soil structure, tilth, and crop-producing potential of the soils. Good management consists of one or of a combination of these practices.

Plants need large amounts of nitrogen, phosphorus, and potassium. They need smaller amounts of additional minor elements, for example, copper, zinc, iron, sulfur, boron, manganese, cobalt, calcium, molybdenum, and magnesium. Present yields indicate that the soils of Pratt County are not limited by lack of these minor elements. Field trials and soil tests that are conducted by a qualified laboratory will indicate the kinds and amounts of elemental fertilizer needed.

Capability Groups of Soils

Capability classification is the grouping of soils to show, in a general way, their suitability for most kinds of farming. It is a practical classification based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment. The classification does not apply to most horticultural crops, or to rice and other crops that have their special requirements. The soils are classified according to degree and kind of permanent limitations, but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soils; and without consideration of possible but unlikely major reclamation projects.

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 grouping, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. Classes are defined as follows:

Class I. (None in Pratt County). Soils have few limitations that restrict their use.

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

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

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

Class V. Soils subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife food and cover.

Class VI. Soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife food and cover.

Class VII. Soils have very severe limitations that make them unsuited to cultivation and restrict their use largely to grazing, woodland, or wildlife.

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

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation; (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c* 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 subclasses indicated by *w*, *s*, and *c*, because the soils in it are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe–1 or IIIw–1. Thus, in one symbol, the Roman numeral designates the capability class or degree of limitation, and the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph. The Arabic numeral specifically identifies the capability unit within each subclass.

In the following pages, the capability units of Pratt County are described and suggestions for the use and management of the soils are given. The names of soil series represented are mentioned in the description of each capability unit, but this does not mean that all the soils of a given series appear in the unit. To find the names of all of the soils in any given capability unit, refer to the "Guide to Mapping Units" at the back of this soil survey.

CAPABILITY UNIT IIe–1

Naron loam, 1 to 3 percent slopes, is the only soil in this capability unit. It is on uplands and is deep, friable, and gently sloping or gently undulating. The surface layer is loam that has granular structure. The subsoil is moderately permeable sandy clay loam.

Roots, water, and air easily penetrate this soil, but water erosion is a hazard when the surface is bare. The surface sometimes seals over after a hard rain.

This soil is well suited to the field crops commonly grown in the county, and it is also well suited to grasses and trees. Wheat and sorghum are the main crops. Proper management of crop residue is needed to conserve moisture and to provide protection from erosion. Terraces are also needed in places to help to control erosion, or farming can be done on the contour. Stubble-mulch tillage helps to control wind erosion and increases the rate at which water is taken in. Crops benefit from applications of commercial fertilizer, especially nitrogen and phosphorus.

CAPABILITY UNIT IIe–2

This capability unit consists of deep, dark-colored, gently sloping soils of the uplands. These soils are in the Bethany and Farnum series. They have a surface layer of silt loam or loam and a subsoil of clay loam or firm clay.

Permeability is moderate, and these soils have good water-holding capacity. They are moderately well supplied with organic matter and plant nutrients. The soils are easily penetrated by roots, water, and air, but their surface sometimes seals over during rainstorms when it is not protected by crop residue or a cover of plants. Then, excessive runoff and serious erosion result.

The soils of this unit are well suited to wheat, grain sorghum, and all the other crops commonly grown in the county. A suitable cropping system includes sweetclover or some other legume. Terracing and contour farming help to control water erosion. Managing crop residue properly is essential for increasing the infiltration of water, reducing soil losses from erosion, and improving soil tilth. Stubble-mulch tillage is also effective in conserving moisture and helping to control erosion. Crops benefit from applications of commercial fertilizer, especially nitrogen and phosphorus.

CAPABILITY UNIT IIe–3

This capability unit consists of deep, nearly level soils of the Farnum, Naron, and Shellabarger series. These soils have a surface layer of fine sandy loam and a subsoil of sandy clay loam and clay loam.

Permeability is moderate, and the soils are easily penetrated by roots, water, and air. They are subject to wind erosion.

The soils of this unit are well suited to wheat, sorghum, and all the other crops commonly grown in the county. A suitable cropping system includes sweetclover or some other legume. Crop residue needs to be managed properly, and commercial fertilizer should be added according to the requirements of the crop to be grown. Stubble-mulch tillage, stripcropping, and minimum tillage are effective in controlling wind erosion.

CAPABILITY UNIT IIw–1

Zenda clay loam is the only soil in this capability unit. It is a nearly level soil, mainly on terraces along the Ninnescah River and branches of Elm Creek, and it is deep, dark colored, and somewhat poorly drained. Both the surface layer and the subsoil have a texture of clay loam. The subsoil is calcareous.

Natural fertility and permeability are moderate. The water table is normally at a depth of about 4 feet, but it fluctuates and sometimes rises to within 2 feet of the surface. In places the wetter areas contain a few saline spots. Improving drainage and maintaining the content of organic matter and the supply of plant nutrients are the main management needs.

This soil is well suited to wheat, sorghum, alfalfa, and sweetclover. It is also suited to grasses and all the other crops commonly grown in the county. Needed practices are proper management of crop residue and shallow ditch drainage. In intensively cropped fields, crops also benefit from small applications of commercial fertilizer, especially nitrogen and phosphorus.

CAPABILITY UNIT IIw-2

Carwile fine sandy loam is the only soil in this capability unit. It is nearly level and occurs in depressions in some places. The surface layer is fine sandy loam, and the finer textured part of the subsoil is mottled clay.

Permeability is slow, and drainage is somewhat poor. Surface drainage is needed in places. During wet weather, water is sometimes ponded on the surface and remains for several days. Planting and harvesting are often delayed, and crops are sometimes drowned. Wind erosion is also a hazard whenever this soil lacks a protective cover.

Wheat and sorghum are the main crops, but this soil is suited to all the field crops and grasses commonly grown in the county. Stripcropping, growing a cover crop, and practicing stubble-mulch tillage increase the infiltration of water and reduce wind erosion during critical periods. Fertilizer is also needed to maintain fertility. In places surface drainage needs to be improved by installing shallow ditches.

CAPABILITY UNIT IIs-1

Tabler clay loam is the only soil in this capability unit. It is a deep, dark-colored, moderately well drained, nearly level soil in low spots in the uplands. The surface layer is clay loam, and the subsoil is dense silty clay not easily penetrated by roots, water, and air.

This soil has high natural fertility and good water-holding capacity. Very slow permeability and slow runoff are the main hazards when crops are grown. When the subsoil begins to dry, it does not release much moisture to plants.

This soil is suited to all the crops commonly grown in the county. Wheat and sorghum are the main crops, but wheat grows better than sorghum because it matures before the dry season in fall. Incorporating crop residue into the surface soil during tillage helps to conserve moisture, increases the absorption of water, and improves soil tilth. Crops also benefit from applications of fertilizer, especially nitrogen and phosphorus. In places shallow drainage ditches are needed to improve surface drainage.

CAPABILITY UNIT IIc-1

The only soil in this capability unit is Naron loam, 0 to 1 percent slopes. It is well drained and nearly level, and it occurs on the uplands. The surface layer is loam that has granular structure. The subsoil is sandy clay loam that has weak subangular blocky structure.

This soil has moderate permeability and is easily penetrated by roots, water, and air. The surface seals over after hard rains, however, if it is not protected by a cover of plants or by crop residue. Natural fertility is high, and crops do well when enough moisture is available. Lack of moisture from precipitation is the chief hazard when field crops are grown. In places wind erosion is a hazard when this soil is dry and is not protected by a cover of plants or crop residue.

This soil is suited to all the crops commonly grown in the county, but wheat and sorghum are the main crops. Good management of crops residue is needed, as well as a cropping system that provides cover during critical periods when wind erosion usually occurs. Crops benefit from applications of commercial fertilizer, especially nitrogen and phosphorus.

CAPABILITY UNIT IIc-2

Kaw silt loam is the only soil in this capability unit. It is a deep, well-drained, nearly level soil on terraces along intermittent streams. The surface layer is silt loam that has granular structure. The subsoil is friable silt loam or light silty clay loam.

This soil is moderately permeable, has good water-holding capacity, and has high natural fertility. It is easily penetrated by roots, water, and air. Lack of moisture from precipitation is the main hazard when crops are grown. Occasional flooding is also a hazard, but flooding does not occur frequently enough to be especially damaging to crops or the soil.

This soil is well suited to all the crops commonly grown in the county, but wheat and sorghum are the main crops. Managing crop residue properly and keeping tillage to a minimum are needed practices. Crops benefit from applications of commercial fertilizer.

CAPABILITY UNIT IIc-3

This capability unit consists of deep, dark-colored, nearly level Bethany and Farnum soils, as well as Carwile soils of the Farnum-Carwile complex. These soils are mainly on uplands. In most places the surface layer is loam or silt loam, but the Carwile soil has a surface layer of fine sandy loam. The texture of the subsoil ranges from sandy clay loam to clay.

Permeability is generally moderate, but the Carwile soil has slow permeability. Lack of moisture is likely to limit yields, though all of the soils have high water-holding capacity. Wind erosion is a hazard if these soils are not protected by a cover of plants or crop residue. The surface of the Bethany soil seals over after a hard rain unless it is protected by a cover of plants or crop residue.

The soils of this unit are well suited to wheat, sorghum, and other crops commonly grown in the county. Crop residue needs to be well managed, and tillage should be kept to a minimum to conserve moisture, increase the infiltration of water, and improve soil tilth. Crops also benefit from applications of commercial fertilizer.

CAPABILITY UNIT IIc-4

This capability unit consists of deep, well-drained, nearly level Clark and Ost soils of the uplands. The surface layer is dark-colored clay loam, and the subsoil is a highly calcareous clay loam.

These soils have moderately slow permeability and moderate natural fertility. Their subsoil contains a large amount of lime, but it is friable and is easily penetrated by roots, water, and air. Lack of moisture is likely to limit yields, though the soils have good water-holding capacity. Droughtiness and wind erosion are hazards during dry periods. Unless the surface of these soils is protected by a cover of plants or crop residue, it sometimes crusts after hard rains.

These soils are well suited to wheat and legumes, but sorghum grown on them is likely to be affected by chlorosis because of the large amount of lime. A suitable cropping system includes a legume. Crop residue, properly managed, helps to conserve moisture and to increase the absorption of water. It also improves soil tilth and helps to protect the soil from wind erosion. Crops benefit from applications of commercial fertilizer.

CAPABILITY UNIT IIIe-1

This capability unit consists of deep, mostly sandy, undulating Pratt and Carwile soils of the uplands. The surface layer is loamy fine sand or fine sandy loam, and the subsoil is loamy fine sand to clay.

These soils are well drained to somewhat poorly drained and have moderately rapid to slow permeability. They generally absorb all the water from rainfall. Except for the low areas where water sometimes stands on the surface, however, the Pratt soils do not hold a large amount of water. In most places the content of organic matter is low, and these soils are moderately low in natural fertility. Wind erosion is a serious hazard when the soils are not adequately protected by a cover of plants or crop residue. The soils of this unit are suited to wheat and grain sorghum, but they are susceptible to wind erosion and require careful management (fig. 9). Incorporating crop residue into the surface layer or leaving it on the surface is effective in helping to control wind erosion. Stubble-mulch tillage is also a good practice because it keeps crop residue on the surface throughout most of the year. Practicing stripcropping and growing a cover crop or a crop as green manure are other good practices, for they help to prevent soil losses from erosion, maintain or increase the content of organic matter, and conserve moisture. Crops also benefit from applications of commercial fertilizer.

CAPABILITY UNIT IIIe-2

This capability unit consists of deep, gently sloping to moderately sloping soils of the Naron and Shellabarger series, as well as soils of the Naron-Farnum complex. These soils are on uplands. In most places they have a surface layer of fine sandy loam, but the Farnum soil has a surface layer of loam. The subsoil is sandy clay loam to clay loam.

Permeability is moderate, and these soils are easily penetrated by roots, water, and air. They are moderately low in content of organic matter but have high water-holding capacity. Excessive runoff and serious water erosion are hazards, and wind erosion is a hazard when the surface is dry and is not protected by a cover of plants or crop residue.

These soils are well suited to all the crops commonly grown in the county, but wheat and sorghum are the main crops. Terraces and contour farming are needed to help to control water erosion and conserve moisture. On some complex slopes where terraces are not feasible, stubble-mulch tillage is effective for controlling erosion and conserving moisture. Other good practices consist of managing crop residue well, keeping tillage to a minimum, and applying the proper kinds and amounts of commercial fertilizer.

Figure 9.—**Wide spacing of sorghum rows to control wind erosion on Pratt loamy fine sand, undulating.**

CAPABILITY UNIT IIIe-3

This capability unit consists of deep, dark-colored, calcareous soils of the Clark and Ost series. These soils are gently sloping or gently undulating and are on the uplands. The surface layer is clay loam or fine sandy loam that has granular structure and is neutral in reaction or is calcareous. It is underlain by a highly calcareous subsoil.

Permeability is moderate, water-holding capacity is good, and natural fertility is moderately high. Water erosion is a serious hazard, however, unless these soils are properly managed. These soils are readily penetrated by roots, water, and air, but the surface tends to seal over during hard rains, and runoff then becomes excessive. Wind erosion is also a hazard unless the surface layer is protected by a cover of plants or crop residue.

These soils are well suited to wheat and legumes, but sorghum is likely to be affected by chlorosis, because of the large amount of lime. Terracing and contour farming are necessary to help to control erosion. Good management of crop residue and use of a cropping system that includes a legume are other practices that help to conserve moisture and increase the absorption of water. Sweetclover is a good cover crop for these soils when other crops do not supply an adequate cover. Even though the soils are limy, sweetclover grows well, and it adds needed organic matter.

CAPABILITY UNIT IIIe-4

Only Farnum loam, 3 to 6 percent slopes, a deep, moderately sloping soil on knolls and around drainageways in the uplands is in this capability unit. It has a surface layer of loam and a subsoil of clay loam.

Permeability is moderate, and this soil is easily penetrated by roots, water, and air. It has good water-holding capacity and moderately high natural fertility. Water erosion is a serious hazard because of the strong slopes.

This soil is suited to all the crops commonly grown in the county, but wheat and sorghum are the crops generally grown. Terraces and contour farming are needed to help to control water erosion. Needed practices are good management of crop residue and choice of a cropping system that consists mostly of legumes and grasses. Another suitable practice is stubble-mulch tillage, which is effective in conserving moisture and increasing the infiltration of water.

CAPABILITY UNIT IIIe-5

Bethany silty clay loam, 1 to 4 percent slopes, eroded, is the only soil in this capability unit. It is a deep, gently sloping soil on knobs and side slopes around upland drainageways. The surface layer is silty clay loam, and the subsoil is compact clay.

This soil has moderate natural fertility and good water-holding capacity, but water erosion has removed much of the original surface layer. The present surface layer is thin, is low in content of organic matter, and tends to seal over during hard rains. As a result, runoff is excessive, and serious erosion is a hazard.

This soil is suited to all the crops commonly grown in the county, but wheat and sorghum are the main crops. Good management consists of terracing, farming on the contour, keeping tillage to a minimum, and using crop residue properly. Crops benefit from applications of commercial fertilizer, especially nitrogen and phosphorus.

CAPABILITY UNIT IIIw-1

Waldeck fine sandy loam is the only soil in this capability unit. It is a moderately sandy, nearly level, calcareous soil on low terraces along the Ninnescah River. Both the surface layer and the subsoil have a texture of fine sandy loam.

Natural fertility is moderately high, but drainage is somewhat poor and the water table fluctuates between depths of 2 and 5 feet. Occasional flooding and the fluctuating high water table are hazards when this soil is used for crops. Wind erosion is also a hazard when the surface is not protected by a cover of plants or crop residue.

This soil is suited to wheat, sorghum, and alfalfa, but good management of crop residue is needed. A suitable cropping system is one that provides a cover crop for the soil throughout the year. Stubble-mulch tillage is another good management practice that helps to control wind erosion. Crops benefit from applications of commercial fertilizer, especially nitrogen and phosphorus.

CAPABILITY UNIT IIIw-2

Kaw silt loam, frequently flooded, is the only soil in this capability unit. It is a deep, dark-colored, well-drained, nearly level soil on flood plains of intermittent streams. The surface layer is silt loam, and the underlying material is silt loam or silty clay loam. Both the surface layer and the underlying material have granular structure.

This soil is moderately permeable, has good water-holding capacity, and has high natural fertility. It is easily penetrated by roots, water, and air. Extra water is received as runoff from the uplands. As a result, frequent flooding is a hazard.

This soil is well suited to wheat and sorghum. A suitable cropping system is needed that protects the soil from silting or washing. Diversion terraces can be used, where feasible, to give protection from flooding. Managing crop residue properly is another good management practice, and crops also benefit from applications of commercial fertilizer, especially nitrogen and phosphorus.

CAPABILITY UNIT IVe-1

Pratt loamy fine sand, hummocky, is the only soil in this capability unit. It is deep and sandy, and it occupies hummocks in the uplands. Both the surface layer and the subsoil are loose and have a texture of loamy fine sand.

Permeability is moderately rapid, and the water-holding capacity is low. Though rainfall is easily absorbed, not much of the moisture is retained by the subsoil. Wind erosion is a serious hazard whenever this soil is not protected.

This soil is suited to the native grasses. It is not well suited to field crops, but it can be used for them. A cover of plants or crop residue needs to be on the surface at all times. If cultivated crops are grown, crop residue needs to be well managed, a cover crop grown, and tillage kept to a minimum. Stripcropping and stubble-mulch tillage help to control wind erosion. The grasses and field crops benefit from applications of commercial fertilizer, especially nitrogen and phosphorus.

CAPABILITY UNIT IVe-2

This capability unit consists of deep, moderately sandy, gently sloping or moderately sloping soils of the Albion and Shellabarger series. These soils are on the uplands. They have a surface layer of sandy loam or fine sandy loam, a subsoil of sandy clay loam, and a gravelly substratum.

Permeability is moderate, but the water-holding capacity, the content of organic matter, and the natural fertility are low. Water erosion and wind erosion are serious hazards.

Cultivated crops can be grown on these soils if suitable practices are used to control erosion by water and wind. Including grasses and legumes in the cropping system helps to protect the soils. Terraces and contour farming are needed to help to control water erosion. Managing crop residue properly, growing a cover crop, and practicing stubble-mulch tillage help to control wind erosion. Crops benefit from applications of commercial fertilizer.

CAPABILITY UNIT IVe-3

Farnum clay loam, 3 to 6 percent slopes, eroded, is the only soil in this capability unit. It is a deep, moderately sloping, moderately eroded soil around drainageways and on knolls in the uplands. Both the surface layer and the subsoil have a texture of clay loam.

This soil is moderately permeable, has good water-holding capacity, and is easily penetrated by roots, water, and air. Water erosion is a serious hazard, however, if cultivated crops are grown. Wind erosion is also a hazard when this soil is dry and is not protected by some kind of cover.

This soil is not well suited to cultivated crops. The surface layer is thin and is likely to seal over during rains. Then, excessive runoff and water erosion occur. If cultivated crops are grown, terraces, contour farming, and good management of crop residue are needed to help to control water erosion. A cropping system consisting of grasses and legumes grown most of the time is essential. Effective practices that conserve moisture and that help to protect against erosion are minimum tillage and stubble-mulch tillage. Crops also benefit from applications of commercial fertilizer, especially nitrogen and phosphorus.

CAPABILITY UNIT IVe-4

Case-Clark complex, 3 to 7 percent slopes, is the only mapping unit in this capability unit. It consists of light-colored, calcareous, moderately sloping soils on knolls and around drainageways. Past erosion has removed much of the original surface layer, and part of the highly calcareous underlying material is mixed with the surface soil when this soil is tilled. The present surface layer is calcareous clay loam. It is underlain by highly calcareous clay loam.

These soils are moderately permeable, are well drained, and have good water-holding capacity. They are easily penetrated by roots, water, and air, but further water erosion is a serious hazard.

The soils of this capability unit are not well suited to field crops and need to be kept in native grasses and used as range. A cultivated crop can be grown occasionally if good management is used. Terracing, farming on the contour, and managing crop residue properly are practices needed to help to control water erosion. A cropping system consisting largely of grasses and legumes is needed. Other good management practices are keeping tillage to a minimum and growing a cover crop. Crops benefit from applications of commercial fertilizer, especially nitrogen and phosphorus.

CAPABILITY UNIT IVs-1

Zenda-Slickspots complex is the only mapping unit in this capability unit. It consists of deep, dark-colored, nearly level soils that have been affected by salts. Both the surface layer and the subsoil have textures ranging from sandy loam to clay loam.

These soils are somewhat poorly drained and have a high water table that fluctuates between a depth of 2 feet and the surface. They contain salts that rise to the surface during dry weather and leave on the surface white and gray spots, called Slickspots. Salinity and somewhat poor drainage are the main limitations to use of these soils for farming.

These soils are better suited to native grasses than to field crops, and they need to be kept in range. If cultivated crops are grown, barley, rye, sorghum, and other crops that are moderately tolerant of salts are suitable. Wheat is less tolerant of salts than most other crops, and the stand is generally thin and spotty. The soils need proper management of crop residue, and they need cover crops turned under as green manure. These practices improve the structure of the surface layer and add organic matter. Drainage is generally impractical.

CAPABILITY UNIT Vw-1

Kanza-Plevna complex is the only mapping unit in this capability unit. It consists of deep, wet, nearly level soils on second bottoms along permanent streams. The surface layer and the subsoil have a texture of fine sandy loam to loamy fine sand.

These soils are somewhat poorly drained and have a high water table that fluctuates between a depth of 2 feet and the surface. They are too wet for cultivation but are suitable for range, woodland, and wildlife. Wind erosion is a hazard in areas that are overgrazed.

These soils support good stands of tall native grasses. If management is good, yields of forage are generally the highest of any in the county.

CAPABILITY UNIT VIe-1

Case-Clark complex, 7 to 15 percent slopes, on uplands, makes up this capability unit. The soils are light colored and are highly calcareous. They have a surface layer of light loam to clay loam. The underlying material has a texture of clay loam and contains a large amount of lime.

These soils have moderate permeability and good water-holding capacity. They are easily penetrated by roots, water, and air, but severe water erosion is a hazard if cultivated crops are grown.

The soils are suitable for range but are not suitable for cultivation. Suitable native grasses should be seeded in the areas still used for cultivated crops. Proper range management is needed to produce adequate grass for livestock and a cover for the soils.

CAPABILITY UNIT VIe-2

This capability unit consists of deep, sandy, gently sloping or hummocky soils of the Croft, Pratt, and Tivoli series. The soils have a surface layer of loamy fine sand and a subsoil also of loamy fine sand, or they are underlain by sandy and gravelly material. They are on uplands and on terraces along the major streams. Permeability is moderately rapid or rapid, and these soils have low water-holding capacity, though they absorb water easily. The soils are susceptible to severe wind erosion when they are cultivated and are not protected by a cover of plants or crop residue.

These soils are not suitable for cultivated crops but are suitable for range. They need to have adapted native grasses seeded in areas that are still cultivated. Grazing must be controlled to prevent soil blowing and the growth of undesirable vegetation.

CAPABILITY UNIT VIe-3

This capability unit consists of moderately sandy, moderately sloping to strongly sloping Albion and Shellabarger soils, and of areas of Sandy breaks and Alluvial land. The soils are adjacent to drainageways.

These soils are moderately permeable and are easily penetrated by roots, water, and air. They have low water-holding capacity and are low in natural fertility. Runoff and water erosion are excessive if these soils are used for cultivated crops.

These soils can be used for range but are not suited to cultivated crops. Areas now in cultivation need to be reseeded to suitable native grasses and good rangeland management practiced.

CAPABILITY UNIT VIw-1

Wet alluvial land is the only mapping unit in this capability unit. It consists of dark-colored, wet, loamy soil material and occurs in depressions or low areas on the flood plains of the Ninnescah River and other permanent streams. The soil material near the surface is fine sandy loam to clay loam. Beneath it is clay loam to sand.

The water table is high and rises to the surface during some seasons of the year. Flooding is frequent.

Flooding and the high water table make this land type too wet for cultivated crops. The land is suited to use for range, however, and can be used as areas for wildlife. In areas that are well managed, as much as 85 percent of the cover of plants consists of tall native grasses, and the rest of the cover consists of cattails, rushes, and sedges. Information about use of this land type for range is given under the Wet Land range site in the section "Range Management."

CAPABILITY UNIT VIIe-1

Tivoli fine sand is the only soil in this capability unit. It is deep, sandy, and steep and occurs on dunes in the northwestern part of the county. Both the surface layer and the underlying material have a texture of fine sand.

This soil has very rapid permeability and low water-holding capacity. It is loose and noncoherent and contains only a small amount of organic matter. Wind erosion is a serious hazard when the surface is bare. Blowouts quickly occur if the grass is overgrazed, or where the soil material from adjacent fields drifts across the top of the dunes.

This soil is too susceptible to wind erosion to be suitable for cultivation. It is suited to use as range, but grazing must be controlled so that the present stand of plants is maintained and soil drifting and blowouts are prevented. Some information about use of this soil for range is given under the Choppy Sands range site in the section "Range Management."

CAPABILITY UNIT VIIw-1

Only one miscellaneous land type, Broken alluvial land, is in this capability unit. It is composed of soil material in the channel of the stream and of material that makes up the banks of the Ninnescah River. The land type consists largely of sandbars. Little of it is stable enough to support plants, but a few pockets contain soil material that supports some shrubs, annual plants, and trees. The soil material near the surface is mostly sand.

This land type is nonarable and has little value for grazing. It is used chiefly for recreation and as areas for wildlife.

Predicted Yields

Table 2 gives the predicted average yields per acre of the principal crops, wheat and grain sorghum, grown on the arable soils of the county, in capability classes II, III, and IV. The yields shown are for two levels of management. They are based mainly on information gathered from interviews with farmers, but partly on information obtained from the county agricultural agent and from members of the Farm Management Association. In addition, information was obtained from records of yields obtained on test plots managed in cooperation with the Kansas State University.

Yields to be expected under the average, or most common system of management, are shown in columns A. This kind of management consists of—

1. Planting varieties of crops that are adapted to the area.
2. Seeding at the proper rates and on the proper dates, and using efficient methods of planting and harvesting.
3. Controlling weeds, insects, and diseases.
4. Applying a starter fertilizer.
5. Managing crop residue properly only part of the time.

Yields to be expected under improved management are shown in columns B. This kind of management includes all the practices listed for columns A, plus the following:

1. Applying enough fertilizer and lime for maximum yields.
2. Establishing terraces and grassed waterways, farming on the contour, and using other practices that conserve moisture and help to control erosion.
3. Managing crop residue so that it helps to control erosion by wind and water, increases the infiltration of water, and encourages the emergence of seedlings.

TABLE 2.—*Predicted average yields per acre of seeded wheat and grain sorghum grown on the arable soils under two levels of management*

Columns A show yields to be expected under average management, and columns B show yields to be expected under improved management]

Soil	Wheat A	Wheat B	Grain sorghum A	Grain sorghum B
	Bu.	*Bu.*	*Bu.*	*Bu.*
Albion sandy loam, 1 to 4 percent slopes	12	17	16	24
Bethany silty clay loam, 1 to 4 percent slopes, eroded	16	22	24	38
Bethany silt loam, 0 to 1 percent slopes	21	26	32	44
Bethany silt loam, 1 to 3 percent slopes	19	25	28	40
Carwile fine sandy loam	18	23	24	36
Case-Clark complex, 3 to 7 percent slopes:				
Case soil	12	16	18	28
Clark soil	14	19	20	32
Clark clay loam, 1 to 4 percent slopes	16	20	24	36
Clark fine sandy loam, 1 to 3 percent slopes	16	22	24	38
Clark-Ost clay loams, 0 to 1 percent slopes:				
Clark soil	16	20	24	36
Ost soil	20	26	30	44
Farnum clay loam, 3 to 6 percent slopes, eroded	14	22	20	30
Farnum fine sandy loam, 0 to 1 percent slopes	20	26	28	40
Farnum loam, 0 to 1 percent slopes	20	25	32	46
Farnum loam, 1 to 3 percent slopes	18	24	28	44
Farnum loam, 3 to 6 percent slopes	16	23	24	40
Farnum-Carwile complex:				
Farnum soil	20	25	32	46
Carwile soil	18	23	24	36
Kaw silt loam	24	30	32	46
Kaw silt loam, frequently flooded	18	24	28	40
	Bu.	*Bu.*	*Bu.*	*Bu.*
Naron fine sandy loam, 0 to 1 percent slopes	20	26	36	52
Naron fine sandy loam, 1 to 3 percent slopes	17	25	34	48
Naron fine sandy loam, 3 to 6 percent slopes	15	23	30	44
Naron loam, 0 to 1 percent slopes	23	29	32	46
Naron loam, 1 to 3 percent slopes	21	28	30	42
Naron-Farnum complex:				
Naron soil	17	25	34	48
Farnum soil	18	24	28	44
Ost clay loam, 0 to 1 percent slopes	20	26	30	44
Ost clay loam, 1 to 4 percent slopes	18	24	28	40
Pratt loamy fine sand, undulating	14	20	26	40
Pratt loamy fine sand, hummocky	10	18	18	30
Pratt-Carwile complex:				
Pratt soil	14	20	26	40
Carwile soil	18	23	24	36
Shellabarger fine sandy loam, 0 to 1 percent slopes	18	25	30	46
Shellabarger fine sandy loam, 1 to 4 percent slopes	16	24	26	44
Shellabarger fine sandy loam, 3 to 7 percent slopes, eroded	13	20	20	30
Tabler clay loam	20	25	30	44
Waldeck fine sandy loam	17	22	30	44
Zenda clay loam	17	22	30	44
Zenda-Slickspots complex (Zenda soil only)	17	22	30	44

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4. Choosing a cropping system that fits the needs of the operator and keeps the soil in good condition.

Irrigation

This brief subsection gives facts about irrigation in Pratt County. Irrigation, using water from drilled wells, was begun in this area about the middle 1940's. By 1954 a total of 13 irrigated farms was in the county, according to the U.S. Bureau of the Census. In 1962, 48 sprinkler systems were used to supply water to crops grown on 6,180 acres, and 14 gravity systems were used to supply water to crops grown on 850 acres. Water for these systems was obtained from 62 irrigation wells.

An additional 60,000 acres in this county, consisting mainly of Pratt, Bethany, Farnum, Naron, and Shellabarger soils, is suitable for irrigation. The irrigation wells in various parts of the county appear to have an adequate supply of water of good quality for irrigating the soils in these additional acreages.

For irrigation to be successful, soils that have high water-holding capacity and favorable permeability are necessary, and an abundant supply of water of good quality is also required. Table 7, in the section "Engineering Uses of the Soils," names factors, such as low water-holding capacity or unfavorable permeability, that could adversely affect the suitability of the soils for irrigation. Some facts about the supply of available water can be found in the subsection "Physiography, Drainage, and Water Supply." Other information about irrigation can be obtained from a local representative of the Soil Conservation Service or the Extension Service.

Range Management [2]

Rangeland makes up about 18 percent of the total acreage in Pratt County. Large areas in range are concentrated in the sandhills in the northwestern part of the county and along the Ninnescah River, and other areas are scattered throughout the county. The soils used for range are generally not suitable for cultivation.

The raising of livestock, mainly feeder-stocker cattle, is an important agricultural enterprise in this county. The success of this enterprise depends on the way ranchers and farmers manage their range and feed reserves. A few farmers maintain cattle-breeding herds. In 1964 a total of 40,441 cattle and calves was in the county according to the U.S. Census of Agriculture.

Range sites and condition classes

Different kinds of rangeland produce different kinds and amounts of grass. For proper range management, an operator needs to know the different kinds of land or range sites in his holdings, and the plants each site can produce. Management can then be used that favors the growth of the best forage plants on each range site.

Range sites are areas of rangeland that differ from each other in their ability to produce significantly different kinds or amounts of climax, or original, vegetation. A significant difference is one that is great enough to require different grazing practices or other management that maintains or improves the present vegetation.

Climax vegetation is the combination of plants that originally grew on a given site. The most productive combination of range plants on a range is generally the climax type of vegetation.

Range condition is classified according to the percentage of vegetation on the site that is original, or climax, vegetation. This classification is used for comparing the kind and amount of present vegetation with the vegetation the site can produce, or the climax vegetation. Changes in range condition mainly result from intense grazing and drought. The condition of the range is considered to be *excellent* if more than 75 percent of the cover of plants consists of original, or climax, vegetation. It is *good* if the percentage is 51 to 75, *fair* if the percentage is 26 to 50, and *poor* if the percentage is less than 25.

In describing range sites, the kinds of native vegetation are classed as *decreasers*, *increasers*, and *invaders*. Decreasers and increasers are climax plants. Generally, decreasers are the most heavily grazed and, consequently, are the first to be injured by overgrazing. Increasers withstand grazing better or are less palatable to livestock; they increase under grazing and replace the decreasers. Invaders are plants, not native to the site, that become established after the climax vegetation has been reduced by grazing.

Descriptions of range sites

The range sites in this county are described in the pages that follow. Each mapping unit in the county has been placed in a range site, but the units in each site are not listed in the descriptions of the range sites. To find the range site to which any soil in the county is assigned, turn to the description of that soil in the section "Descriptions of the Soils," or refer to the "Guide to Mapping Units" at the back of this soil survey.

SUBIRRIGATED RANGE SITE

This range site consists of nearly level soils in shallow depressions in some places. These soils have a surface layer and a subsoil of clay loam to loamy fine sand, and they are underlain by sand and gravel. The water table is within 4 feet of the surface.

The climax plant cover is a mixture of big bluestem, switchgrass, indiangrass, eastern gamagrass, prairie cordgrass, and other decreasers. These grasses make up about 80 percent of the total cover, and other grasses and forbs make up the rest. The main increasers are sedges and western wheatgrass. Annuals, western ragweed, and foxtail barley are the common invaders.

When this site is in excellent condition, its total annual yield ranges from 6,000 to 8,000 pounds of air-dry herbage per acre when rainfall is average.

SALINE SUBIRRIGATED RANGE SITE

Zenda-Slickspots complex is the only mapping unit in this range site. It consists of nearly level, somewhat poorly drained, saline soils that have a surface layer and a subsoil of clay loam. These soils receive extra moisture from flooding or a high water table.

The climax plant cover is a mixture of switchgrass, alkali sacaton, indiangrass, western wheatgrass, and other decreasers. These grasses make up at least 70 percent of

[2] By PETER N. JENSEN, range conservationist, Soil Conservation Service, Lincoln, Nebr.

the total cover, and other perennial grasses and forbs make up the rest. The main increasers are inland saltgrass and sedges. Alkali muhly, western ragweed, foxtail barley, and tamarisk are the common invaders.

When this site is in excellent condition, its total annual yield ranges from 5,000 to 6,000 pounds of air-dry herbage per acre when rainfall is average.

LOAMY TERRACE RANGE SITE

Kaw silt loam, on terraces along Sand Creek, is the only soil in this range site. It is nearly level and well drained. The surface layer is moderately permeable and is underlain by a layer of light silty clay loam to heavy silt loam. This soil receives extra moisture in runoff from the nearby uplands.

The cover of climax vegetation is a mixture of big bluestem, little bluestem, switchgrass, indiangrass, Canada wildrye, and other decreasers. These grasses make up at least 65 percent of the total cover, and other perennial grasses and forbs make up the rest. The main increasers are western wheatgrass, sideoats grama, blue grama, and buffalograss. Windmillgrass, tumblegrass, and annual bromes are the common invaders.

When this site is in excellent condition, its total annual yield ranges from 3,000 to 4,000 pounds of air-dry herbage per acre when rainfall is average.

LOAMY LOWLAND RANGE SITE

Deep, nearly level, permeable, loamy soils that have high water-holding capacity make up this range site. These soils receive extra moisture from runoff or from the floodwaters of streams that frequently overflow.

The cover of climax vegetation is a mixture of big bluestem, little bluestem, switchgrass, indiangrass, Canada wildrye, and other decreasers. These grasses make up at least 70 percent of the total cover, and other perennial grasses and forbs make up the rest. The main increasers are western wheatgrass, sideoats grama, and blue grama. Ironweed and verbena are the common invaders.

When this site is in excellent condition, its total annual yield ranges from 4,000 to 6,000 pounds of air-dry herbage per acre when rainfall is average.

LOAMY UPLAND RANGE SITE

This range site consists of nearly level to moderately sloping soils that are well drained. These soils are moderately permeable and have high water-holding capacity. They have a surface layer of loam to clay loam, and a subsoil of clay loam to clay.

The cover of climax vegetation is a mixture of little bluestem, big bluestem, switchgrass, sideoats grama, and other decreasers. These grasses make up at least 60 percent of the total cover, and other perennial grasses and forbs make up the rest. The principal increasers are blue grama, buffalograss, and western wheatgrass. Annuals and western ragweed are common invaders.

When this site is in excellent condition, its total annual yield ranges from 2,000 to 3,000 pounds of air-dry herbage per acre when rainfall is average.

CLAY UPLAND RANGE SITE

Tabler clay loam is the only soil in this range site. It is nearly level and is on the uplands. Both the surface layer and the subsoil are clayey. Permeability is slow, and this soil is droughty.

The cover of climax vegetation is a mixture of switchgrass, little bluestem, sideoats grama, western wheatgrass, and other decreasers. These grasses make up at least 25 percent of the total cover, and other perennial grasses and forbs make up the rest. The principal increasers are blue grama and buffalograss. Annuals are the common invaders. In droughty years pricklypear is the most common invader.

When this site is in excellent condition, its total annual yield ranges from 1,500 to 2,500 pounds of air-dry herbage per acre when rainfall is average.

LIMY UPLAND RANGE SITE

This range site consists of nearly level to strongly sloping soils that have a surface layer and a subsoil of calcareous fine sandy loam to clay loam. These soils are moderately permeable in most places and are well drained.

The cover of climax vegetation is a mixture of little bluestem, sideoats grama, big bluestem, and other decreasers. These grasses make up at least 60 percent of the total cover, and other perennial grasses and forbs make up the rest. The principal increasers are blue grama, buffalograss, and sand dropseed. Annuals and broom snakeweed are the common invaders.

When this site is in excellent condition, its total annual yield ranges from 1,500 to 2,500 pounds of air-dry herbage per acre when rainfall is average.

SANDY RANGE SITE

This range site consists of deep, nearly level to strongly sloping soils of the uplands. These soils have a surface layer of sandy loam or fine sandy loam and a subsoil of sandy clay loam to clay. They absorb moisture at a moderate to rapid rate and have moderate to high water-holding capacity.

The cover of climax vegetation is a mixture of sand bluestem, little bluestem, switchgrass, sand lovegrass, and other decreasers.

These grasses make up at least 60 percent of the total cover, and other perennial grasses and forbs make up the rest. The principal increasers are blue grama, sideoats grama, and sand dropseed. Windmillgrass, tumblegrass, and annuals are the common invaders.

When this site is in excellent condition, its total annual yield ranges from 2,000 to 3,000 pounds of air-dry herbage per acre when rainfall is average.

SANDS RANGE SITE

Deep, rolling or hummocky soils that have a surface layer and a subsoil of loamy fine sand make up this range site. These soils absorb moisture rapidly but have low water-holding capacity.

The cover of climax vegetation is a mixture of sand bluestem, little bluestem, switchgrass, indiangrass, sand lovegrass, and other decreasers. These grasses make up at least 65 percent of the total cover, and other perennial grasses and forbs make up the rest. The principal increasers are sideoats grama, blue grama, sand dropseed, and sand paspalum (fig. 10). Windmillgrass, purple sandgrass, and red lovegrass are the common invaders.

When this site is in excellent condition, its total annual yield ranges from 2,500 to 3,500 pounds of air-dry herbage per acre when rainfall is average.

Figure 10.—Cattle grazing on an area of Pratt loamy fine sand, undulating, in the Sands range site. This range is in fair condition. Blue grama and sand dropseed are the dominant grasses.

CHOPPY SANDS RANGE SITE

Tivoli fine sand is the only soil in this range site. It is a deep, sandy, steep soil that occurs in duny areas. Blowouts are common in some of the areas (fig. 11). This soil is rapidly permeable, is somewhat excessively drained, and has low water-holding capacity.

The cover of climax vegetation is a mixture of sand bluestem, little bluestem, switchgrass, indiangrass, sand lovegrass, and other decreasers. These grasses make up at least 70 percent of the total cover, and other perennial grasses and forbs make up the rest. The principal increasers are sideoats grama, sand dropseed, and sand paspalum. Purple sandgrass and red lovegrass are the common invaders.

When this site is in excellent condition, its total annual yield ranges from 1,500 to 2,500 pounds of air-dry herbage per acre when rainfall is average.

WET LAND RANGE SITE

Wet alluvial land is the only mapping unit in this range site. It is a dark, wet, nearly level land type, mainly in low areas or depressions on flood plains along the Ninnescah River. The soil material near the surface is generally fine sandy loam to clay loam, and the underlying material is clay loam to sand. Frequent flooding is a hazard, and the water table is within 2 feet of the surface during most of the year.

Figure 11.—An area of Choppy Sands range site that contains blowouts. The dominant vegetation is sand bluestem, little bluestem, and switchgrass.

The cover of climax vegetation is a mixture of prairie cordgrass, Canada wildrye, switchgrass, American bulrush, slough sedge, Illinois bundleflower, and other decreasers. These plants make up at least 80 percent of the total cover, and other perennial grasses and forbs make up the rest. The principal increasers are sedges, foxtail barley, swamp smartweed, and cattails. Barnyardgrass, annual bristlegrasses, and annual sedges are the common invaders.

When this site is in excellent condition, its total annual yield ranges from 6,000 to 8,000 pounds of air-dry herbage per acre when rainfall is average.

UNSTABLE RANGE SITE

This is not a true range site, because it consists only of Broken alluvial land, an unstable, loamy miscellaneous land type on the banks and in the beds of streams. Floodwaters frequently disturb these areas, but the water quickly recedes.

The cover of plants on this site consists primarily of annuals, shrubs, and trees, but scouring and cutting make the cover unstable. Therefore, yields of herbage were not estimated.

Management of Windbreaks [3]

This section provides information about the management of windbreaks in Pratt County. Most of the trees on uplands in the county are grown in windbreaks. The trees and shrubs in natural stands grow only in narrow bands in the valleys and on bottom lands along the major streams and their tributaries. Plains cottonwood is the principal kind of tree in areas along the headwaters of the Ninnescah and Chikaskia Rivers and their tributaries. It grows in scattered stands along those streams. Black willow, sandbar willow, American plum, and western snowberry grow in minor stands with plains cottonwood. The soils and climate are not favorable enough for any of the trees to grow large enough to have commercial value. The native trees and shrubs growing in these narrow strips, however, stabilize the banks of streams and provide food and cover for wildlife.

Trees do not grow extensively on the prairie soils of the uplands, but trees and shrubs that are suited to the climate and soils can be successfully grown if they are planted in rows in windbreaks, properly spaced, and given special care. A well-planned windbreak (fig. 12) provides an effective barrier against wind. It protects field crops, buildings, livestock, orchards, and gardens, and it also provides food and cover for wildlife.

Windbreak suitability groups

The soils of Pratt County have been placed in six windbreak suitability groups according to their suitability for trees and shrubs. Each windbreak group consists of soils

[3] By F. DeWitt Abbott, State soil conservationist, Soil Conservation Service.

Figure 12.—**Field windbreak on Clark clay loam. This windbreak is about 25 years old. The trees on the left are Russian-olive, those in the center are ponderosa pine, and those on the right are American plum.**

that are suitable for about the same kinds of trees and shrubs, that require similar management, and that provide about the same chance of survival and rate of growth. The soils in each group are listed in the "Guide to Mapping Units" at the back of this soil survey and are described in the section "Descriptions of the Soils." The suitability of the soils in groups 1 through 5 for named species is rated in table 3. The ratings given are *excellent*, *good*, *fair*, and *poor*, based on the rate of growth and the chance of survival of the trees.

Not rated in table 3 are the soils of suitability group 6, because the soils in that group are generally too sandy, steep, or wet for trees and shrubs to be successfully established in windbreaks.

WINDBREAK SUITABILITY GROUP 1

This windbreak group consists of deep, loamy and silty, nearly level or moderately sloping soils of the uplands. Most of these soils are dark colored and well drained. Water percolates downward through the profile at a moderate rate, but the soils are generally dry below a depth of about 4 feet.

The soils of this group are porous enough and generally hold enough moisture to be well suited to the growing of trees and shrubs. The areas selected for planting need to be summer fallowed before trees or shrubs are planted, however, so that extra moisture will be stored and insure good initial growth and survival of the seedlings.

On these soils the rate of growth of trees and shrubs varies. Eastern redcedar, for example, normally grows about 1 foot in height each year until the tree is 20 years of age. Siberian elm grows about 2 feet in height each year until the tree is 20 years of age.

WINDBREAK SUITABILITY GROUP 2

Deep, sandy, nearly level to moderately sloping soils of the uplands are in this windbreak group. These soils have good drainage and absorb water well. The water moves rapidly downward through the profile, and the soil material is frequently moist below a depth of about 4 feet.

The soils of this group are subject to erosion both by water and wind. Nevertheless, they are well suited to trees and shrubs grown for windbreaks. The year before the trees or shrubs are planted, the areas selected for a windbreak should be planted to a forage crop or grain sorghum to provide cover and protect the soils from wind erosion.

In the areas likely to blow, rows of cover crops in strips 15 to 20 feet apart need to be left unharvested. Trees and shrubs can be planted between the strips and are protected by the unharvested cover crop. This practice reduces the damaging effects of hot winds from the south. It helps the trees and shrubs become established and helps them survive during their first growing season. As on the soils of windbreak group 1, eastern redcedar grows about 1 foot in height each year for the first 20 years on the soils of this group, and Siberian elm grows about 2 feet in height each year.

WINDBREAK SUITABILITY GROUP 3

This windbreak group consists of deep, loamy soils on the flood plains and in the valleys of streams. These soils receive extra water as runoff from the higher slopes, and

TABLE 3.—*Ratings of windbreak suitability groups for specified trees and shrubs*

Trees and shrubs	Windbreak suitability groups				
	1	2	3	4	5
American plum	Good	Fair	Excellent	Fair	Poor.
Aromatic sumac	Good	Poor	Good	Fair	Poor.
Austrian pine	Fair to good	Good	Excellent	Fair to good	Poor
Bur oak	Good	Fair	Excellent	Good	Poor.
Cottonwood	Poor	Fair	Excellent	Poor	Poor
Eastern redcedar	Excellent	Excellent	Excellent	Good	Poor.
Hackberry	Good	Good	Excellent	Poor	Poor.
Honeylocust	Fair	Good	Good	Poor	Poor.
Mulberry	Fair	Good	Excellent	Poor	Poor
Osage-orange	Excellent	Excellent	Excellent	Good	Poor.
Ponderosa pine	Fair to good	Good	Excellent	Fair to good	Poor.
Russian-olive	Poor	Fair	Good	Poor	Good.
Siberian elm (Chinese)	Good	Good	Excellent	Fair	Fair.
Tamarisk	Good	Fair	Good	Poor	Good.

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they also receive moisture when the adjacent streams overflow. They retain this extra moisture for a much longer period than do the soils of groups 1 and 2.

Most trees and shrubs grow well on these soils. Eastern redcedar grows about 1½ feet in height each year until the tree is about 20 years of age, and Siberian elm grows about 2½ feet each year during the same period.

WINDBREAK SUITABILITY GROUP 4

Only Tabler clay loam is in this windbreak suitability group. It is a deep, dark-colored, nearly level, clayey soil of the uplands, and it occurs in slight depressions in some places. Permeability is slow, and this soil is nearly always dry below a depth of about 4 feet.

This soil is poorly aerated and has only moderately good drainage. Surface drainage needs to be provided where water stands on the surface. Clean cultivation, repeated year after year, helps to make windbreaks successful. The trees need to be planted in more widely spaced rows than those planted on the soils of the other windbreak groups.

WINDBREAK SUITABILITY GROUP 5

Only Zenda-Slickspots complex is in this windbreak group. The Slickspots soils are saline. Therefore, the soils of this complex are suited only to trees and shrubs that are the most tolerant of salt. Growth of Russian-olive is fair to good, however, and growth of tamarisk is fair. Some areas of the complex can be improved by drainage.

WINDBREAK SUITABILITY GROUP 6

This group consists of soils that are generally too sandy, too steep, or too wet to be suitable for growing trees and shrubs in windbreaks. Where a farmstead windbreak or livestock windbreak is desired, however, and where no other soils are available, fairly good growth of some trees can be obtained under good management. On the very sandy soils, such as those of the Tivoli series, eastern redcedar can be grown if wind erosion is controlled, and if the trees are frequently watered. Also, some trees can be grown on the steep soils if the area is terraced and water erosion is controlled.

Use of the Soils for Wildlife [4]

All living animals depend upon plant life, either directly or indirectly, for survival. The kinds and amounts of vegetation are, in large measure, influenced by the soils upon which the plants grow. Climate also influences soils, plants, and animals, and it is an important consideration in the overall ecological complex.

Wildlife reacts to any change in environment. It can be managed, however, so that it produces a sustained crop if the proper kinds and amounts of food and cover are provided, and if food and cover are properly distributed. Because much of the land in the county is privately owned, the individual landowner or operator must be responsible for providing the kind of habitat essential for wildlife.

Wildlife responds favorably to fertile soils, but the response is poor to eroded soils that have lost much of their natural content of organic matter and minerals. Fertile soils can produce good crops or plentiful vegetation of other kinds. In contrast, the crops or other plants on severely eroded soils generally produce little cover and food for wildlife.

WILDLIFE HABITAT.—A convenient way of discussing the wildlife in the county is by soil associations, which are described in the section "General Soil Map." The location of each association is shown on the general soil map at the back of this soil survey. Table 4 rates the potential of each of the soil associations for producing food and cover for three main groups of wildlife—openland, woodland, and wetland—which are defined in the following paragraphs.

Openland wildlife consists of species that normally inhabit areas of cropland, pasture, meadow, and odd areas where herbaceous plants grow. Examples of openland wildlife are pheasant, quail, cottontail rabbit, and coyote.

Woodland wildlife consists of species that normally inhabit wooded or partly wooded areas. Examples of woodland wildlife are thrushes, deer, raccoon, and squirrel.

Wetland wildlife consists of species that normally inhabit ponds, marshes, streams, and swamps. Examples of wetland wildlife are ducks, shore birds, beaver, mink, and muskrat.

KINDS OF WILDLIFE.—Pratt County contains a number of kinds of wildlife. Of special importance are the species referred to as game animals, which are managed by the Kansas Forestry, Fish, and Game Commission. Of all the game birds in the county, ring-necked pheasant and bobwhite quail are the most important.

Pheasant inhabit all parts of the county. They are especially numerous in areas used for farming, because cultivated crops contribute substantially to their supply of food. The population of pheasant is largest on the soils that are the finest textured. Pheasant are most numerous on the Naron and Farnum soils of association 4; on the Clark and Ost soils of association 5; on the Farnum, Ost, and Clark soils of association 6; on the Bethany and Ost soils of association 7; on the Shellabarger, Albion, and Farnum soils of association 8; and on the Zenda and Waldeck soils of association 9. A fairly large number of pheasant also inhabit the Pratt and Carwile soils of association 2. A large part of the acreage in the associations inhabited by pheasant is used to grow wheat and sorghum.

Bobwhite quail prefer a habitat similar to that occupied by pheasant, and they prefer a habitat near fields used for crops. The Pratt and Carwile soils of association 2 support a large population of bobwhite quail. Most of that association is in cultivated crops, though wind erosion is a serious hazard unless the soils are well managed. The shelterbelts and cover of woody plants in some places on the soils of association 2 help to reduce erosion and provide well-distributed cover. Odd areas that contain grass, weeds, and woody plants and that are adjacent to areas of cropland are ideally suited to quail, for those areas supply nesting sites, places to roost and loaf, and escape from enemies. The Zenda and Waldeck soils of association 9 provide many of these requirements and are especially productive of quail.

A small population of the lesser prairie chicken inhabits areas of Tivoli and Pratt soils of association 1, which is primarily north of U.S. Highway No. 54. This species is especially numerous within an area of 4 to 5 sections occupied by Tivoli soils in the extreme western

[4] By JACK W. WALSTROM, biologist, Soil Conservation Service, Salina, Kans.

TABLE 4.—*Potential of the soil associations for providing the habitat required by three main groups of wildlife*

[Absence of entry indicates that potential of soil association is not rated]

Soil association	Kind of wildlife	Potential for producing, for group of wildlife named			
		Woody cover	Herbaceous cover	Food	Aquatic habitat
Tivoli-Pratt.	Openland	Good	Good	Good	
	Woodland	Poor	Fair	Fair	
Pratt-Carwile.	Openland	Good	Good	Good	
	Woodland	Fair	Fair	Fair	
	Wetland				Fair.
Pratt-Naron-Clark.	Openland	Good	Good	Good	
	Woodland	Good	Good	Good	
Naron-Farnum.	Openland	Good	Good	Good	
	Woodland	Fair	Fair	Fair	
	Fish				Good.
Clark-Ost.	Openland	Poor	Good	Fair	
	Woodland	Poor	Fair	Poor	
Farnum-Ost-Clark.	Openland	Poor	Good	Fair	
	Woodland	Poor	Fair	Poor	
Bethany-Ost.	Openland	Poor	Fair	Fair	
	Woodland	Poor	Fair	Fair	
Shellabarger-Albion-Farnum.	Openland	Good	Good	Good	
	Woodland	Good	Good	Good	
Zenda-Waldeck.	Openland	Good	Good	Good	
	Woodland	Good	Good	Good	
	Wetland				Good
	Fish				Good

part of the county. That area is the eastern limit occupied by this species in Kansas. The lesser prairie chicken is primarily a grouse that prefers a grassland-shrub type of vegetation.

Mourning dove inhabit this county. The dove is a migratory game bird for which bag limits are set within the framework established each year by the Bureau of Sport Fisheries and Wildlife. Mourning dove live in many different kinds of habitat, but they require woody plants in their environment. Generally, cover consisting of scattered plants, rather than a dense stand, is preferred. All of the soil associations contain habitat suitable for mourning dove, but a source of water is a limiting factor in some places.

White-tailed deer are predominant in this county, but it is possible that mule deer may also have come in, since mule deer have been reported in counties in the eastern part of Kansas. The numbers of white-tailed deer are increasing throughout the county, especially along the Ninnescah River and its tributaries.

Many deer inhabit association 9, which is on the flood plains and low terraces of the Ninnescah River. About half of the acreage of Zenda and Waldeck soils that make up a large part of that association is used for cultivated crops, and the rest supports an excellent stand of grass. Whenever the number of deer increases in an area where crops are grown extensively, crops are generally damaged by those animals. The management plan implemented by members of the Kansas Forestry, Fish, and Game Department is based on harvesting enough deer within the State each year so that the number is reduced to a desirable level.

The vegetation on the Kanza and Plevna soils that are intermingled on the flood plains of Turkey Creek in the southwestern part of Pratt County supports, or has the potential to support, both deer and the wild Rio Grande turkey. The Zenda soils and the Kanza and Plevna soils adjacent to branches of Elm Creek provide good habitats for deer and turkey. In this county the numbers of Rio Grande turkey are limited, but these turkeys have been seen in areas of intermingled Kanza and Plevna soils along branches of Elm Creek. It is probable that they are transient along the part of Turkey Creek that flows through Pratt County, because they inhabit areas along Turkey Creek in the adjacent county to the south.

Other mammals besides deer in Pratt County are beaver, muskrat, and mink, in areas along the Ninnescah River and its tributaries, and the fox squirrel in shelterbelts, in windbreaks, in areas around farmsteads, and in wooded tracts along streams. Coyote also occupy a number of kinds of habitat and maintain a high population in spite of continued hunting by sportsmen who use dogs and two-way radios; prairie dogs generally occupy areas that support a cover of short grasses or closely grazed plants; raccoon occupy areas, mainly along the major watercourses; and cottontail rabbit and jackrabbit occupy areas throughout the county.

Waterfowl are transient during the migration periods in spring and fall but generally do not nest in this county. In years when the amount of rainfall is above average, temporary ponds are created prior to the time the hunting season for waterfowl opens, especially in areas of Pratt and Carwile soils of association 2. The ponds offer hunting possibilities to hunters of waterfowl.

Good opportunities for fishing are limited to the Ninnescah River, Pratt County Lake, and farm ponds. The fish that are caught are mainly channel catfish, bullhead, crappie, bass, and bluegill, as well as carp and other rough fish.

The State fish hatchery occupies 187 acres east of the town of Pratt. It contains 95 ponds and is among the largest such ponds in the United States. About 1 million fingerling fish are raised each year. About half of this number are channel catfish, and the rest are bass, bluegill, and a few crappie. These fish are used each fall to stock farm ponds, State-owned lakes, and other bodies of water in the State of Kansas. In addition, about 800,000 walleyes are placed in the larger impoundments.

Practices Helpful to Wildlife.—Practices that protect the soils and that conserve water are generally beneficial to wildlife. Terracing, stripcropping, stubble mulching, properly managing grazing, and managing woodland well all help to reduce erosion on sloping soils, such as the Bethany, Farnum, Clark, and Ost. They protect the soils so that soil material will not be lost to pollute rivers and lakes.

Practices that are harmful to wildlife include mowing of roadsides before July 15, and burning and clearing of brush and trees. Also harmful are overgrazing rangeland and pasture and draining areas of Wet alluvial land and other spots used by wildlife for water supply, nesting, or other purposes.

Technical assistance in planning developments for wildlife and in putting the plans into practice may be obtained from a representative of the Soil Conservation Service in the town of Pratt. Other assistance can be obtained from the Kansas Forestry, Fish, and Game Commission, Bureau of Sport Fisheries and Wildlife, and from the Extension Service.

Engineering Uses of the Soils [5]

This part of the survey describes the outstanding engineering properties of the soils, especially in relation to highway construction and conservation engineering. It also briefly describes the engineering soil classification systems, and defines the engineering terms used.

Soil properties influence design, construction, and maintenance of engineering structures. The properties most important to the engineer are permeability to water, shear strength, compaction characteristics, soil drainage, shrink-swell characteristics, grain size, plasticity, and reaction. Also important are depth to bedrock, depth to the water table, and topography.

The information in this soil survey can be used to—

1. Make preliminary studies that will aid in selecting and locating sites for industries, residences, businesses and recreation.
2. Make preliminary evaluations that would aid in selecting routes for highways, locations for airports, and other routes or locations for transportation facilities.
3. Make preliminary evaluations and estimates that will aid in planning irrigation systems, systems that supply agricultural drainage, farm ponds, terraces, waterways, and dams that divert water or help to control erosion.
4. Make preliminary studies and evaluations for selecting routes for pipelines and other underground utilities.
5. Locate probable sources of sand or gravel and topsoil.
6. Develop information that would be useful in designing and maintaining engineering structures.
7. Supplement information from other sources so that a broader general understanding of the conditions pertinent to the particular area are obtained.
8. Help to develop other preliminary information that might be useful for construction purposes.

Used with the soil map to identify the soils, the engineering interpretations in this section are useful for many purposes. It should be emphasized, however, that these interpretations may not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads or where the excavations are deeper than the depth of layers here reported. Nevertheless, even in such situations, the soil map is useful for planning more detailed field investigations and for suggesting the kinds of problems that can be expected.

Much of the information in this subsection is given in the tables. Table 5 gives engineering test data obtained when the samples of selected soil series were tested. Table 6 gives estimates of the properties of the soils, and table 7 provides engineering interpretations of these properties.

Additional information of value in planning engineering work is given throughout the text, especially in the sections "Descriptions of the Soils" and "Formation and Classification of Soils." Some terms used by soil scientists may be unfamiliar to engineers, and many words have special meaning in soil science. These and other special terms are defined in the Glossary at the back of this soil survey.

Engineering classification systems

Agricultural scientists of the U.S. Department of Agriculture (USDA) classify soils according to texture, color, and structure (*10*).[6] This system is useful only as the initial step for making engineering classifications of soils. Additional properties important to engineering must be determined by tests, or estimated after the textural classification has been made. In some ways this system of naming textural classes is comparable to the two systems commonly used by engineers for classifying soils; that is, the system of the American Association of State Highway Officials (AASHO) and the Unified system. These systems are explained briefly in the following paragraphs. The explanations are taken largely from the PCA Soil Primer (*7*).

AASHO Classification System.—The AASHO system of classifying soils is based on actual performance of ma-

[5] Gerald D. Norris, agricultural engineer, assisted in the preparation of this section.

[6] Italic numbers in parentheses refer to Literature Cited, p. 55.

terial used as a base for roads and highways (*1*). In this system all the soils are classified in seven basic groups. The soils most suitable for road subgrade are classed as A–1, and those least suitable are classed as A–7. Within rather broad limits, all soil materials are classified numerically between these two extremes, according to their load-carrying ability. Three of the seven basic groups may be further divided into subgroups to designate variations within a group. Within each group, the relative engineering value of the soil material is indicated by a group index number, which is shown in parentheses following the group classification. Group indexes range from 0 for the best material to 20 for the poorest. Increasing values of group indexes denote decreasing load-carrying capacity.

In the AASHO system, the soil material may be further divided into the two general groups: (1) Granular material in which 35 percent or less of the soil material passes a 200-mesh sieve; and (2) silt-clay material in which more than 35 percent passes a 200-mesh sieve. The silty part of the silt-clay material has a plasticity index of 10 or less, and the clayey material has a plasticity index greater than 10. The plasticity index refers to the numerical difference between the liquid limit and the plastic limit. The liquid limit is the moisture content, expressed as a percentage of the ovendry weight of the soil, at which the soil material passes from a plastic to a liquid. The plastic limit is the moisture content, expressed in percentage of the ovendry weight of the soil, at which the soil material passes from a semisolid to a plastic.

Unified Classification System.—In the Unified system (*13*), the soils are grouped on the basis of their texture and plasticity, as well as on their performance when used in engineering structures. The soil materials are identified as coarse grained, which are gravel (G) and sands (S); fine grained, which are silts (M) and clays (C); and highly organic (Pt). No highly organic soils were mapped in Pratt County.

Under the Unified system, clean sands are identified by the symbols SW or SP; sands that include fines of silt and clay are identified by the symbols SM and SC; silts and clays that have a low liquid limit are identified by the symbols ML and CL; and silts and clays that have a high liquid limit are identified by the symbols MH and CH.

After an engineer has been trained and has obtained experience, he can make approximate classifications of soils, based on visual field inspection and observation. Exact classification, however, must be based on review and application of data obtained from complete laboratory analyses. Field classifications are useful in determining when and upon which soils laboratory analyses should be made.

Soil test data

The information given in table 5 shows the results of tests made by the State Highway Commission of Kansas under a cooperative agreement with the Department of Commerce, Bureau of Public Roads. Results of the tests help to evaluate the soils for engineering purposes. Except for the variations described in the discussions of moisture density and mechanical analyses, the tests were made in accordance with standard procedures.

The table shows the specific locations where samples were taken, the depth to which sampling was done, and the results of tests to determine particle-size distribution and other properties significant in soil engineering.

In the column titled "Moisture density," the tests were based on AASHO Designation T 99–57, Method A, except for the following variations: (1) All material was ovendried at 230° F.; (2) all material was crushed in a laboratory crusher after it was dried; and (3) no time was allowed for dispersion of moisture after water was mixed with the soil material.

The *maximum dry density* is the maximum unit dry weight of a soil that has been compacted at the optimum moisture content, using the prescribed method of compaction. The moisture content that gives the highest dry unit weight is called the optimum moisture content for the specific method of compaction.

The *optimum moisture content*, also called *field moisture equivalent* (FME), is the minimum moisture content at which a smooth soil surface will absorb no more water during a period 30 seconds long when the water is added in individual drops. This is the moisture content required to fill all the pores in sands and the content required to approach saturation in cohesive soils.

Mechanical analyses show the percentages of soil particles that pass sieves of specified sizes. Sands and coarser textured materials do not pass through a No. 200 sieve, but silt and clay pass through a sieve of that size; silt is the material larger than 0.002 millimeter in diameter, and clay is the material smaller than 0.002 millimeter in diameter. The clay fraction was determined by the hydrometer method, rather than the pipette method used by most soil scientists in determining the clay in soil samples.

Mechanical analyses for which results are shown in table 5 were according to AASHO Designation T 88–57 (*1*), except for the following variations: (1) All material was ovendried at 230° F. and crushed in a laboratory crusher; (2) the sample was not soaked prior to dispersion; (3) sodium silicate was used as the dispersing agent; and (4) the dispersing time, in minutes, was established by dividing the plasticity index value by 2; the maximum time was 15 minutes, and the minimum time was 1 minute. Results by this procedure frequently differ somewhat from the 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 soils.

Engineering properties of soils

In table 6 some of the descriptions of the soil layers and of depth from the surface differ slightly from the descriptions of the typical profiles given in the section "Descriptions of the Soils." The purpose of the descriptions given in table 6 is to show the horizons that have features significant to engineering. The kind of underlying material is generally not given. The soils are underlain, however, by rather thick deposits of old alluvium, outwash, or windblown sand. The soils underlain by windblown sand are in the northwestern and north-central parts of the county, and the thickness of the sand in those areas ranges from 5 to more than 30 feet. The sand is underlain

TABLE 5.—*Engineering*

Soil name and location	Parent material	Report No.	Depth	Horizon	Moisture density	
					Maximum dry density	Optimum moisture
			In.		*Lb. per cu. ft.*	*Pct.*
Albion sandy loam: [4]						
1,820 feet south and 80 feet west of the NE. corner of sec. 18, T. 27 S., R. 12 W.	Moderately sandy old alluvium.	76-15-1	0-9	A1	125	8
		76-15-2	9-17	B2t	123	11
		76-15-3	26-50	IIC	108	13
320 feet west and 75 feet north of the SE. corner of sec. 5, T. 28 S., R. 11 W.	Moderately sandy old alluvium.	76-16-1	0-7	A1	124	8
		76-16-2	7-17	B2t	117	13
		76-16-3	27-50	IIC	123	12
Clark clay loam:						
1,690 feet west and 75 feet north of the SE. corner of sec. 13, T. 28 S., R. 12 W.	Highly calcareous old alluvium.	76-13-1	0-9	A1	109	15
		76-13-2	15-27	C1ca	105	19
		76-13-3	27-52	C2ca	107	18
150 feet north and 50 feet west of the SW. corner of sec. 35, T. 26 S., R. 12 W.	Highly calcareous old alluvium.	76-14-1	0-10	A1	107	18
		76-14-2	15-30	C1ca	106	19
		76-14-3	30-52	C2ca	105	19
Naron fine sandy loam:						
1,400 feet west and 20 feet south of the NE. corner of sec. 4, T. 27 S., R. 13 W.	Wind-deposited material and old alluvium.	76-21-1	0-11	A1	111	14
		76-21-2	20-40	B22t	113	14
		76-21-3	40-60	C	118	12
100 feet south and 20 feet west of the NE. corner of sec. 24, T. 27 S., R. 13 W.	Wind-deposited material and old alluvium.	76-22-1	0-11	A1	120	10
		76-22-2	21-33	B22t	114	15
		76-22-3	33-60	C	118	12
Ost clay loam:						
230 feet west and 25 feet north of the SE. corner of sec. 29, T. 28 S., R. 15 W.	Highly calcareous outwash sediment.	76-23-1	0-9	A1	108	17
		76-23-2	9-15	B21t	99	21
		76-23-3	24-52	C	105	18
100 feet north and 50 feet east of the SW. corner of sec. 35, T. 28 S., R. 15 W.	Highly calcareous outwash sediment.	76-24-1	0-10	A1	105	18
		76-24-2	10-17	B21t	98	23
		76-24-3	24-54	C	107	18
Pratt loamy fine sand:						
100 feet east and 20 feet north of the SW. corner of sec. 24, T. 26 S., R. 14 W.	Sands deposited by wind.	76-19-1	0-12	A1	115	12
		76-19-2	12-26	B21t	117	11
		76-19-3	45-70	C	115	12
1,910 feet west and 20 feet north of the SE. corner of sec. 20, T. 26 S., R. 13 W.	Sands deposited by wind.	76-20-1	0-9	A1	114	11
		76-20-2	9-29	B21t	115	12
		76-20-3	48-65	C	111	12
Tivoli fine sand:						
2,505 feet east and 1,150 feet north of the SW. corner of sec. 4, T. 25 S., R. 15 W.	Sands deposited by wind.	76-17-1	0-5	A1	106	13
		76-17-2	5-62	C	105	13
600 feet south and 120 feet east of the NW. corner of sec. 35, T. 26 S., R. 15 W.	Sands deposited by wind.	76-18-1	0-6	A1	106	11
		76-18-2	6-60	C	105	13

[1] Tests performed by the State Highway Commission of Kansas under a cooperative agreement with the Department of Commerce, Bureau of Public Roads, in accordance with standard procedures, except as described in the discussions of moisture density and mechanical analyses.

[2] Based on AASHO Designation M 145-49 (*1*).

[3] Based on the Unified Soil Classification System (*13*). The SCS and Bureau of Public Roads have agreed to consider that all soils

test data [1]

Mechanical analysis: Percentage passing sieve— No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Percentage smaller than— 0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.	Liquid limit	Plasticity index	Classification: AASHO [2]	Unified [3]
100	78	31	21	10	5	2	18	3	A-2-4(0)	SM
99	77	33	24	16	12	9	25	10	A-2-4(0)	SC
100	49	4	2	1	0	0	17	0	A-1-b(0)	SP
100	75	29	19	10	3	1	17	2	A-2-4(0)	SM
98	75	44	34	24	14	13	34	20	A-6(5)	SC
72	29	7	4	3	2	1	18	2	A-1-b(0)	SP-SM
100	95	58	39	27	15	8	31	13	A-6(6)	CL
100	94	79	64	53	34	17	38	17	A-6(10)	CL
100	96	81	66	50	35	22	36	19	A-6(12)	CL
100	95	79	56	32	17	9	34	13	A-6(9)	CL
100	97	90	74	48	31	22	40	21	A-6(12)	CL
100	98	88	66	40	26	20	41	24	A-7-6(14)	CL
100	97	48	32	18	9	5	25	7	A-4(3)	SM-SC
100	98	38	27	21	15	13	28	14	A-6(2)	SC
100	98	31	22	18	12	9	21	7	A-2-4(0)	SM-SC
100	95	34	24	14	8	5	19	4	A-2-4(0)	SM-SC
100	96	39	26	20	15	11	26	12	A-6(1)	SC
100	97	33	23	18	11	9	20	7	A-2-4(0)	SM-SC
100	99	84	62	32	17	11	31	11	A-6(8)	CL
100	99	88	69	44	30	25	47	28	A-7-6(17)	CL
100	99	90	79	55	38	29	43	24	A-7-6(14)	CL
100	99	89	67	38	19	14	33	12	A-6(9)	CL
100	99	92	76	51	34	29	49	30	A-7-6(18)	CL
100	99	95	78	56	39	29	38	20	A-6(12)	CL
100	99	16	11	8	6	4	18	2	A-2-4(0)	SM
100	98	25	15	9	6	5	18	2	A-2-4(0)	SM
100	98	19	9	6	4	3	15	0	A-2-4(0)	SM
100	97	19	12	6	3	2	17	1	A-2-4(0)	SM
100	97	16	11	9	7	6	18	3	A-2-4(0)	SM
100	99	20	13	9	7	6	18	1	A-2-4(0)	SM
100	98	7	3	2	0	0	18	0	A-3(0)	SP-SM
100	98	6	3	2	1	1	18	1	A-2-4(0)	SP-SM
100	99	9	4	2	0	0	18	0	A-3(0)	SP-SM
100	98	6	3	2	2	1	20	3	A-2-4(0)	SP-SM

having plasticity indexes within two points from A-line are to be given a borderline classification, for example SP-SM.

[4] In the Albion sandy loam, report No. 76-15-2, 99 percent of the soil material passed a No. 4 sieve and 100 percent passed a ⅜-inch sieve. In the same soil type, report No. 76-16-2, 98 percent of the soil material passed a No. 4 sieve and 100 percent passed a ⅜-inch sieve. Also in the same soil type, report No. 76-16-3, 93 percent of the soil material passed a ⅜-inch sieve and 100 percent passed a 1½-inch sieve.

TABLE 6.—*Estimated*

[The properties of Broken alluvial land (Br), Sandy breaks-Alluvial land complex (Sa),

Soil series and map symbols	Depth from surface	Classification: USDA texture	Classification: Unified [1]	Classification: AASHO
	Inches			
Albion (Ab, Ao, As). For properties of the Shellabarger soils in As, refer to the Shellabarger series.	0–8	Sandy loam	SM	A–2
	8–29	Sandy clay loam or sandy loam.	SM	A–2
	29–60	Sand and gravel	SP–SM	A–1 or A–3
Bethany (Bc, Be, Bh).	0–13	Silt loam	CL	A–6
	13–46	Silty clay	CH	A–7
	46–72	Silty clay loam	CL	A–7
Carwile (Ca).	0–12	Fine sandy loam	SM	A–2
	12–20	Sandy clay loam	SM or SC	A–2
	20–60	Sandy clay and clay	CL–CH	A–7
Case (Cc, Ck). For properties of the Clark soils in these mapping units, refer to the Clark series.	0–50	Clay loam	CL	A–6
Clark (Cm, Cn, Co). For properties of the Ost soil in Co, refer to the Ost series.	0–50	Clay loam	CL	A–6
Croft (Cs).	0–25	Loamy fine sand	SM	A–2
	25–50	Sand	SP–SM	A–1 or A–3
Farnum (Fa, Fe, Fm, Fn, Fu, Fw). For properties of the Carwile soils in Fw, refer to the Carwile series.	0–10	Loam	CL or ML–CL	A–6 or A–4
	10–42	Clay loam	CL	A–7
	42–72	Fine sandy loam and sandy clay loam.	CL, SC, or SM–SC	A–6 or A–4
Kanza (Kp). For properties of the Plevna soils in this mapping unit, refer to the Plevna series.	0–11	Loamy fine sand	SM	A–2
	11–50	Loamy fine sand and sand.	SP–SM	A–2 or A–3
Kaw (Ks, Kw).	0–18	Silt loam	CL	A–6
	18–60	Silt loam and light silty clay loam.	CL	A–7
Naron (Nd, Nf, Ng, Nk, Nm, Nn). For properties of the Farnum soils in Nn, refer to the Farnum series.	0–13	Fine sandy loam	SM	A–2 or A–4
	13–38	Sandy clay loam	SC	A–2 or A–6
	38–60	Fine sandy loam	SM	A–2
Ost (Oc, Os).	0–10	Clay loam	CL	A–6
	10–23	Clay loam	CL	A–7
	23–60	Heavy clay loam	CL	A–6 or A–7
Plevna.	0–40	Fine sandy loam	SM	A–4
	40–60	Fine sand and sand	SP–SM	A–3
Pratt (Pm, Pn, Po, Pt). For properties of the Carwile soils in Po, refer to the Carwile series; for properties of the Tivoli soils in Pt, refer to the Tivoli series.	0–70	Loamy fine sand	SM	A–2
Shellabarger (Sb, Se, Sf).	0–11	Fine sandy loam	SM	A–2 or A–4
	11–50	Light sandy clay loam	SC	A–2
	50–60	Sand and gravel	SP–SM	A–1
Tabler (Ta).	0–9	Clay loam	CL	A–6
	9–60	Silty clay	CH	A–7
Tivoli (Tf).	0–72	Fine sand	SP–SM	A–2 or A–3
Waldeck (Wa).	0–46	Fine sandy loam	SM	A–2
	46–60	Fine sand	SM or SP–SM	A–2 or A–3
Zenda (Ze, Zs).	0–22	Clay loam	CL	A–6
	22–50	Clay loam	CL	A–6

[1] The Soil Conservation Service and Bureau of Public Roads have agreed to consider that all soils having plasticity indexes within two points from A-line are to be given a borderline classification. Examples of borderline classifications obtained by this use are SP–SM, CL–CH, and SM–SC.

properties of the soils

and Wet alluvial land (Wd) are too variable to be estimated]

Percentage passing sieve—			Permeability	Available water capacity	Reaction	Dispersion	Shrink-swell potential
No. 4	No. 10	No. 200					
			Inches per hour	*Inches per inch of soil*	*pH*		
100	95–100	15–35	0. 5 –1. 0	0. 15	5. 6–6. 0	Low	Low.
100	95–100	15–35	0. 2 –0. 5	. 17	6. 1–6. 5	Low	Low.
90–100	(2)	5–10	(3)	. 09	6. 6–7. 3	Low	Low.
100	100	85–90	0. 2 –0. 5	. 18	6. 1–6. 5	High	Moderate.
100	100	90–95	0. 1 –0. 3	. 16	6. 6–7. 3	High	High.
100	100	90–95	0. 2 –0. 5	. 18	7. 9–8. 4	High	High.
95–100	95–100	15–25	0. 5 –1. 0	. 15	6. 1–6. 5	Low	Low.
95–100	95–100	20–30	0. 5 –1. 0	. 15	6. 1–6. 6	Low	Low.
95–100	95–100	80–90	0. 05–0. 3	. 18	6. 6–7. 3	Low	Moderate to high.
100	100	70–85	0. 2 –0. 5	. 18	7. 4–8. 4	Low	Moderate.
100	100	70–85	0. 2–0. 5	. 18	7. 4–8. 4	Low	Moderate.
95–100	60–80	15–25	2. 0–5. 0	. 06	6. 6–7. 3	Low	Low.
90–100	(2)	5–10	5. 0–10. 0	. 04	7. 4–7. 8	Low	Low.
100	100	70–80	0. 2–0. 5	. 18	6. 1–6. 5	Moderate	Low.
100	100	75–85	0. 1–0. 3	. 18	6. 6–7. 3	Moderate	Moderate.
100	100	40–75	0. 5–1. 0	. 15	7. 4–7. 8	Moderate	Moderate.
100	100	12–20	2. 0–5. 0	. 09	6. 6–7. 3	Low	Low.
100	100	6–15	2. 0–5. 0	. 09	7. 4–7. 8	Low	Low
100	100	85–90	0. 5–1. 0	. 18	6. 6–7. 3	High	Moderate.
100	100	90–95	0. 2–0. 5	. 18	6. 6–7. 3	High	High
98–100	95–100	30–45	0. 5–1. 0	. 15	6. 6–7. 3	Low	Low.
98–100	95–100	25–40	0. 2–0. 5	. 18	7. 4–7. 8	Low	Low.
98–100	95–100	25–35	0. 5–1. 0	. 15	7. 4–7. 8	Low	Low.
100	100	75–90	0. 2–0. 5	. 18	7. 4–7. 8	Low	Moderate.
100	100	80–95	0. 2–0. 5	. 18	7. 0–7. 8	Low	High.
100	100	80–95	0. 2–0. 5	. 18	7. 9–8. 4	Low	High.
100	100	35–45	0. 5–1. 0	. 15	7. 4–7. 8	Low	Low.
100	100	6–10	2. 0–5. 0	. 09	7. 4–7. 8	Low	Low.
100	100	15–25	2. 0–5. 0	. 12	6. 6–7. 3	Low	Low.
98–100	90–100	25–40	0. 5–1. 0	. 15	6. 0–6. 5	Low	Low.
98–100	90–100	25–35	0. 2–0. 5	. 17	6. 6–7. 3	Low	Low.
90–100	(4)	5–10	5. 0–10. 0	. 09	7. 4–7. 8	Low	Low.
100	100	70–80	0. 2–0. 5	. 18	6. 1–6. 5	Low	Moderate.
100	100	90–95	0. 1–0. 3	. 16	7. 9–8. 4	Low to slight	High.
100	100	6–10	5. 0	. 09	6. 1–6. 5	Low	Low.
98–100	80–98	20–40	0. 5–1. 0	. 16	7. 9–8. 4	Low	Low.
98–100	70–95	6–15	2. 0–5. 0	. 04	7. 4–7. 8	Low	Low.
100	95–100	60–75	0. 2–0. 5	. 18	6. 6–7. 3	Low	Moderate.
100	95–100	60–75	0. 2–0. 5	. 18	7. 4–7. 8	Low	Moderate.

[2] More than 70.
[3] More than 5.0.
[4] More than 50.

TABLE 7.—*Interpretation of*

[The properties of Broken alluvial land (Br), Sandy breaks-Alluvial land complex (Sa),

Soil series and map symbols	Suitability as a source of—					Soil features affecting engineering practices	
	Topsoil	Sand	Gravel	Road subgrade [1]	Road fill [1]	Highway location [1]	Dikes and levees
Albion (Ab, Ao, As). For properties of the Shellabarger soils in As, refer to the Shellabarger series.	Fair	Good	Good	Good if mixed.	Good if mixed.	Well drained; erodible in sloping areas.	Erodible in sloping areas; pervious and seepy in places.
Bethany (Bc, Be, Bh)	Good	Not suitable.	Not suitable.	Poor	Fair	Well drained; high plasticity.	High plasticity; fair to poor stability.
Carwile (Ca)	Fair	Not suitable.	Not suitable.	Surface layer good; subsoil poor.	Fair	Somewhat poorly drained; in places has seasonal perched water table.	Erodible in sloping areas; fair stability and compaction.
Case (Cc, Ck). For properties of the Clark soils in these mapping units, refer to the Clark series.	Poor	Not suitable.	Not suitable.	Fair	Good	Well drained; highly calcareous; erodible in sloping areas.	Erodible in sloping areas; fair stability and compaction.
Clark (Cm, Cn, Co). For properties of the Ost soils in Co, refer to the Ost series.	Surface layer fair; subsoil poor.	Not suitable.	Not suitable.	Fair	Good	Well drained; highly calcareous.	Erodible in sloping areas; fair stability and compaction.
Croft (Cs)	Poor	Good	Good	Good	Good	Occasional flooding; somewhat excessively drained.	Erodible in sloping areas; porous and seepy; soil binder needed.
Farnum (Fa, Fe, Fm, Fn, Fu, Fw). For properties of the Carwile soils in Fw, refer to the Carwile series.	Good	Not suitable.	Not suitable.	Poor	Fair	Well drained	Fair stability
Kanza (Kp). For properties of the Plevna soils in this mapping unit, refer to the Plevna series.	Poor	Poor	Not suitable.	Good on elevated grade.	Good	High water table; somewhat poorly drained; nearly level.	Erodible in sloping areas; porous and seepy; soil binder needed.
Kaw (Ks, Kw)	Good	Not suitable.	Not suitable.	Fair	Fair	Subject to flash flooding; well drained; nearly level.	Fair stability and compaction.
Naron (Nd, Nf, Ng, Nk, Nm, Nn). For properties of the Farnum soils in Nn, refer to the Farnum series.	Good	Not suitable.	Not suitable.	Fair	Good	Well drained	Erodible in sloping areas; fair stability; subject to seepage in places.

See footnotes at end of table.

engineering properties of soils

Wet alluvial land (Wd), and the Slickspot soils in (Zs) are too variable to be estimated]

Soil features affecting engineering practices—Continued					
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
Reservoir area	Embankment [2]				
Rapid permeability.	Well drained; substratum lacks fines; erodible in sloping areas; subject to seepage in places.	Well drained	Low water-holding capacity.	Lack of stability; intensive maintenance required.	Low water-holding capacity; high erodibility.
Slow permeability	High plasticity; low strength.	Moderately well drained.	Slow permeability	No features that significantly affect design.	No features that significantly affect design.
Slow permeability	Temporary perched water table; fair stability and compaction; erodible in sloping areas.	Temporary perched water table; slow permeability in the subsoil; undulating.	Moderate water intake rate; slow permeability in the subsoil; somewhat poorly drained.	Nearly level; limited surface runoff.	Nearly level; limited surface runoff; subject to wind erosion.
No features that significantly affect design.	Calcareous; erodible in sloping areas; fair stability and compaction.	No detrimental features; well drained.	Sloping, irregular terrain; erodible in sloping areas.	No features that significantly affect design.	Highly calcareous; erodible in sloping areas; fair to poor fertility.
No features that significantly affect design.	Calcareous; erodible in sloping areas; fair stability and compaction.	Well drained	Highly calcareous; sloping; sloping areas subject to erosion.	No features that significantly affect design.	Highly calcareous; difficult to establish vegetation on the subsoil.
Rapid permeability.	Erodible in sloping areas; porous and seepy; soil binder needed.	Somewhat excessively drained.	Very low water-holding capacity; high intake rate; subject to occasional flooding.	Nearly level; little or no surface runoff.	Nearly level; high intake rate; subject to occasional flooding.
Moderate permeability.	No features that significantly affect design.	Well drained	Moderate permeability.	No features that significantly affect design.	No features that significantly affect design.
Rapid permeability; seasonal high water table.	Stable in fill; high strength; steep areas unstable; porous; subject to piping.	High water table; somewhat poorly drained; seasonal subirrigation.	Rapid permeability; seasonal high water table; subject to wind erosion.	Nearly level; rapid permeability.	Nearly level; rapid permeability; low fertility; subject to wind erosion.
Stratification	Stable in fill	Well drained	Deep; high water-holding capacity; subject to flash flooding.	Nearly level; subject to flash flooding.	Nearly level; well drained; high fertility.
Moderate permeability.	Erodible in sloping areas; fair stability; subject to seepage in places.	Well drained	No features that significantly affect design.	Complex topography common; erodible in sloping areas.	No features that significantly affect design.

TABLE 7.—*Interpretation of engineering*

Soil series and map symbols	Suitability as a source of—					Soil features affecting engineering practices	
	Topsoil	Sand	Gravel	Road subgrade [1]	Road fill [1]	Highway location [1]	Dikes and levees
Ost (Oc, Os)	Surface layer good; subsoil poor.	Not suitable.	Not suitable.	Poor	Fair	Highly calcareous; well drained; high plasticity.	Fair stability
Plevna	Fair	Poor	Not suitable.	Surface layer good if highway is elevated; subsoil poor.	Fair	Depth to water table ranges from surface to 3 feet; somewhat poorly drained; nearly level.	Erodible in sloping areas; subject to piping.
Pratt (Pm, Pn, Po, Pt)	Poor	Poor	Not suitable.	Good	Good	The sloping soils lack stabillty.	Erodible in sloping areas; porous and seepy; binder needed.
Shellabarger (Sb, Se, Sf)	Fair	Poor	Poor	Poor to fair	Good	No detrimental features.	Fair stability; subject to piping; erodible in sloping areas.
Tabler (Ta)	Surface layer fair; subsoil poor.	Not suitable.	Not suitable.	Poor	Fair	Somewhat poorly drained; possible frost heaving; high plasticity; high shrink-swell potential.	Fair to poor stability; cracks when dry.
Tivoli (Tf)	Not suitable.	Good; very fine and poorly graded.	Not suitable.	Good if confined.	Good if confined.	Sand dunes; well drained.	Binder needed in the loose sand; excessive seepage; erodible in sloping areas.
Waldeck (Wa)	Poor	Good	Good	Good	Good	Subject to flooding; seasonal high water table.	Moderately rapid permeability; fair stability.
Zenda (Ze, Zs)	Good	Good	Good	Poor	Good	Water table within 2 to 4 feet of surface.	No features that significantly affect design.

[1] C. W. HECKATHORN, field soils engineer, and HERBERT E. WORLEY, soils research engineer, Kansas State Highway Commission, helped prepare these columns. This assistance was performed under a cooperative agreement with the U.S. Department of Commerce, Bureau of Public Roads.

properties of soils—Continued

Soil features affecting engineering practices—Continued					
Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
Reservoir area	Embankment [2]				
No features that significantly affect design.	Cracks when dry	Well drained	Calcareous; deep; high water-holding capacity.	No features that significantly affect design.	Subsoil only fair to poor for vegetation.
Stratification	Erodible in sloping areas; subject to piping.	High water table; somewhat poorly drained; seasonal subirrigation.	Shallow water table	Generally not applicable; nearly level; shallow water table.	Generally not applicable; nearly level; shallow water table.
Rapid permeability.	Erodible in sloping areas; porous and seepy; binder needed.	Excessively drained	Moderate to high intake rate; low water-holding capacity.	Generally not applicable; little runoff.	Generally not applicable; subject to wind erosion; a solid cover of sod difficult to establish.
Contains areas where permeability is rapid.	Fair stability; subject to piping; erodible in sloping areas.	Well drained	Gentle to moderate slopes; low water-holding capacity.	No features that significantly affect design.	High erodibility of surface layer.
Very slow permeability.	Fair to poor stability; cracks when dry.	Very slow permeability; flat surface; drainage needed.	Very slow permeability; somewhat poorly drained.	Nearly level; somewhat poorly drained.	Nearly level; somewhat poorly drained.
Excessively drained.	Binder needed in the loose sands; excessive seepage; erodible in sloping areas.	Excessively drained	Areas contain sandhills; excessively drained; subject to severe wind erosion.	Generally not applicable; areas contain sandhills.	Generally not applicable; areas contain sandhills.
Moderately rapid permeability.	Moderately rapid permeability; fines needed.	Generally not applicable.	Subject to flooding; seasonal, shallow water table.	Generally not applicable; nearly level; subject to flooding.	Generally not applicable; nearly level; subject to flooding; low fertility.
Rapid permeability in substratum; shallow, fluctuating water table.	Moderate strength	Generally not applicable.	Shallow, fluctuating water table.	Generally not applicable; nearly level.	Generally not applicable; nearly level.

[2] Embankments more than about 25 feet high not considered.

in some places by silt, clay, and gravel. In others it is underlain by sand and gravel, by unconsolidated deposits of lime, or by silt.

Where the material beneath the sand and gravel is limy, the limy material is in soft and hard nodules. Some areas underlain by limy material are south of Preston, and a large area extends south of Cairo to Isabel. In places the limy material crops out and is the material in which soils have formed.

Red beds of Permian age underlie all of the county, but at no point do they crop out. Depth to these red beds ranges from more than 500 feet, in the northwestern part of the county, to about 30 feet in the NE¼ sec. 34, T. 29 S., R. 15 W., along the Barber County line. Additional information about the underlying material is given under "Parent Material" in the section "Formation and Classification of Soils."

Table 6 gives the classification for each significant layer, according to the textural classes of the U.S. Department of Agriculture and the estimated AASHO and Unified classifications.

In the columns that give percentage passing sieves of various sizes, the percentage of material smaller in diameter than the openings of the given screens is shown.

Soil permeability is the ability of the soil to transmit water or air. It is measured in terms of the rate at which water passes through a saturated soil profile. The column that shows permeability gives, in inches per hour, the estimated rate of water percolation through a soil in place and not compacted. The estimates were based on observations of the porosity and the kind of structure of the soils.

In the column that shows available water capacity are estimates, in inches per inch of soil material, of capillary water in the soil when that soil is wet to field capacity. When the soil is air dry, or is at the wilting point of most plants, this amount of moisture will wet it to a depth of 1 inch without deeper percolation.

The column titled "Reaction" gives pH values for the soils. Because the values are estimated, a range is given.

Salinity of the soils is not rated in table 6. In none of the soils is the degree of salinity great enough to be significant. The Slickspots in the mapping unit Zenda-Slickspots complex, however, are saline.

Dispersion is defined as the amount of naturally dispersed particles measured at micron level by hydrometer method. The ratings given for dispersion are *low*, *moderate*, and *high*, based on the strength of the soil aggregates. A rating of *high* means that the soil aggregates slake readily, and a rating of *low*, that they do not slake readily. A rating of *moderate* means that the degree to which the soil slakes is moderate.

By shrink-swell potential is meant the amount a soil will expand when wet and contract when dry. The soils are given a rating for shrink-swell potential of *low*, *moderate*, and *high*, according to their content of plastic fines. The shrink-swell potential is based, not only on comparisons with the soils in this county, but also on comparisons with other soils throughout the United States.

In general, though some desirable features are named in table 6, only detrimental or undesirable features are given. The agricultural engineering practices named are those commonly used in Pratt County.

Engineering interpretations of soils

In table 7 the suitability of the soils as a source of topsoil is indicated by the terms *good*, *fair*, or *poor*, or if the soils are not suitable, that fact is indicated. In making these estimates, the entire soil profile was considered, though only one horizon of some soils is qualified and only one rating is generally shown in the table.

Ratings are also given the soils as a source of sand and gravel. In this county fairly large areas are underlain by beds of sand and gravel. The largest such area consists of a band, 1 to 2 miles wide, along the Ninnescah River. It begins several miles west of the city of Pratt and extends in an easterly direction to the Kingman County line. Other beds of gravel are along Turkey, Sand, and Silver Creeks, and some of those beds are also good sources of sand. Only the availability of sand and gravel is indicated in table 7. No consideration is given to the total quantity or to the quality as related to specific engineering uses.

Ratings as a source of material for road subgrade and road fill were determined by representatives of the Kansas State Highway Commission. The interpretations on which the ratings were given are based on the experience of those representatives and on their knowledge of the soil properties that affect use of the soils for road subgrade and road fill.

The soil features that affect suitability of the soils for the location of highways and for dikes or levees, farm ponds, agricultural drainage, irrigation, terraces and diversions, and waterways are given only as a guide. Primarily, the information is given to emphasize features that might cause problems if the soil is used as a site for a highway or for the engineering practice named. As an example, though most of the soils in the county have favorable permeability and are well drained, the Tabler and Carwile soils occur in nearly level or concave areas, have a slowly permeable subsoil and substratum, and are somewhat poorly drained. If those soils are used as a site for a highway or for various kinds of engineering structures, designing and building a suitable structure is difficult. Other soils not suited to use for highways and engineering structures are those that occupy small areas on the flood plains of the Ninnescah River and other major streams. Those soils have a fluctuating high water table and are subject to frequent flooding.

The information given in table 7 is not intended to replace soil testing and interpretations made at the site of construction or to diminish the intensity of testing. The column titled "Irrigation," for example, shows that a number of the soils are suitable for irrigation, but extensive soil tests are needed at the site to determine the suitability of a specific area if an irrigation system is planned. General facts about irrigation in Pratt County are given in the subsection "Irrigation."

Formation and Classification of Soils

This section consists of two main parts. The first part tells how the factors of soil formation have affected the development of soils in Pratt County. The second explains the system of soil classification currently used and places each soil series in the classes of that system.

Factors of Soil Formation

Soil is produced by soil-forming processes acting on materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material; (2) the climate under which the soil material has accumulated and existed since accumulation; (3) the plant and animal life on and in the soil; (4) the relief, or lay of the land; and (5) the length of time the forces of soil formation have acted on the soil material.

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

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

Parent material

The parent material from which the soils of Pratt County have formed were deposited largely during the last segment of geologic time, known as the Pleistocene epoch or Quaternary period (*5*). This segment of geologic time began about 1 million years ago and includes the present time.

Two formations of Pleistocene age, the Sanborn and Meade (fig. 13), are exposed in this county. They are underlain by the Blanco formation, which is of Pliocene age and is not exposed. The Sanborn is the most exposed formation. It consists mainly of loess, sand, and gravel. The Meade formation consists chiefly of sand, gravel, and silt that are cemented in some places with calcium carbonate. The Meade formation contains deposits of volcanic ash.

Eolian Sands.—Of all kinds of soils in the county, more than one-third formed in well-sorted fine sands that were deposited by streams during the early part of the Quaternary period and were later reworked and redeposited by wind. The soils formed in these fine sands are undulating to hummocky and are similar in profile characteristics. The principal soils that formed in these fine sands are Tivoli, Pratt, and Naron, but the Farnum, Kanza, and Carwile soils formed partly in that material. The largest area occupied by the undulating soils formed in eolian sands is in the northern half of the county.

Outwash Sediment.—During the early part of the Quaternary period, swift streams carried sediment from the west into the central part of the area that is now the State of Kansas. This material, called outwash sediment, settled in old valleys and covered most of the area that is now Pratt County. More recently, much of the area covered by this outwash sediment has been covered by material deposited by wind.

The outwash sediment consists of unconsolidated, stratified sand, silt, and clay, or of weakly cemented, limy sand, silt, and clay. The sediment contains beds of limy deposits that are exposed in several places. In these deposits the Clark, Case, and Ost soils, which are highly calcareous, have formed.

In the valleys of the Ninnescah River, Turkey Creek, and other entrenched streams, gravelly deposits, coarse sands, and deposits of lime are exposed on the hills and in eroded areas. The gravel and coarse sand are of early Pleistocene age. They underlie the Albion and Shellabarger soils, which have formed in more recent outwash deposits. Other sediment of early Pleistocene age consists of deposits of volcanic ash, which occur in pockets in this general area.

Soils formed in outwash sediment that has been modified by wind are the Farnum, Carwile, Plevna, Tabler, and Bethany. Those soils have formed in finer textured sediment than the Albion and Shellabarger soils.

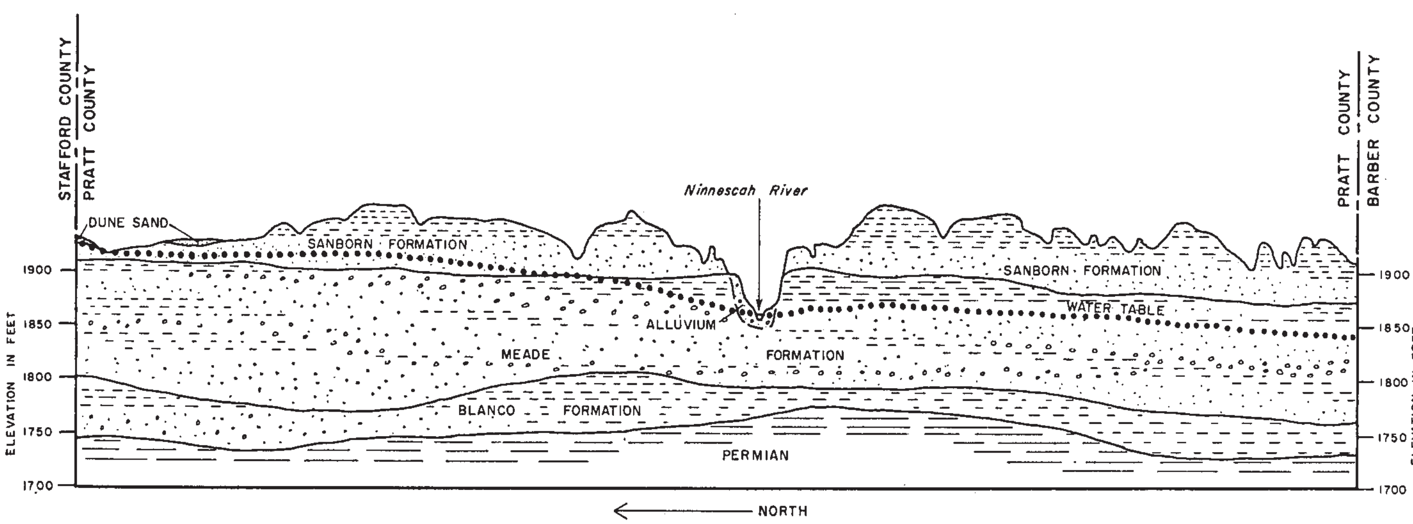

***Figure 13.*—Geologic profile extending in a north-south direction through the central part of Pratt County.**

ALLUVIAL DEPOSITS.—These deposits consist of material laid down by streams. They make up the most recently deposited sediment in the county. Soils developed in this sediment are the Kaw, Waldeck, Zenda, and Croft, which occur along streams.

LOESSAL DEPOSITS.—Loessal deposits consist of silty material deposited by wind. They mantle the nearly level areas in the south-central and southwestern parts of the county.

The Bethany and Tabler soils are the principal ones that have formed in a thin layer of loess. The development of the Naron, Farnum, and Ost soils was apparently modified by loess, and those soils contain a large amount of silt.

Climate

Climate has played an important role in the formation of soils in this county. Precipitation, temperature, and wind have all acted to help change the soil material into a soil profile. These climatic agents have caused the three principal types or processes of weathering—physical, chemical, and biological—to take place. The processes of weathering are all related.

Moisture from rainfall and other sources enters the soil, dissolves soluble materials, and transports those materials downward in the soil. It permits plants to grow and to contribute organic matter to the soils. As the moisture moves downward, it carries fine particles of soil material and minerals with it and deposits them in layers known as the subsoil, or B horizon. Moisture also allows the soil organisms to increase in number and activity. These organisms help to darken the soil by changing plant material to soil organic matter.

Variations in wind and in temperature from season to season affect the soils in several ways. Hot summer winds evaporate moisture rapidly. They blow the fine particles from the surface layer, thus decreasing the fertility of the soils. Alternating cold and warm temperatures in winter cause freezing and thawing of the soil material, break up the soil aggregates, and change the soil structure. Winds also blow particles of soil material from one area to another and thus modify the texture of the surface layer. Large particles or aggregates are caught up by the wind, which causes them to saltate, or bounce along the surface. Wherever these large particles are deposited, they disturb the fine particles, causing them to rise, to be caught by the wind and carried into the air, and to be deposited many miles away.

Plant and animal life

Plants and animals aid the soil-forming processes. The roots and tops of plants decay and add organic matter to the soils. Burrowing animals mix the soil material and move it from one layer to another. Micro-organisms break down the organic matter, as well as the minerals and rocks.

Plants are the primary source of organic matter that causes the dark color of soils. The soils of this county have formed under tall and mid grasses, and these grasses supply the soils with enormous amounts of roots that decay and add organic matter. The organic matter from the decayed roots accounts for the dark color of the surface layer of most of the soils in the county.

Micro-organisms play an important role in the development of soils by changing plant residue into organic matter in the soils. Earthworms also play an important role by thoroughly mixing the mineral matter and organic matter. Many soils in the county show the influence of earthworm and rodent activities. The Ost and Clark soils, for example, have worm casts and dark streaks in the upper layers, as a result of the activities of earthworms and rodents.

Relief

Relief, or lay of the land, influences the formation of soils through its effects upon drainage, runoff, erosion, and vegetation. Runoff becomes excessive on moderate and steep slopes because the soils are unable to absorb the moisture from rainfall. When the soils are not protected by a cover of plants, excessive runoff causes steep soils to erode more readily than less sloping ones.

Soils that are nearly level or that occur in low places where surface drainage is poor are likely to have a gray or dark color and a mottled subsoil. Carwile, Zenda, and Waldeck are examples of such soils in Pratt County.

Relief influences the other factors of soil formation. For example, vegetation is sparse on some steep soils because those soils do not absorb enough moisture to support a good cover of plants. Because of this sparse cover, only a limited amount of residue is available to supply organic matter to the soils.

Time

The length of time required for the formation of a soil depends largely on the other factors of soil formation. In parent material consisting of weathered rock, a much longer period of time is required for a soil profile to develop than in a thick deposit of outwash sediment. A soil profile also develops more quickly in areas where weathering is extensive than in areas where little weathering takes place.

Among the oldest soils in Pratt County are the Bethany and Tabler. Those soils have formed in loess and old alluvial sediment, and they have a thick, clayey subsoil. Younger soils that have formed in material similar in age to that of the loess and old alluvial sediment, but that have been more recently reworked by wind, are the Tivoli, Pratt, and Naron.

In some soils more time is required for a soil profile to develop than in others because the parent material is resistant to leaching or is susceptible to erosion. Examples of such soils are the Clark and Case. Those soils have formed in highly calcareous outwash sediment that is resistant to leaching and that is easily eroded.

The youngest soils in the county are the Zenda, Kaw, and Waldeck, which have formed in alluvium. Those soils have formed in the most recently deposited material, which is alluvium, or stream-laid, sediment. In those soils not enough time has elapsed since the parent material was deposited for distinct soil horizons to have developed.

Classification of the Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us understand their behavior and their response to manipulation. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

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

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (*2*) and later revised (*9*). The system currently used was adopted for general use by the National Cooperative Soil Survey in 1965. The current system is under continual study. Therefore, readers interested in developments of the current system should search the latest literature available (*8, 11*). In table 8 the soil series of Pratt County are placed in some categories of the current system and in the great soil groups of the older system.

The current system of classification has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped together.

New soil series must be established and concepts of some established series, especially older ones that have been little used in recent years, must be revised in the course of the soil survey program across the country. A proposed new series has tentative status until review of the series concept at State, regional, and national levels of responsibility for soil classification results in a judgment that the new series should be established. Most of the soil series described in this publication have been established earlier. Five of the soil series used in this survey had tentative status when the survey was sent to the printer. They are the Case, Croft, Kanza, Waldeck, and Zenda series.

The Kaw series, which appears in this publication, was made inactive shortly before the survey was sent to the printer. Studies subsequent to completion of the survey indicate that soils that have been classified as the Kaw series should be included in the Verdigris series.

Most of the classes of the current system are briefly defined in the following paragraphs.

ORDER.—Ten soil orders are recognized. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate these soil orders are those that tend to give broad climatic groupings of soils. The two exceptions to this are the Entisols and Histosols, which occur in many different kinds of climate. Table 8 shows that the four soil orders in Pratt County are Entisols, Inceptisols, Mollisols, and Alfisols.

Entisols are light-colored soils that do not have natural genetic horizons or that have only very weakly expressed beginnings of such horizons. These soils do not have traits that reflect soil mixing caused by shrinking and swelling. In Pratt County this order includes some soils previously classified as Regosols.

Inceptisols typically occur on flood plains and other youthful land surfaces. Many soils of this order were formerly classified as Chernozems intergrading toward Calcisols.

Mollisols have formed under grass and have a thick, dark-colored surface horizon containing colloids dominated by bivalent cations. The soil material in these soils has not been mixed by shrinking and swelling. Soils of this order were formerly called Reddish Prairie soils, Chestnut soils intergrading toward Planosols, Chernozems

TABLE 8.—*Soils classified according to the current system of classification and the 1938 system*

Soil series	Family	Subgroup	Order	Great soil group of the 1938 system
Albion	Coarse-loamy, mixed, thermic	Udic Argiustolls	Mollisols	Reddish Prairie soils.
Bethany	Fine, mixed, thermic	Typic Paleustolls	Mollisols	Reddish Prairie soils.
Carwile	Fine, mixed, noncalcareous, thermic	Typic Argiaquolls	Mollisols	Chestnut soils intergrading toward Planosols.
Case	Fine-carbonatic, mixed, thermic	Typic Ustochrepts	Inceptisols	Chernozems intergrading toward Calcisols.
Clark	Fine-carbonatic, mixed, thermic	Typic Calciustolls	Mollisols	Chernozems intergrading toward Calcisols.
Croft	Sandy, mixed, thermic	Typic Ustipsamments	Entisols	Regosols.
Farnum	Fine-loamy, mixed, thermic	Pachic Argiustolls	Mollisols	Brunizems.
Kanza	Sandy, mixed, noncalcareous, thermic	Typic Haplaquolls	Mollisols	Chernozems intergrading toward Calcisols.
Kaw	Fine-silty, mixed, thermic	Cumulic Hapludolls	Mollisols	Alluvial soils.
Naron	Fine-loamy, mixed, thermic	Udic Argiustolls	Mollisols	Chernozems.
Ost	Fine-loamy, mixed, thermic	Typic Argiustolls	Mollisols	Chernozems.
Plevna	Coarse-loamy, mixed, noncalcareous, thermic.	Fluventic Haplaquolls	Mollisols	Humic Gley soils.
Pratt	Sandy, mixed, thermic	Psammentic Haplustalfs	Alfisols	Chestnut soils.
Shellabarger	Fine-loamy, mixed, thermic	Udic Argiustolls	Mollisols	Reddish Prairie soils.
Tabler	Fine, montmorillonitic, thermic	Aquic Argiustolls	Mollisols	Reddish Prairie soils.
Tivoli	Sandy, mixed, thermic	Typic Ustipsamments	Entisols	Regosols.
Waldeck	Coarse-loamy, mixed, thermic	Aquic Fluventic Haplustolls.	Mollisols	Alluvial soils.
Zenda	Fine-loamy, mixed, thermic	Aquic Fluventic Haplustolls.	Mollisols	Alluvial soils.

intergrading toward Calcisols, Brunizems, Alluvial soils, Chernozems, and Humic Gley soils.

Alfisols are mineral soils that contain horizons of clay accumulation. Unlike the Mollisols, they lack a thick, dark-colored surface layer that contains colloids dominated by bivalent cations, but the base status of the lower horizons is not extremely low. In Pratt County this order includes soils formerly classified as Chestnut soils.

SUBORDER.—Each order has been subdivided into suborders, primarily on the basis of the characteristics that seemed to produce classes that have the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging or soil differences resulting from the climate or vegetation.

GREAT GROUPS.—Suborders are separated into great groups on basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron or humus have accumulated or those that contain a pan that interferes with the growth of roots or movement of water. The features used are the self-mulching properties of clays, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), and the like. The great group is not shown separately in table 8, because it is the last word in the name of the subgroup.

SUBGROUP.—Great groups are subdivided into subgroups, one representing the central (typic) segment of the group, and others, called intergrades, that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the great group.

FAMILY.—Families are separated within a subgroup primarily on the basis of properties important to the growth of plants or behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence.

General Facts About the County

This section was written mainly for those unfamiliar with Pratt County. It tells about the physiography, drainage, and water supply; the climate; and the agriculture of the county. Unless indicated otherwise, the statistics used are from the U.S. Bureau of the Census.

Physiography, Drainage, and Water Supply

Pratt County lies within the southern part of the Great Bend Sand Plains resource area, which is a part of the Central Great Plains Wheat and Range resource region. In general, the landscape in the county consists of a slightly dissected nearly level to gently rolling or sloping plain (*6*), but the slopes are steeper along the major drainageways and around the sandhills in the northwestern part.

The elevations in Pratt County range from about 2,100 feet above sea level near Cullison, along the county line on the west, to about 1,725 feet at the point where U.S. Highway No. 54 crosses the county line on the east. Other approximate elevations are 1,950 feet near Hopewell; 1,800 feet near Preston; and 1,900 feet near Sawyer. The elevation is about 2,000 feet above sea level in the southwestern corner of the county.

In the northern third of the county the soils are mostly sandy or moderately sandy and are undulating. In that area not enough moisture runs off for a drainage pattern to have developed. Rattlesnake Creek flows through the northwestern tip of the county and drains any excess water from the areas surrounding Hopewell and Byers. Any excess water from the northernmost tier of townships, extending from the town of Byers on the west to the Reno and Kingman County lines on the east, drains into the Medicine Lodge River in Barber County. Elm watershed to the north, and into Reno County to the east. The headwaters of Silver Creek are near Preston in the northeastern part of the county. Silver Creek drains into Kingman County on the east.

The central part of the county is drained by the South Fork Ninnescah River, the headwaters of which are about one-half mile north of the town of Cullison. That stream follows a meandering course along U.S. Highway No. 54 to the county line on the east. The southwestern part of the county is drained by Turkey Creek, which drains south into the Medicine Lodge River in Barber County. Elm Creek, mainly in Barber County, drains the south-central part of the county west of Sawyer. It also flows to the south into the Medicine Lodge River. The southeastern part of the county is drained by Sand Creek, east of Sawyer. It is also drained by the headwaters of the Chikaskia River, which starts in the southeastern part of the county.

The Ninnescah River, Turkey Creek, and Rattlesnake Creek are the only permanently flowing streams in the county. They are fed by springs located along the channels of the streams. Artesian wells are situated along the Ninnescah River in several places. The steep breaks along the Ninnescah River can be seen from U.S. Highway No. 54, east of the town of Pratt. Where they occur, the stream channel has cut through thick layers of outwash sand and gravel between the breaks.

All of the water for domestic use, and most of the water for livestock, is taken from wells. A number of ponds have been constructed, however, along intermittent streams throughout the county, and they supply some of the water for livestock. Most of the wells are drilled. They range from 15 to 200 feet in depth.

The supply of ground water is good in nearly all parts of the county, and an especially large supply is in the northwestern part. In the extensive area of sandy soils in the northern half of the county, most of the water from precipitation is absorbed and recharges the supply of ground water. Most of the water that is pumped comes from the Meade formation. Figure 13, page 49, shows the approximate level of the ground water in an area through the central part of the county.

Climate[7]

The climate of Pratt County is subhumid continental. It is characterized by large daily and annual ranges in temperature and by hot summers and rather cold winters. Precipitation falls mainly during the growing season. Table 9 gives facts about the temperatures and precipitation in Pratt County. The information in that table was taken from records kept at the town of Pratt.

Pratt County is in the south-central part of Kansas, near the geographical center of the United States. The average elevation is about 1,950 feet above sea level. Almost all of the county is within the drainage system of the Arkansas River. The county is in the rain shadow of the Rocky Mountains, which form a massive barrier, blocking storms that frequently move in from the Pacific Ocean in fall, winter, and spring. The effect of these mountains is not so great in Pratt County, however, as in areas farther to the west.

The Gulf of Mexico is the principal source of moisture, but the county does not receive as much moisture from the Gulf as do areas to the east. From east to west, the average annual amount of precipitation received decreases about 1 inch for each 17 miles of distance (*4*). Because Pratt County is in the south-central part of the State, the amount of precipitation it receives is about halfway between that received in the eastern part of the State and that received in the western part. Furthermore, the eastern border of the county receives about 25 inches of precipitation annually, and the western border receives only about 23 inches. Shortage of moisture limits the number of cultivated crops that can be grown successfully on the dryland farms in the county. The effect of this lack of moisture is minimized, however, by allowing the soils to remain fallow in summer and by using other management practices that conserve moisture.

Most of the rain in Pratt County falls late in spring and early in summer in showers, or it accompanies thunderstorms. Some of the thunderstorms are violent. The heavy downpour of rain, large hailstones, and tornadoes that sometimes accompany these storms wash out spring-seeded crops and cause considerable erosion in cultivated fields. They also pack the surface layer in fields not protected by a crop or crop residue, and this packing reduces aeration of the soils, affects the soil structure, and increases the amount of runoff from subsequent rains. Thunderstorms generally occur in this county on an average of 55 to 60 days each year.

After the maximum average monthly amount of about 3.59 inches of precipitation is received in June (see table 9), the amount of precipitation gradually tapers off. The least amount of precipitation, an average of about 0.59 inch, is received in January. In 1 year in every 10, on the average, precipitation amounting to less than 0.01 inch will be received in each of the months of January, February, and November, and precipitation that exceeds 6 inches will be received in May and June. The probability of receiving a significant amount of rainfall in summer is least in July.

Table 10 shows the probability of receiving various

[7] By MERLE J. BROWN, State climatologist, U.S. Weather Bureau, Manhattan, Kans.

TABLE 9.—*Temperature and precipitation*

[From records kept at Pratt, Kans.]

Month	Temperature				Precipitation				
	Average daily maximum[1]	Average daily minimum[1]	Two years in 10 will have at least 4 days with—		Average total[3]	One year in 10 will have—		Days with snow cover of 1.0 inch or more[4]	Average depth of snow on days that have a snow cover[4]
			Maximum temperature equal to or higher than—[2]	Minimum temperature equal to or lower than—[2]		Totals less than—[1]	Totals greater than—[1]		
	°F.	°F.	°F.	°F.	Inches	Inches	Inches		
January	44.4	20.9	63	4	0.59	0.01	1.38	3	2.7
February	49.0	23.9	68	9	.93	.01	1.96	4	3.3
March	58.7	31.7	79	15	1.27	.06	2.65	3	3.1
April	69.7	42.7	86	30	2.24	.51	4.65	(5)	1.5
May	78.0	53.0	92	41	3.58	1.19	6.55	0	0
June	88.4	62.8	101	53	3.59	.78	6.47	0	0
July	94.1	67.6	105	60	2.84	.63	5.52	0	0
August	93.5	66.6	105	58	2.70	.59	5.81	0	0
September	84.9	58.1	99	44	2.57	.63	5.20	0	0
October	73.0	46.4	88	33	2.07	.41	4.47	0	0
November	58.3	32.9	74	17	1.21	.01	2.60	1	3.3
December	46.4	23.9	65	11	.73	.05	2.12	3	2.2
Year	69.9	44.2	[6] 106	[7] −6	24.32	16.78	34.79	14	2.9

[1] Data from records kept from 1898 to 1963.
[2] Data from records kept from 1936 to 1960.
[3] Data from records kept from 1898 to 1964.
[4] Data from records kept from 1949 to 1964.
[5] Less than 1 day.
[6] Average annual highest temperature.
[7] Average annual lowest temperature.

TABLE 10.—*Frequency of rains of stated duration and intensity*

Frequency [1]	Durations of—						
	30 minutes	1 hour	2 hours	3 hours	6 hours	12 hours	24 hours
Years	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
1	1.0	1.4	1.5	1.6	1.9	2.0	2.4
2	1.4	1.6	1.9	2.0	2.3	2.6	3.0
5	1.7	2.2	2.5	2.7	3.1	3.5	4.0
10	2.0	2.6	3.0	3.2	3.7	4.2	4.9
25	2.4	3.0	3.5	3.8	4.4	5.0	5.6
50	2.7	3.4	4.0	4.3	4.9	5.4	6.5
100	3.1	3.8	4.5	4.8	5.4	6.4	7.3

[1] Number of years that elapse before rainfall of the stated amount occurs in the time shown. For example, rainfall of 1.7 inches can be expected in a 30-minute interval once in 5 years.

amounts of rainfall during specified periods ranging from one-half hour to 24 hours (*12*). The probabilities are, for example, that once in 5 years a total of 2½ inches of rainfall will be received in 2 hours. Similarly, once in 10 years the probabilities are that a total of 2 inches of rainfall will be received in 30 minutes.

Since 1898, the amount of annual precipitation received has ranged from a low of 10.98 inches in 1956 to a high of 39.30 inches in 1957. Droughts that damage crops sometimes continue for several years. Droughts were very serious during the 1930's and again from 1952 to 1957. The drought of the 1950's was of the longest duration and of the greatest intensity of any drought during a 30-year period. During that period, the weather was dry for 57 months and drought was severe or extreme for 46 months.

Table 9 shows the average daily maximum and minimum temperatures for each month in the year and for the year. It also gives the probabilities that, 2 years in 10, specified temperatures will occur. In 2 years in every 10, on the average, a maximum temperature of 63° or higher will be reached on 4 days in January, and a minimum temperature of 4° or lower will be reached on 4 days during the same month.

The principal crops grown in the county are seldom damaged by freezing temperatures. In the northwestern corner of the county, the average freeze-free period is about 185 days, and in the southeastern part, it is about 193 days (*3*). The latest date in spring on which a temperature of 32° has occurred is May 25, in 1907, and the earliest date in fall on which a temperature of 32° has occurred is September 20, in 1901 and again in 1918. Table 11 gives the probabilities of the last freeze after a specified date in spring and probabilities of the first freeze before a specified date in fall for 5 thresholds, calculated from records at the town of Pratt. Table 11 shows that in one-half of the years, on the average, the last temperature of 32° in spring will occur after April 18. It also shows that in about one-half of the years, the first temperature of 32° or lower in fall will occur before October 25.

Surface winds are moderate to occasionally strong in all seasons. The windiest period is March and April, when the average hourly speed of the wind exceeds 15 miles per hour. The prevailing wind is southerly, but northerly and northwesterly winds are not uncommon, especially in winter. Because of the wind and the dry weather, soil blowing is a hazard, especially in March and April. Tornadoes occur occasionally, but they generally affect only a small area.

Sunshine is abundant in this county. About 75 percent of the total amount of possible sunshine is received during July and August. The average for the year is about 65 percent.

Agriculture

Tall prairie grasses originally covered most of the area that is now Pratt County. In the late 1870's, however, farmers began to plow the prairie. By about 1880, crops were harvested from about 60,000 acres. At first, corn was the main crop and was grown on about two-thirds of the acreage.

Hard red winter wheat was introduced in this county in the 1870's. Because many farmers had lost corn crops when the weather turned hot and dry in summer, a number of them switched to growing wheat. Yields of wheat were unusually good in 1900 and 1901, and the hopes that these yields would continue brought many new settlers to

TABLE 11.—*Probabilities of last freezing weather in spring and first in fall*

[Data for Pratt, Kans.]

Probability	Dates for given probability and temperature				
	16° F. or lower	20° F. or lower	24° F. or lower	28° F. or lower	32° F. or lower
Spring:					
1 year in 10 later than	March 28	April 4	April 10	April 20	May 3
2 years in 10 later than	March 22	March 29	April 5	April 15	April 28
5 years in 10 later than	March 10	March 19	March 27	April 5	April 18
Fall:					
1 year in 10 earlier than	November 14	November 7	October 29	October 22	October 11
2 years in 10 earlier than	November 20	November 12	November 2	October 27	October 15
5 years in 10 earlier than	December 2	November 23	November 12	November 5	October 25

the county. By 1928 about 376,000 acres was cultivated. Since that time, however, large tracts, thousands of acres in extent, have been reseeded to grass. In 1964 a total of 210,241 acres consisted of land from which crops were harvested, and 81,359 acres was in grass. In 1964 the number of farms in the county had dropped to 672 from a total of 1,023 in 1949, and the average-sized farm contained 673.4 acres. In that year about 82 percent of the total number of farm operators owned or partly owned the farm they operated.

Most of the towns have facilities for handling and storing grain. The railroads provide a means of transporting grain to terminal elevators, and of transporting grain, livestock, and livestock products to markets to the east and west. Federal and State highways crisscross the county and provide access to market by truck.

Crops.—Wheat and sorghum are better suited to the climate of this county than most crops. They are the main crops, but alfalfa, corn, oats, barley, sweetclover, and rye are grown to some extent. According to the biennial reports of the Kansas State Board of Agriculture, the principal crops harvested in Pratt County in 1961 were wheat, 170,000 acres; grain sorghum, 53,000 acres; forage sorghum, 5,000 acres; barley, 8,500 acres; rye, 2,420 acres; oats, 480 acres; alfalfa cut for hay, 3,400 acres; sweetclover grown for seed, 60 acres; and corn, 980 acres.

Livestock.—Livestock is an important source of income in Pratt County. In 1964 income from the sale of livestock and livestock products, other than poultry and dairy, accounted for nearly 62 percent of the total value of all farm products sold. Of the kinds of livestock raised, beef cattle are, by far, the most important as a source of income. According to biennial reports of the Kansas State Board of Agriculture, the approximate numbers of livestock on farms in the county in 1961 were beef cattle, 26,200; milk cows, 1,800; hogs, 5,300; sheep, 7,900; and chickens, 52,000.

Literature Cited

(1) American Association of State Highway Officials.
1961. STANDARD SPECIFICATIONS FOR HIGHWAY MATERIALS AND METHODS OF SAMPLING AND TESTING. Ed. 8, 2 v., illus.

(2) Baldwin, M., Kellogg, C., and Thorp, J.
1938. SOIL CLASSIFICATION. U.S. Dept. Agr. Ybk.: 970–1001.

(3) Bark, L. Dean.
1959. WHEN TO EXPECT LATE-SPRING AND EARLY-FALL FREEZES IN KANSAS. Agr. Expt. Sta. and Kans. State Univ. Agr. and Applied Sci. Bul. 415, 23 pp., illus.

(4) ———
1961. RAINFALL PATTERNS IN KANSAS. Kans. State Univ. of Agr. and Applied Sci., Kans. Agr. Situation Reprint No. 9, 4 pp., illus.

(5) Frye, John C., and Leonard, A. Byron.
1952. PLEISTOCENE GEOLOGY OF KANSAS. Univ. of Kans., State Geol. Survey of Kans., Bul. 99, 230 pp., illus.

(6) Kansas Agricultural Experiment Station and Kansas State Planning Board.
1937. AGRICULTURAL RESOURCES OF KANSAS. Kans. State Col. Bul. 21: (10) 227 pp.

(7) Portland Cement Association.
1956. PCA SOIL PRIMER. 86 pp., illus. Chicago.

(8) Simonson, Roy W.
1962. SOIL CLASSIFICATION IN THE UNITED STATES. Sci. 137: 1027–1034.

(9) Thorp, James, and Smith, Guy D.
1949. HIGHER CATEGORIES OF SOIL CLASSIFICATION: ORDER, SUBORDER, AND GREAT SOIL GROUPS. Soil Sci. 67: 117–126.

(10) United States Department of Agriculture.
1951. SOIL SURVEY MANUAL. U.S. Dept. Agr. Handbk. 18, 503 pp., illus.

(11) ———
1960. SOIL CLASSIFICATION, A COMPREHENSIVE SYSTEM. 7th Approximation. Soil Survey Staff, Soil Conservation Service, 265 pp., illus. (Supplement issued in March 1967)

(12) United States Department of Commerce, Weather Bureau.
1961. RAINFALL FREQUENCY ATLAS OF THE UNITED STATES FOR DURATIONS FROM 30 MINUTES TO 24 HOURS AND RETURN PERIODS FROM 1 TO 100 YEARS. Tech. Paper 40, 115 pp., illus.

(13) Waterways Experiment Station, Corps of Engineers.
1953. THE UNIFIED SOIL CLASSIFICATION SYSTEM. Tech. Memo. 3-357, 2 v. and appendix.

Glossary

Aggregate. Many fine particles of soil held in a single mass or cluster, such as a clod, crumb, block, or prism.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Blowout. An excavation produced by wind action in a loose soil, generally sand.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Chlorosis. A condition in plants resulting from the failure of chlorophyll (the green coloring matter) to develop, usually because of deficiency of an essential nutrient. The color of leaves of chlorotic plants ranges from light green through yellow to almost white.

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. Also called clay coat, clay skin.

Clay loam. Soil material that contains 27 to 40 percent clay and 20 to 45 percent sand.

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; soil does not hold together in a mass.

Friable.—When moist, soil crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, soil crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, soil 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, soil adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, soil moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, soil breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

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 residue.

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 it is therefore marked by an 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 (1) distinctive characteristics caused by accumulation of clay, sesquioxides, humus, or some combination of these; (2) prismatic or blocky structure; (3) redder or stronger colors than the A horizon; or (4) 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 the A or B horizon.

Internal soil drainage. The downward movement of water through the soil profile. The rate of movement is determined by the texture, structure, and other characteristics of the soil profile and underlying layers, and by the height of the water table, either permanent or perched. Relative terms for expressing internal drainage are *none, very slow, slow, medium, rapid,* and *very rapid.*

Leaching. The removal of soluble material from soil or other material by percolating water.

Loam. Soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand.

Loess. A deposit of fine-grained windblown material consisting dominantly of silt-sized particles.

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

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability. The quality 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.*

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.

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	Mildly alkaline	7.4 to 7.8
Very strongly acid	4.5 to 5.0	Moderately alkaline	7.9 to 8.4
Strongly acid	5.1 to 5.5	Strongly alkaline	8.5 to 9.0
Medium acid	5.6 to 6.0	Very strongly alkaline	9.1 and higher
Slightly acid	6.1 to 6.5		
Neutral	6.6 to 7.3		

Red beds. Sedimentary strata that are largely of Permian and Triassic age, that contain few fossils, and that are prevailingly red in color.

Relief. The elevation 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.

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.

Slickspots. Small areas in a field that are slick when wet because they contain excess exchangeable sodium, or alkali.

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 without any regular cleavage, as in many claypans and hardpans).

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

Substratum. Any layer lying beneath the solum, or true soil; the C or D horizon.

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."

Weathering. All physical and chemical changes produced in rocks at or near the earth's surface by atmospheric agents. These changes result in more or less complete disintegration and decomposition of the rock.

GUIDE TO MAPPING UNITS

[For a full description of a mapping unit, read both the description of the mapping unit and the description of the soil series to which it belongs.

[See table 1, p. 7 for the approximate acreage and proportionate extent of the soils and table 2, p. 31, for predicted average yields. For facts about managing range, refer to the section "Range Management," beginning on p. 32; for facts about managing windbreaks, refer to the section "Management of Windbreaks," beginning on p. 34; and for information significant to engineering, refer to the section "Engineering Uses of the Soils," beginning on p. 38]

Map symbol	Mapping unit	Described on page	Capability unit		Range site	Windbreak group
			Symbol	Page	Name	Number
Ab	Albion sandy loam, 1 to 4 percent slopes	8	IVe-2	29	Sandy	2
Ao	Albion sandy loam, 3 to 7 percent slopes, eroded	8	VIe-3	30	Sandy	6
As	Albion and Shellabarger soils, 7 to 15 percent slopes	8	VIe-3	30	Sandy	6
Bc	Bethany silty clay loam, 1 to 4 percent slopes, eroded	9	IIIe-5	28	Loamy Upland	1
Be	Bethany silt loam, 0 to 1 percent slopes	9	IIc-3	27	Loamy Upland	1
Bh	Bethany silt loam, 1 to 3 percent slopes	9	IIe-2	26	Loamy Upland	1
Br	Broken alluvial land	10	VIIw-1	31	Unstable	6
Ca	Carwile fine sandy loam	10	IIw-2	27	Sandy	3
Cc	Case-Clark complex, 3 to 7 percent slopes	11	IVe-4	29	Limy Upland	1
Ck	Case-Clark complex, 7 to 15 percent slopes	11	VIe-1	30	Limy Upland	6
Cm	Clark clay loam, 1 to 4 percent slopes	12	IIIe-3	28	Limy Upland	1
Cn	Clark fine sandy loam, 1 to 3 percent slopes	12	IIIe-3	28	Limy Upland	2
Co	Clark-Ost clay loams, 0 to 1 percent slopes	13	IIc-4	27	Limy Upland and Loamy Upland	1
Cs	Croft soils	13	VIe-2	30	Sands	6
Fa	Farnum clay loam, 3 to 6 percent slopes, eroded	14	IVe-3	29	Loamy Upland	1
Fe	Farnum fine sandy loam, 0 to 1 percent slopes	14	IIe-3	26	Sandy	2
Fm	Farnum loam, 0 to 1 percent slopes	14	IIc-3	27	Loamy Upland	1
Fn	Farnum loam, 1 to 3 percent slopes	14	IIe-2	26	Loamy Upland	1
Fu	Farnum loam, 3 to 6 percent slopes	14	IIIe-4	28	Loamy Upland	1
Fw	Farnum-Carwile complex	15	IIc-3	27	Loamy Upland and Sandy	1,3
Kp	Kanza-Plevna complex	15	Vw-1	30	Subirrigated	6
Ks	Kaw silt loam	16	IIc-2	27	Loamy Terrace	3
Kw	Kaw silt loam, frequently flooded	16	IIIw-2	29	Loamy Lowland	3
Nd	Naron fine sandy loam, 0 to 1 percent slopes	17	IIe-3	26	Sandy	2
Nf	Naron fine sandy loam, 1 to 3 percent slopes	17	IIIe-2	28	Sandy	2
Ng	Naron fine sandy loam, 3 to 6 percent slopes	17	IIIe-2	28	Sandy	2
Nk	Naron loam, 0 to 1 percent slopes	17	IIc-1	27	Loamy Upland	1
Nm	Naron loam, 1 to 3 percent slopes	17	IIe-1	26	Loamy Upland	1
Nn	Naron-Farnum complex	17	IIIe-2	28	Sandy and Loamy Upland	1,2
Oc	Ost clay loam, 0 to 1 percent slopes	18	IIc-4	27	Loamy Upland	1
Os	Ost clay loam, 1 to 4 percent slopes	18	IIIe-3	28	Loamy Upland	1
Pm	Pratt loamy fine sand, undulating	19	IIIe-1	28	Sands	2
Pn	Pratt loamy fine sand, hummocky	20	IVe-1	29	Sands	2
Po	Pratt-Carwile complex	20	IIIe-1	28	Sands and Sandy	2,3
Pt	Pratt-Tivoli loamy fine sands	20	VIe-2	30	Sands	2
Sa	Sandy breaks-Alluvial land complex	20	VIe-3	30	Sandy and Loamy Lowland	6
Sb	Shellabarger fine sandy loam, 0 to 1 percent slopes	21	IIe-3	26	Sandy	2
Se	Shellabarger fine sandy loam, 1 to 4 percent slopes	21	IIIe-2	28	Sandy	2
Sf	Shellabarger fine sandy loam, 3 to 7 percent slopes, eroded	21	IVe-2	29	Sandy	2
Ta	Tabler clay loam	22	IIs-1	27	Clay Upland	4
Tf	Tivoli fine sand	23	VIIe-1	30	Choppy Sands	6
Wa	Waldeck fine sandy loam	23	IIIw-1	29	Subirrigated	3
Wd	Wet alluvial land	24	VIw-1	30	Wet Land	6
Ze	Zenda clay loam	24	IIw-1	26	Subirrigated	3
Zs	Zenda-Slickspots complex	24	IVs-1	30	Saline Subirrigated	5

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