United States Department of Agriculture

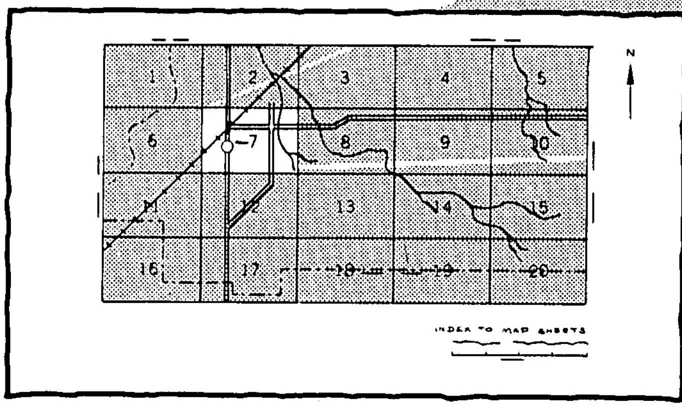
Soil Conservation Service

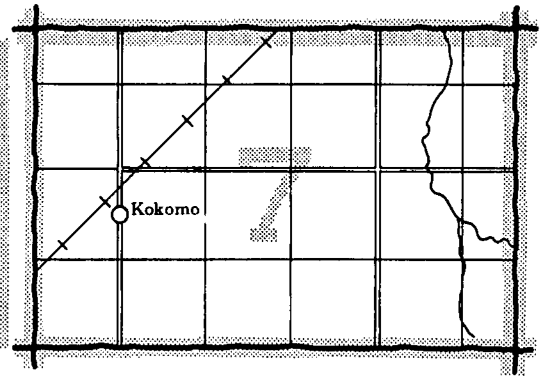
In Cooperation with Kansas Agricultural Experiment Station

Soil Survey of Sheridan County, Kansas

HOW TO USE

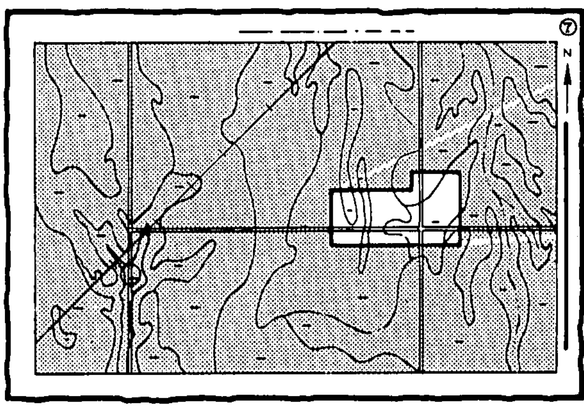
1. Locate your area of interest on the "Index to Map Sheets" (the last page of this publication).

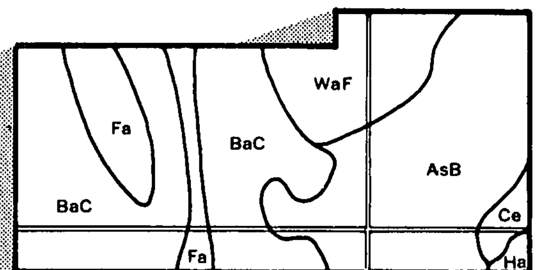




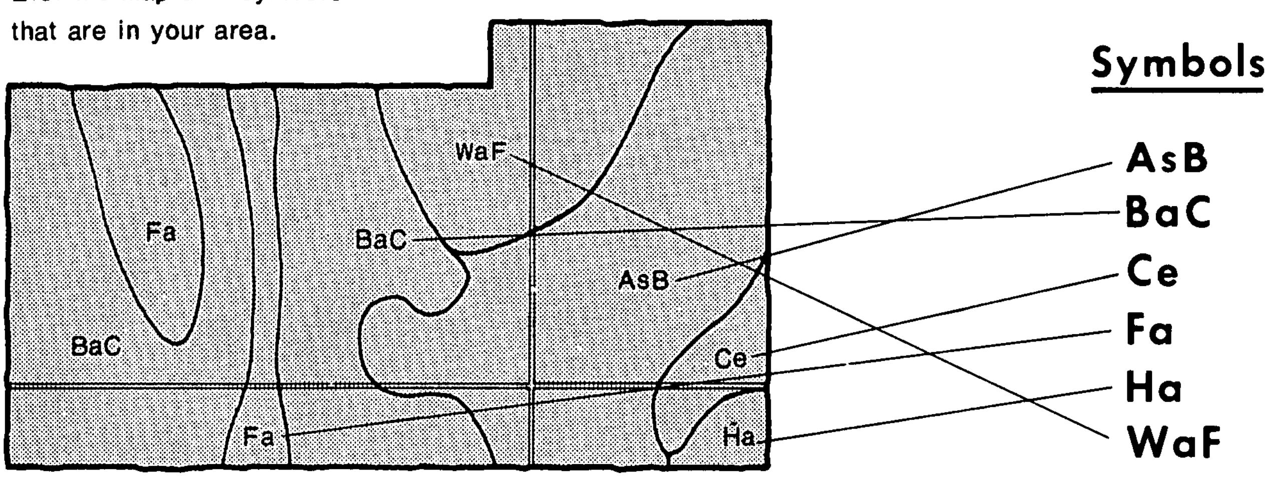
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



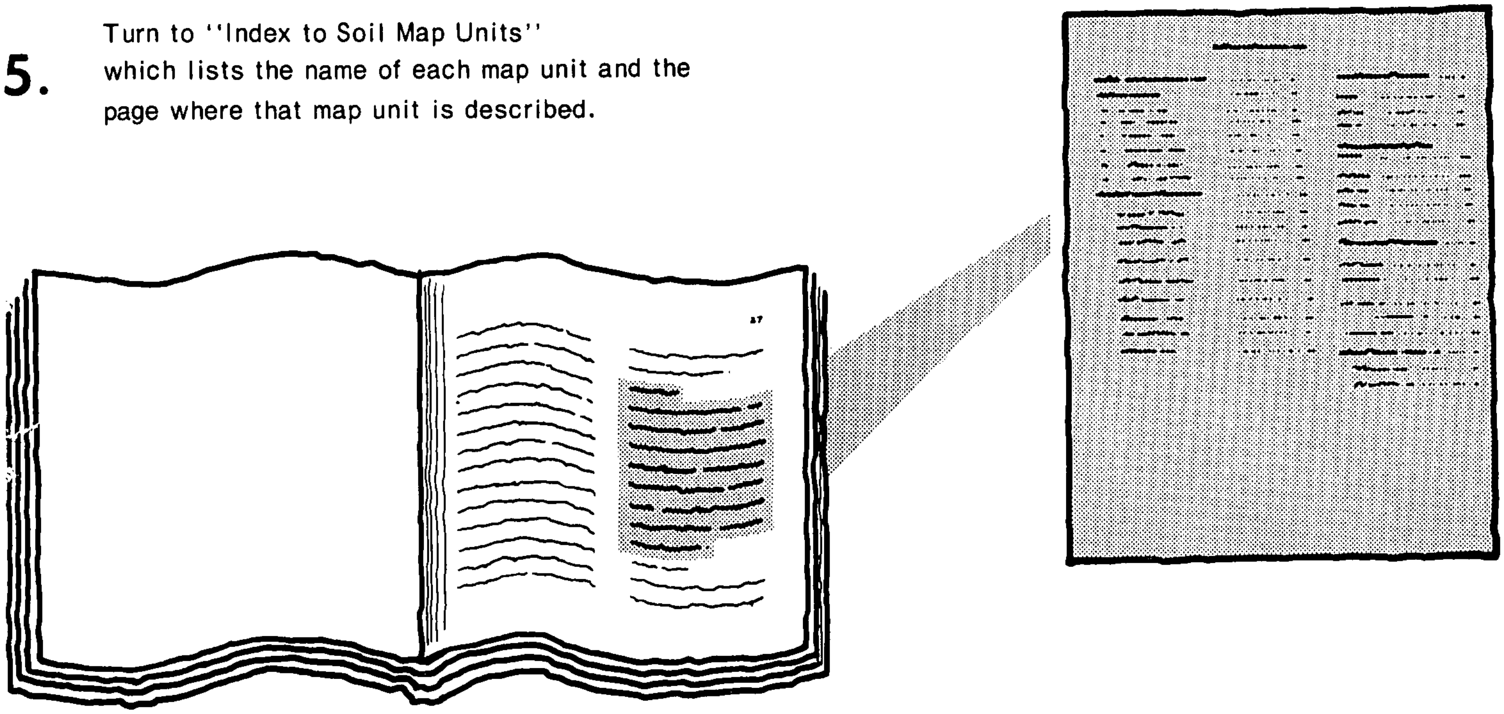


4. List the map unit symbols that are in your area.

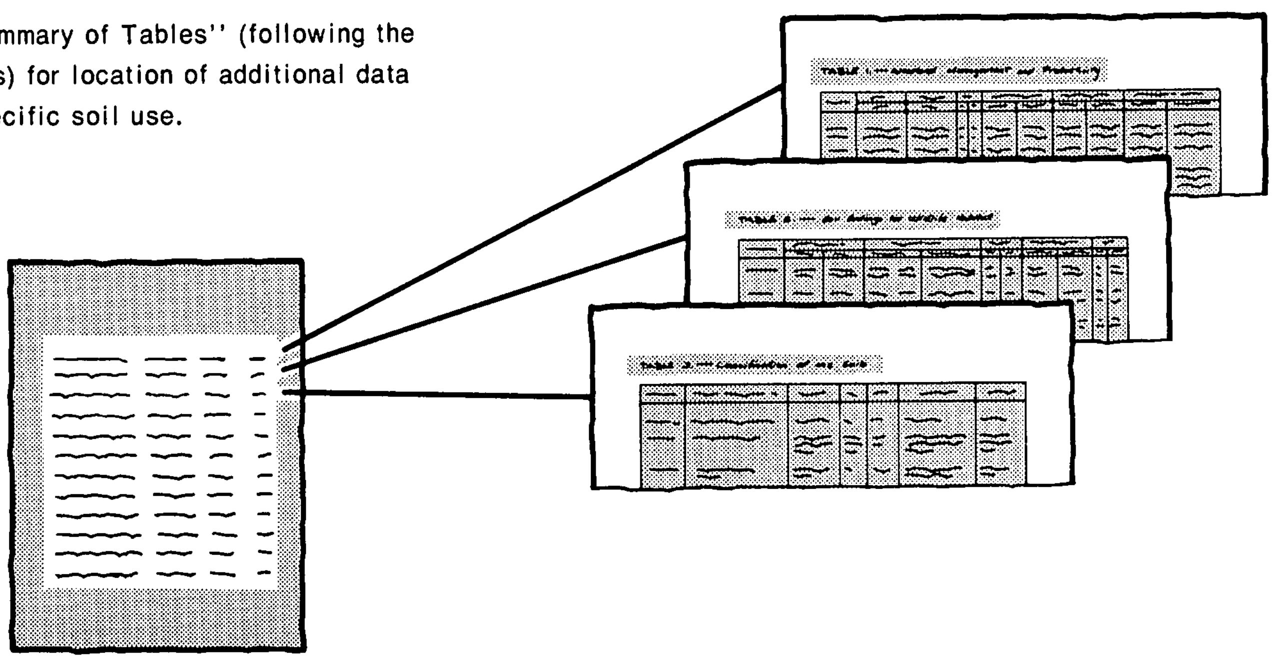


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; for specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in 1978-81. Soil names and descriptions were approved in 1981. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1981. This survey was made cooperatively by the Soil Conservation Service and the Kansas Agricultural Experiment Station. It is part of the technical assistance furnished to the Sheridan County Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: A farmstead windbreak in an area of Keith silt loam, 0 to 2 percent slopes.

Contents

Soil Series

Issued March 1984

Index to Map Units

Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Sheridan County, Kansas. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

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

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

John W. Tippie
State Conservationist
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Soil Survey of Sheridan County, Kansas

By Raymond C. Angell, Bobby D. Tricks, Wesley L. Barker, and Vernon L. Hamilton, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service, in cooperation with the Kansas Agricultural Experiment Station

General Nature of the County

SHERIDAN COUNTY is in the northwestern part of Kansas (fig. 1). It has a total area of 571,520 acres, or 893 square miles. The population in 1980 was 3,470. In that year Hoxie, the county seat, had a population of 1,694. The county was organized in 1880.

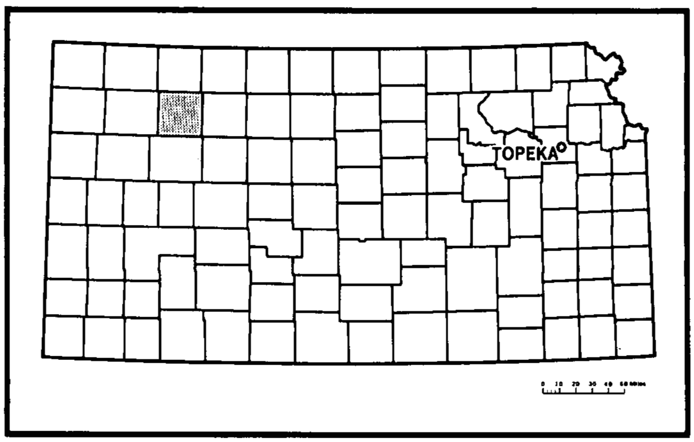

Figure 1.—Location of Sheridan County in Kansas.

The western part of the county is in the Central High Tablelands land resource area, and the eastern part is in the Rolling Plains and Breaks land resource area. Generally, the soils are deep, are nearly level to strongly sloping, and have a silty subsoil. Elevation ranges from about 2,900 feet above sea level in the western part to about 2,250 feet in an area along South Fork Solomon River in the eastern part. Most of the county is drained by the North and South Forks of the Solomon River and by the Saline River. These streams are intermittent.

The main enterprises are farming and ranching. Winter wheat, sorghum, and corn are the principal crops. Most of the corn is irrigated.

Climate

Prepared by L. Dean Bark, climatologist, Kansas Argricultural Experiment Station.

The climate of Sheridan County is typical continental, as can be expected of a location in the interior of a large land mass in the middle latitudes. This climate is characterized by large daily and annual variations in temperature. Winter is cold because of frequent outbreaks of polar air, especially from December through February. Warm summer temperatures last for about 6 months every year. They provide a long growing season for the crops commonly grown in the county. Spring and fall temperatures are generally variable.

The county generally is to the west of the flow of moisture-laden air from the Gulf of Mexico and to the east of the strong rain-shadow effects of the Rocky Mountains. As a result, the annual amount of precipitation is marginal for cropping year after year. It falls during showers and thunderstorms that can be extremely heavy at times. Severe windstorms and tornadoes can accompany the heavier thunderstorms, but they are infrequent and are local in extent. Hail is a severe hazard, but the hailstorms are not so frequent or so severe as those in counties to the west of Sheridan County.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Hoxie in the period 1941 to 1970. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 31.7 degrees F, and the average daily minimum temperature is 18.5 degrees. The lowest temperature on record, which occurred at Hoxie on February 13, 1899, is minus 30 degrees. In summer the average temperature is 75.9 degrees, and the average daily maximum temperature is 90.1 degrees. The highest recorded temperature, which occurred at Hoxie on July 25, 1940, is 114 degrees.

The total annual precipitation is 21.35 inches. Of this, 16.69 inches, or about 78 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 12.18 inches. The heaviest 1-day rainfall was 4.19 inches at Hoxie on June 18, 1975.

The average seasonal snowfall is 29.0 inches. The greatest snow depth at any one time was 56.8 inches. It was recorded during the winter of 1923-24. On an average of 35 days, at least 1 inch of snow is on the ground. Snow rarely covers the ground for more than 10 days in a row.

The sun shines 77 percent of the time possible in summer and 68 percent in the winter. The prevailing wind is from the south. Average windspeed is 13.0 miles per hour. It is highest in March. It can result in significant soil loss and crop damage during the drier years. Measures that conserve moisture and control soil blowing are needed.

Natural Resources

Soil is the most widely used natural resource in Sheridan County. If managed and used properly, it is a renewable resource. Other natural resources are water, sand, gravel, oil, and volcanic ash. An adequate supply of sand and gravel is available for roads and other uses. The ash has been used as a mineral filler during road construction.

A sufficient amount of water suitable for irrigation is available in many areas. Most of the water is pumped from the Ogallala Formation. Lesser amounts are pumped from wells in alluvial and terrace deposits along the major streams. A small amount is from streams. The concentration of irrigation wells is greatest in the west-central part of the county, where the saturated material in the Ogallala Formation is thickest. Recharge of water in the Ogallala aquifer is minor, and the water level is dropping in the areas where use is heavy. Recharge in the alluvial and terrace deposits is somewhat higher, but heavy pumping has reduced streamflow, particularly during periods of heavy use.

How This Survey Was Made

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

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

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

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, acidity, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

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

Map Unit Composition

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

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

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

General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Soil Descriptions

1. Keith-Ulysses-Kuma association

Deep, nearly level to moderately sloping, well drained soils that have a silty subsoil; on uplands

This association is on broad ridgetops and on side slopes that are dissected by small drainageways. Slope generally ranges from 0 to 7 percent.

This association makes up about 62 percent of the county. It is about 74 percent Keith soils, 17 percent Ulysses soils, 5 percent Kuma soils, and 4 percent minor soils (fig. 2).

The nearly level Keith soils formed in loess, mainly on the divides between drainageways. Typically, the surface layer is grayish brown silt loam about 5 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 8 inches thick. The subsoil is about 29 inches thick. The upper part is brown, friable silty clay loam, and the lower part is very pale brown, very friable, calcareous silt loam. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam.

The moderately sloping Ulysses soils formed in loess on the upper side slopes along drainageways. Typically, the surface layer is dark grayish brown silt loam about 10 inches thick. The subsoil is dark grayish brown, friable silt loam about 5 inches thick. The substratum to a depth of about 60 inches is light gray and very pale brown, calcareous silt loam.

The nearly level Kuma soils formed in loess on tableland, mainly in the highest position on the landscape. Typically, the surface layer is grayish brown silt loam about 5 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 6 inches thick. The subsoil is about 27 inches thick. The upper part is dark grayish brown, firm silty clay loam; the next part is dark gray, friable silty clay loam; and the lower part is grayish brown, friable, calcareous silt loam. The substratum to a depth of about 60 inches is pale brown and very pale brown, calcareous silt loam.

Minor in this association are Colby, Pleasant, and Roxbury soils. The calcareous Colby soils are on the steeper side slopes. The moderately well drained Pleasant soils are in upland depressions. The occasionally flooded Roxbury soils are on flood plains.

This association is used mainly for cultivated crops. Winter wheat and sorghum are the main dryland crops. Corn, sorghum, wheat, and alfalfa are the main irrigated crops. Measures that help to control erosion, conserve moisture, and maintain the level of fertility are the main management needs.

2. Ulysses-Colby-Keith association

Deep, nearly level to strongly sloping, well drained soils that have a silty subsoil; on uplands

This association is on the tops and sides of ridges dissected by entrenched drainageways. Slope ranges from 0 to 15 percent.

This association makes up about 14 percent of the county. It is about 38 percent Ulysses soils, 35 percent Colby soils, 15 percent Keith soils, and 12 percent minor soils (fig. 3).

The moderately sloping and strongly sloping Ulysses soils formed in loess, mainly on the upper side slopes along drainageways. Typically, the surface layer is dark grayish brown silt loam about 10 inches thick. The subsoil is dark grayish brown, friable silt loam about 5 inches thick. The substratum to a depth of about 60 inches is light gray and very pale brown, calcareous silt loam.

The strongly sloping Colby soils formed in loess on the lower side slopes. Typically, the surface layer is grayish brown, calcareous silt loam about 3 inches thick. The next 6 inches is light brownish gray, friable, calcareous

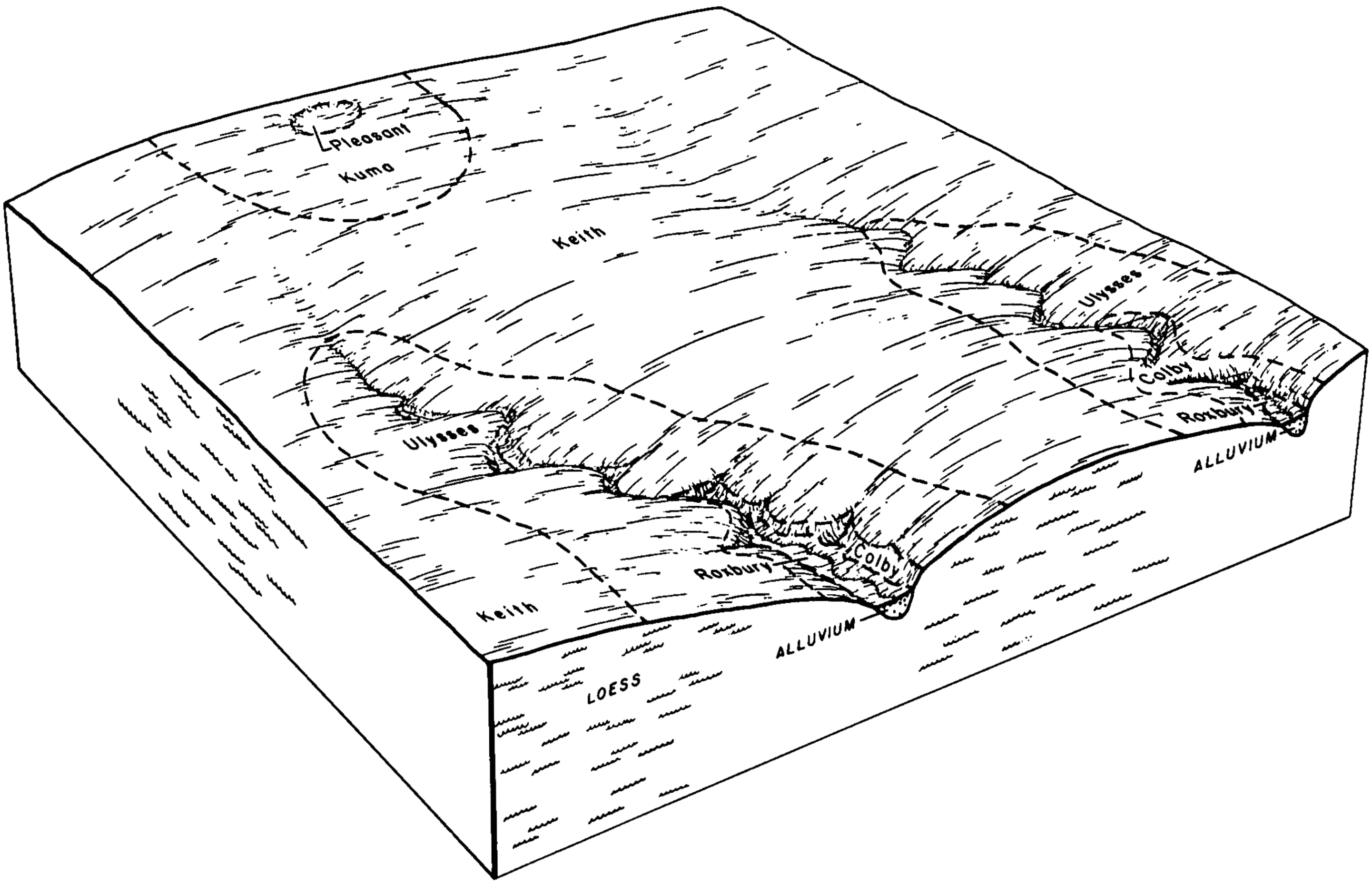

Figure 2.—Typical pattern of soils in the Keith-Ulysses-Kuma association.

silt loam. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam.

The nearly level Keith soils formed in loess, mainly on divides between drainageways. Typically, the surface layer is grayish brown silt loam about 5 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 8 inches thick. The subsoil is about 29 inches thick. The upper part is brown, friable silty clay loam, and the lower part is very pale brown, very friable, calcareous silt loam. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam.

Minor in this association are Bridgeport, Hord, Penden, and Roxbury soils. The rarely flooded Bridgeport and Hord soils are on terraces. The loamy Penden soils are on the sides of deeply entrenched drainageways. The occasionally flooded Roxbury soils are on flood plains.

Most of the nearly level and gently sloping areas of this association are cultivated. The steeper areas are used mainly as range. Wheat and sorghum are the main dryland crops. A few areas are irrigated. Corn, sorghum, alfalfa, and wheat are the main irrigated crops. Controlling erosion, maintaining tilth and fertility, and conserving moisture are the main management concerns in cultivated areas. Maintaining the growth and vigor of desirable grasses is the main concern in managing range.

3. Ulysses-Penden-Colby association

Deep, moderately sloping and strongly sloping, well drained soils that have a silty or loamy subsoil; on uplands

This association is on narrow ridgetops and side slopes that are dissected by drainageways. Slope generally ranges from 2 to 15 percent.

This association makes up about 24 percent of the county. It is about 32 percent Ulysses soils, 31 percent Penden soils, 11 percent Colby soils, and 26 percent minor soils (fig. 4).

The moderately sloping and strongly sloping Ulysses soils formed in loess on the upper side slopes. Typically, the surface layer is dark grayish brown silt loam about 10 inches thick. The subsoil is dark grayish brown, friable silt loam about 5 inches thick. The substratum to a depth

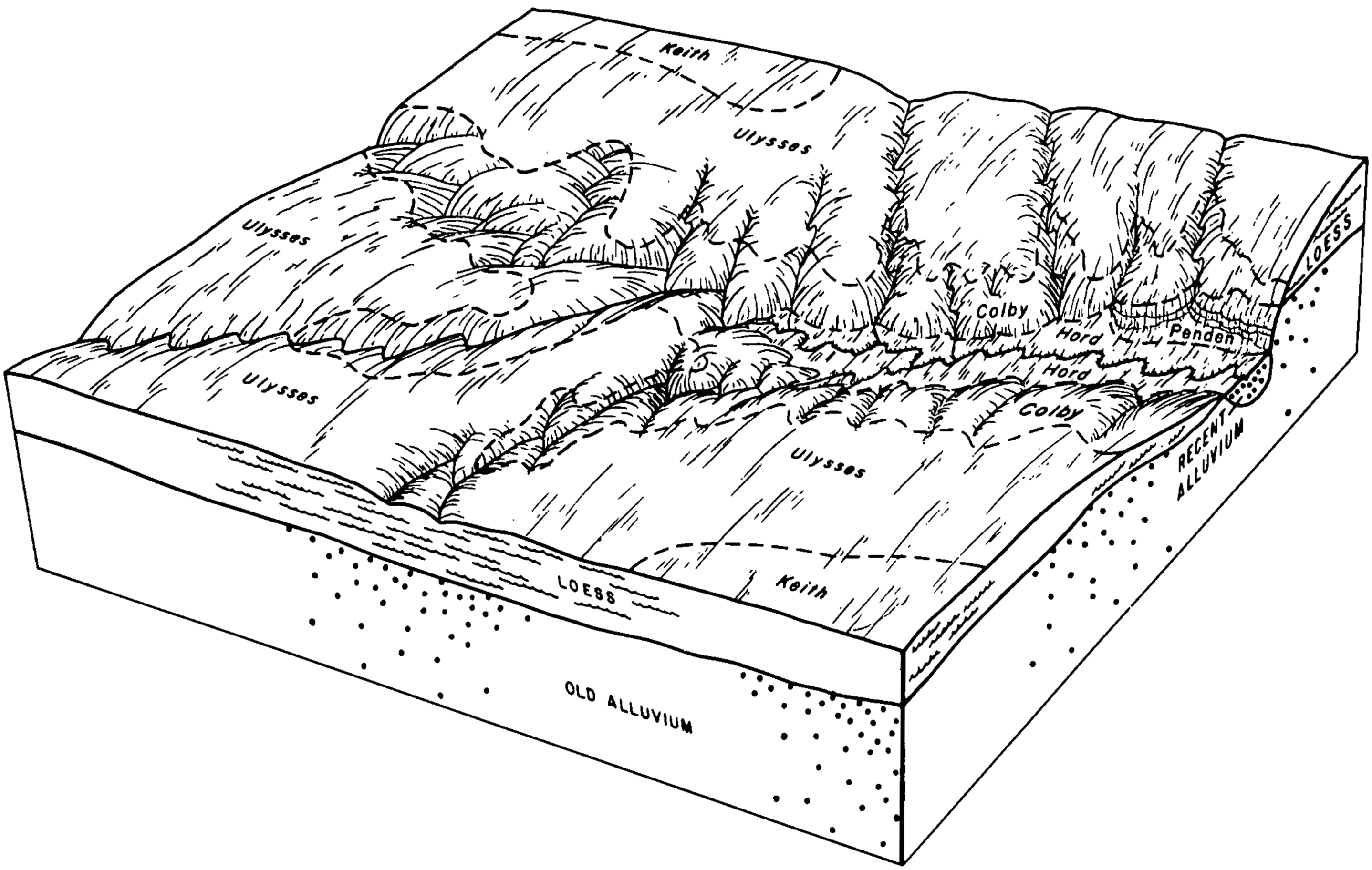

Figure 3.—Typical pattern of soils in the Ulysses-Colby-Keith association.

of about 60 inches is light gray and very pale brown, calcareous silt loam.

The moderately sloping and strongly sloping Penden soils formed in loamy old alluvium on the lower side slopes. Typically, the surface soil is grayish brown, calcareous clay loam about 14 inches thick. The subsoil is brown, firm, calcareous clay loam about 11 inches thick. The substratum to a depth of about 60 inches is light yellowish brown, calcareous clay loam.

The strongly sloping Colby soils formed in loess on side slopes that generally are below the Ulysses soils and above the Penden soils. Typically, the surface layer is grayish brown, calcareous silt loam about 3 inches thick. The next 6 inches is light brownish gray, friable, calcareous silt loam. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam.

Minor in this association are Bridgeport, Canlon, Caruso, and Keith soils. The rarely flooded Bridgeport soils are on terraces. The shallow Canlon soils are on the steeper side slopes. The somewhat poorly drained Caruso soils are on flood plains. The nearly level Keith soils are on ridgetops. They have a silty subsoil.

This association is used mainly as range. Some of the less sloping areas, however, are used for cultivated crops, chiefly wheat and sorghum. Controlling erosion and conserving moisture are the main management concerns in cultivated areas. Maintaining the growth and vigor of desirable grasses is the main concern in managing range.

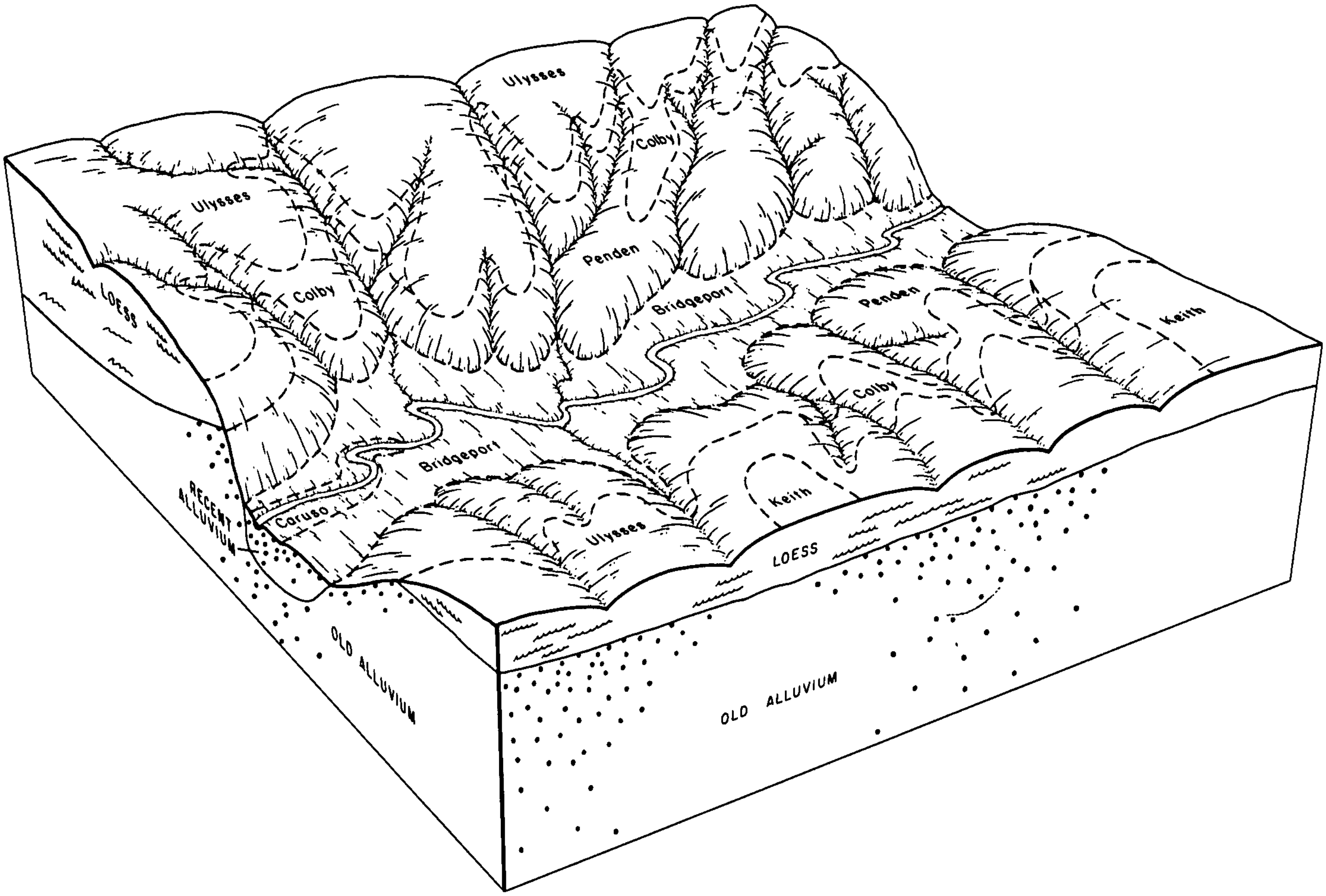

Figure 4.—Typical pattern of soils in the Ulysses-Penden-Colby association.

Detailed Soil Map Units

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

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

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

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

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Bridgeport silt loam, 0 to 2 percent slopes, is one of several phases in the Bridgeport series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Penden-Ulysses complex, 7 to 15 percent slopes, is an example.

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

The descriptions, names, and delineations of the soils identified on the detailed soil maps of this county do not fully agree with those of the soils identified on the maps of adjacent counties. Differences result from a better knowledge of the soils, modifications in series concepts, a higher or lower intensity of mapping, or variations in the extent of the soils in the counties.

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

Soil Descriptions

Bd—Bridgeport silt loam, 0 to 2 percent slopes. This deep, nearly level, well drained soil is on low terraces and alluvial fans near the larger streams. It is subject to rare flooding. Individual areas are irregular in shape and range from 10 to about 1,000 acres in size.

Typically, the surface soil is dark grayish brown silt loam about 13 inches thick. The next 13 inches is brown, friable, calcareous silt loam. The substratum to a depth of about 60 inches is pale brown, calcareous silt loam. In some areas the surface layer is sandy loam.

Permeability is moderate, and surface runoff is slow. Available water capacity is high. Natural fertility also is high. The surface soil is mildly alkaline. Tilth is good.

About 70 percent of the acreage is cultivated. The rest is used as range. This soil is well suited to dryland and irrigated crops. Wheat and sorghum are the main dryland crops. Alfalfa is grown in a few areas. Inadequate rainfall is the main concern in managing the areas used for dryland crops. Measures that conserve moisture and help to control soil blowing are the main management needs. Examples are summer fallowing, minimum tillage, and stubble mulching.

Many areas are irrigated. Corn, sorghum, and alfalfa are the main irrigated crops. The main management needs are measures that maintain fertility, tilth, and the content of organic matter and the efficient use of irrigation water. Minimizing tillage and keeping crop residue on the surface help to maintain the content of organic matter, tilth, and fertility. Land leveling and water management improve water distribution.

This soil is suited to range. In many areas, however, the range is overgrazed and the more desirable grasses have been replaced by less productive grasses and by weeds. The cattle tend to congregate around the watering facilities and shade trees near these areas. Big bluestem, sideoats grama, and western wheatgrass are the more desirable grasses. The overgrazed areas are dominated by blue grama, buffalograss, and inland saltgrass. Placing salt blocks on the steeper adjacent soils helps to distribute grazing more evenly.

This soil is poorly suited to dwellings because of the flooding. Dikes, levees, or other flood-control structures are needed. The higher parts of the landscape should be selected as building sites.

This soil is moderately well suited to septic tank absorption fields and sewage lagoons. The flooding is a hazard in septic tank absorption fields. It can be controlled, however, by levees. Seepage is a limitation on sites for sewage lagoons. It can be controlled, however, by sealing the lagoon.

The capability subclass is IIc, dryland, and the capability class is I, irrigated. The range site is Loamy Terrace.

Be—Bridgeport silt loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on terraces and alluvial fans. It is subject to rare flooding. Individual areas are irregular in shape and range from 10 to about 80 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 10 inches thick. The next 6 inches is brown, friable, calcareous silt loam. The substratum to a depth of about 60 inches is pale brown, calcareous silt loam.

Included with this soil in mapping are small areas of soils that have a surface layer of sandy loam. These soils are on high terraces adjacent to the uplands. They make up about 10 percent of the unit.

Permeability is moderate in the Bridgeport soil, and surface runoff is medium. Available water capacity is high. Natural fertility also is high. The surface layer is mildly alkaline. Tilth is good.

About 60 percent of the acreage is cultivated. The rest is used as range. This soil is moderately well suited to dryland and irrigated crops. Wheat and sorghum are the main dryland crops. If cultivated crops are grown, erosion is a hazard. Conserving moisture is an additional concern. Minimum tillage, terraces, contour farming, and stubble mulching conserve moisture and help to prevent excessive soil loss. In some areas diversions are needed to protect the soil from the runoff from adjacent uplands.

Some areas are irrigated. Corn, sorghum, and alfalfa are the main irrigated crops. Erosion is the main hazard. Minimum tillage helps to prevent excessive soil loss. If a gravity irrigation system is used, some land leveling generally is needed before the irrigation water can be managed efficiently. Controlling the rate of water application conserves irrigation water.

This soil is suited to range. The native vegetation dominantly is big bluestem, sideoats grama, and western wheatgrass. Overgrazed areas are dominated by less productive grasses, such as blue grama, buffalograss, and inland saltgrass. Timely deferment of grazing helps to prevent a decrease in the extent of desirable grasses. Spraying and winter grazing help to control weedy vegetation.

This soil is poorly suited to dwellings because of the flooding. Dikes, levees, and other flood-control structures are needed. Onsite inspection and knowledge of the past flooding of a given area are needed when building sites are selected.

This soil is moderately well suited to septic tank absorption fields and sewage lagoons. The flooding may be a probelm in septic tank absorption fields. It can be controlled, however, by levees. Seepage is a limitation on sites for sewage lagoons. It can be controlled, however, by sealing the lagoon.

The capability subclass is IIIe, dryland and irrigated. The range site is Loamy Terrace.

Ca—Caruso silt loam, occasionally flooded. This deep, nearly level, somewhat poorly drained soil is on flood plains along the major streams. It is occasionally flooded. Individual areas are long and narrow and range from 10 to several hundred acres in size.

Typically, the surface layer is dark grayish brown, calcareous silt loam about 6 inches thick. The subsurface layer is grayish brown, friable, calcareous silt loam about 8 inches thick. The substratum to a depth of about 60 inches is calcareous. The upper part is light brownish gray clay loam; the next part is light brownish gray and grayish brown, mottled loam; and the lower part is very pale brown sandy loam.

Included with this soil in mapping are small areas of the well drained Bridgeport soils on terraces. Also included are small areas of saline soils. Included soils make up about 10 percent of the unit.

Permeability is moderate in the Caruso soil, and surface runoff is slow. Available water capacity is high. Natural fertility also is high. The seasonal high water table is at a depth of 2 to 3 feet. The surface layer is moderately alkaline. Tilth is good.

About 25 percent of the acreage is used for cultivated crops. The rest is used as range. This soil is well suited to sorghum and alfalfa. It is poorly suited to wheat, however, because of the flooding. The wetness sometimes delays tillage. It can be reduced by open drains or tile drains if adequate outlets are available.

This soil is suited to range. In many areas, however, the range is overgrazed and the more desirable grasses have been replaced by less productive grasses and by weeds. Also, trees and shrubs are common in these areas. The cattle tend to congregate around the watering facilities and shade trees in or near these areas. Little bluestem and big bluestem are the more desirable grasses. The overgrazed areas are dominated by inland saltgrass, sedge, and western wheatgrass. Placing salt blocks on the steeper adjacent soils helps to distribute grazing more evenly.

The vegetation commonly growing on this soil provides habitat for many kinds of wildlife, including deer, wild turkey, and pheasants. The wildlife population can be maintained by increasing the number of fringe areas where woodland is adjacent to cropland.

This soil generally is unsuited to building site development because of the flooding. Overcoming this hazard is difficult without major flood-control measures.

The capability subclass is IIw, dryland and irrigated. The range site is Subirrigated.

Cd—Colby silt loam, 7 to 15 percent slopes. This deep, strongly sloping, well drained soil is on side slopes along upland drainageways. Individual areas are long and narrow and range from 10 to several hundred acres in size.

Typically, the surface layer is grayish brown, calcareous silt loam about 3 inches thick. The next 6 inches is light brownish gray, friable, calcareous silt loam about 6 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam. In some areas erosion has exposed the very pale brown substratum. In other areas the surface layer is dark grayish brown.

Included with this soil in mapping are small areas of Canlon, Penden, and Roxbury soils, which make up about 15 percent of the unit. The shallow Canlon soils and the loamy Penden soils are on the lower side slopes. The Roxbury soils are on bottom land and are occasionally flooded.

Permeability is moderate in the Colby soil, and surface runoff is rapid. Available water capacity is high. Natural fertility is medium. The surface layer is moderately alkaline.

Nearly all of the acreage is used as range. Because of a severe hazard of erosion, this soil generally is unsuited to cultivated crops. It is best suited to range. The native vegetation dominantly is little bluestem, sideoats grama, western wheatgrass, and blue grama. Overgrazed areas are dominated by blue grama, buffalograss, tall dropseed, and small soapweed. Well distributed watering and salting facilities and properly located fences improve the distribution of grazing. Proper stocking rates, a uniform distribution of grazing, and timely deferment of grazing help to keep the range in good condition. Range seeding is needed to restore the productivity of abandoned cropland.

This soil is moderately well suited to dwellings. Because of the slope, some land shaping commonly is needed. The south-facing slopes may be ideal sites for dwellings that are partly underground.

Because of the slope, this soil generally is unsuitable as a site for sewage lagoons. It is moderately well suited to septic tank absorption fields. Because of the slope, the lateral lines should be installed on the contour.

The capability subclass is VIe, dryland. The range site is Limy Upland.

Ho—Hord silt loam. This deep, nearly level, well drained soil is on terraces. It is subject to rare flooding. Individual areas are irregular in shape and range from 10 to more than 100 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 15 inches thick. The subsoil is friable silt loam about 23 inches thick. The upper part is dark grayish brown, and the lower part is light brownish gray. The substratum to a depth of about 60 inches is light brownish gray and very pale brown, calcareous silt loam.

Included with this soil in mapping are a few small areas of Munjor soils on flood plains. These soils have a surface layer of sandy loam. They make up about 5 percent of the unit.

Permeability is moderate in the Hord soil, and surface runoff is slow. Available water capacity is high. Natural fertility also is high. The surface layer is neutral. Tilth is good.

About 60 percent of the acreage is cultivated. The rest is used as range. This soil is well suited to dryland and irrigated crops. Sorghum and wheat are the main dryland crops. Alfalfa is grown in a few areas. Inadequate rainfall is the main concern in managing the areas used for dryland crops. Summer fallowing, minimum tillage, and stubble mulching conserve moisture.

Many areas are irrigated. Corn, sorghum, and alfalfa are the main irrigated crops. The main management needs are measures that maintain fertility, tilth, and the content of organic matter and the efficient use of irrigation water. Minimizing tillage and keeping crop residue on the surface help to maintain the content of organic matter, tilth, and fertility. Land leveling and water management improve water distribution.

This soil is suited to range. The native vegetation dominantly is big bluestem, switchgrass, and indiangrass. In areas that are continually overgrazed, these productive grasses are replaced by less desirable grasses, such as blue grama, western wheatgrass, and sideoats grama. Well distributed watering and salting facilities improve the distribution of grazing.

This soil is poorly suited to dwellings because of the flooding. Dikes, levees, and other flood-control structures are needed. Onsite inspection and knowledge of the past flooding of a given area are needed when building sites are selected.

This soil is moderately well suited to septic tank absorption fields and sewage lagoons. The flooding may be a problem in septic tank absorption fields. It can be controlled, however, by levees. Seepage is a limitation on sites for sewage lagoons. It can be controlled, however, by sealing the lagoon.

The capability subclass is IIc, dryland, and the capability class is I, irrigated. The range site is Loamy Terrace.

In—Inavale loamy sand, occasionally flooded. This deep, nearly level, somewhat excessively drained soil is on flood plains. It is dissected by stream channels and is occasionally flooded. Individual areas are long and narrow and range from 10 to more than 100 acres in size.

Typically, the surface layer is grayish brown loamy sand about 5 inches thick. The next 13 inches is pale brown, loose loamy sand. The substratum to a depth of about 60 inches is very pale brown fine sand. In some areas the surface layer ranges from sand to silt loam. In other areas it is dark grayish brown and is more than 7 inches thick.

Included with this soil in mapping are small areas of Caruso and Munjor soils, which make up about 15 percent of the unit. The somewhat poorly drained Caruso soils are in the slightly lower positions on the flood plains, and the well drained Munjor soils are in the sightly higher positions.

Permeability is rapid in the Inavale soil, and surface runoff is slow. Available water capacity is low. Natural fertility also is low. The surface layer is mildly alkaline. It is very friable and can be easily tilled.

Most of the acreage is used as range. Some areas are used for irrigated crops, and very few are used for dryland crops. Because of the hazard of soil blowing and the low available water capacity, this soil is poorly suited to dryland crops. It is moderately well suited to irrigated crops, such as corn, sorghum, and alfalfa. The low fertility, the hazard of soil blowing, and the efficient use of irrigation water are the main concerns of management. Minimizing tillage and returning crop residue to the soil increase the content of organic matter, improve fertility, and help to control soil blowing. Sprinkler irrigation systems are used more often than gravity systems. Frequent applications of water are needed because applying too much water at one time leaches plant nutrients below the root zone.

This soil is suited to range. In many areas, however, the range is overgrazed and the more desirable grasses have been replaced by less productive grasses and by weeds. The cattle tend to congregate around the watering facilities and shade trees near these areas. Sand bluestem and prairie sandreed are the more desirable grasses. The less productive vegetation, such as blue grama and sand sagebrush, is more extensive in the overgrazed areas. Placing salt blocks on the steeper adjacent soils helps to distribute grazing more evenly.

This soil generally is unsuited to building site development because of the flooding. Overcoming this hazard is difficult without major flood-control measures.

The capability subclass is IVe, dryland, and IIIe, irrigated. The range site is Sandy Lowland.

Ke—Keith silt loam, 0 to 2 percent slopes. This deep, nearly level, well drained soil is on uplands, mainly on the divides between drainageways. Individual areas are irregular in shape and range from 10 to several hundred acres in size.

Typically, the surface layer is grayish brown silt loam about 5 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 8 inches thick. The subsoil is about 29 inches thick. The upper part is brown, friable silty clay loam, and the lower part is very pale brown, very friable, calcareous silt loam. The substratum to a depth of about 60 inches is very pale brown, calcareous silt loam. In some areas the surface layer is calcareous.

Included with this soil in mapping are small areas of the moderately well drained Pleasant soils in shallow depressions. These soils make up less than 1 percent of the unit.

Permeability is moderate in the Keith soil, and surface runoff is slow. Available water capacity is high. Natural fertility also is high. The surface layer is slightly acid. Tilth is good. The shrink-swell potential is moderate in the subsoil.

Nearly all of the acreage is used for cultivated crops. This soil is well suited to dryland and irrigated crops. Wheat and sorghum are the main dryland crops (fig. 5). Measures that conserve moisture are the main management needs. Examples are summer fallowing, minimum tillage, stubble mulching, and level terraces (fig. 6).

Corn and sorghum are the main irrigated crops. Alfalfa and wheat also are grown. The main management needs are measures that maintain fertility and the content of organic matter and the efficient use of irrigation water. Land leveling or contour furrows reduce the runoff rate and improve water distribution in areas irrigated by a flooding system. Leaving crop residue on the surface helps to maintain fertility and the content of organic matter and reduces the runoff rate in areas irrigated by sprinklers. Tailwater pits help to recover irrigation water.

This soil is well suited to dwellings with basements and to septic tank absorption fields. It is moderately well suited to dwellings without basements and to sewage lagoons. The shrink-swell potential is a limitation on sites for dwellings without basements. Properly designing and reinforcing foundations, however, can help to prevent the structural damage caused by shrinking and swelling. Seepage is a limitation on sites for sewage lagoons. It can be controlled, however, by sealing the lagoon.

The capability subclass is IIc, dryland, and the capability class is I, irrigated. The range site is Loamy Upland.

Ku—Kuma silt loam, 0 to 1 percent slopes. This deep, nearly level, well drained soil is on the broad tops of upland ridges. Individual areas are irregular in shape and range from 60 to several thousand acres in size.

Typically, the surface layer is grayish brown silt loam about 5 inches thick. The subsurface layer is dark grayish brown, friable silt loam about 6 inches thick. The subsoil is about 27 inches thick. The upper part is dark grayish brown, firm silty clay loam; the next part is dark gray, friable silty clay loam; and the lower part is grayish brown, friable, calcareous silt loam. The substratum to a depth of about 60 inches is pale brown and very pale brown, calcareous silt loam.

Included with this soil in mapping are small areas of the moderately well drained Pleasant soils in shallow depressions. These soils make up less than 1 percent of the unit.

Permeability is moderate in the Kuma soil, and surface runoff is slow. Available water capacity is high. Natural fertility also is high. The surface layer is slightly acid. Tilth is good. The shrink-swell potential is moderate in the subsoil.

Nearly all of the acreage is cultivated. This soil is well suited to dryland and irrigated crops. Wheat and sorghum are the main dryland crops. Measures that conserve moisture are the main management needs. Examples are summer fallowing, minimum tillage, and stubble mulching.

Many areas are irrigated. Corn and sorghum are the main irrigated crops. Alfalfa and wheat also are grown. The main management needs are measures that maintain fertility, tilth, and the content of organic matter and the efficient use of irrigation water. Minimizing tillage and keeping crop residue on the surface help to maintain the content of organic matter, tilth, and fertility. Land leveling and water management improve water distribution.

This soil is well suited to dwellings with basements and to septic tank absorption fields. It is moderately well suited to dwellings without basements and to sewage lagoons. The shrink-swell potential is a limitation on sites for dwellings without basements. Properly designing and

Figure 5.—Sorghum baled for forage on Keith silt loam, 0 to 2 percent slopes.

reinforcing foundations, however, can help to prevent the structural damage caused by shrinking and swelling. Seepage is a limitation on sites for sewage lagoons. It can be controlled, however, by sealing the lagoon.

The capability subclass is IIc, dryland, and the capability class is I, irrigated. The range site is Loamy Upland.

Mu—Munjor sandy loam, occasionally flooded. This deep, nearly level, well drained soil is on flood plains along the major streams. It is occasionally flooded for very brief periods. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is grayish brown, calcareous sandy loam about 5 inches thick. The substratum to a depth of about 60 inches is calcareous. The upper part is pale brown sandy loam and loam, and the lower part is dark grayish brown silt loam.

Included with this soil in mapping are small areas of Caruso and Roxbury soils. The somewhat poorly drained Caruso soils are in the slightly lower positions on the flood plains. The silty Roxbury soils are in positions similar to those of the Munjor soils. Included soils make up about 15 percent of the unit.

Permeability is moderately rapid in the Munjor soil, and surface runoff is slow. Available water capacity is moderate. Natural fertility is medium. The soil is moderately alkaline throughout. Tilth is good.

About half of the acreage is used for cultivated crops. The rest is used as range. This soil is moderately well suited to dryland and irrigated crops. Flooding, soil blowing, and drought are hazards in the areas used for dryland crops. Minimum tillage and stubble mulching conserve moisture and help control soil blowing. In some years crop yields are reduced because of the flooding but in other years they can be increased by the extra moisture.

Corn, sorghum, and alfalfa are the main irrigated crops. The main management concerns are the level of fertility, the efficient use of irrigation water, and the flooding. Returning crop residue to the soil improves fertility. Management that improves water distribution and conserves water is needed.

This soil is suited to range. Many areas are overgrazed because they are near watering sites and shade trees. In

Figure 6.—Wheat on Keith silt loam, 0 to 2 percent slopes. Residue on the surface conserves moisture.

these areas the grasses are dominantly western wheatgrass and blue grama. In areas where the range is in good condition, the principal grasses are sand bluestem and switchgrass. Well distributed salting and watering facilities help to distribute the grazing more evenly.

This soil generally is unsuited to building site development because of the flooding. Overcoming this hazard is difficult without major flood-control measures.

The capability subclass is IIIw, dryland and irrigated. The range site is Sandy Lowland.

Pe—Penden loam, 2 to 7 percent slopes. This deep, moderately sloping, well drained soil is on upland side slopes along deeply dissected drainageways. Individual areas are long and narrow and range from 10 to several hundred acres in size.

Typically, the surface soil is grayish brown, calcareous loam about 14 inches thick. The subsoil is brown, firm, calcareous clay loam about 11 inches thick. The substratum to a depth of about 60 inches is light yellowish brown, calcareous clay loam. In some areas the surface soil is sandy loam. In a few small eroded areas, it is pale brown clay loam.

Included with this soil in mapping are small areas of Simeon and Ulysses soils, which make up about 10 percent of the unit. The sandy Simeon soils are on the lower side slopes. The silty Ulysses soils are on ridgetops.

Permeability is moderate in the Penden soil, and surface runoff is medium. Available water capacity is high. Natural fertility also is high. The surface soil is moderately alkaline. Tilth is good. The shrink-swell potential is moderate in the subsoil.

About 60 percent of the acreage is used for cultivated crops. The rest is used as range. This soil is moderately well suited to dryland and irrigated crops. Wheat and sorghum are the main dryland crops. Sorghum is susceptible to chlorosis because of the high content of lime. Erosion and drought are the main hazards. Summer fallowing, terraces, contour farming, and stubble mulching conserve moisture and help to prevent excessive soil loss.

Some areas are irrigated, mainly by sprinklers. Corn, sorghum, and alfalfa are the main irrigated crops. Some wheat also is grown. The main management needs are measures that help to control erosion and maintain fertility and the efficient use of irrigation water. Minimizing tillage, applying fertilizer, and keeping crop residue on the surface help to maintain the content of organic matter, tilth, and fertility. Terraces and contour farming help to prevent excessive soil loss. Proper application rates help to prevent excessive runoff of irrigation water.

This soil is suited to range. The native grasses dominantly are big bluestem and little bluestem. Overgrazed areas are dominated by less productive grasses, such as blue grama. Proper stocking rates and timely deferment of grazing help to keep the range in good condition. Range seeding is needed to restore the productivity of abandoned cropland.

The many areas where range is adjacent to cropland can be managed as habitat for upland wildlife, such as pheasants. Planting shrubs in these fringe areas provides winter cover for the wildlife.

This soil is moderately well suited to dwellings. The shrink-swell potential is a limitation. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material, however, help to prevent the structural damage caused by shrinking and swelling.

This soil is moderately well suited to septic tank absorption fields and sewage lagoons. The moderate permeability somewhat restricts the absorption of effluent in septic tank absorption fields. Increasing the size of the field, however, helps to overcome this limitation. Seepage and slope are limitations on sites for sewage lagoons. Sealing the lagoon helps to prevent seepage. Some land shaping commonly is needed.

The capability subclass is IIIe, dryland and irrigated. The range site is Limy Upland.

Ph—Penden-Canlon loams, 7 to 20 percent slopes. These strongly sloping and moderately steep soils are on upland side slopes along deeply dissected drainageways. The deep, well drained Penden soil is on the upper and lower side slopes. The shallow, somewhat excessively drained Canlon soil is in the steeper, midslope areas, generally near rock outcrop. Individual areas are long and narrow and range from 10 to several hundred acres in size. They are about 45 percent Penden soil and 30 percent Canlon soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Penden soil has a grayish brown, calcareous loam surface soil about 11 inches thick. The subsoil is brown, firm, calcareous clay loam about 14 inches thick. The substratum to a depth of about 60 inches is light yellowish brown, calcareous clay loam. In some areas the surface soil and subsoil are sandy loam.

Typically, the Canlon soil has a light brownish gray, calcareous loam surface layer about 6 inches thick. The substratum is light gray, friable, calcareous fine sandy loam. Hard caliche is at a depth of about 13 inches. In some areas the surface layer and substratum are clay loam.

Included with these soils in mapping are small areas of Colby and Simeon soils and rock outcrop. These included areas make up about 25 percent of the unit. The deep, silty Colby soils are on the upper side slopes. The sandy Simeon soils are on the lower side slopes. The rock outcrop is caliche or chalky shale. It is on the steeper side slopes.

Permeability is moderate in the Penden and Canlon soils. Surface runoff is rapid on the Canlon soil and medium on the Penden soil. Available water capacity is very low in the Canlon soil and high in the Penden soil. Root penetration is restricted by the caliche at a depth of about 13 inches in the Canlon soil. Natural fertility is low in the Canlon soil and high in the Penden soil. The shrink-swell potential is moderate in the subsoil of the Penden soil.

Nearly all of the acreage is used as range. Because of a severe hazard of erosion, these soils generally are unsuited to cultivated crops. They are best suited to range. The native grasses are dominantly big bluestem, little bluestem, and sideoats grama. Sideoats grama is more extensive on the shallow Canlon soil than on the Penden soil. The grass on these soils commonly is grazed less intensively than the grass on adjacent soils that are less sloping and are more accessible to livestock. Well distributed watering and salting facilities and properly located fences improve the distribution of grazing.

The Penden soil is moderately well suited to dwellings and septic tank absorption fields and generally is unsuitable as a site for sewage lagoons. The slope is the main limitation. Also, the shrink-swell potential is a limitation on sites for buildings, and the moderate permeability is a limitation in septic tank absorption fields. Building sites can be improved by land shaping. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with porous material help to prevent the structural damage caused by shrinking and swelling. Because of the slope, lateral lines in septic tank absorption fields should be installed on the contour. The moderate permeability somewhat restricts the absorption of effluent in these fields. It can be overcome, however, by enlarging the field.

The Canlon soil generally is unsuited to building site development because it is shallow over bedrock.

The capability subclass is VIe, dryland. The Penden soil is in Limy Upland range site, and the Canlon soil is in Shallow Limy range site.

Pm—Penden-Ulysses complex, 7 to 15 percent slopes. These deep, strongly sloping, well drained soils are on upland side slopes along deeply dissected drainageways. The loamy Penden soil is on the lower slopes, and the silty Ulysses soil is on the upper slopes. Individual areas are long and narrow and range from 10 to several hundred acres in size. They are about 45 percent Penden soil and 30 percent Ulysses soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Penden soil has a grayish brown, calcareous clay loam surface soil about 14 inches thick. The subsoil is brown, firm, calcareous clay loam about 11 inches thick. The substratum to a depth of about 60 inches is light yellowish brown, calcareous clay loam. In some areas the surface soil and subsoil are sandy loam.

Typically, the Ulysses soil has a dark grayish brown silt loam surface layer about 8 inches thick. The subsoil is grayish brown, friable silt loam about 5 inches thick. The substratum to a depth of about 60 inches is light gray and very pale brown, calcareous silt loam. In some areas the surface layer is calcareous.

Included with these soils in mapping are small areas of Canlon, Inavale, and Roxbury soils and rock outcrop. These included areas make up about 25 percent of the unit. The shallow Canlon soils and the rock outcrop are on the steeper side slopes. The rock outcrop is caliche. The sandy Inavale and silty Roxbury soils are on flood plains along drainageways.

Permeabilty is moderate in the Penden and Ulysses soils. Surface runoff is medium. Available water capacity is high. Natural fertility also is high. The shrink-swell potential is moderate in the Penden soil.

Nearly all of the acreage is used as range. Because of a severe hazard of erosion, these soils generally are unsuitable for cultivated crops. They are best suited to range. The native vegetation is dominantly big bluestem, little bluestem, blue grama, and western wheatgrass. Blue grama and western wheatgrass are more extensive on the Ulysses soil than on the Penden soil. The major concerns of management are maintaining a good population of desirable plants and controlling weedy vegetation. In overgrazed areas the more desirable grasses and forbs are replaced by less desirable grasses and by weedy vegetation. Proper stocking rates, a uniform distribution of gazing, and timely deferment of grazing help to keep the range in good condition. Well distributed salting and watering facilities improve the distribution of grazing. Stock water wells, pipelines, and pits improve the range. Range seeding is needed to improve the productivity of abandoned cropland.

These soils are moderately well suited to dwellings. The slope of both soils and the shrink-swell potential of the Penden soil are limitations. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse material help to prevent the structural damage caused by shrinking and swelling. Some land shaping commonly is needed. The south-facing slopes commonly are good sites for dwellings that are partly underground.

These soils generally are unsuitable as sites for sewage lagoons because of the slope. They are moderately well suited to septic tank absorption fields. The slope is the main limitation. Also, the moderate permeability of the Penden soil somewhat restricts the absorption of effluent. It can be overcome, however, by enlarging the absorption field. Because of the slope, the lateral lines should be installed on the contour.

The capability subclass is VIe, dryland. The Penden soil is in Limy Upland range site, and the Ulysses soil is in Loamy Upland range site.

Ps—Pleasant silty clay loam. This deep, nearly level, moderately well drained soil is in upland depressions. It is frequently ponded in the fall and spring. Individual areas are irregular in shape and range from about 3 to 40 acres in size.

Typically, the surface layer is gray silty clay loam about 5 inches thick. The subsoil is about 45 inches thick. The upper part is gray, firm silty clay loam; the next part is gray, very firm silty clay; and the lower part is grayish brown, firm silty clay loam. The substratum to a depth of about 60 inches is light brownish gray, calcareous silt loam.

Permeability is very slow, and surface runoff is ponded. Available water capacity is moderate. Natural fertility is high. The surface layer is neutral. Tilth is fair. The shrink-swell potential is high in the subsoil.

Nearly all areas are cultivated along with the surrounding areas. Wheat and sorghum are the main crops. Because of the ponding, this soil is poorly suited to cultivated crops. Stubble mulching, terracing, and contour farming on the surrounding soils help to control the ponding on this soil. Soil blowing is a hazard during dry periods. It can be controlled, however, by minimum tillage and stubble mulching.

The ponding on this soil results in shallow water areas that can be used as habitat by waterfowl and other kinds of wildlife. The cultivated crops in the adjacent areas supply food and nesting areas.

This soil generally is unsuited to building site development because of the ponding.

The capability subclass is IVw, dryland. The range site is Clay Upland.

Rx—Roxbury silt loam, occasionally flooded. This deep, nearly level, well drained soil is on flood plains along the larger streams. It is dissected by stream channels. Individual areas are long and narrow and range from 10 to several hundred acres in size.

Typically, the surface layer is grayish brown, calcareous silt loam about 5 inches thick. The subsurface layer is grayish brown, friable, calcareous silt loam about 28 inches thick. The substratum to a depth of about 60 inches is light brownish gray, calcareous silt loam. In some areas the surface layer has thin, light brownish gray strata.

Included with this soil in mapping are small areas of the sandy Inavale soils and the somewhat poorly drained Caruso soils. These soils are in the slightly lower positions on the landscape. They make up about 5 percent of the unit.

Permeability is moderate in the Roxbury soil, and surface runoff is slow. Available water capacity is high. Natural fertility also is high. The surface layer is mildly alkaline. Tilth is good. The shrink-swell potential is moderate in the subsoil.

About 60 percent of the acreage is used for cultivated crops. The rest is used as range. This soil is well suited to dryland and irrigated crops. Sorghum and alfalfa are the main dryland crops (fig. 7). Crop yields are reduced in some years because of the flooding, but in other years they can be increased by the extra moisture. Minimizing tillage and leaving crop residue on the surface conserve moisture and increase the infiltration rate.

Some areas are irrigated. Corn, sorghum, and alfalfa are the main irrigated crops. The main management needs are measures that help to control flooding and maintain fertility and the efficient use of irrigation water. Returning crop residue to the soil helps to maintain fertility. Management that improves water distribution and conserves water is needed.

This soil is suited to range. In many areas, however, the range is overgrazed and is in poor condition. In these areas the more desirable grasses are replaced by less productive grasses and by weeds. In areas where the range is in good condition, the dominant vegetation is big bluestem, western wheatgrass, and sideoats grama. Livestock tend to congregate in areas near shade trees and watering facilities. Placing salt blocks on the steeper adjacent soils helps to achieve a uniform distribution of grazing.

This soil generally is unsuited to building site development because of the flooding. Overcoming this hazard is difficult without major flood-control measures.

The capability subclass is IIw, dryland and irrigated. The range site is Loamy Lowland.

Figure 7.—First cutting of alfalfa swathed and ready for baling in an area of Roxbury silt loam, occasionally flooded.

Sm—Simeon loamy sand, 5 to 15 percent slopes. This deep, strongly sloping, excessively drained soil is on upland side slopes along drainageways. Individual areas are long and narrow and range from 10 to several hundred acres in size.

Typically, the surface layer is brown loamy sand about 5 inches thick. The next 8 inches is pale brown, soft loamy sand. The substratum to a depth of about 60 inches is very pale brown sand. In some areas the part of the substratum below a depth of 40 inches is clay loam. In other areas the soil is 40 to 60 inches deep over lime-cemented sandstone.

Included with this soil in mapping are small areas of Canlon and Penden soils, which make up about 15 percent of the unit. The shallow Canlon soils are on the steeper side slopes. The loamy Penden soils are on the upper side slopes.

Permeability is rapid in the Simeon soil, and surface runoff is very slow. Available water capacity is low. Natural fertility also is low. The surface layer is neutral.

Nearly all of the acreage is used as range. Because of the low available water capacity, this soil generally is unsuited to cultivated crops. The dominant native grasses are blue grama, prairie sandreed, and needleandthread. In overgrazed areas the more desirable grasses are replaced by less productive vegetation, such as threeawn, windmillgrass, and sand sagebrush. Proper stocking rates, a uniform distribution of grazing, and timely deferment of grazing help to keep the range in good condition.

This soil is only moderately well suited to dwellings because of the slope. If the less sloping areas are selected as sites for dwellings, less leveling and earthmoving are needed during construction. Because of the low available water capacity, maintaining lawns may be difficult.

This soil is poorly suited to septic tank absorption fields and sewage lagoons. The effluent from these disposal systems can contaminate shallow ground water because of seepage. Also, smoothing of earthworks to maintain a uniform lagoon depth is difficult because of the slope. The loamy included soils are better sites for septic tank absorption fields. Sealing sewage lagoons with clayey material helps to control seepage. If the less sloping areas are selected as sites for lagoons, less leveling and banking are needed during construction. The soil is a probable source of sand.

The capability subclass is VIs, dryland. The range site is Sands.

Uc—Ulysses silt loam, 2 to 7 percent slopes. This deep, moderately sloping, well drained soil is on the upper side slopes along drainageways in the uplands. Individual areas are long and narrow and range from 10 to several hundred acres in size.

Typically, the surface layer is dark grayish brown silt loam about 10 inches thick. The subsoil is dark grayish brown, friable silt loam about 5 inches thick. The substratum to a depth of about 60 inches is light gray and very pale brown, calcareous silt loam. In some areas the surface layer is calcareous.

Permeability is moderate, and surface runoff is medium. Available water capacity is high. Natural fertility also is high. The surface layer is mildly alkaline. Tilth is good.

About 50 percent of the acreage is used for cultivated crops. The rest is used as range. This soil is moderately well suited to dryland crops but is poorly suited to irrigated crops. Wheat and sorghum are the main dryland crops. Sorghum is susceptible to chlorosis because of the high content of lime. Measures that control erosion and conserve moisture are the main management needs. Examples are summer fallowing, terracing, contour farming, and stubble mulching.

Some areas are irrigated, mainly by sprinklers. Corn, sorghum, and alfalfa are the main irrigated crops. Some wheat also is grown. The major management needs are measures that help to control erosion and maintain fertility and the efficient use of irrigation water. Minimizing tillage and keeping crop residue on the surface help to maintain the content of organic matter, tilth, and fertility. Terraces and contour farming help to prevent excessive soil loss.

This soil is suited to range. The dominant native vegetation in the areas used as range is blue grama, western wheatgrass, buffalograss, and sideoats grama. If the range is overgrazed, the more desirable grasses and forbs are replaced by less productive plants. Proper stocking rates, a uniform distribution of grazing, and timely deferment of grazing help to keep the range in good conditon. Well distributed salting and watering facilities help to obtain a uniform distribution of grazing.

This soil is well suited to dwellings and to septic tank absorption fields. It is only moderately well suited to sewage lagoons because seepage and slope are limitations. Sealing the lagoon helps to control seepage. Some land shaping commonly is needed.

The capability subclass is IIIe, dryland and irrigated. The range site is Loamy Upland.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in providing the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cropland, pasture, woodland, or other land, but it is not urban and built-up land or water areas. It either is used for food or fiber or is available for these uses. The soil qualities, growing season, and moisture supply are those needed for a well managed soil economically to produce a sustained high yield of crops. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland usually has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 7 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

In Sheridan County about 75,000 acres, or 13 percent of the total acreage, meets the requirements for prime farmland. All of this land is used for irrigated crops. The soils meet the requirements for prime farmland only in irrigated areas. Most of these areas are in the western part of the county and along the larger stream valleys.

The map units that are considered prime farmland in Sheridan County are listed in this section. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

The map units listed in this section qualify for prime farmland only in areas where inadequate rainfall has been overcome by irrigation. Onsite evaluation is needed to identify the irrigated areas.

The map units that, in irrigated areas, meet the requirements for prime farmland are:

Bd Bridgeport silt loam, 0 to 2 percent slopes
Be Bridgeport silt loam, 2 to 5 percent slopes
Ca Caruso silt loam, occasionally flooded
Ho Hord silt loam
Ke Keith silt loam, 0 to 2 percent slopes
Ku Kuma silt loam, 0 to 1 percent slopes
Mu Munjor sandy loam, occasionally flooded
Pe Penden loam, 2 to 7 percent slopes
Rx Roxbury silt loam, occasionally flooded
Uc Ulysses silt loam, 2 to 7 percent slopes

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops

John C. Dark, conservation agronomist, Soil Conservation Service, helped prepare this section.

General management needed for crops is suggested in this section. The crops best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

About 63 percent of Sheridan County is used for cultivated crops or is summer fallowed. During the period 1970 to 1980, wheat was grown on about 33 percent of the cropland, corn on 11 percent, sorghum on 10 percent, and alfalfa, rye, oats, barley, pinto beans, soybeans, or sunflowers on 13 percent (*3*). About 33 percent of the cropland was summer fallowed.

A total of 75,800 acres was available for irrigation in 1980. From 1970 to 1980, the acreage of irrigated corn increased from about 18,000 to 51,000 acres. In recent years, grain sorghum, forage sorghum, and soybeans have replaced corn in some irrigated areas (fig. 8).

The productivity of most soils can be increased by applying the latest crop production technology. This soil survey can facilitate the application of such technology. The main concerns in managing the soils for crops are controlling erosion and soil blowing, making the most efficient use of avilable water, and maintaining fertility and tilth.

Erosion is a problem on about 30 percent of the cropland in Sheridan County. Soil blowing and inadequate rainfall are problems on all of the cropland. Soil blowing is a major problem on Munjor, Inavale, Penden, Roxbury, Caruso, Colby, and Bridgeport soils.

Erosion reduces the productivity of the soil. If the surface layer is lost through erosion, most of the plant food and organic matter, which has a positive effect on soil structure, water infiltration, the available water capacity, and tilth, are lost. In many areas erosion on farmland results in the pollution of streams by sediment, nutrients, and pesticides. Controlling erosion minimizes this pollution and improves the quality of water.

Measures that control erosion provide a protective cover of plants or crop residue, reduce the runoff rate, and increase the rate of water infiltration. A cropping system that keeps a plant cover on the soil for extended periods helps to control erosion and preserves the productive capacity of the soil. Measures that reduce the

Figure 8.—Furrow-irrigated soybeans in an area of Kuma soils.

runoff rate and help to control soil blowing also help to maintain tilth.

Minimum tillage, terraces, diversions, contour farming, and a cropping system in which drilled crops are alternated with row crops help to control erosion on cropland. Minimum tillage is helping to control both erosion and soil blowing on an increasing acreage in Sheridan County. Terraces and diversions reduce the length of slopes and thereby reduce the runoff rate and the susceptibility to erosion. They are most practical on deep, well drained soils that have uniform, regular slopes. Most of the soils used as cropland in Sheridan County have those characteristics.

Information about the design of erosion-control practices for each kind of soil is available at the local office of the Soil Conservation Service.

Plants on most of the arable soils in the county respond well to applications of nitrate and phosphate fertilizer. On all soils the amount of fertilizer to be applied should be based on the results of soil tests, on the needs of the crop, on the expected level of yields, and on past experience. The Cooperative Extension Service can help to determine the kind and amount of fertilizer needed.

Organic matter is a source of available plant nutrients. It also is beneficial because it increases the rate of water intake, helps to prevent surface crusting and deterioration of tilth, and helps to control erosion. Most of the soils in the county that are used for crops have a silt loam surface layer. During periods of intensive rainfall, a crust forms at the surface. Because the crust is nearly impervious to water when dry, the runoff rate increases. Regularly adding organic matter and leaving crop residue on the surface help to prevent surface crusting.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that insures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

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

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

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

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed Soil Map Units" and in table 5.

Rangeland

Loren J. Pearson, range conservationist, Soil Conservation Service, helped prepare this section.

About 200,000 acres in Sheridan County, or 35 percent of the total acreage, is rangeland. About 35 percent of the total farm income is derived from the sale of livestock and livestock products, principally cattle. The ranches are primarily cow-calf units. The larger tracts of rangeland are most common in the area south of Studley and in the steeper areas along the major streams.

Most of the ranches and stock farms are a combination of rangeland and cropland. Sorghum stubble and cornstalks are used for fall grazing on most ranches (fig. 9). During the winter, alfalfa hay and protein concentrates supplement the forage produced on rangeland.

Figure 9.—Fall grazing of grain sorghum stubble after the crop has been harvested. The soil is Kuma silt loam, 0 to 1 percent slopes.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 6 shows, for each soil, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as rangeland or are suited to use as rangeland are listed. An explanation of the column headings in table 6 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was ascertained during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, they are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre of air-dry vegetation. Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—is listed by common name. Under *composition*, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, control of undesirable brush species, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Forage production has been reduced in some areas because the natural plant community has been depleted by overgrazing. Sound range management is designed to improve the vigor and production of the major forage plants. Proper stocking rates and a uniform distribution of grazing help to keep the range in good condition. Timely deferment of grazing and reseeding abandoned cropland improve the range condition.

Native Woodland and Windbreaks and Environmental Plantings

Keith A. Ticknor, forester, Soil Conservation Service, helped prepare this section.

The native woodland in Sheridan County is restricted to areas along the major streams. Trees and shrubs grow along Prairie Dog Creek, the Saline River, and the North and South Forks of the Solomon River. A high percentage of the trees are eastern cottonwood, black willow, and green ash. Other trees and shrubs are boxelder, Russian mulberry, American plum, hackberry, American elm, honeylocust, Siberian elm, and osageorange. A few black walnut trees grow along the major streams (fig. 10). The wooded areas are small. The trees are not sufficiently concentrated to be of commercial value for wood products. They are valuable, however, as a source of firewood.

Landowners have established windbreaks and environmental plantings at various times on most of the farmsteads and ranch headquarters in Sheridan County (fig. 11). Siberian elm and eastern redcedar are the most common trees in these areas. Other trees and shrubs are honeylocust, Russian-olive, lilac, tamarisk, black locust, ponderosa pine, osageorange, Russian mulberry, hackberry, and American plum. Tree planting around ranch headquarters and farmsteads is a continual need because old trees deteriorate when they pass maturity, because insects and diseases destroy some trees, and because new windbreaks are needed in areas where farming or ranching is expanding.

In order for windbreaks to fulfill their intended purpose, the soils on the site should be suited to the trees or shrubs selected for planting. Selecting suitable species helps to ensure survival and a maximum growth rate. Permeability, available water capacity, and fertility greatly affect the growth rate.

An inadequate moisture supply limits the survival of windbreaks and environmental plantings in Sheridan County. As a result, the main management needs are proper site preparation prior to planting and control of weeds and other competing plants after planting. Drip irrigation or any other method of supplemental watering also helps to overcome the moisture deficiency.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 7 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 7 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

Figure 10.—Black walnut trees planted on Caruso silt loam, occasionally flooded.

Recreation

Robert J. Higgins, biologist, Soil Conservation Service, helped prepare this section.

Opportunities for recreation in Sheridan County are somewhat limited. Sheridan State Fishing Lake provides public facilities for fishing, picnicking, and camping (fig. 12). The old Quinter Lake area is open to the public for hunting. Recreation on private land is limited mainly to fishing in farm ponds or streams and to hunting pheasants, cottontail rabbits, and deer. The fall pheasant season attracts hunters to the county from throughout the state. Coyote hunting with dogs is a popular sport among some residents.

The potential for further recreational development in the county is good. Additional facilities for fishing, camping, and picnicking would be used extensively.

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

Figure 11.—A young windbreak of eastern redcedar along the north side of a farmstead on Keith silt loam, 0 to 2 percent slopes.

In table 8, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

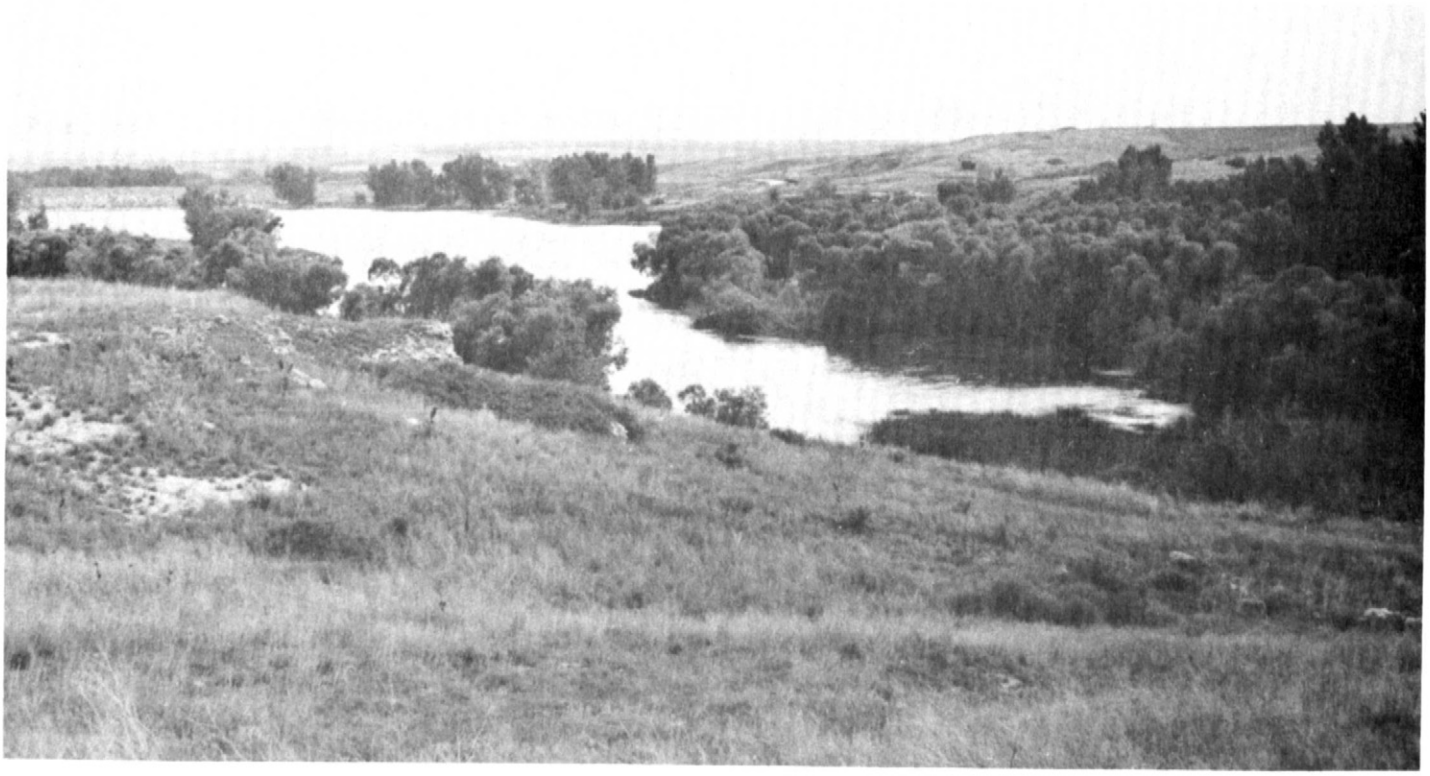

Figure 12.—An area of Sheridan State Fishing Lake. Canlon and Penden soils are on the adjacent uplands.

Wildlife Habitat

Robert J. Higgins, biologist, Soil Conservation Service, helped prepare this section.

The primary game species in Sheridan County are pheasant, cottontail rabbit, mourning dove, mule deer, and whitetail deer. Pheasant hunting and coyote hunting with dogs are popular sports.

Nongame species are numerous because the habitat types are diverse. Cropland, woodland, and grassland are interspersed throughout the county. Each of these types of land provides habitat for a particular group of species.

Furbearers are sparse to common along the wooded streams. They are trapped on a limited basis. Farm ponds and Sheridan State Fishing Lake provide limited opportunities for fishing. The species commonly caught are bass, bluegill, and channel catfish.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, and grain sorghum.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are big bluestem, little bluestem, goldenrod, switchgrass, wheatgrass, ragweed, sunflowers, native legumes, and grama.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are eastern cottonwood, black willow, green ash, boxelder, and hackberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, American plum, and crabapple.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are ponderosa pine, eastern redcedar, and Rocky Mountain juniper.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are golden currant, plum, fragrant sumac, prairie rose, and sagebrush.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, cattail, arrowhead, saltgrass, prairie cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, pheasant, mourning dove, meadowlark, field sparrow, cottontail rabbit, and coyote.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, thrushes, woodpeckers, squirrels, raccoon, and deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, redwing blackbirds, muskrat, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include pheasants, deer, horned larks, killdeer, badgers, jackrabbits, meadowlarks, and hawks.

Technical assistance in planning wildlife areas and in determining the vegetation suitable for planting can be obtained from the local office of the Soil Conservation Service. Additional information and assistance can be obtained from the Kansas Fish and Game Commission and the Cooperative Extension Service.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet.

Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock or a very firm dense layer, stone content, soil texture, and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Sanitary Facilities

Table 11 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock, and flooding affect absorption of the effluent. Large stones and bedrock interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 17.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

Physical and Chemical Properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 15, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Engineering Index Test Data

Table 17 shows laboratory test data for a pedon of Keith soils sampled at a carefully selected site in the survey area. The pedon is typical of the series and is described in the section "Soil Series and Their Morphology." The soil sample was tested by the Kansas Department of Transportation.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are: AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); and Moisture density, Method A—T 99 (AASHTO), D 698 (ASTM).

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*5*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ustoll (*Ust*, meaning intermittent dryness, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Argiustolls (*Argi*, meaning argillic horizon, plus *ustoll*, the suborder of the Mollisols that have an ustic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Aridic* identifies the subgroup that is drier than is typical for the great group. An example is Aridic Argiustolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed, mesic Aridic Argiustolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (*4*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*5*). Unless otherwise stated, matrix colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Bridgeport Series

The Bridgeport series consists of deep, well drained, moderately permeable soils on terraces and alluvial fans. These soils formed in calcareous, silty alluvium. Slope ranges from 0 to 5 percent.

Bridgeport soils are similar to Hord and Roxbury soils and commonly are adjacent to Caruso, Colby, Munjor, and Penden soils. Caruso soils are somewhat poorly drained and are on flood plains. Colby and Penden soils are on uplands. Colby soils lack a mollic epipedon, and Penden soils have a loamy subsoil. Hord soils do not have lime within a depth of 15 inches. Munjor soils contain more sand in the subsoil than the Bridgeport soils. They are on flood plains. Roxbury soils have a mollic epipedon that is more than 20 inches thick.

Typical pedon of Bridgeport silt loam, 0 to 2 percent slopes, about 2,300 feet north and 950 feet east of the southwest corner of sec. 35, T. 8 S., R. 28 W.

A—0 to 13 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable; many fine roots; mildly alkaline; clear smooth boundary.

AC—13 to 26 inches; brown (10YR 5/3) silt loam, brown (10YR 4/3) moist; moderate fine granular and medium subangular blocky structure; slightly hard, friable; many fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

C—26 to 60 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; thin strata of darker loamy material; massive; soft, very friable; common fine roots in the upper part; few fine threads and soft accumulations of lime; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 10 to 30 inches. The depth to lime ranges from 0 to 15 inches. All horizons are mildly alkaline or moderately alkaline.

The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 to 3. It is dominantly silt loam, but the range includes fine sandy loam, loam, clay loam, and silty clay loam. The AC horizon has hue of 10YR, value of 5 or 6 (4 or 5 moist), and chroma of 2 or 3. It is silt loam, silty clay loam, or loam. Some pedons have a Bw horizon. The C horizon has hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 or 3. It is loam, silt loam, or silty clay loam. Strata that are more sandy or clayey, mottles, and buried soils are below a depth of 40 inches in some pedons.

Canlon Series

The Canlon series consists of shallow, somewhat excessively drained, moderately permeable soils on uplands. These soils formed in residuum of lime-cemented sandstone or caliche. Slope ranges from 7 to 20 percent.

Canlon soils commonly are adjacent to Colby, Penden, and Ulysses soils. The adjacent soils are more than 40 inches deep over bedrock. Colby and Ulysses soils are higher on the landscape than the Canlon soils. Penden soils are on side slopes both above and below the Canlon soils.

Typical pedon of Canlon loam, in an area of Penden-Canlon loams, 7 to 20 percent slopes, about 1,500 feet west and 1,600 feet north of the southeast corner of sec. 9, T. 6 S., R. 26 W.

A—0 to 6 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; moderate fine granular structure; slightly hard, friable; many fine roots; few small caliche fragments; violent effervescence; moderately alkaline; clear smooth boundary.

C—6 to 13 inches; light gray (10YR 7/2) fine sandy loam, grayish brown (10YR 5/2) moist; massive; soft, friable; common fine roots; many small caliche fragments; violent effervescence; moderately alkaline; abrupt wavy boundary.

R—13 inches; hard caliche.

The solum is 6 to 12 inches thick. The depth to hard caliche bedrock ranges from 10 to 20 inches. The A and C horizons are loam, fine sandy loam, silt loam, or gravelly loam. The content of coarse fragments in these horizons ranges from 0 to 35 percent.

The A horizon has hue of 7.5YR or 10YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 or 3. The C horizon has hue of 10YR, value of 6 to 8 (5 to 7 moist), and chroma of 2 or 3.

Caruso Series

The Caruso series consists of deep, somewhat poorly drained, moderately permeable soils on flood plains. These soils formed in loamy and silty alluvium. Slope ranges from 0 to 2 percent.

Caruso soils commonly are adjacent to the well drained Bridgeport, Munjor, and Penden soils. Bridgeport soils are on terraces. They have a silty subsoil. Munjor soils are slightly higher on the flood plains than the Caruso soils. Also, their subsoil contains less clay. Penden soils are on uplands.

Typical pedon of Caruso silt loam, occasionally flooded, about 1,240 feet south and 2,590 feet west of the northeast corner of sec. 5, T. 9 S., R. 28 W.

A1—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, friable; many fine roots; slight effervescence; moderately alkaline; clear smooth boundary.

A2—6 to 14 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; soft, friable; many fine roots; strong effervescence; moderately alkaline; diffuse smooth boundary.

C1—14 to 28 inches; light brownish gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable; few fine and medium pebbles; few small soft accumulations of lime; strong effervescence; moderately alkaline; clear smooth boundary.

C2—28 to 43 inches; light brownish gray (10YR 6/2) loam, grayish brown (10YR 5/2) moist; common medium distinct yellowish brown (10YR 5/6) mottles; massive; soft, friable; strong effervescence; moderately alkaline; clear smooth boundary.

Ab—43 to 54 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; common medium distinct light yellowish brown (10YR 6/4) mottles; massive; soft, friable; moderately alkaline; strong effervescence; clear smooth boundary.

C—54 to 60 inches; very pale brown (10YR 7/3) sandy loam, brown (10YR 5/3) moist; massive; soft, friable; strong effervescence; moderately alkaline.

The solum and the mollic epipedon range from 7 to 20 inches in thickness. The depth to lime ranges from 0 to 10 inches. All horizons are mildly alkaline or moderately alkaline.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It is dominantly silt loam, but the range includes loam, sandy loam, and silty clay loam. The C horizon has hue of 7.5YR or 10YR, value of 5 to 7 (3 to 5 moist), and chroma of 1 to 3. It is dominantly loam, silt loam, or clay loam but in many pedons is sandy loam or fine sandy loam below a depth of 40 inches.

Colby Series

The Colby series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in loess. Slope ranges from 7 to 15 percent.

Colby soils are similar to Ulysses soils and commonly are adjacent to Canlon, Penden, and Ulysses soils. Ulysses and Penden soils have a mollic epipedon. Canlon soils are 10 to 20 inches deep over bedrock. Canlon and Penden soils are lower on the landscape than the Colby soils.

Typical pedon of Colby silt loam, 7 to 15 percent slopes (fig. 13), about 2,380 feet west and 260 feet south of the northeast corner of sec. 7, T. 6 S., R. 29 W.

A—0 to 3 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; many fine roots; many wormcasts; strong effervescence; moderately alkaline; clear smooth boundary.

AC—3 to 9 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; some mixing of colors from the horizon below because of worm action; moderate fine granular structure; slightly hard, friable; many fine roots; many wormcasts; strong effervescence; moderately alkaline; gradual smooth boundary.

Ck—9 to 24 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; soft, very friable; many fine roots; few wormcasts; common fine soft accumulations and films of lime; strong effervescence; moderately alkaline; diffuse smooth boundary.

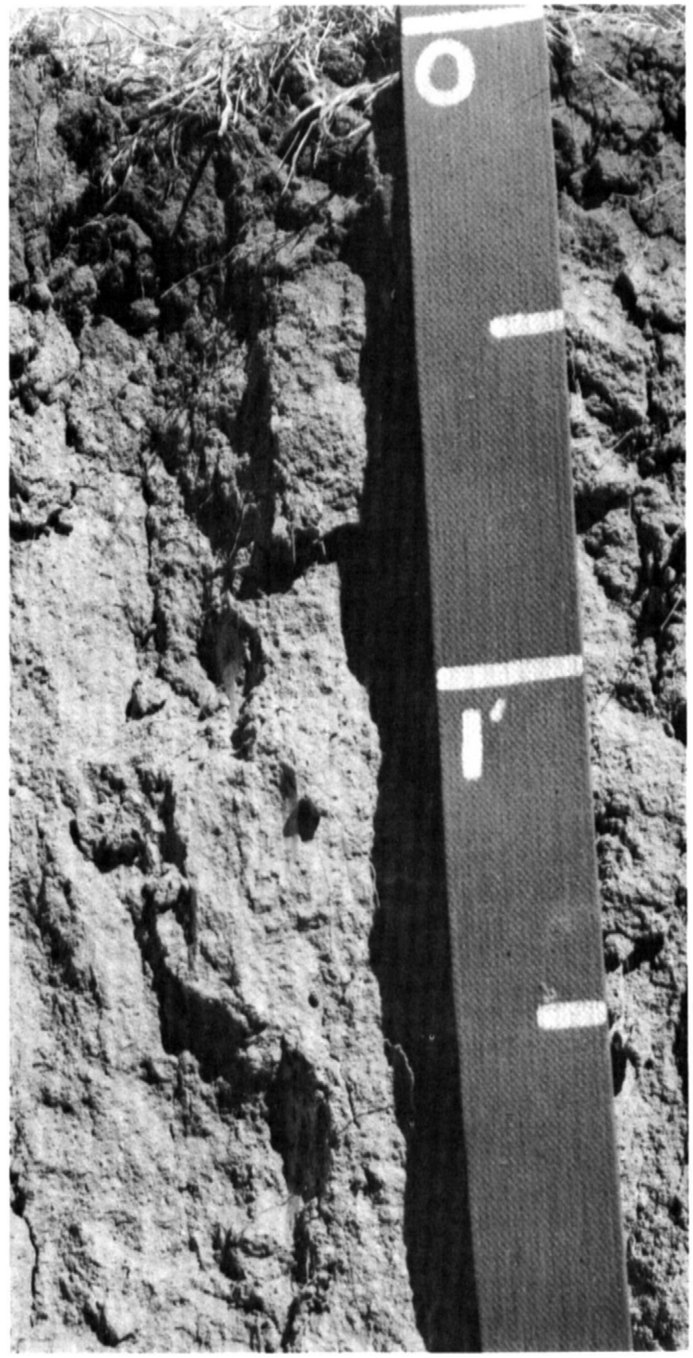

Figure 13.—Typical profile of Colby silt loam, which has a thin surface layer.

C—24 to 60 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; soft, very friable; few fine roots; few fine threads of lime; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 3 to 12 inches. Typically, lime is throughout the profile, but some pedons do not have lime in the upper 6 inches. All horizons are silt loam or loam and are mildly alkaline or moderately alkaline.

The A horizon has hue of 10YR, value of 5 to 7 (3 to 5 moist), and chroma of 2 or 3. The AC and C horizons have hue of 10YR or 7.5YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4.

Hord Series

The Hord series consists of deep, well drained, moderately permeable soils on terraces. These soils formed in alluvium. Slope ranges from 0 to 2 percent.

Hord soils are similar to Bridgeport and Roxbury soils and commonly are adjacent to those soils and to Colby and Penden soils. Bridgeport and Roxbury soils have lime within a depth of 15 inches. Colby and Penden soils are on uplands. Colby soils lack a mollic epipedon, and Penden soils contain more sand in the subsoil than the Hord soils.

Typical pedon of Hord silt loam, about 500 feet east and 2,400 feet north of the southwest corner of sec. 6, T. 6 S., R. 26 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, friable; common fine roots; neutral; abrupt smooth boundary.

A—8 to 23 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak medium granular structure; slightly hard, friable; common fine roots; slightly acid; clear smooth boundary.

Bw—23 to 34 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; slightly hard, friable; few fine roots; neutral; diffuse smooth boundary.

BC—34 to 46 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, friable; mildly alkaline; clear smooth boundary.

Ck—46 to 56 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; medium subangular blocky structure; slightly hard, friable; common fine threads and soft accumulations of lime; strong effervescence; moderately alkaline; clear smooth boundary.

C—56 to 60 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; soft, friable; common fine threads and soft accumulations of lime; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 24 to 60 inches. The mollic epipedon ranges from 20 to 40 inches in thickness. The depth to lime ranges from 20 to 48 inches. The soils are dominantly silt loam, silty clay loam, or loam throughout, but in a few pedons fine sandy loam is below a depth of 40 inches.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. The Bw horizon has colors similar to those of the A horizon. It is neutral or mildly alkaline. The C horizon has hue of 10YR, value of 4 to 7 (3 to 5 moist), and chroma of 2 or 3. It is mildly alkaline or moderately alkaline.

Inavale Series

The Inavale series consists of deep, somewhat excessively drained, rapidly permeable soils on flood plains. These soils formed in sandy alluvium. Slope ranges from 0 to 3 percent.

Inavale soils commonly are adjacent to Bridgeport, Caruso, Munjor, and Penden soils. Bridgeport and Munjor soils contain less sand than the Inavale soils. Bridgeport soils are on terraces, and Munjor soils are on the slightly higher flood plains. Caruso and Penden soils have a loamy subsoil. The somewhat poorly drained Caruso soils are on the slightly lower flood plains, and Penden soils are on uplands.

Typical pedon of Inavale loamy sand, occasionally flooded, about 500 feet south and 200 feet west of the northeast corner of sec. 14, T. 8 S., R. 27 W.

A—0 to 5 inches; grayish brown (10YR 5/2) loamy sand, dark grayish brown (10YR 4/2) moist; single grained; loose; few fine roots; few pebbles; mildly alkaline; gradual smooth boundary.

AC—5 to 18 inches; pale brown (10YR 6/3) loamy sand, dark brown (10YR 4/3) moist; single grained; loose; few fine roots; few pebbles; mildly alkaline; gradual smooth boundary.

C—18 to 60 inches; very pale brown (10YR 7/3) fine sand, brown (10YR 5/3) moist; thin strata of finer and coarser textured material; single grained; loose; few fine roots; mildly alkaline.

The thickness of the solum ranges from 8 to 30 inches. Typically, these soils do not have lime, but some pedons are slightly effervescent. Reaction ranges from neutral to moderately alkaline throughout the profile.

The A horizon has hue of 10YR, value of 5 to 7 (4 or 5 moist), and chroma of 2 or 3. It is dominantly loamy sand, but the range includes sand, fine sand, loamy fine sand, sandy loam, fine sandy loam, loam, and silt loam. The AC and C horizons have hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 or 3. They are loamy fine sand, loamy sand, fine sand, or sand. Some pedons have strata of coarse sand. Some have a few faint mottles below a depth of 40 inches.

Keith Series

The Keith series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in loess. Slope ranges from 0 to 2 percent.

Keith soils are similar to Kuma and Ulysses soils and commonly are adjacent to those soils. Kuma soils have a mollic epipedon that is more than 20 inches thick. They are on broad upland flats. Ulysses soils do not have an argillic horizon. They are more sloping than the Keith soils and generally are lower on the landscape.

Typical pedon of Keith silt loam, 0 to 2 percent slopes (fig. 14), about 2,640 feet east and 160 feet south of the northwest corner of sec. 29, T. 6 S., R. 30 W.

Ap—0 to 5 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; a 1-inch plowpan in the lower part; soft, friable; many fine roots; slightly acid; abrupt smooth boundary.

A—5 to 13 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate medium granular structure; slightly hard, friable; many fine roots; neutral; gradual smooth boundary.

Bt1—13 to 19 inches; brown (10YR 5/3) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, friable; common fine roots; mildly alkaline; abrupt smooth boundary.

Bt2—19 to 27 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; slightly hard, friable; common fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

BCk—27 to 42 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; soft, very friable; common fine roots; few fine threads and soft accumulations of lime; strong effervescence; moderately alkaline; gradual smooth boundary.

C—42 to 60 inches; very pale brown (10YR 7/4) silt loam, light yellowish brown (10YR 6/4) moist; massive; soft, very friable; strong effervescence; moderately alkaline.

The solum ranges from 16 to 48 inches in thickness. It is silt loam or silty clay loam. The mollic epipedon ranges from 8 to 20 inches in thickness. The depth to lime ranges from 15 to 30 inches.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. The Bt horizon has hue of 10YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 or 3. It ranges from neutral to moderately alkaline. The C horizon has hue of 10YR, value of 6 to 8 (5 or 6 moist), and chroma of 2 to 4.

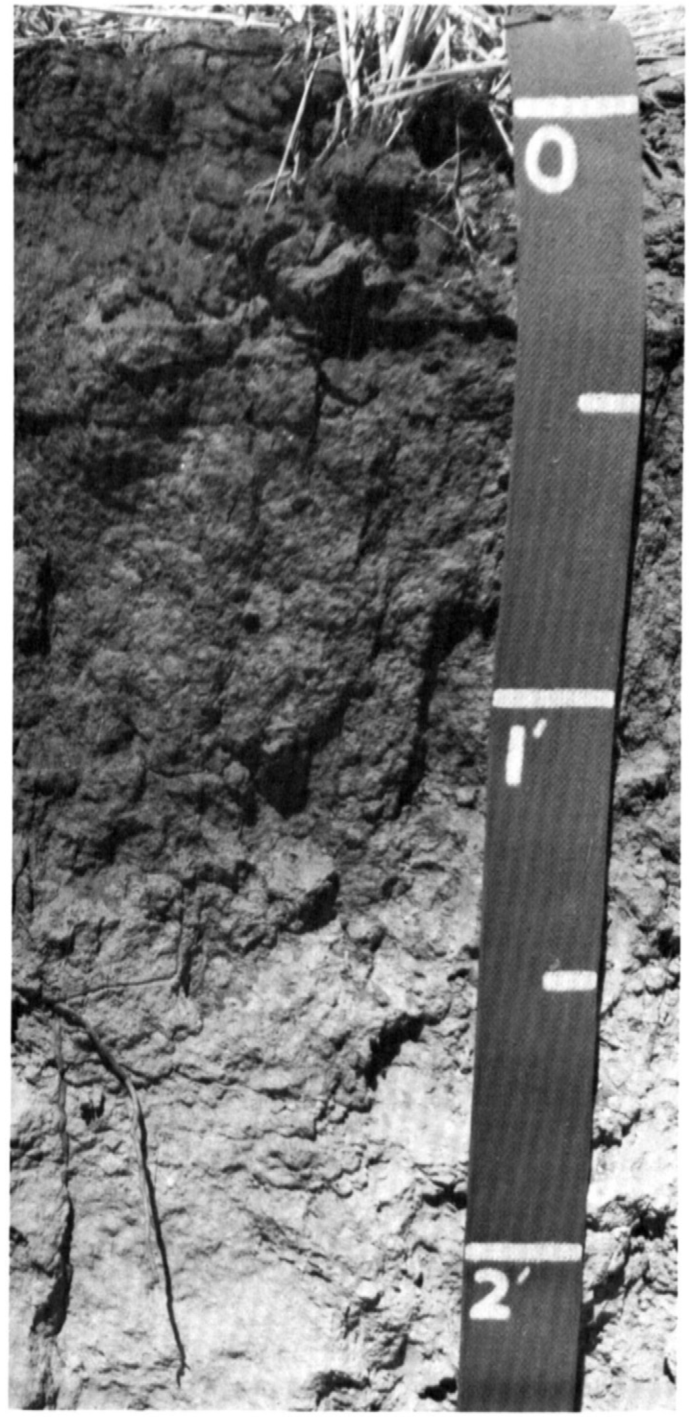

Figure 14.—Typical profile of Keith silt loam. The structure in the subsoil is subangular blocky.

Kuma Series

The Kuma series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in calcareous, silty loess. Slope is 0 to 1 percent.

Kuma soils are similar to Keith soils and commonly are adjacent to those soils. Keith soils have a mollic epipedon that is less than 20 inches thick. They are mainly on divides between drainageways.

Typical pedon of Kuma silt loam, 0 to 1 percent slopes, about 2,600 feet north and 200 feet east of the southwest corner of sec. 5, T. 8 S., R. 29 W.

Ap—0 to 5 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; common fine roots; slightly acid; abrupt smooth boundary.

A—5 to 11 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate medium granular structure; slightly hard, friable; common fine roots; slightly acid; gradual smooth boundary.

Bt1—11 to 18 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; hard, firm; few fine roots; neutral; clear smooth boundary.

Bt2—18 to 25 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; hard, firm; few fine roots; neutral; clear wavy boundary.

Btb—25 to 32 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure parting to weak medium granular; slightly hard, friable; few fine roots; moderately alkaline; gradual wavy boundary.

BCkb—32 to 38 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; moderate medium granular structure; slightly hard, friable; few fine roots; common fine accumulations of lime; strong effervescence; moderately alkaline; clear irregular boundary.

Ck—38 to 47 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; massive; slightly hard, friable; common fine accumulations of lime; strong effervescence; moderately alkaline; diffuse smooth boundary.

C—47 to 60 inches; very pale brown (10YR 7/4) silt loam, light yellowish brown (10YR 6/4) moist; massive; slightly hard, friable; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 30 to 60 inches. The mollic epipedon ranges from 20 to 48 inches in thickness. The depth to lime ranges from 14 to 35 inches.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It ranges from slightly acid to mildly alkaline. The Bt1 and Bt2 horizons have hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. They are silt loam or silty clay loam. The Btb horizon has hue of 10YR or 7.5YR, value of 4 to 6 (2 to 4 moist), and chroma of 1 to 3. It is silt loam or silty clay loam. The C horizon has hue of 10YR or 7.5YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4.

Munjor Series

The Munjor series consists of deep, well drained soils on flood plains. Permeability is moderately rapid. These soils formed in alluvium. Slope ranges from 0 to 2 percent.

Munjor soils commonly are adjacent to Bridgeport, Caruso, and Inavale soils. Bridgeport soils have a silty subsoil. They are on rarely flooded terraces. Caruso and Inavale soils are slightly lower on the flood plains than the Munjor soils. The somewhat poorly drained Caruso soils have a mollic epipedon, and Inavale soils are sandy.

Typical pedon of Munjor sandy loam, occasionally flooded, about 1,700 feet east and 1,000 feet south of the northwest corner of sec. 27, T. 8 S., R. 26 W.

Ap—0 to 5 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, friable; few fine roots; slight effervescence; moderately alkaline; clear smooth boundary.

C1—5 to 35 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 4/3) moist; massive; slightly hard, friable; few fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

C2—35 to 45 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; massive; slightly hard, friable; strong effervescence; moderately alkaline; gradual smooth boundary.

Akb—45 to 60 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; medium subangular blocky structure; hard, friable; strong effervescence; common films and threads of lime; moderately alkaline.

The thickness of the solum ranges from 3 to 20 inches. The depth to lime is less than 10 inches, and most pedons are calcareous to the surface. All horizons are mildly alkaline or moderately alkaline.

The A horizon has hue of 10YR, value of 5 to 7 (3 to 5 moist), and chroma of 2 or 3. It is dominantly sandy loam, but the range includes loamy sand, loamy fine sand, fine sandy loam, and loam. The C horizon has hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 or 3. It is sandy loam, fine sandy loam, or loam. In most pedons it is underlain by darker buried horizons of silt loam below a depth of 40 inches.

Penden Series

The Penden series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in calcareous, loamy old alluvium. Slope ranges from 2 to 15 percent.

Penden soils commonly are adjacent to Canlon, Colby, and Ulysses soils. Canlon soils are 10 to 20 inches deep over bedrock. They are in the steeper areas. Colby and Ulysses soils have a silty subsoil. They are higher on the landscape than the Penden soils.

Typical pedon of Penden clay loam, in an area of Penden-Ulysses complex, 7 to 15 percent slopes, about 2,500 feet north and 600 feet west of the southeast corner of sec. 17, T. 9 S., R. 28 W.

A—0 to 14 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; strong fine granular structure; slightly hard, friable; many fine roots; many wormcasts; strong effervescence; moderately alkaline; gradual smooth boundary.

Bk—14 to 25 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; hard, firm; many fine roots; many threads and soft accumulations of lime; strong effervescence; moderately alkaline; gradual smooth boundary.

C—25 to 60 inches; light yellowish brown (10YR 6/4) clay loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, friable; few fine roots; many threads and soft accumulations of lime; strong effervescence; moderately alkaline.

The solum ranges from 20 to 40 inches in thickness. It is loam, clay loam, or silty clay loam. The mollic epipedon ranges from 7 to 20 inches in thickness.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It is clay loam or loam. The Bk horizon has hue of 10YR or 7.5YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 or 3. The C horizon has hue of 10YR or 7.5YR, value of 5 to 8 (4 to 7 moist), and chroma of 2 to 4. It is clay loam or loam.

Pleasant Series

The Pleasant series consists of deep, moderately well drained, very slowly permeable soils in small upland depressions a few inches to several feet below the surrounding areas. These soils formed in silty and clayey alluvium from the adjacent uplands. Slope is 0 to 1 percent.

Pleasant soils commonly are adjacent to Keith and Kuma soils. The adjacent soils are slightly higher on the landscape than the Pleasant soils. Also, their subsoil is less clayey.

Typical pedon of Pleasant silty clay loam, about 30 feet north and 1,900 feet east of the southwest corner of sec. 17, T. 7 S., R. 26 W.

Ap—0 to 5 inches; gray (10YR 5/1) silty clay loam, very dark gray (10YR 3/1) moist; strong fine granular structure; slightly hard, friable; few fine roots; neutral; clear smooth boundary.

BA—5 to 10 inches; gray (10YR 5/1) silty clay loam, very dark gray (10YR 3/1) moist; strong fine subangular blocky structure; hard, firm; few fine roots; neutral; gradual smooth boundary.

Bt1—10 to 30 inches; gray (10YR 5/1) silty clay, very dark gray (10YR 3/1) moist; strong fine and medium subangular blocky structure; very hard, very firm; few fine roots; neutral; gradual smooth boundary.

Bt2—30 to 50 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; strong medium blocky structure; hard, firm; mildly alkaline; clear smooth boundary.

C—50 to 60 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable; strong effervescence; few fine threads of lime; moderately alkaline.

The thickness of the solum and the depth to lime range from 50 to more than 60 inches. The mollic epipedon ranges from 20 to 50 inches in thickness.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 to 3. It is dominantly silty clay loam, but the range includes silt loam. The Bt horizon has hue of 10YR, value of 4 to 7 (2 to 6 moist), and chroma of 1 to 3. It is silty clay loam, silty clay, or clay. The C horizon has hue of 10YR, value of 5 or 6 (4 or 5 moist), and chroma of 2 to 5. Some pedons have dark buried horizons below a depth of 40 inches.

Roxbury Series

The Roxbury series consists of deep, well drained, moderately permeable soils on flood plains. These soils formed in calcareous alluvium. Slope ranges from 0 to 2 percent.

Roxbury soils are similar to Bridgeport and Hord soils and commonly are adjacent to Colby, Hord, Penden, and Ulysses soils. Bridgeport and Ulysses soils have a mollic epipedon that is less than 20 inches thick. Hord soils do not have lime within a depth of 15 inches. Colby, Penden, and Ulysses soils are on uplands. Colby soils lack a mollic epipedon. Penden soils contain more sand in the subsoil than the Roxbury soils.

Typical pedon of Roxbury silt loam, occasionally flooded, about 1,350 feet north and 100 feet west of the southeast corner of sec. 24, T. 10 S., R. 30 W.

Ap—0 to 5 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, friable; few fine roots; mildly alkaline; gradual smooth boundary.

A1—5 to 16 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable; few fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

A2—16 to 33 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; strong effervescence; moderately alkaline; gradual smooth boundary.

C—33 to 60 inches; light brownish gray (10YR 6/2) silt loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable; many small soft accumulations of lime; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 50 inches. The mollic epipedon is more than 20 inches thick. The depth to lime is less than 15 inches. These soils generally are mildly alkaline or moderately alkaline throughout, but a few pedons are neutral within a depth of 10 inches.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 or 2. It is dominantly silt loam, but the range includes loam and silty clay loam. The C horizon has hue of 10YR or 7.5YR, value of 5 to 7 (4 or 5 moist), and chroma of 2 or 3. It is silt loam, silty clay loam, or loam. Some pedons have thin strata of more clayey or more sandy material.

Simeon Series

The Simeon series consists of deep, excessively drained, rapidly permeable soils on uplands. These soils formed in sandy old alluvium. Slope ranges from 5 to 15 percent.

Simeon soils commonly are adjacent to Penden soils. Penden soils have a loamy subsoil. They are higher on the landscape than the Simeon soils.

Typical pedon of Simeon loamy sand, 5 to 15 percent slopes, about 2,600 feet south and 3,800 feet west of the northeast corner of sec. 4, T. 9 S., R. 26 W.

A—0 to 5 inches; brown (10YR 5/3) loamy sand, brown (10YR 4/3) moist; single grained; soft, very friable; few pebbles; many fine roots; neutral; clear smooth boundary.

AC—5 to 13 inches; pale brown (10YR 6/3) loamy sand, brown (10YR 5/3) moist; single grained; soft, very friable; few pebbles; few fine roots; neutral; clear smooth boundary.

C—13 to 60 inches; very pale brown (10YR 7/4) sand, yellowish brown (10YR 5/4) moist; single grained; loose; few pebbles; mildly alkaline.

The thickness of the solum ranges from 7 to 20 inches. All horizons range from slightly acid to mildly alkaline.

The A horizon has hue of 10YR, value of 3 to 6 (2 to 5 moist), and chroma of 2 or 3. It is dominantly loamy sand or sand, but the range includes sandy loam. The AC horizon has hue of 10YR, value of 4 to 6 (4 or 5 moist), and chroma of 2 or 3. It is sand or loamy sand. The C horizon has hue of 10YR, value of 6 to 8 (5 to 7 moist), and chroma of 2 to 4. It is sand, loamy sand, loamy coarse sand, or coarse sand. The content of gravel in this horizon ranges from 0 to 15 percent.

Ulysses Series

The Ulysses series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in loess. Slope ranges from 2 to 15 percent.

Uylsses soils are similar to Colby and Keith soils and commonly are adjacent to those soils and to Penden soils. Colby soils lack a mollic epipedon. They are on the steeper slopes, generally below the Ulysses soils. Keith soils have an argillic horizon. They are nearly level and are generally higher on the landscape than the Ulysses soils. Penden soils are on the lower side slopes. They contain more sand than the Ulysses soils.

Typical pedon of Ulysses silt loam, 2 to 7 percent slopes (fig. 15), about 2,360 feet south and 560 feet east of the northwest corner of sec. 17, T. 8 S., R. 28 W.

A—0 to 10 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; many fine roots; mildly alkaline; gradual smooth boundary.

Bw—10 to 15 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, friable; many fine roots; mildly alkaline; clear smooth boundary.

Ck—15 to 33 inches; light gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable; common fine roots; few fine threads and soft accumulations of lime; strong effervescence; moderately alkaline; gradual smooth boundary.

C—33 to 60 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; soft, friable; strong effervescence; moderately alkaline.

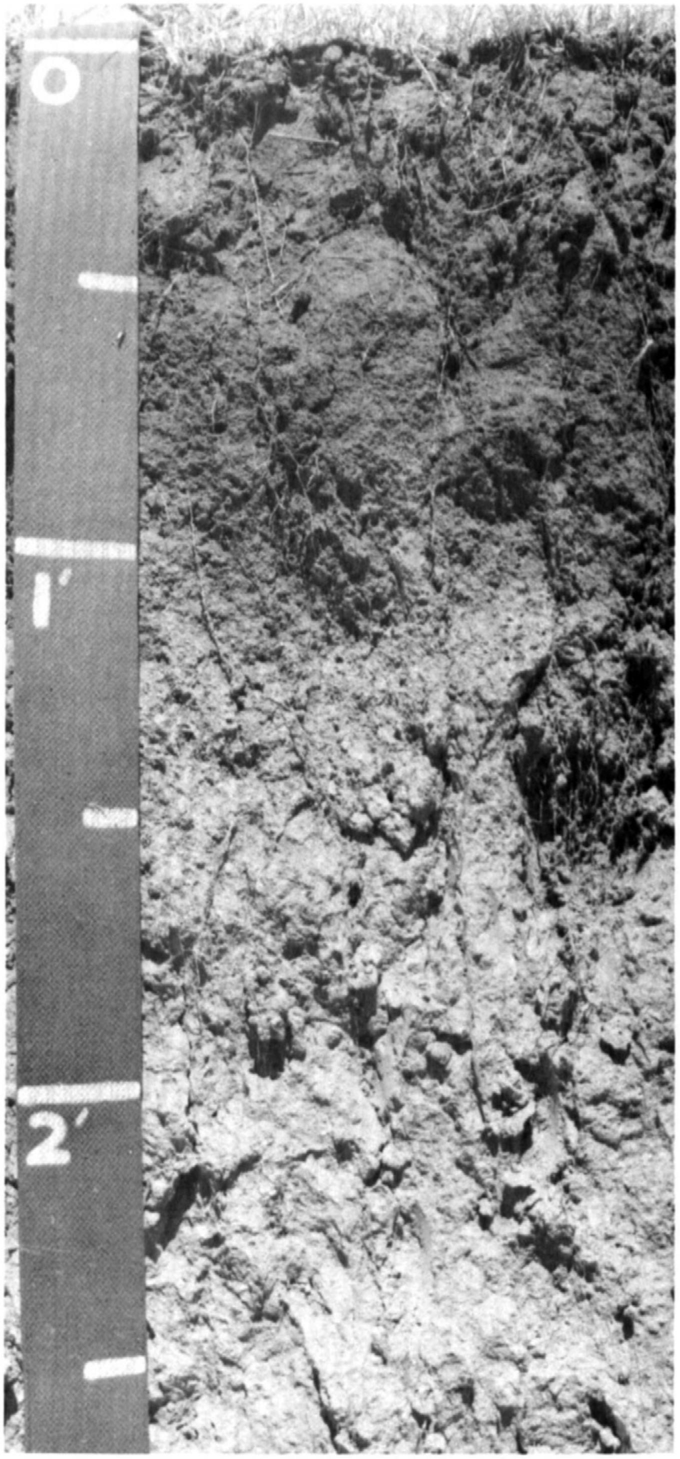

Figure 15.—Typical profile of Ulysses silt loam. The surface layer is dark.

The solum ranges from 10 to 24 inches in thickness. It is silt loam or silty clay loam. The depth to lime ranges from 7 to 15 inches. The thickness of the mollic epipedon ranges from 7 to 20 inches.

The A horizon has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It is neutral or mildly alkaline. The Bw horizon has hue of 10YR, value of 4 or 5 (3 or 4 moist), and chroma of 2 or 3. It is mildly alkaline or moderately alkaline. The C horizon has hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 or 3.

Formation of the Soils

This section explains how soils form and describes the effects of the factors of soil formation on the soils in Sheridan County.

Soil forms through processes that act on deposited or accumulated geologic material. The characteristics of the soil at any given point are determined by the physical and mineralogical composition of the parent material, the climate during and after the accumulation of the soil material, the plant and animal life on and in the soil, the relief, and the length of time that the forces of soil formation have acted on the soil material.

Climate, animal life, and 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 into a natural body that has genetically related horizons. The effects of climate, plants, and animal life are conditioned by relief. The parent material affects the kind of soil profile that forms and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil. Generally, a long period is needed for the formation 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.

Parent Material

Parent material is the unconsolidated material in which a soil forms. It mainly determines the chemical and mineralogical composition of the soil and the rate of soil formation. The parent material in Sheridan County is loess, old alluvium of the Ogallala Formation or Pleistocene epoch, recent alluvium, and residuum.

The soils that formed in loess are the most extensive soils in the county. These are the Colby, Keith, Kuma, and Ulysses soils. The loess is porous, calcareous silt loam that is more than 50 percent silt and less than 15 percent fine sand or coarser sand. It is many feet thick throughout much of the county.

Old and recent alluvium is sediment that has been transported by water. The old alluvial sediment is on uplands. Penden and Simeon soils formed in this material. The recent alluvial sediment is on flood plains and terraces. Bridgeport, Caruso, Hord, Inavale, Munjor, and Roxbury soils formed in recent alluvium.

The bedrock that crops out in Sheridan County is dominantly lime-cemented sandstone or caliche. Canlon soils formed in residuum of this calcareous material.

Climate

Climate directly affects soil formation by weathering the parent material. It indirectly affects soil formation through its effect on plants and animals.

The climate of Sheridan County is continental. It is characterized by intermittent dry and moist periods, which can last for less than a year or for several years. The soil material dries to varying depths during dry periods. It slowly regains moisture during wet periods and can become so saturated that excess moisture penetrates the substratum. The accumulation of soft lime in the substratum of Keith soils is an indication of this excess moisture. As a result of the wetting and drying, some of the basic nutrients, and even clay particles, have been leached from the upper horizons of some soils.

Plant and Animal Life

Plant and animal life is an important factor of soil formation. Plants generally affect the content of nutrients and organic matter in the soil and the color of the surface layer. Earthworms, cicadas, and burrowing animals help to keep the soil open and porous. Earthworms in some soils have left many wormcasts. Bacteria and fungi help to decompose plants, thus releasing more plant nutrients.

The mid and tall prairie grasses have had the greatest effect on soil formation in Sheridan County. As a result of the grasses, the upper part of a typical soil in the county is dark and has a high content of organic matter. The next part in many places is slightly finer textured and somewhat lighter colored than the layer above. The underlying parent material generally is light in color and high in content of carbonates.

Relief

Relief affects soil formation through its effect on drainage, runoff, plant cover, and soil temperature. The temperature of the soil, for example, is slightly lower on east- and north-facing slopes than on west- and south-facing slopes. Most important is the effect of relief on the movement of water on the surface and into the soil.

The runoff rate is higher on the more sloping soils in the uplands than in the less sloping areas. As a result, erosion is more extensive. Relief has retarded the formation of Penden and Canlon soils, which formed in the oldest parent material in the county. Runoff is medium or rapid on these moderately sloping and strongly sloping soils, and much of the soil material is removed as soon as the soil forms.

Runoff is slow on the nearly level Hord soils on stream terraces. Most of the precipitation received penetrates the surface. As a result, these soils have well defined horizons even though they formed in recent alluvium.

Time

As water moves through the soil, soluble matter and fine particles are gradually leached from the surface layer to the subsoil. The amount of leaching depends on the amount of time that has elapsed and the amount of water that penetrates the surface. Differences in the length of time that the parent material has been exposed to the processes of soil formation are reflected in the degree of profile development. For example, Caruso soils, which formed in recent alluvium, show very little evidence of horizon development other than a slight darkening of the surface layer. In contrast, Keith soils, which have been exposed to soil-forming processes for thousands of years, have well defined horizons.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Argillic horizon. A subsoil horizon characterized by an accumulation of illuvial clay.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds just beneath the solum, or it is exposed at the surface by erosion.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—
Loose.—Noncoherent when dry or moist; does not hold together in a mass.
Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.
Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.
Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.
Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.
Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.
Soft.—When dry, breaks into powder or individual grains under very slight pressure.
Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:
Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.
Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.
Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.
Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.
Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.
Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.
Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Forb. Any herbaceous plant not a grass or a sedge.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but can be directly below an A or a B horizon.

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

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

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

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

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

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

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

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

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Mollic epipedon. A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor filter (in tables). Because of rapid permeability the soil may not adequately filter effluent from a waste disposal system.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to insure satisfactory performance of the soil for a specific use.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

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

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. Includes all subdivisions of these horizons.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1941-1970 at Hoxie, Kansas]

Month	Temperature					Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	In	In	In		In
January----	42.6	15.9	29.3	72	-14	0.45	0.01	0.66	1	4.6
February---	47.4	20.3	33.9	78	-6	.52	.12	.73	1	4.4
March------	53.8	25.0	39.4	88	-1	1.16	.29	1.96	3	8.8
April------	67.4	37.7	52.6	91	15	1.80	.72	2.48	4	2.9
May--------	77.1	48.3	62.7	99	28	2.94	1.21	5.18	6	0.4
June-------	86.4	58.3	72.4	105	42	4.00	1.71	6.61	6	0
July-------	92.5	63.9	78.2	107	49	3.53	1.20	4.84	5	0
August-----	91.5	62.5	77.0	106	48	2.77	1.69	3.76	4	0
September--	82.4	52.6	67.5	102	31	1.65	.39	3.25	4	0
October----	71.4	40.8	56.1	93	20	1.40	.18	2.00	3	0.5
November---	55.3	27.1	41.2	78	1	.64	.02	1.61	2	3.1
December---	44.6	19.2	31.9	73	-9	.49	.09	.73	1	4.3
Year-----	67.7	39.3	53.5	108	-15	21.35	15.82	26.70	40	29.0

TABLE 2.--FREEZE DATES IN SPRING AND FALL

Probability	Minimum temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 20	April 30	May 17
2 years in 10 later than--	April 15	April 25	May 12
5 years in 10 later than--	April 6	April 15	May 2
First freezing temperature in fall:			
1 year in 10 earlier than--	October 16	October 11	September 28
2 years in 10 earlier than--	October 20	October 16	October 2
5 years in 10 earlier than--	October 30	October 25	October 12

TABLE 3.--GROWING SEASON

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	182	167	136
8 years in 10	190	176	145
5 years in 10	207	193	163
2 years in 10	224	210	180
1 year in 10	233	219	189

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Bd	Bridgeport silt loam, 0 to 2 percent slopes	10,845	1.9
Be	Bridgeport silt loam, 2 to 5 percent slopes	1,090	0.2
Ca	Caruso silt loam, occasionally flooded	5,080	0.9
Cd	Colby silt loam, 7 to 15 percent slopes	53,320	9.3
Ho	Hord silt loam	9,200	1.6
In	Inavale loamy sand, occasionally flooded	2,850	0.5
Ke	Keith silt loam, 0 to 2 percent slopes	281,994	49.3
Ku	Kuma silt loam, 0 to 1 percent slopes	16,155	2.8
Mu	Munjor sandy loam, occasionally flooded	2,550	0.5
Pe	Penden loam, 2 to 7 percent slopes	1,830	0.3
Ph	Penden-Canlon loams, 7 to 20 percent slopes	3,130	0.6
Pm	Penden-Ulysses complex, 7 to 15 percent slopes	65,352	11.4
Ps	Pleasant silty clay loam	2,090	0.4
Rx	Roxbury silt loam, occasionally flooded	6,440	1.1
Sm	Simeon loamy sand, 5 to 15 percent slopes	630	0.1
Uc	Ulysses silt loam, 2 to 7 percent slopes	108,900	19.1
	Water	64	*
	Total	571,520	100.0

* Less than 0.1 percent.

TABLE 5.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS

[Yields in the N columns are for nonirrigated soils; those in the I columns are for irrigated soils. Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Capability subclass		Winter wheat		Grain sorghum		Corn	Corn silage	Alfalfa hay
	N	I	N	I	N	I	I	I	I
			Bu	Bu	Bu	Bu	Bu	Ton	Ton
Bd: Bridgeport	IIc	I	33	55	50	115	130	19	5.0
Be: Bridgeport	IIIe	IIIe	30	55	42	110	120	17	4.0
Ca: Caruso	IIw	IIw	27	---	42	100	110	---	5.0
Cd: Colby	VIe	---	---	---	---	---	---	---	---
Ho: Hord	IIc	I	36	58	54	120	140	20	5.0
In: Inavale	IVe	IIIe	20	---	32	80	100	---	4.0
Ke: Keith	IIc	I	35	55	48	115	135	19	4.5
Ku: Kuma	IIc	I	36	58	50	120	140	20	5.0
Mu: Munjor	IIIw	IIIw	30	40	46	---	---	---	4.5
Pe: Penden	IIIe	IIIe	26	34	38	---	---	---	---
Ph: Penden-Canlon	VIe	---	---	---	---	---	---	---	---
Pm: Penden-Ulysses	VIe	---	---	---	---	---	---	---	---
Ps: Pleasant	IVw	---	27	---	36	---	---	---	---
Rx: Roxbury	IIw	IIw	32	38	46	110	130	19	5.0
Sm: Simeon	VIs	---	---	---	---	---	---	---	---
Uc: Ulysses	IIIe	IIIe	27	34	38	90	110	16	4.0

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

[Only the soils that support rangeland vegetation suitable for grazing are listed]

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Bd, Be: Bridgeport	Loamy Terrace	Favorable	4,000	Big bluestem	35
		Normal	3,000	Sideoats grama	25
		Unfavorable	2,000	Western wheatgrass	15
				Little bluestem	10
Ca: Caruso	Subirrigated	Favorable	5,000	Little bluestem	25
		Normal	4,300	Big bluestem	20
		Unfavorable	3,200	Prairie cordgrass	15
				Indiangrass	15
				Switchgrass	10
				Sedge	5
Cd: Colby	Limy Upland	Favorable	2,400	Little bluestem	30
		Normal	1,800	Sideoats grama	15
		Unfavorable	1,000	Blue grama	10
				Western wheatgrass	10
				Tall dropseed	5
				Small soapweed	5
Ho: Hord	Loamy Terrace	Favorable	4,500	Big bluestem	30
		Normal	3,500	Little bluestem	10
		Unfavorable	2,000	Switchgrass	10
				Indiangrass	10
				Sideoats grama	5
				Blue grama	5
				Tall dropseed	5
				Western wheatgrass	5
				Sedge	5
In: Inavale	Sandy Lowland	Favorable	3,500	Sand bluestem	30
		Normal	3,000	Prairie sandreed	20
		Unfavorable	2,200	Little bluestem	15
				Needleandthread	15
				Switchgrass	5
				Sedge	5
Ke: Keith	Loamy Upland	Favorable	3,200	Western wheatgrass	20
		Normal	2,300	Blue grama	20
		Unfavorable	1,500	Needleandthread	10
				Buffalograss	10
				Little bluestem	10
				Sedge	5
				Big bluestem	5
				Sideoats grama	5
Ku: Kuma	Loamy Upland	Favorable	3,200	Blue grama	25
		Normal	2,300	Western wheatgrass	20
		Unfavorable	1,500	Little bluestem	10
				Buffalograss	10
				Needleandthread	10
				Sedge	5
Mu: Munjor	Sandy Lowland	Favorable	4,500	Sand bluestem	35
		Normal	3,500	Switchgrass	15
		Unfavorable	2,500	Indiangrass	10
				Little bluestem	10
				Western wheatgrass	5
				Chickasaw plum	5
Pe: Penden	Limy Upland	Favorable	4,000	Big bluestem	40
		Normal	2,500	Little bluestem	20
		Unfavorable	1,000	Sideoats grama	10
				Switchgrass	5
				Indiangrass	5
				Western wheatgrass	5
				Leadplant	5

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Ph*:					
Penden	Limy Upland	Favorable	4,000	Big bluestem	40
		Normal	2,500	Little bluestem	20
		Unfavorable	1,000	Sideoats grama	10
				Switchgrass	5
				Indiangrass	5
				Western wheatgrass	5
				Leadplant	5
Canlon	Shallow Limy	Favorable	2,400	Little bluestem	25
		Normal	1,600	Sideoats grama	20
		Unfavorable	900	Big bluestem	10
				Switchgrass	5
				Hairy grama	5
				Plains muhly	5
				Blue grama	5
Pm*:					
Penden	Limy Upland	Favorable	4,000	Big bluestem	40
		Normal	2,500	Little bluestem	20
		Unfavorable	1,000	Sideoats grama	10
				Switchgrass	5
				Indiangrass	5
				Western wheatgrass	5
				Leadplant	5
Ulysses	Loamy Upland	Favorable	3,000	Blue grama	25
		Normal	2,000	Western wheatgrass	15
		Unfavorable	1,000	Sideoats grama	10
				Little bluestem	10
				Buffalograss	10
				Big bluestem	10
				Small soapweed	5
Ps Pleasant	Clay Upland	Favorable	2,400	Western wheatgrass	50
		Normal	1,800	Buffalograss	15
		Unfavorable	1,000	Blue grama	10
				Sedge	5
Rx Roxbury	Loamy Lowland	Favorable	5,000	Big bluestem	30
		Normal	4,000	Western wheatgrass	15
		Unfavorable	2,500	Sideoats grama	10
				Indiangrass	5
				Switchgrass	5
				Little bluestem	5
Sm Simeon	Sands	Favorable	2,000	Blue grama	20
		Normal	1,500	Prairie sandreed	15
		Unfavorable	1,000	Needleandthread	15
				Sand bluestem	15
				Hairy grama	5
				Little bluestem	5
				Sand dropseed	5
Uc Ulysses	Loamy Upland	Favorable	3,000	Blue grama	25
		Normal	2,000	Western wheatgrass	15
		Unfavorable	1,000	Sideoats grama	10
				Little bluestem	10
				Buffalograss	10
				Big bluestem	10

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
Bd, Be Bridgeport	American plum	Lilac	Eastern redcedar, Russian-olive, Austrian pine, green ash, ponderosa pine, Russian mulberry.	Hackberry, honeylocust.	Eastern cottonwood.
Ca Caruso	American plum, lilac.	Amur honeysuckle	Russian-olive, eastern redcedar, Rocky Mountain juniper, green ash, ponderosa pine, hackberry.	Honeylocust	Siberian elm, eastern cottonwood.
Cd Colby	Siberian peashrub, fragrant sumac, silver buffaloberry.	Easter redcedar, Rocky Mountain juniper, ponderosa pine, green ash, Russian-olive.	Honeylocust, Siberian elm.	---	---
Ho Hord	Peking cotoneaster	Lilac, Siberian peashrub, American plum.	Eastern redcedar, ponderosa pine, blue spruce, Manchurian crabapple.	Golden willow, green ash, hackberry.	Eastern cottonwood.
In Inavale	Lilac, American plum.	Common chokecherry	Eastern redcedar, Austrian pine, Scotch pine, Russian mulberry, green ash, honeylocust, hackberry, Russian mulberry.	Siberian elm	---
Ke Keith	Lilac, American plum.	Rocky Mountain juniper, Manchurian crabapple, common chokecherry, Siberian peashrub.	Hackberry, ponderosa pine, green ash, honeylocust, Russian-olive.	Siberian elm	---
Ku Kuma	Fragrant sumac, lilac, Amur honeysuckle.	Russian-olive, common chokecherry.	Eastern redcedar, green ash, ponderosa pine, honeylocust, bur oak.	Siberian elm	---
Mu Munjor	American plum, lilac.	Amur honeysuckle	Russian-olive, Rocky Mountain juniper, ponderosa pine, eastern redcedar, hackberry, green ash.	Honeylocust, Siberian elm.	Eastern cottonwood.
Pe Penden	Fragrant sumac, silver buffaloberry, Siberian peashrub, Tatarian honeysuckle.	Eastern redcedar, Russian-olive, Rocky Mountain juniper, bur oak.	Siberian elm, honeylocust, ponderosa pine, green ash.	---	---

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of-- <8	8-15	16-25	26-35	>35
Ph*:					
Penden	Fragrant sumac, silver buffaloberry, Siberian peashrub, Tatarian honeysuckle.	Eastern redcedar, Russian-olive, Rocky Mountain juniper, bur oak.	Siberian elm, honeylocust, ponderosa pine, green ash.	---	---
Canlon.					
Pm*:					
Penden	Fragrant sumac, silver buffaloberry, Siberian peashrub, Tatarian honeysuckle.	Eastern redcedar, Russian-olive, Rocky Mountain juniper, bur oak.	Siberian elm, honeylocust, ponderosa pine, green ash.	---	---
Ulysses	Fragrant sumac, Siberian peashrub, silver buffaloberry, Tatarian honeysuckle.	Eastern redcedar, ponderosa pine, Russian-olive, green ash, Rocky Mountain juniper, black locust.	Honeylocust, Siberian elm.	---	---
Ps. Pleasant					
Rx Roxbury	---	Tatarian honeysuckle, Siberian peashrub, silver buffaloberry.	Eastern redcedar, Russian-olive, ponderosa pine, green ash, Russian mulberry.	Siberian elm, hackberry, honeylocust.	Eastern cottonwood.
Sm. Simeon					
Uc Ulysses	Fragrant sumac, Siberian peashrub, silver buffaloberry, Tatarian honeysuckle.	Eastern redcedar, ponderosa pine, Russian-olive, green ash, Rocky Mountain juniper, black locust.	Honeylocust, Siberian elm.	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe"]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Bd------------------ Bridgeport	Severe: flooding.	Slight--------------	Slight--------------	Slight.
Be------------------ Bridgeport	Severe: flooding.	Slight--------------	Moderate: slope.	Slight.
Ca------------------ Caruso	Severe: flooding.	Moderate: wetness.	Moderate: wetness, flooding.	Slight.
Cd------------------ Colby	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Severe: erodes easily.
Ho------------------ Hord	Severe: flooding.	Slight--------------	Slight--------------	Slight.
In------------------ Inavale	Severe: flooding.	Slight--------------	Slight--------------	Slight.
Ke------------------ Keith	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
Ku------------------ Kuma	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
Mu------------------ Munjor	Severe: flooding.	Slight--------------	Moderate: flooding.	Slight.
Pe------------------ Penden	Slight--------------	Slight--------------	Moderate: slope.	Slight.
Ph*:				
Penden--------------	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Canlon--------------	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock, small stones.	Slight.
Pm*:				
Penden--------------	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Ulysses-------------	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.
Ps------------------ Pleasant	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Rx------------------ Roxbury	Severe: flooding.	Slight--------------	Moderate: flooding.	Slight.
Sm------------------ Simeon	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Uc------------------ Ulysses	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WILDLIFE HABITAT POTENTIALS

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Bd: Bridgeport	Good	Good	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor	Fair.
Be: Bridgeport	Fair	Good	Good	Fair	Fair	Fair	Poor	Very poor.	Good	Fair	Very poor.	Fair.
Ca: Caruso	Fair	Fair	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
Cd: Colby	Poor	Fair	Fair	---	---	Poor	Very poor.	Very poor.	Fair	---	Very poor.	Poor.
Ho: Hord	Good	Good	Good	Fair	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.	Fair.
In: Inavale	Fair	Fair	Good	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
Ke: Keith	Good	Good	Fair	---	---	Fair	Very poor.	Very poor.	Good	---	Very poor.	Fair.
Ku: Kuma	Good	Good	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
Mu: Munjor	Fair	Fair	Good	Fair	Fair	Fair	Poor	Poor	Fair	Fair	Poor	Fair.
Pe: Penden	Fair	Good	Fair	---	---	Poor	Very poor.	Poor	Fair	---	Very poor.	Fair.
Ph*:												
Penden	Poor	Fair	Fair	---	---	Poor	Very poor.	Poor	Fair	---	Very poor.	Fair.
Canlon	Poor	Poor	Poor	---	---	Poor	Very poor.	Very poor.	Poor	---	Very poor.	Poor.
Pm*:												
Penden	Poor	Fair	Fair	---	---	Poor	Very poor.	Poor	Fair	---	Very poor.	Fair.
Ulysses	Poor	Fair	Fair	---	---	Poor	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Ps: Pleasant	Fair	Fair	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
Rx: Roxbury	Good	Good	Good	Fair	Fair	Fair	Poor	Fair	Good	Fair	Poor	Fair.
Sm: Simeon	Poor	Poor	Fair	---	---	Poor	Very poor.	Very poor.	Poor	---	Very poor.	Fair.
Uc: Ulysses	Fair	Good	Fair	---	---	Poor	Poor	Poor	Fair	---	Poor	Fair.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe"]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Bd, Be: Bridgeport	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.
Ca: Caruso	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength, flooding.
Cd: Colby	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength.
Ho: Hord	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.
In: Inavale	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Ke: Keith	Slight	Moderate: shrink-swell.	Slight	Moderate: shrink-swell.	Severe: low strength.
Ku: Kuma	Slight	Moderate: shrink-swell.	Slight	Moderate: shrink-swell.	Severe: low strength.
Mu: Munjor	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Pe: Penden	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Ph*:					
Penden	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.
Canlon	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.
Pm*:					
Penden	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.
Ulysses	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength.
Ps: Pleasant	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, shrink-swell.
Rx: Roxbury	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.
Sm: Simeon	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Uc: Ulysses	Slight	Slight	Slight	Moderate: slope.	Severe: low strength.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Bd, Be: Bridgeport	Moderate: flooding.	Moderate: seepage.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
Ca: Caruso	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: too clayey, wetness.
Cd: Colby	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Ho: Hord	Moderate: flooding.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
In: Inavale	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: seepage, too sandy, flooding.	Severe: seepage, flooding.	Poor: too sandy, seepage.
Ke: Keith	Slight	Moderate: seepage.	Slight	Slight	Good.
Ku: Kuma	Slight	Moderate: seepage.	Slight	Slight	Good.
Mu: Munjor	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding.	Severe: flooding, seepage.	Good.
Pe: Penden	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Ph*:					
Penden	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Canlon	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
Pm*:					
Penden	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Ulysses	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Ps: Pleasant	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
Rx: Roxbury	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
Sm: Simeon	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Uc------------------- Ulysses	Slight-----------	Moderate: seepage, slope.	Slight-----------	Slight-----------	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable"]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Bd, Be: Bridgeport	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Ca: Caruso	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Cd: Colby	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Ho: Hord	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
In: Inavale	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Ke: Keith	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Ku: Kuma	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Mu: Munjor	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Pc: Penden	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Ph*:				
Penden	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Canlon	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
Pm*:				
Penden	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.
Ulysses	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Ps: Pleasant	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
Rx: Roxbury	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Sm: Simeon	Good	Probable	Improbable: too sandy.	Fair: too sandy, small stones.
Uc: Ulysses	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "moderate" and "severe"]

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Bd------------------ Bridgeport	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable-------	Erodes easily	Erodes easily.
Be------------------ Bridgeport	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope-----------	Erodes easily	Erodes easily.
Ca------------------ Caruso	Moderate: seepage.	Severe: piping.	Flooding--------	Wetness, flooding.	Wetness---------	Favorable.
Cd------------------ Colby	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
Ho------------------ Hord	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable-------	Favorable-------	Favorable.
In------------------ Inavale	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
Ke------------------ Keith	Moderate: seepage.	Severe: piping.	Deep to water	Favorable-------	Erodes easily	Erodes easily.
Ku------------------ Kuma	Moderate: seepage.	Severe: piping.	Deep to water	Favorable-------	Erodes easily	Erodes easily.
Mu------------------ Munjor	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, flooding.	Soil blowing---	Favorable.
Pe------------------ Penden	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope-----------	Erodes easily	Erodes easily.
Ph*:						
Penden-------------	Severe: slope.	Moderate: piping.	Deep to water	Slope-----------	Slope, erodes easily.	Slope, erodes easily.
Canlon-------------	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Depth to rock, slope.	Slope, depth to rock.
Pm*:						
Penden-------------	Severe: slope.	Moderate: piping.	Deep to water	Slope-----------	Slope, erodes easily.	Slope, erodes easily.
Ulysses------------	Severe: slope.	Severe: piping.	Deep to water	Slope-----------	Slope, erodes easily.	Slope, erodes easily.
Ps------------------ Pleasant	Moderate: seepage.	Severe: hard to pack, ponding.	Ponding, percs slowly.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
Rx------------------ Roxbury	Moderate: seepage.	Moderate: thin layer, piping.	Deep to water	Flooding--------	Erodes easily	Erodes easily.
Sm------------------ Simeon	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
Uc------------------ Ulysses	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope-----------	Erodes easily	Erodes easily.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Bd, Be----------- Bridgeport	0-13	Silt loam--------	CL	A-4, A-6	0	100	100	95-100	75-100	25-40	8-20
	13-60	Silt loam, silty clay loam, loam.	CL	A-4, A-6	0	100	100	95-100	85-100	25-40	8-20
Ca--------------- Caruso	0-14	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	65-90	25-40	5-20
	14-60	Loam, clay loam, sandy loam.	CL, CL-ML	A-4, A-6, A-7	0	100	100	95-100	65-85	25-45	5-20
Cd--------------- Colby	0-3	Silt loam--------	CL, ML, CL-ML	A-4, A-6	0	100	100	90-100	85-100	25-40	3-15
	3-60	Silt loam, loam	CL, ML	A-4, A-6	0	100	100	90-100	85-100	25-40	3-15
Ho--------------- Hord	0-23	Silt loam--------	CL, ML, CL-ML	A-4, A-6	0	100	100	95-100	85-100	20-35	3-18
	23-46	Silt loam, silty clay loam, loam.	CL	A-6, A-4	0	100	100	98-100	85-100	25-40	8-23
	46-60	Silt loam, very fine sandy loam, silty clay loam.	CL, CL-ML	A-6, A-4	0	100	100	100	85-100	25-40	6-21
In--------------- Inavale	0-5	Loamy sand-------	SM, SP-SM, SM-SC	A-2, A-3	0	100	100	85-95	5-35	<25	NP-5
	5-18	Fine sand, loamy fine sand, loamy sand.	SP-SM, SM, SM-SC	A-2, A-3	0	100	90-100	65-85	5-30	<25	NP-5
	18-60	Fine sand, loamy fine sand, loamy sand.	SP-SM, SM, SM-SC	A-2, A-3	0	100	100	70-90	5-30	<25	NP-5
Ke--------------- Keith	0-13	Silt loam--------	ML, CL, CL-ML	A-4	0	100	100	85-100	85-100	20-35	2-10
	13-42	Silt loam, silty clay loam, loam.	CL	A-6, A-7	0	100	100	95-100	85-100	30-45	10-25
	42-60	Silt loam, loam, very fine sandy loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	85-100	20-35	2-12
Ku--------------- Kuma	0-11	Silt loam--------	CL, CL-ML, ML	A-4, A-6	0	100	95-100	95-100	75-95	25-40	NP-15
	11-32	Silty clay loam, silt loam, loam.	CL	A-6	0	100	95-100	95-100	85-95	30-40	10-20
	32-60	Silt loam, loam, very fine sandy loam.	CL, CL-ML	A-4, A-6	0	95-100	95-100	95-100	75-95	25-40	5-15
Mu--------------- Munjor	0-5	Sandy loam-------	SM, ML, SM-SC, CL-ML	A-2, A-4	0	100	95-100	65-100	25-55	15-30	NP-7
	5-45	Sandy loam, fine sandy loam, loam.	SM, SC, ML, CL	A-4	0	100	95-100	65-100	35-65	15-30	3-10
	45-60	Silt loam, loam	CL, CL-ML	A-4, A-6	0	100	100	85-100	60-90	20-40	5-20
Pe--------------- Penden	0-14	Loam-------------	CL	A-4, A-6	0	100	100	85-100	65-95	25-40	7-20
	14-25	Clay loam, loam, silty clay loam.	CL	A-6, A-7-6	0	100	100	85-100	60-90	30-45	11-25
	25-60	Clay loam, loam	CL	A-6, A-7-6	0	100	100	75-100	55-75	30-45	11-25
Ph*: Penden-----------	0-11	Loam-------------	CL	A-4, A-6	0	100	100	85-100	65-95	25-40	7-20
	11-25	Clay loam, loam, silty clay loam.	CL	A-6, A-7-6	0	100	100	85-100	60-90	30-45	11-25
	25-60	Clay loam, loam	CL	A-6, A-7-6	0	100	100	75-100	55-75	30-45	11-25

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Ph*:											
Canlon----------	0-6	Loam-------------	CL, CL-ML	A-4, A-6	0	90-100	75-100	65-100	50-90	20-40	4-20
	6-13	Loam, gravelly loam, fine sandy loam.	CL, SC, CL-ML, SM-SC	A-4, A-6	0	75-100	55-100	50-95	35-85	20-40	4-20
	13	Unweathered bedrock.									
Pm*:											
Penden----------	0-14	Clay loam--------	CL	A-6, A-7-6	0	100	100	85-100	65-95	30-45	11-25
	14-25	Clay loam, loam, silty clay loam.	CL	A-6, A-7-6	0	100	100	85-100	60-90	30-45	11-25
	25-60	Clay loam, loam	CL	A-6, A-7-6	0	100	100	75-100	55-75	30-45	11-25
Ulysses---------	0-8	Silt loam--------	CL, ML	A-4, A-6	0	100	100	90-100	85-100	25-40	3-15
	8-13	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	85-100	25-43	11-20
	13-60	Silt loam, loam	CL, ML	A-4, A-6	0	100	100	90-100	85-100	25-40	3-15
Ps---------------- Pleasant	0-5	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	95-100	35-50	15-25
	5-50	Silty clay loam, silty clay, clay.	CL, CH	A-7	0	100	100	95-100	95-100	40-65	25-45
	50-60	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	95-100	95-100	25-35	5-15
Rx---------------- Roxbury	0-16	Silt loam--------	CL	A-4, A-6	0	100	100	95-100	65-100	25-40	7-20
	16-33	Silt loam, silty clay loam.	CL	A-4, A-6, A-7-6	0	100	100	95-100	80-100	30-50	8-25
	33-60	Silt loam, silty clay loam, loam.	ML, CL	A-4, A-6, A-7-6	0	100	100	95-100	65-100	30-50	7-25
Sm---------------- Simeon	0-5	Loamy sand-------	SM, SP-SM	A-2, A-3	0	95-100	90-100	51-80	5-35	<20	NP
	5-60	Sand, coarse sand, loamy sand.	SP, SP-SM, SM	A-1, A-2, A-3	0	90-100	75-100	40-80	2-30	---	NP
Uc---------------- Ulysses	0-10	Silt loam--------	CL, ML	A-4, A-6	0	100	100	90-100	85-100	25-40	3-15
	10-15	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	85-100	25-43	11-20
	15-60	Silt loam, loam	CL, ML	A-4, A-6	0	100	100	90-100	85-100	25-40	3-15

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH	Mmhos/cm					Pct
Bd, Be------------	0-13	18-27	1.30-1.40	0.6-2.0	0.20-0.24	6.6-8.4	<2	Low--------	0.32	5	4L	1-4
Bridgeport	13-60	18-30	1.35-1.50	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low--------	0.43			
Ca----------------	0-14	18-27	1.30-1.40	0.6-2.0	0.19-0.23	7.4-8.4	<4	Low--------	0.28	5	4L	1-4
Caruso	14-60	18-35	1.35-1.50	0.2-2.0	0.16-0.22	7.4-8.4	<4	Low--------	0.28			
Cd----------------	0-3	15-30	1.20-1.30	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low--------	0.43	5	4L	.5-2
Colby	3-60	18-27	1.25-1.40	0.6-2.0	0.17-0.22	7.4-8.4	<2	Low--------	0.43			
Ho----------------	0-23	17-27	1.30-1.40	0.6-2.0	0.20-0.24	6.1-7.3	<2	Low--------	0.32	5	6	2-4
Hord	23-46	20-35	1.35-1.45	0.6-2.0	0.17-0.22	6.6-7.8	<2	Low--------	0.32			
	46-60	18-30	1.30-1.50	0.6-2.0	0.17-0.22	6.6-8.4	<2	Low--------	0.43			
In----------------	0-5	7-18	1.50-1.60	6.0-20	0.10-0.12	6.6-7.8	<2	Low--------	0.17	5	2	.5-1
Inavale	5-18	3-10	1.50-1.60	6.0-20	0.06-0.11	6.6-8.4	<2	Low--------	0.17			
	18-60	3-10	1.50-1.60	6.0-20	0.05-0.10	6.6-8.4	<2	Low--------	0.17			
Kc----------------	0-13	15-25	1.20-1.30	0.6-2.0	0.20-0.24	6.1-7.3	<2	Low--------	0.32	5	6	1-3
Keith	13-42	20-35	1.10-1.20	0.6-2.0	0.18-0.22	6.6-8.4	<2	Moderate	0.32			
	42-60	10-20	1.30-1.40	0.6-2.0	0.20-0.22	7.4-8.4	<2	Low--------	0.43			
Ku----------------	0-11	15-27	---	0.6-2.0	0.18-0.21	6.1-8.4	<2	Low--------	0.32	5	6	2-4
Kuma	11-32	18-35	---	0.6-2.0	0.18-0.21	6.6-8.4	<2	Moderate	0.37			
	32-60	15-27	---	0.6-2.0	0.16-0.18	7.9-9.0	<2	Low--------	0.32			
Mu----------------	0-5	7-15	1.30-1.40	2.0-6.0	0.14-0.20	7.4-8.4	<2	Low--------	0.24	5	3	.5-1
Munjor	5-45	7-18	1.30-1.40	2.0-6.0	0.13-0.18	7.4-8.4	<2	Low--------	0.24			
	45-60	15-27	1.30-1.40	0.6-2.0	0.17-0.22	7.4-8.4	2-4	Low--------	0.43			
Pc----------------	0-14	20-27	1.30-1.45	0.6-2.0	0.20-0.22	7.4-8.4	<2	Low--------	0.28	5	4L	1-4
Penden	14-25	24-35	1.35-1.50	0.6-2.0	0.15-0.19	7.9-8.4	<2	Moderate	0.37			
	25-60	24-35	1.30-1.50	0.6-2.0	0.14-0.19	7.9-8.4	<2	Moderate	0.37			
Ph*:												
Penden------------	0-11	20-27	1.30-1.45	0.6-2.0	0.20-0.22	7.4-8.4	<2	Low--------	0.28	5	4L	1-4
	11-25	24-35	1.35-1.50	0.6-2.0	0.15-0.19	7.9-8.4	<2	Moderate	0.37			
	25-60	24-35	1.30-1.50	0.6-2.0	0.14-0.19	7.9-8.4	<2	Moderate	0.37			
Canlon------------	0-6	12-27	1.30-1.45	0.6-2.0	0.15-0.24	7.4-8.4	<2	Low--------	0.32	2	4L	---
	6-13	8-27	1.35-1.50	0.6-2.0	0.15-0.22	7.4-8.4	<2	Low--------	0.32			
	13											
Pm*:												
Penden------------	0-14	28-35	1.30-1.45	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	0.28	5	4L	1-4
	14-25	24-35	1.35-1.50	0.6-2.0	0.15-0.19	7.9-8.4	<2	Moderate	0.37			
	25-60	24-35	1.30-1.50	0.6-2.0	0.14-0.19	7.9-8.4	<2	Moderate	0.37			
Ulysses-----------	0-8	10-27	1.15-1.25	0.6-2.0	0.20-0.24	6.6-7.8	<2	Low--------	0.32	5	6	1-3
	8-13	21-32	1.20-1.35	0.6-2.0	0.18-0.22	7.4-8.4	<2	Moderate	0.43			
	13-60	18-27	1.25-1.35	0.6-2.0	0.18-0.22	7.9-8.4	<2	Low--------	0.43			
Ps----------------	0-5	27-40	1.10-1.30	0.2-0.6	0.19-0.21	6.6-7.3	<2	Moderate	0.24	3	7	2-5
Pleasant	5-50	35-45	1.10-1.30	<0.06	0.14-0.18	6.6-7.8	<2	High-------	0.24			
	50-60	20-27	1.10-1.30	0.6-2.0	0.18-0.20	7.4-8.4	<2	Low--------	0.24			
Rx----------------	0-16	18-27	1.30-1.45	0.6-2.0	0.22-0.24	6.6-8.4	<2	Low--------	0.32	5	4L	2-4
Roxbury	16-33	18-35	1.35-1.50	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	0.43			
	33-60	18-35	1.35-1.50	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	0.43			
Sm----------------	0-5	3-10	1.30-1.50	6.0-20	0.06-0.12	6.1-7.8	<2	Low--------	0.15	5	2	.5-1
Simeon	5-60	2-10	1.50-1.70	6.0-20	0.05-0.10	6.1-7.8	<2	Low--------	0.15			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH	Mmhos/cm					Pct
Uc---------------- Ulysses	0-10	10-27	1.15-1.25	0.6-2.0	0.20-0.24	6.6-7.8	<2	Low--------	0.32	5	6	1-3
	10-15	21-32	1.20-1.35	0.6-2.0	0.18-0.22	7.4-8.4	<2	Moderate	0.43			
	15-60	18-27	1.25-1.35	0.6-2.0	0.18-0.22	7.9-8.4	<2	Low--------	0.43			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "very brief," "apparent," and "perched" are explained in the text. The symbol > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Bd, Be-------------- Bridgeport	B	Rare---------	---	---	>6.0	---	---	>60	---	Moderate	Low-------	Low.
Ca------------------ Caruso	C	Occasional	Very brief	Apr-Sep	2.0-3.0	Apparent	Mar-Jun	>60	---	Moderate	High------	Moderate.
Cd------------------ Colby	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	Low-------	Low.
Ho------------------ Hord	B	Rare---------	---	---	>6.0	---	---	>60	---	Moderate	High------	Low.
In------------------ Inavale	A	Occasional	Very brief	Jan-Jul	>6.0	---	---	>60	---	Low-------	Moderate	Low.
Ke------------------ Keith	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
Ku------------------ Kuma	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	High------	Low.
Mu------------------ Munjor	B	Occasional	Very brief	Apr-Sep	>6.0	---	---	>60	---	Low-------	Moderate	Low.
Pe------------------ Penden	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	Moderate	Low.
Ph*:												
Penden------------	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	Moderate	Low.
Canlon------------	D	None---------	---	---	>6.0	---	---	10-20	Hard	Low-------	Low-------	Low.
Pm*:												
Penden------------	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	Moderate	Low.
Ulysses-----------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
Ps------------------ Pleasant	D	None---------	---	---	+2-0	Perched	Apr-Sep	>60	---	Low-------	High------	Low.
Rx------------------ Roxbury	B	Occasional	Very brief	Apr-Sep	>6.0	---	---	>60	---	Moderate	Low-------	Low.
Sm------------------ Simeon	A	None---------	---	---	>6.0	---	---	>60	---	Low-------	Low-------	Low.
Uc------------------ Ulysses	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--ENGINEERING INDEX TEST DATA

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution							Liquid limit	Plasticity index	Moisture density	
			Percentage passing sieve--				Percentage smaller than--						
	AASHTO	Unified	No. 4	No. 10	No. 40	No. 200	.02 mm	.005 mm	.002 mm			Moisture density	Optimum moisture
										Pct		Lb/ft3	Pct
Keith silt loam, 0 to 2 percent slopes: (S79KS 179-001)													
Ap------ 0 to 5	A-4	CL	100	100	100	95	47	18	10	31	9	100	15
Bt2----- 19 to 27	A-7	CL	100	100	100	96	58	25	15	41	19	100	16
C------- 42 to 60	A-4	CL	100	100	100	96	51	14	9	33	10	102	16

TABLE 18.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Bridgeport	Fine-silty, mixed, mesic Fluventic Haplustolls
Canlon	Loamy, mixed (calcareous), mesic Lithic Ustorthents
Caruso	Fine-loamy, mixed, mesic Fluvaquentic Haplustolls
Colby	Fine-silty, mixed (calcareous), mesic Ustic Torriorthents
Hord	Fine-silty, mixed, mesic Cumulic Haplustolls
Inavale	Sandy, mixed, mesic Typic Ustifluvents
Keith	Fine-silty, mixed, mesic Aridic Argiustolls
Kuma	Fine-silty, mixed, mesic Pachic Argiustolls
Munjor	Coarse-loamy, mixed (calcareous), mesic Typic Ustifluvents
Penden	Fine-loamy, mixed, mesic Typic Calciustolls
Pleasant	Fine, montmorillonitic, mesic Torrertic Argiustolls
Roxbury	Fine-silty, mixed, mesic Cumulic Haplustolls
Simeon	Mixed, mesic Typic Ustipsamments
Ulysses	Fine-silty, mixed, mesic Aridic Haplustolls

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