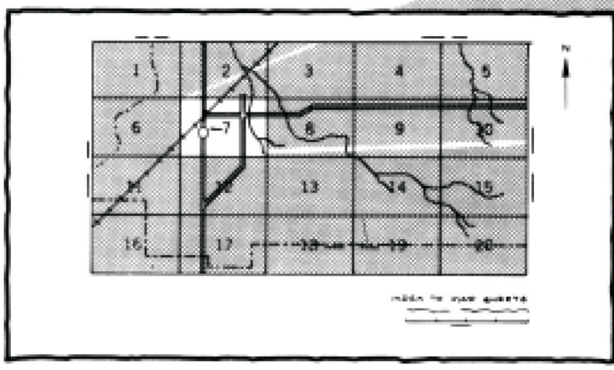
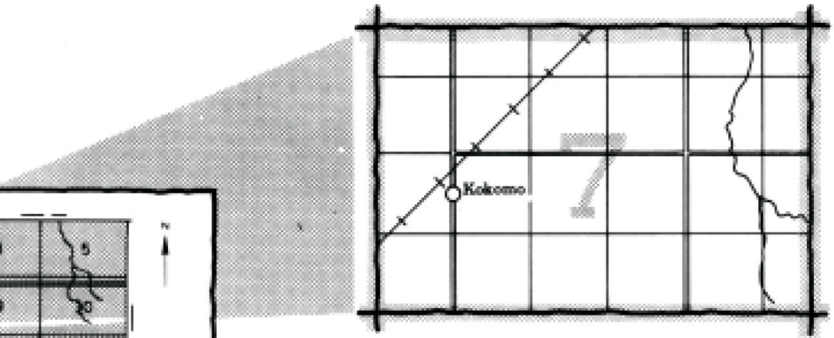
SOIL SURVEY OF
KINGMAN COUNTY, KANSAS

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

HOW TO USE

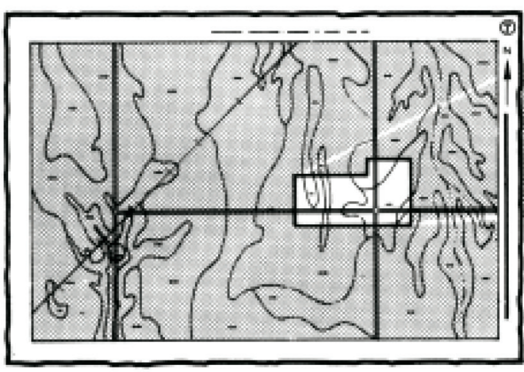
1. Locate your area of interest on the "Index to Map Sheets"

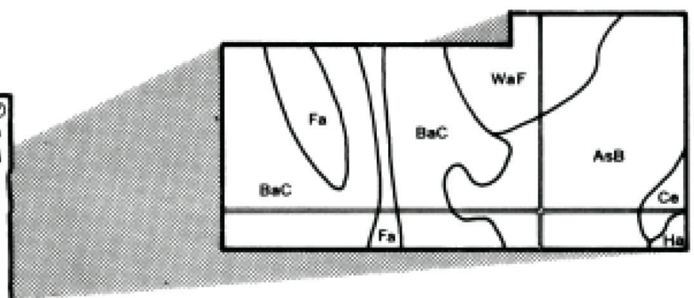




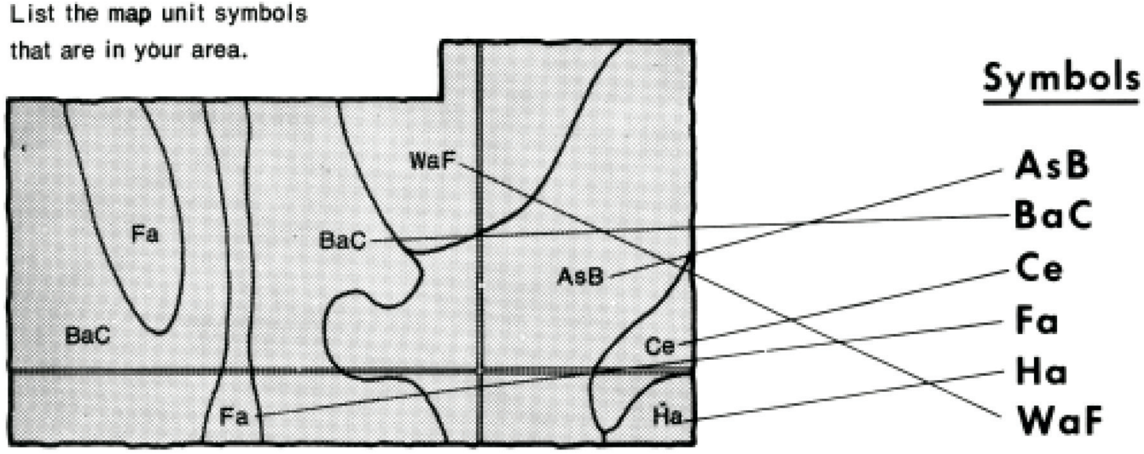
2. Note the number of the map sheet and turn to that sheet.

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



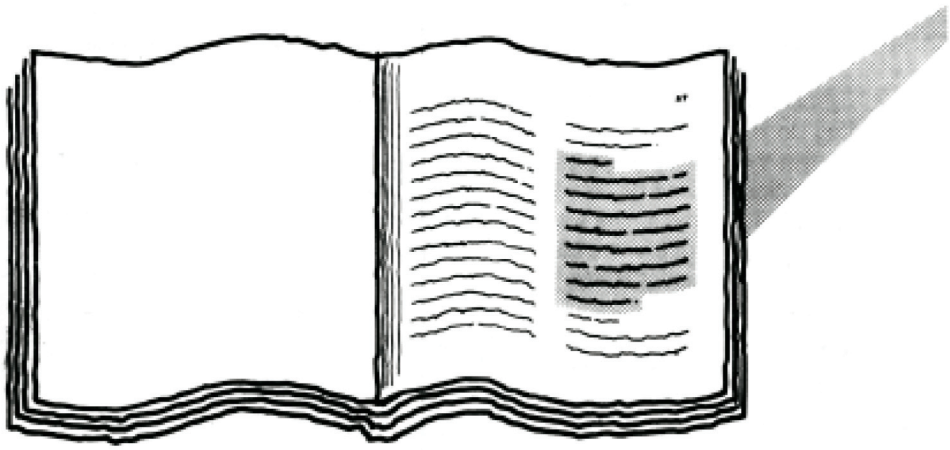


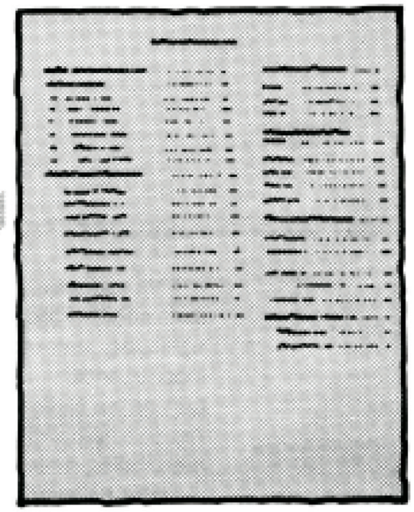
4. List the map unit symbols that are in your area.



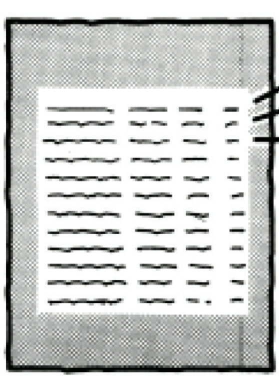
THIS SOIL SURVEY

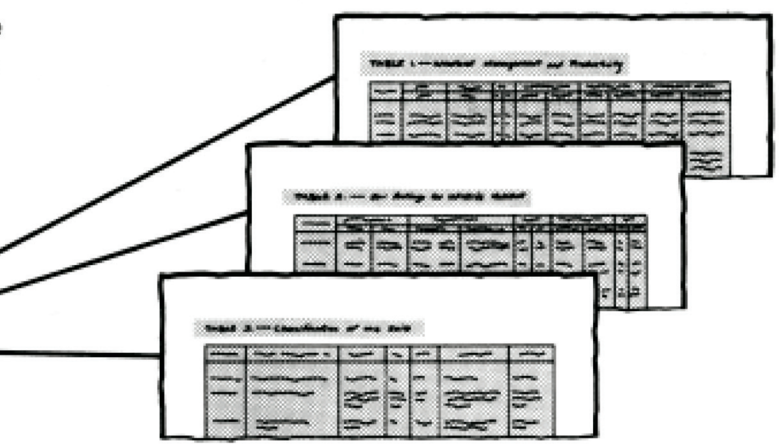
5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.





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; to specialists in wildlife management, waste disposal, or pollution control.

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

Major fieldwork for this soil survey was completed in the period 1970-1976. Soil names and descriptions were approved in 1977. Unless otherwise indicated, statements in the publication refer to conditions in the survey area in 1976. 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 Kingman County Conservation District.

Soil maps in this survey may be copied without permission, but any enlargement of these maps could cause misunderstanding of the detail of mapping and result in erroneous interpretations. Enlarged maps do not show small areas of contrasting soils that could have been shown at a larger mapping scale.

Cover: Contour farming on Farnum loam, 1 to 3 percent slopes.

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Issued May 1979

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Summary of tables

Foreword

The Soil Survey of Kingman County, Kansas, contains much information useful in any land planning program. Of prime importance are the predictions of soil behavior for selected land uses. Also highlighted are limitations or hazards to land uses that are inherent in the soil, improvements needed to overcome these limitations, and the impact that selected land uses will have on the environment.

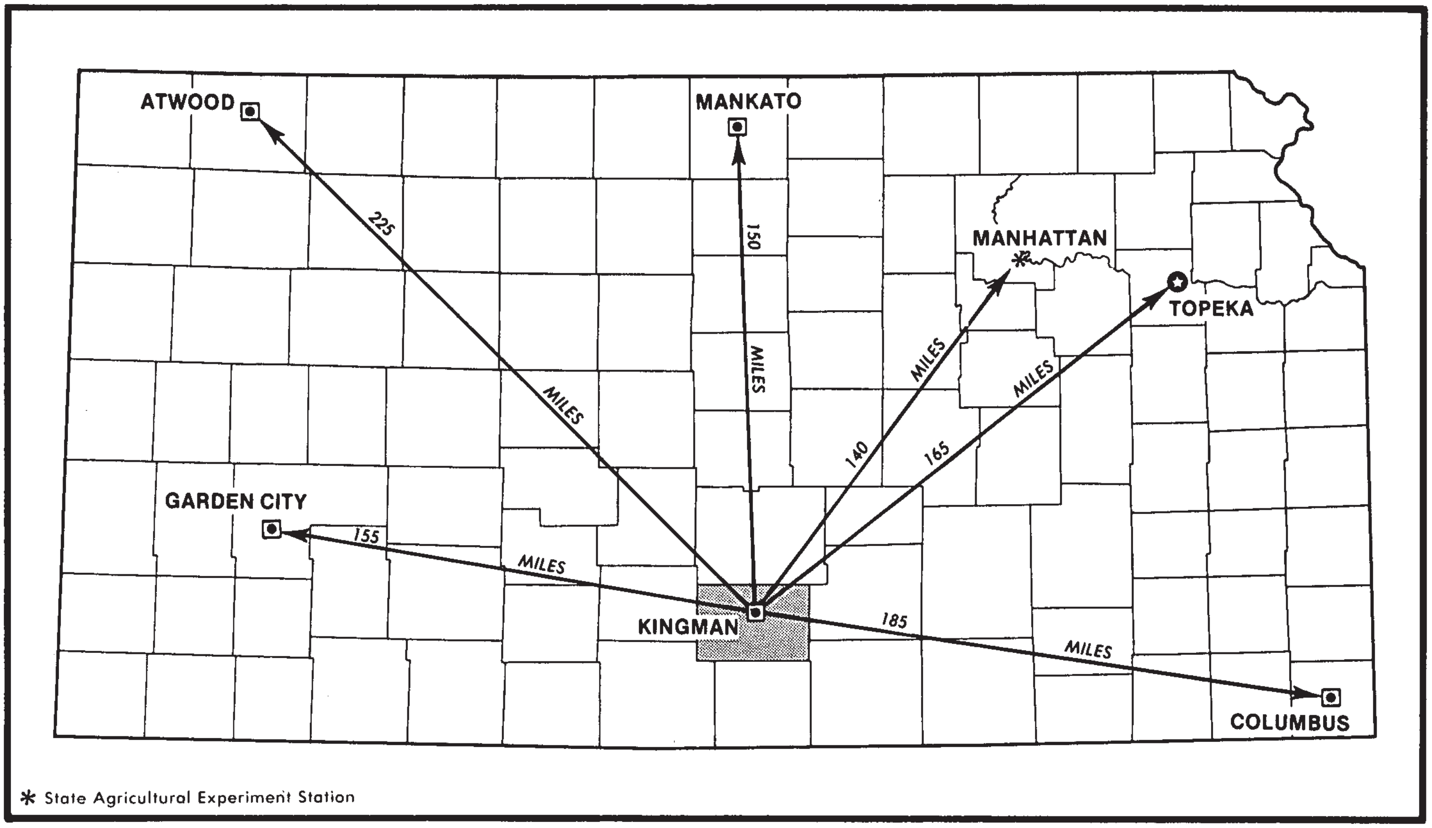
This soil survey has been prepared for many different users. Farmers, ranchers, foresters, and agronomists can use it to determine the potential of the soil and the management practices required for food and fiber production. Planners, community officials, engineers, developers, builders, and homebuyers can use it to plan land use, select sites for construction, develop soil resources, or identify any special practices that may be needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the soil survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur even within short distances. Soils may be seasonally wet or subject to flooding. They may be shallow to bedrock. They may be too unstable to be used as a foundation for buildings or roads. Very clayey or wet soils are poorly suited to 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 kind of soil is shown on detailed soil maps. Each kind of soil in the survey area is described, and much information is given about each soil for specific uses. Additional information or assistance in using this publication can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

This soil survey can be useful in the conservation, development, and productive use of soil, water, and other resources.

Robert K. Griffin
State Conservationist
Soil Conservation Service



Location of Kingman County in Kansas.

SOIL SURVEY OF KINGMAN COUNTY, KANSAS

By Bruce R. Hoffman and Stanley A. Glaum, Soil Conservation Service

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

Kingman County is in the south-central part of Kansas (see facing page). It has an area of 553,600 acres, or 864 square miles. In 1976, the population of Kingman County was 10,059. In Kingman, the county seat, the population was 3,905.

Kingman County was organized in 1874 from parts of Harper and Reno Counties. It lies within the Central Rolling Red Prairies resource area (*3*), which is characterized by a nearly level to gently rolling plain only slightly or moderately dissected (*5*). Drainage of the county is by the South Fork of Ninnescah River and the Chikaskia River. The soils generally are deep, loamy or clayey, and nearly level to strongly sloping. Elevation ranges from 1,340 to 1,840 feet above sea level.

Kingman County has a continental climate. Annual precipitation ranges from 22 to 34 inches.

The main enterprise in the county is farming. Wheat, grain sorghum, and alfalfa are the main crops.

General nature of the county

This section gives general information about the county. It discusses climate and natural resources.

Climate

Dr. L. Dean Bark, climatologist, Kansas Agricultural Experiment Station, helped prepare this section.

The climate of Kingman County is a typical continental type as would be expected from its location in the interior of a large land mass in the middle latitudes. Such climates are characterized by large daily and annual variations in temperature. Winters are cold because of the frequent air flows from the polar region. These cold air flows, however, only last from December through February. The warm temperature of summer lasts for about 6 months every year. The transition seasons of spring and fall are relatively short. The warm temperature provides a long growing season for crops in the county.

Kingman County is generally along the western edge of the moisture-laden air flow from the Gulf of Mexico. Shifts in this current produce a rather large range in the amount of precipitation received. Precipitation is heaviest from May through September. Most of the rainfall comes from late evening or nighttime thunderstorms. Precipitation in dry years is marginal for agricultural production, and even in wet years prolonged periods without rain produce stress in growing crops.

Tornadoes and severe thunderstorms occur occasionally in Kingman County. These storms are usually local in extent and of short duration so that risk is small. Hail occurs during the warmer part of the year, but again, it is infrequent and of local nature. Crop damage by hail is less in this part of the State than it is further west.

Table 1 gives data on temperature and precipitation for the survey area, as recorded at Kingman for 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 34.8 degrees F, and the average daily minimum temperature is 23.0 degrees. The lowest temperature on record, which occurred at Kingman on January 4, 1959, is -15 degrees. In summer the average temperature is 79.1 degrees, and the average daily maximum temperature is 91.9 degrees. The highest recorded temperature, which occurred on July 14, 1954, is 116 degrees.

Of the total annual precipitation, 20.20 inches, or 72 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 13.61 inches. The heaviest 1-day rainfall during the period of record was 5.25 inches at Kingman on September 5, 1951.

Average seasonal snowfall is 18.0 inches. The greatest snow depth at any one time during the period of record was 15 inches. On the average, 16 days have at least 1 inch of snow on the ground, but the number of such days varies greatly from year to year.

The percentage of possible sunshine is 76 in summer and 62 in winter. The prevailing wind is from the south. Average windspeed is highest, 15 miles per hour, in March and April.

Climatic data in this section were specially prepared for the Soil Conservation Service by the National Climatic Center, Asheville, North Carolina.

Natural resources

Soil is the most important natural resource in the county. Livestock that graze the rangeland and cash crops produced on farms are the main marketable products.

Salt deposits underlie all of Kingman County and range in thickness from about 250 feet in the eastern part of the county to 450 feet in the southwestern part. The salt beds are interstratified with thin beds of shale, anhydrite, and limestone, but many beds of minable thickness are present. Huge salt reserves are present, but salt is not being produced in the county (*4*).

Sand and gravel are obtained in Kingman County from Pleistocene deposits in the valleys of the South Fork of the Ninnescah River and the Chikaskia River. Extensive deposits of sand and gravel are also available in the uplands in much of the county.

How this survey was made

Soil scientists made this survey to learn what kinds of soil are in the survey area, where they are, and how they can be used. The soil scientists went into the area knowing they likely would locate many soils they already knew something about and perhaps identify some they had never seen before. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; the kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material, which has been changed very little by leaching or by the action of plant roots.

The soil scientists recorded the characteristics of the profiles they studied, and they compared those profiles with others in counties nearby and in places more distant. Thus, through correlation, they classified and named the soils according to nationwide, uniform procedures.

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

The areas shown on a soil map are called soil map units. Some map units are made up of one kind of soil, others are made up of two or more kinds of soil, and a few have little or no soil material at all. Map units are discussed in the sections "General soil map for broad land use planning" and "Soil maps for detailed planning."

While a soil survey is in progress, samples of soils are taken as needed for laboratory measurements and for engineering tests. The soils are field tested, and interpretations of their behavior are modified as necessary during the course of the survey. New interpretations are added to meet local needs, mainly through field observations of different kinds of soil in different uses under different levels of management. Also, data are assembled from other sources, such as test results, records, field experience, and information available from state and local specialists. For example, data on crop yields under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it is readily available to different groups of users, among them farmers, managers of rangeland, engineers, planners, developers and builders, homebuyers, and those seeking recreation.

General soil map for broad land use planning

The general soil map at the back of this publication shows, in color, map units that have a distinct pattern of soils and of relief and drainage. Each map unit is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map provides a broad perspective of the soils and landscapes in the survey area. It provides a basis for comparing the potential of large areas for general kinds of land use. Areas that are, for the most part, suited to certain kinds of farming or to other land uses can be identified on the map. Likewise, areas of soils having properties that are distinctly unfavorable for certain land uses can be located.

Because of its small scale, the map does not show the kind of soil at a specific site. Thus, it 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 kinds of soil in any one map unit differ from place to place in slope, depth, stoniness, drainage, or other characteristics that affect their management.

1. Farnum-Shellabarger

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

This map unit consists of broad ridges and side slopes. The side slopes and ridges generally are smooth. The ridges are uniform in elevation.

This map unit occupies about 43 percent of the county. It is about 40 percent Farnum, 20 percent Shellabarger, and 40 percent minor soils (fig. 1).

Farnum soils generally are on the ridges, and Shellabarger soils are on the side slopes. Farnum soils have a loam or sandy loam surface layer and a clay loam, loam, or sandy clay loam subsoil. Shellabarger soils have a loamy sand or sandy loam surface layer and a sandy clay loam or sandy loam subsoil.

The minor soils in this unit are the well drained Blanket soils on nearly level ridges; the well drained Albion, Clark, and Renfrow soils on lower side slopes; the somewhat poorly drained Carwile soils in depressional areas; and the well drained Kaski soils on flood plains.

Nearly all the acreage is used for crops. Wheat is the main crop; some sorghum and alfalfa are grown. Many small areas are rangeland. Controlling erosion and maintaining soil tilth and fertility are concerns in managing these soils.

When erosion is controlled, this map unit has good potential for crops, rangeland, and most engineering uses.

2. Albion-Shellabarger

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

This map unit consists of broad ridges and side slopes. The side slopes and ridges generally are smooth.

This map unit occupies about 22 percent of the county. It is about 55 percent Albion, 40 percent Shellabarger, and 5 percent minor soils (fig. 2).

Albion soils are on the side slopes, and Shellabarger soils are on the ridges. Albion soils have a sandy loam surface layer and subsoil. They are moderately deep over sand or sand and gravel. Shellabarger soils have a sandy loam or loamy sand surface layer and a sandy clay loam or sandy loam subsoil.

The minor soils in this unit are the well drained Farnum soils on ridges and the somewhat excessively drained Lincoln soils, somewhat poorly drained Dillwyn soils, and poorly drained Plevna soils on flood plains.

About half of the acreage is used for crops, and the rest is rangeland. Wheat is the main crop; some sorghum and alfalfa are grown. Controlling erosion and soil blowing and proper range management are concerns on these soils.

This map unit has fair potential for crops. It has good potential for rangeland and most engineering uses.

3. Blanket-Clark-Farnum

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

This map unit consists of broad ridges and side slopes. The side slopes and ridges generally are smooth. The ridges are uniform in elevation.

This map unit occupies about 8 percent of the county. It is about 35 percent Blanket, 35 percent Clark, 15 percent Farnum, and 15 percent minor soils (fig. 3).

Blanket soils generally are on the ridges; Clark and Farnum soils are on side slopes. Blanket soils have a silt loam or silty clay loam surface layer and a silty clay loam or silty clay subsoil. Clark soils are clay loam throughout and are calcareous. Farnum soils have a loam surface layer and a clay loam, loam, or sandy clay loam subsoil.

The minor soils in this unit are the well drained Case and Pond Creek soils on side slopes.

Most of the acreage is used for crops. Wheat is the main crop; some sorghum and alfalfa are grown. Many small areas are rangeland. Controlling erosion and maintaining tilth and fertility are concerns in managing these soils.

This map unit has good potential for crops and rangeland. It has fair potential for most engineering uses.

4. Pratt-Carwile

Deep, nearly level to rolling, well drained and somewhat poorly drained soils that have a sandy, loamy, and clayey subsoil; on uplands

This map unit consists of nearly level to rolling areas. The slopes are complex.

This map unit occupies about 5 percent of the county. It is about 40 percent Pratt, 25 percent Carwile, and 35 percent minor soils (fig. 4).

The undulating or rolling Pratt soils are on ridges. The Carwile soils are nearly level or are in depressional areas. Pratt soils have a loamy fine sand surface layer and subsoil and are well drained. Carwile soils have a fine sandy loam surface layer and a clay, clay loam, or sandy clay loam subsoil. They are somewhat poorly drained.

The minor soils in this unit are the well drained, nearly level Farnum soils and the excessively drained, rolling or hilly Tivoli soils on ridges.

About half of this unit is used for crops. Wheat is the main crop; some sorghum and alfalfa are grown. Large areas in the southwestern and southeastern parts of the county are rangeland. Controlling soil blowing is the main concern in managing these soils.

This map unit has fair potential for crops and most engineering uses. It has good potential for rangeland.

5. Quinlan-Nashville

Shallow and moderately deep, gently sloping to strongly sloping, well drained soils that have a loamy subsoil; on uplands

This map unit consists of ridges and side slopes. Slopes are smooth.

This map unit occupies about 7 percent of the county. It is about 45 percent Quinlan, 45 percent Nashville, and 10 percent minor soils (fig. 5).

Quinlan soils are on side slopes. Nashville soils are on ridges and side slopes. Quinlan soils have a loam surface layer and subsoil and are shallow to bedrock. Nashville soils have a silt loam surface layer and subsoil and are moderately deep to bedrock.

The minor soils in this unit are the well drained Pond Creek and Shellabarger soils on ridges.

About half of this unit is used for crops, and about half is rangeland. Wheat is the main crop; some sorghum and alfalfa are grown. Controlling erosion is the main concern in managing these soils.

This map unit has fair potential for crops and most engineering uses. It has good potential for rangeland.

6. Renfrow-Owens

Deep and shallow, gently sloping, well drained soils that have a dominantly clayey subsoil; on uplands

This map unit consists of ridges and side slopes. The side slopes and ridges generally are smooth. The ridges are gently sloping.

This map unit occupies about 6 percent of the county. It is about 50 percent Renfrow, 15 percent Owens, and 35 percent minor soils (fig. 6).

Renfrow soils are on the ridges and side slopes, and Owens soils are on side slopes. Renfrow soils have a clay loam surface layer and a clay or clay loam subsoil. They are deep to bedrock. Owens soils have a clay loam surface layer and a clay subsoil. They are shallow to bedrock.

The minor soils in this unit are the well drained Ruella, Shellabarger, and Farnum soils on ridges and the well drained Kaski soils on flood plains.

Nearly all the acreage is used for crops. Wheat is the main crop. Many small areas are rangeland. Controlling erosion and maintaining soil tilth are concerns in managing these soils.

This map unit has fair potential for crops and rangeland. It has poor potential for most engineering uses.

7. Waldeck-Dillwyn-Plevna

Deep, nearly level, somewhat poorly drained and poorly drained soils that have a loamy and sandy subsoil; on flood plains and low terraces

This map unit consists of long, narrow areas along the major streams.

This map unit occupies about 9 percent of the county. It is about 25 percent Waldeck, 15 percent Dillwyn, 15 percent Plevna, and 45 percent minor soils (fig. 7).

Waldeck soils are on low terraces or higher areas of the flood plains. Dillwyn and Plevna soils are on lower areas of flood plains. Waldeck soils have a fine sandy loam surface layer and subsoil and are somewhat poorly drained. Dillwyn soils are loamy fine sand throughout and are somewhat poorly drained. Plevna soils have a fine sandy loam surface layer and subsoil and are poorly drained.

The minor soils in this unit are the well drained Canadian soils on terraces; the well drained Kaski soils on flood plains; the somewhat poorly drained Zenda soils on low terraces; the somewhat excessively drained Lincoln soils on flood plains; the well drained, undulating or rolling Pratt soils on ridges; and the excessively drained, rolling or hilly Tivoli soils on ridges.

Most of this unit is used for rangeland. Some of the better drained soils are used for crops. Wheat, sorghum, and alfalfa are grown. Excess wetness and flooding are the main concerns in managing these soils.

This map unit has poor potential for crops and most engineering uses. It has good potential for rangeland.

Soil maps for detailed planning

The map units shown on the detailed soil maps at the back of this publication represent the kinds of soil in the survey area. They are described in this section. The descriptions together with the soil maps can be useful in determining the potential of a soil and in managing it for food and fiber production; in planning land use and developing soil resources; and in enhancing, protecting, and preserving the environment. More information for each map unit, or soil, is given in the section "Use and management of the soils."

Preceding the name of each map unit is the symbol that identifies the soil on the detailed soil maps. Each soil description includes general facts about the soil and a brief description of the soil profile. In each description, the principal hazards and limitations are indicated, and the management concerns and practices needed are discussed.

The map units on the detailed soil maps represent an area on the landscape made up mostly of the soil or soils for which the unit is named. Most of the delineations shown on the detailed soil map are phases of soil series.

Soils that have profiles that are almost alike make up a *soil series*. Except for allowable differences in texture of the surface layer or of the underlying substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement in the profile. A soil series commonly is named for a town or geographic feature near the place where a soil of that series was first observed and mapped. The Pratt series, for example, was named for the town of Pratt in Pratt County.

Soils of one series can differ in texture of the surface layer or in the underlying substratum and in slope, erosion, stoniness, salinity, wetness, or other characteristics that affect their use. On the basis of such differences, a soil series is divided into phases. The name of a *soil phase* commonly indicates a feature that affects use or management. For example, Farnum loam, 1 to 3 percent slopes, is one of several phases within the Farnum series.

Some map units are made up of two or more dominant kinds of soil. Such map units are called soil complexes.

A *soil complex* consists of areas of two or more soils that are so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area includes some of each of the two or more dominant soils, and the pattern and proportion are somewhat similar in all areas. Dillwyn-Plevna complex is an example

Most map units include small, scattered areas of soils other than those that appear in the name of the map unit. Some of these soils have properties that differ substantially from those of the dominant soil or soils and thus could significantly affect use and management of the map unit. These soils are described in the description of each map unit. Some of the more unusual or strongly contrasting soils that are included are identified by a special symbol on the soil map.

Some mapped areas include places that have little or no soil material and support little or no vegetation. Such places are called *miscellaneous areas*; they are delineated on the soil map and given descriptive names. Rock outcrop is an example.

The acreage and proportionate extent of each map unit are given in table 4, and additional information on properties, limitations, capabilities, and potentials for many soil uses is given for each kind of soil in other tables in this survey. (See "Summary of tables.") Many of the terms used in describing soils are defined in the Glossary.

Aa—Albion sandy loam, 0 to 1 percent slopes. This is a deep, nearly level, well drained soil on uplands. It occurs on ridgetops. Depth to sand or gravel ranges from 20 to 40 inches. Individual areas range from 10 to 300 acres.

Typically, the surface layer is grayish brown sandy loam about 8 inches thick. The subsoil is friable sandy loam about 20 inches thick. The upper part is grayish brown, the middle part is brown, and the lower part is light yellowish brown. The substratum, to a depth of about 60 inches, is light yellowish brown sand. In some places, the subsoil is sandy clay loam and the depth to sand is more than 40 inches.

The surface layer is friable, and tilth is good. Permeability is moderately rapid. Available water capacity and fertility are low. Runoff is slow, and most precipitation soaks into the soil. Shrink-swell potential is low. Reaction is medium acid or slightly acid in the surface layer and slightly acid to moderately alkaline in the subsoil.

Nearly all areas of this soil have been used for crops, but some areas have been reseeded to native grass. Potential is fair for crops, windbreaks, openland wildlife habitat, and rangeland wildlife habitat. It is good for rangeland and most engineering uses.

This soil is moderately well suited to growing wheat and grain sorghum. Small grains are better suited than grain sorghum or alfalfa. If the soil is used for cultivated crops, soil blowing is a hazard. Returning crop residue to the soil and stripcropping help control soil blowing.

The soil is well suited to growing native grasses for range. The use of this soil for rangeland is also effective in controlling soil blowing. Proper stocking rates, uniform grazing distribution, and a planned grazing system help keep the range in good condition and provide enough cover to prevent soil blowing.

This soil is moderately well suited to trees grown as windbreaks and environmental plantings. Planting suitable species and preparing the site to control competing vegetation are necessary for success.

This soil is well suited to dwellings, septic tank absorption fields, and local roads and streets. It has a severe limitation for sewage lagoons because of seepage. Sealing the lagoon reduces seepage. This soil is in capability subclass IIIs.

Ab—Albion sandy loam, 1 to 3 percent slopes. This is a deep, gently sloping, well drained soil on uplands. It occurs primarily on convex side slopes. Depth to sand or gravel ranges from 20 to 40 inches. Individual areas range from 10 acres to several hundred acres.

Typically, the surface layer is grayish brown sandy loam about 8 inches thick. The subsoil is friable sandy loam about 18 inches thick. The upper part is grayish brown, the middle part is brown, and the lower part is light yellowish brown. The substratum, to a depth of about 60 inches, is light yellowish brown sand. In some places, the subsoil is sandy clay loam and the depth to sand is more than 40 inches.

Included with this soil in mapping are small areas of Farnum and Clark soils. The Farnum soils have a more clayey subsoil and occupy higher slopes than the Albion soil. The calcareous Clark soils occupy convex knobs. These soils make up about 6 percent of the map unit.

The surface layer is friable, and tilth is good. Permeability is moderately rapid. Runoff is slow. Available water capacity, fertility, and shrink-swell potential are low. Reaction is medium acid or slightly acid in the surface layer and slightly acid to moderately alkaline in the subsoil.

This soil is mostly cultivated to wheat and sorghum. Potential is fair for crops, windbreaks, openland wildlife habitat, and rangeland wildlife habitat. It is good for rangeland and most engineering uses.

This soil is moderately well suited to growing wheat and grain sorghum. Small grains are better suited than grain sorghum or alfalfa. If the soil is used for cultivated crops, erosion and soil blowing are hazards. Terracing, contour farming, and returning crop residue to the soil help control erosion and soil blowing.

The soil is well suited to growing native grasses for range. The use of this soil for rangeland is also effective in controlling erosion. Proper stocking rates, uniform grazing distribution, and a planned grazing system help keep the range in good condition and provide enough cover to prevent erosion and soil blowing.

This soil is moderately well suited to trees grown as windbreaks and environmental plantings. Planting suitable species and preparing the site to control competing vegetation are necessary for success.

This soil is well suited to dwellings, septic tank absorption fields, and local roads and streets. It has a severe limitation for sewage lagoons because of seepage. Sealing the lagoon reduces seepage. This soil is in capability subclass IIIe.

Ac—Albion sandy loam, 3 to 6 percent slopes. This is a deep, sloping, well drained soil on uplands. It occurs primarily on convex side slopes. Depth to sand or gravel ranges from 20 to 40 inches. Individual areas range from 10 acres to several hundred acres.

Typically, the surface layer is grayish brown sandy loam about 8 inches thick. The subsoil is friable sandy loam about 16 inches thick. The upper part is grayish brown, the middle part is brown, and the lower part is light yellowish brown. The substratum, to a depth of about 60 inches, is light yellowish brown sand. In some places, the subsoil is sandy clay loam and the depth to sand is more than 40 inches.

Included with this soil in mapping are small areas of calcareous Clark soils on convex knobs. Clark soils make up about 5 percent of the map unit.

The surface layer is friable, and tilth is good. Permeability is moderately rapid. Runoff is medium. Available water capacity, fertility, and shrink-swell potential are low. Reaction is medium acid or slightly acid in the surface layer and slightly acid to moderately alkaline in the subsoil.

About half of this soil is cultivated to wheat and sorghum, and half is rangeland. Some areas have been reseeded to grass. Potential is fair for crops, windbreaks, openland wildlife habitat, and rangeland wildlife habitat. Potential is good for rangeland and most engineering uses.

This soil is moderately well suited to growing wheat and grain sorghum. Small grains are better suited than grain sorghum or alfalfa. If the soil is used for cultivated crops, erosion and soil blowing are hazards. Terracing, contour farming, and returning crop residue to the soil help control erosion and soil blowing.

The soil is well suited to growing native grasses for range. The use of this soil for rangeland is also effective in controlling erosion. Proper stocking rates, uniform grazing distribution, and a planned grazing system help keep the range in good condition and provide enough cover to prevent erosion and soil blowing.

This soil is moderately well suited to trees grown as windbreaks and environmental plantings. Planting suitable species and preparing the site to control competing vegetation are necessary for success.

This soil is well suited to dwellings, septic tank absorption fields, and local roads and streets. It has a severe limitation for sewage lagoons because of seepage. Sealing the lagoon reduces seepage. This soil is in capability subclass IVe.

Ad—Albion sandy loam, 6 to 15 percent slopes. This is a deep, strongly sloping, well drained soil on uplands. Depth to sand or gravel ranges from 20 to 40 inches. Individual areas range from 10 acres to a few thousand acres.

Typically, the surface layer is grayish brown sandy loam about 7 inches thick. The subsoil is friable sandy loam about 14 inches thick. The upper part is brown, and the lower part is light yellowish brown. The substratum, to a depth of about 60 inches, is light yellowish brown sand. In about 25 percent of the area, the subsoil is sandy clay loam that has a depth to sand of more than 40 inches. These areas are on ridgetops.

Included with this soil in mapping are about 10 percent Farnum soils, 10 percent Clark soils, and 5 percent Lincoln soils. Farnum soils have a more clayey subsoil and are on ridges. The calcareous Clark soils occur on side slopes and comprise about one-half of some areas. The somewhat excessively drained Lincoln soils are along intermittent drainageways.

Permeability is moderately rapid. Runoff is medium. Available water capacity, fertility, and shrink-swell potential are low. Reaction is medium acid or slightly acid in the surface layer and slightly acid to moderately alkaline in the subsoil.

Nearly all of this soil is rangeland. Potential is poor for crops and good for rangeland. Potential is fair for windbreaks, openland wildlife habitat, rangeland wildlife habitat, and most engineering uses.

This soil is best suited to rangeland. Major concerns in range management are erosion and low available water capacity. Adequate vegetative cover must be maintained to prevent erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the plant community. Under these conditions the taller, more desirable grasses are replaced by less productive short grasses or by weeds. Proper stocking rates, uniform grazing distribution, and a planned grazing system help keep the range and soil in good condition. Potential pond reservoir sites are limited because of seepage.

This soil is moderately well suited to trees grown as windbreaks and environmental plantings. Planting suitable species, preparing the site, and controlling erosion are necessary for success.

This soil has a moderate limitation for dwellings, septic tank absorption fields, and local roads and streets because of the slope. It has a severe limitation for sewage lagoons because of seepage and slope. This soil is in capability subclass VIe.

Ba—Blanket silt loam, 0 to 1 percent slopes. This is a deep, nearly level, well drained soil on uplands. It occurs on ridgetops. Individual areas range from 20 acres to a few hundred acres.

Typically, the surface layer is dark grayish brown silt loam about 14 inches thick. The subsoil is about 42 inches thick. The upper part is dark grayish brown, firm silty clay loam; the middle part is dark grayish brown, very firm silty clay; and the lower part is grayish brown, very firm, calcareous silty clay. The substratum, to a depth of about 60 inches, is pale brown, calcareous silty clay loam. In some places, the subsoil contains less clay.

Included with this soil in mapping are small areas of moderately well drained soils that have a clay loam surface layer and very slow permeability. These areas are concave. They make up about 5 percent of the map unit.

The surface layer is friable, and tilth is good. Permeability is moderately slow. Runoff is slow. Available water capacity is high, and natural fertility is medium. Shrink-swell potential is moderate. Reaction is slightly acid or neutral in the surface layer and slightly acid to moderately alkaline in the subsoil.

This soil is almost entirely cultivated to wheat, sorghum, and alfalfa. Potential is good for crops, rangeland, windbreaks, and openland wildlife habitat. Potential is fair for most engineering uses.

This soil is well suited to growing small grains, grain sorghum, and alfalfa. Minimum tillage and returning crop residue to the soil improve fertility and conserve moisture.

This soil is well suited to rangeland. Overgrazing or grazing when the soil is wet causes soil compaction and poor tilth. Proper stocking rates, uniform grazing distribution, a planned grazing system, and restricted use during wet periods help keep the range and soil in good condition.

This soil is well suited to trees grown as windbreaks and environmental plantings. Planting suitable species and preparing the site to control competing vegetation are necessary for success.

This soil has a moderate limitation for dwellings because of the shrink-swell potential. Using properly designed and reinforced foundations, installing foundation drains, and backfilling with porous material help prevent structural damage caused by shrinking and swelling of the soil. This soil has a severe limitation for local roads and streets because of low strength. The limitation can be lessened by strengthening or replacing the base material. This soil has a severe limitation for septic tank absorption fields because of moderately slow permeability. Increasing the size of the absorption field helps improve the function of the septic tank system. This soil is well suited to sewage lagoons. It is in capability subclass IIc.

Bb—Blanket silt loam, 1 to 3 percent slopes. This is a deep, gently sloping, well drained soil on uplands. It is on ridges and side slopes. Individual areas range from 10 acres to a few hundred acres.

Typically, the surface layer is dark grayish brown silt loam about 12 inches thick. The subsoil is about 38 inches thick. The upper part is dark grayish brown, firm silty clay loam; the middle part is dark grayish brown, very firm silty clay; and the lower part is grayish brown, very firm, calcareous silty clay. The substratum, to a depth of about 60 inches, is pale brown, calcareous silty clay loam. In some places, depth to calcareous material is shallower and the subsoil contains less clay.

The surface layer is friable, and tilth is good. Permeability is moderately slow. Runoff is medium. Available water capacity is high. Natural fertility is medium. Shrink-swell potential is moderate. Reaction is slightly acid to neutral in the surface layer and slightly acid to moderately alkaline in the subsoil.

This soil is almost entirely cultivated to wheat, sorghum, and alfalfa. Potential is good for crops, rangeland, windbreaks, and openland wildlife habitat. It is fair for most engineering uses.

This soil is well suited to small grains, grain sorghum, and alfalfa. If the soil is used for cultivated crops, erosion is a hazard. Terracing, contour farming, and returning crop residue to the soil help control erosion and conserve moisture.

The use of this soil for rangeland is also effective in controlling erosion. Overgrazing or grazing when the soil is wet causes soil compaction and poor tilth. Proper stocking rates, uniform grazing distribution, a planned grazing system, and restricted use during wet periods help keep the range and soil in good condition.

This soil is well suited to trees grown as windbreaks and environmental plantings. Planting suitable species and preparing the site to control competing vegetation are necessary for success.

This soil has a moderate limitation for dwellings because of the shrink-swell potential. Using properly designed and reinforced foundations, installing foundation drains, and backfilling with porous material help prevent structural damage caused by shrinking and swelling of the soil. This soil has a severe limitation for local roads and streets because of low strength. This limitation can be lessened by strengthening or replacing the base material. This soil has a severe limitation for septic tank absorption fields because of the moderately slow permeability. Increasing the size of the absorption field helps improve the function of the septic tank system. This soil has a moderate limitation for sewage lagoons because of slope. It is in capability subclass IIe.

Bc—Blanket silty clay loam, 1 to 4 percent slopes, eroded. This is a deep, gently sloping, well drained soil on uplands. It is on side slopes. Individual areas range from 5 to 100 acres in size.

Typically, the surface layer is dark grayish brown silty clay loam about 5 inches thick. It is as thick as the plowing depth. It includes material that was formerly part of the subsoil. The subsoil is very firm silty clay about 35 inches thick. The upper part is dark grayish brown. The lower part is grayish brown and calcareous. The substratum, to a depth of about 60 inches, is pale brown, calcareous silty clay loam. In some places, the surface layer is silt loam.

Included with this soil in mapping are small areas of Clark soils. The calcareous Clark soils are less clayey and occur in convex areas. They make up about 5 percent of the map unit.

The surface layer is firm, and tilth is fair. Permeability is moderately slow. Runoff is medium. Available water capacity is high. Natural fertility is medium. Shrink-swell potential is moderate. Reaction is slightly acid to neutral in the surface layer and slightly acid to moderately alkaline in the subsoil.

This soil is cultivated to wheat, sorghum, and alfalfa. Potential is fair for cropland, openland wildlife habitat, rangeland wildlife habitat, and most engineering uses. Potential is good for rangeland and windbreaks.

This soil is moderately well suited to small grains, sorghum, and legumes. If the soil is used for cultivated crops, further erosion damage is a hazard. Terracing, contour farming, using minimum tillage, and returning crop residue to the soil help control erosion, conserve moisture, and improve tilth.

The use of this soil for rangeland is also effective in controlling erosion. Overgrazing or grazing when the soil is wet causes soil compaction and poor tilth. Proper stocking rates, uniform grazing distribution, a planned grazing system, and restricted use during wet periods help to keep the range and soil in good condition.

This soil is well suited to trees grown as windbreaks and environmental plantings. Planting suitable species and preparing the site to control competing vegetation are necessary for success.

This soil has a moderate limitation for dwellings because of the shrink-swell potential. Using properly designed and reinforced foundations, installing foundation drains, and backfilling with porous material help prevent structural damage caused by shrinking and swelling of the soil. This soil has a severe limitation for local roads and streets because of low strength. This limitation can be lessened by strengthening or replacing the base material. This soil has a severe limitation for septic tank absorption fields because of the moderately slow permeability. Increasing the size of the absorption field helps improve the function of the septic tank system. This soil has a moderate limitation for sewage lagoons because of the slope. It is in capability subclass IIIe.

Ca—Canadian fine sandy loam. This is a deep, nearly level, well drained soil on low terraces. It is rarely flooded. Individual areas range from 5 to 200 acres.

Typically, the surface layer is dark grayish brown fine sandy loam about 16 inches thick. The subsoil is very friable, brown fine sandy loam about 16 inches thick. The substratum, to a depth of about 60 inches, is brown fine sandy loam. In some places, the subsoil is reddish brown, yellowish red, or red.

Included with this soil in mapping are small areas of Kaski, Waldeck, and Lincoln soils. The well drained Kaski soils are occasionally flooded. The Waldeck soils are somewhat poorly drained and are in slightly concave areas. The somewhat excessively drained Lincoln soils are occasionally flooded. These included soils make up 20 percent of the map unit.

The surface layer is very friable, and tilth is good. Permeability is moderately rapid. Runoff is slow. Available water capacity is moderate. Natural fertility is medium. Shrink-swell potential is low. Reaction is slightly acid or neutral in the surface layer and subsoil and slightly acid to mildly alkaline in the substratum.

This soil is cultivated to wheat, sorghum, and alfalfa. Potential is good for crops, rangeland, windbreaks, openland wildlife habitat, and rangeland wildlife habitat. Potential is poor for most engineering uses.

This soil is well suited to small grains, sorghum, and legumes. If it is used for cultivated crops, soil blowing is a hazard. Returning crop residue to the soil, stripcropping, and minimum tillage help control soil blowing and conserve moisture.

The use of this soil for rangeland is also effective in controlling soil blowing. Proper stocking rates, uniform grazing distribution, and a planned grazing system help keep the range in good condition.

This soil is well suited to trees grown as windbreaks and environmental plantings. Planting suitable species and preparing the site to control competing vegetation are necessary for success.

This soil has a severe limitation for dwellings and sewage lagoons and a moderate limitation for septic tank absorption fields and local roads and streets because of the hazard of flooding. Protection from flooding by dikes or levees or other structures lessens this hazard. This soil has a severe limitation for sewage lagoons because of seepage. Sealing the lagoon reduces seepage. This soil is in capability subclass IIe.

Cb—Carwile fine sandy loam. This is a deep, nearly level, somewhat poorly drained soil on uplands. It occurs on smooth or in slightly concave areas. Individual areas range from 5 to 500 acres.

Typically, the surface layer is grayish brown fine sandy loam about 10 inches thick. The subsoil is about 35 inches thick. The upper part is very dark grayish brown, friable clay loam that has a few faint mottles. The middle part is light brownish gray, mottled, very firm clay. The lower part is mottled light brownish gray and strong brown, firm sandy clay loam. The substratum, to a depth of about 60 inches, is strong brown, mottled sandy clay loam. In some places, the surface layer is loamy fine sand.

Included with this soil in mapping are small areas of Pratt and Farnum soils. The well drained, sandy Pratt soils are in convex areas. The well drained Farnum soils have a less clayey subsoil and are nearly level and convex. These soils make up about 20 percent of the map unit.

The surface layer is very friable, and tilth is good. Permeability is slow. Runoff is slow or the soil is ponded. Available water capacity is high. Natural fertility is medium. Shrink-swell potential is high. Reaction is slightly acid or neutral in the surface layer and subsoil and moderately alkaline in the substratum.

This soil is mostly cultivated to wheat and sorghum. Some areas are rangeland. Potential is good for crops, rangeland, openland wildlife habitat, and rangeland wildlife habitat. It is fair for windbreaks and poor for most engineering uses.

This soil is well suited to small grains and sorghum. It is less suited to alfalfa because of wetness. If the soil is used for cultivated crops, excess wetness is a hazard During wet weather, the soil is ponded. Installing ditches improves surface drainage. Soil blowing is also a hazard. Returning crop residue to the soil, stripcropping, and minimum tillage help control soil blowing and increase water infiltration.

This soil is well suited to rangeland. Overgrazing or grazing when the soil is too wet causes soil compaction and poor tilth. Proper stocking rates, uniform grazing distribution, a planned grazing system, and restricted use during wet periods help keep the range and soil in good condition.

This soil is moderately well suited to trees grown as windbreaks and environmental plantings. The clayey subsoil releases moisture slowly to tree roots. Planting suitable species, preparing the site to control competing vegetation, and providing adequate drainage are necessary for success.

This soil is poorly suited to dwellings, septic tank absorption fields, and local roads and streets because of wetness and the high shrink-swell potential. These limitations are difficult to overcome. This soil is well suited to sewage lagoons. Onsite investigation is essential to evaluate and plan the development of specific sites. This soil is in capability subclass IIw.

Cc—Case-Clark clay loams, 2 to 6 percent slopes. This map unit consists of deep, sloping, well drained soils on uplands (fig. 8). These soils are on side slopes. This unit is 50 to 60 percent Case clay loam and 30 to 40 percent Clark clay loam. Because the two soils are so intricately mixed, it is not practical to separate them in mapping. Areas range from 10 to 300 acres.

Typically, the Case soil has a pale brown, calcareous clay loam surface layer about 8 inches thick. The substratum, to a depth of about 60 inches, is very pale brown, calcareous clay loam.

Typically, the Clark soil has a grayish brown, calcareous clay loam surface layer about 11 inches thick. The next layer is pale brown, friable, calcareous clay loam about 5 inches thick. The substratum, to a depth of about 60 inches, is light yellowish brown, calcareous clay loam.

Included with these soils in mapping are small areas of Farnum and Albion soils. These soils are noncalcareous. Farnum soils are on the upper parts of the side slopes, and Albion soils are on the lower parts. These soils make up about 5 to 20 percent of the map unit.

The surface layer of both soils is friable, and tilth is fair. Permeability is moderate, and available water capacity is high. Runoff is medium. Fertility is low in the Case soil and is medium in the Clark soil. Shrink-swell potential is moderate in both soils. Reaction is mildly alkaline or moderately alkaline in both soils.

Most of this map unit is used for crops. Potential is fair for crops, windbreaks, openland wildlife habitat, and most engineering uses. Potential is good for rangeland.

These soils are suited to small grains and legumes. Sorghums are subject to iron chlorosis. If these soils are used for cultivated crops, erosion is a hazard. Terracing, contour farming, minimum tillage, and returning crop residue to the soil help control erosion, conserve moisture, and improve tilth (fig. 9).

The use of these soils for rangeland is also effective in controlling erosion. Overgrazing or grazing when the soil is wet causes soil compaction and poor tilth. Proper stocking rates, uniform grazing distribution, a planned grazing system, and restricted use during wet periods help to keep the range and soil in good condition.

These soils are moderately well suited to trees grown as windbreaks and environmental plantings. Planting suitable species, preparing the site to control competing vegetation, and controlling erosion are necessary for success.

These soils have a moderate limitation for dwellings because of low strength and moderate shrink-swell potential. Using properly designed and reinforced foundations, installing foundation drains, and backfilling with porous material help prevent structural damage caused by shrinking and swelling of the soils. These soils have a severe limitation for local roads and streets because of low strength. This limitation can be lessened by strengthening or replacing the base material. These soils have a moderate limitation for septic tank absorption fields because of moderate permeability. Increasing the size of the absorption field helps improve the function of the septic tank system. These soils have a moderate limitation for sewage lagoons because of seepage. Sealing the lagoon reduces seepage. These soils are in capability subclass IVe.

Cd—Case-Clark clay loams, 6 to 15 percent slopes. This map unit consists of deep, strongly sloping, well drained soils on uplands. It consists of 50 to 60 percent Case clay loam and 30 to 40 percent Clark clay loam. Because the two soils are so intricately mixed, it is not practical to separate them in mapping. This map unit is on side slopes or broad, rolling areas. The Clark soil is in the less sloping areas. Areas of this map unit range from 10 acres to several hundred acres.

Typically, the Case soil has a pale brown, calcareous clay loam surface layer about 8 inches thick. The substratum, to a depth of about 60 inches, is very pale brown, calcareous clay loam.

Typically, the Clark soil has a grayish brown, calcareous clay loam surface layer about 11 inches thick. The next layer is pale brown, friable, calcareous clay loam about 5 inches thick. The substratum, to a depth of about 60 inches, is light yellowish brown, calcareous clay loam.

Included with these soils in mapping are small areas of Farnum and Albion soils. These soils are noncalcareous. Farnum soils are on ridgetops, and Albion soils are on lower side slopes. These soils make up about 5 to 20 percent of the map unit.

Permeability is moderate, and available water capacity is high. Runoff is rapid. Fertility is low in the Case soil and is medium in the Clark soil. Shrink-swell potential is moderate in both soils. Reaction of both soils is mildly alkaline or moderately alkaline.

This map unit is used for rangeland. Potential is good for rangeland and fair for windbreaks, openland wildlife habitat, and most engineering uses. It is poor for crops.

This map unit is best suited to rangeland. The major concern of range management is erosion. Management that maintains an adequate vegetative cover helps prevent excessive soil losses. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the plant community. Under these conditions the taller, more desirable grasses are replaced by less productive short grasses or by weeds. Grazing when the soil is wet causes soil compaction and poor tilth. Proper stocking rates, uniform grazing distribution, a planned grazing system, and restricted use during wet periods help keep the range and soil in good condition.

These soils are moderately well suited to trees grown as windbreaks and environmental plantings. Planting suitable species, preparing the site to control competing vegetation, and controlling erosion are necessary for success.

These soils have a moderate limitation for dwellings because of low strength, moderate shrink-swell potential, and slope. Using properly designed and reinforced foundations, installing foundation drains, and backfilling with porous material help prevent structural damage caused by shrinking and swelling of the soils. These soils have a severe limitation for local roads and streets because of low strength. This limitation can be lessened by strengthening or replacing the base material. These soils have a moderate limitation for septic tank absorption fields because of moderate permeability and slope. Increasing the size of the absorption field and putting laterals on the contour help improve the function of the septic tank system. These soils have a severe limitation for sewage lagoons because of slope. They are in capability subclass VIe.

Ce—Clark clay loam, 0 to 1 percent slopes. This is a deep, nearly level, well drained soil on uplands. It is on ridges. Individual areas range from 10 to 100 acres.

Typically, the surface layer is grayish brown, calcareous clay loam about 11 inches thick. The next layer is pale brown, calcareous, friable clay loam about 5 inches thick. The substratum, to a depth of about 60 inches, is light yellowish brown, calcareous clay loam. In some places, the depth to calcareous material is more than 12 inches and the subsoil contains more clay than the surface layer. These areas are slightly concave.

Included with this soil in mapping are small areas of Farnum soils, which have a noncalcareous subsoil and are in slightly concave areas. These soils make up about 5 percent of the map unit.

The surface layer is friable, and tilth is fair. Permeability is moderate. Runoff is slow. Available water capacity is high. Fertility is medium. Shrink-swell potential is moderate. Reaction is mildly alkaline or moderately alkaline.

This soil is almost entirely used for crops. Potential is good for crops and rangeland. Potential is fair for windbreaks, openland wildlife habitat, and most engineering uses.

This soil is well suited to small grains and legumes. Sorghums are subject to iron chlorosis. Minimum tillage and returning crop residue to the soil help conserve moisture and improve tilth.

This soil is well suited to rangeland. Overgrazing or grazing when the soil is wet causes soil compaction and poor tilth. Proper stocking rates, uniform grazing distribution, a planned grazing system, and restricted use during wet periods help keep the range and soil in good condition.

This soil is moderately well suited to trees grown as windbreaks and environmental plantings. Planting suitable species and preparing the site to control competing vegetation are necessary for success.

This soil has a moderate limitation for dwellings because of low strength and moderate shrink-swell potential. Using properly designed and reinforced foundations, installing foundation drains, and backfilling with porous material help prevent structural damage caused by shrinking and swelling of the soil. This soil has a severe limitation for local roads and streets because of low strength. This limitation can be lessened by strengthening or replacing the base material. This soil has a moderate limitation for septic tank absorption fields because of moderate permeability. Increasing the size of the absorption field helps improve the function of the septic tank system. This soil has a moderate limitation for sewage lagoons because of seepage. Sealing the lagoon reduces seepage. This soil is in capability subclass IIc.

Cf—Clark clay loam, 1 to 4 percent slopes. This deep, gently sloping, well drained soil is on uplands. It is on ridges and side slopes. Individual areas range from 10 to several hundred acres.

Typically, the surface layer is grayish brown, calcareous clay loam about 11 inches thick. The next layer is pale brown, calcareous, friable clay loam about 5 inches thick. The substratum, to a depth of about 60 inches, is light yellowish brown, calcareous clay loam. In some places, the depth to calcareous material is greater and the subsoil contains more clay than the surface layer. In other places, the surface layer is thinner and lighter colored.

The surface layer is friable, and tilth is fair. Permeability is moderate. Runoff is medium. Available water capacity is high. Fertility is medium. Shrink-swell potential is moderate. Reaction is mildly alkaline or moderately alkaline.

This soil is mostly used for crops, although some small areas are rangeland. Potential is good for crops and rangeland and is fair for windbreaks, openland wildlife habitat, and most engineering uses.

This soil is moderately well suited to small grains and legumes. Sorghums are subject to iron chlorosis. If the soil is used for cultivated crops, erosion is a hazard. Terracing, contour farming, using minimum tillage, and returning crop residue to the soil help control erosion, conserve moisture, and improve tilth.

The use of this soil for rangeland is also effective in controlling erosion. Overgrazing or grazing when the soil is wet causes soil compaction and poor tilth. Proper stocking rates, uniform grazing distribution, a planned grazing system, and restricted use during wet periods help keep the range and soil in good condition.

This soil is moderately well suited to trees grown as windbreaks and environmental plantings. Planting suitable species and preparing the site to control competing vegetation are necessary for success.

This soil has a moderate limitation for dwellings because of low strength and moderate shrink-swell potential. Using properly designed and reinforced foundations, installing foundation drains, and backfilling with porous material help prevent structural damage caused by shrinking and swelling of the soil. This soil has a severe limitation for local roads and streets because of low strength. This limitation can be lessened by strengthening or replacing the base material. This soil has a moderate limitation for septic tank absorption fields because of moderate permeability. Increasing the size of the absorption field helps improve the function of the septic tank system. This soil has a moderate limitation for sewage lagoons because of seepage. Sealing the lagoon reduces seepage. This soil is in capability subclass IIIe.

Da—Dillwyn-Plevna complex. This map unit consists of deep, nearly level, somewhat poorly drained and poorly drained soils on flood plains that are occasionally flooded. Individual areas range from 10 to 1,000 acres. The map unit consists of 40 to 50 percent Dillwyn soils and 30 to 50 percent Plevna soils. Because the two soils are so intricately mixed, it is not practical to separate them in mapping.

Typically, the Dillwyn soils have a grayish brown loamy fine sand surface layer about 8 inches thick. The next layer is pale brown, mottled, very friable loamy fine sand about 12 inches thick. The substratum, to a depth of about 60 inches, is very pale brown, mottled loamy fine sand.

Typically, the Plevna soils have a dark gray fine sandy loam surface layer about 11 inches thick. The subsurface layer is grayish brown fine sandy loam about 8 inches thick. The subsoil is grayish brown, mottled, very friable fine sandy loam about 17 inches thick. The substratum, to a depth of about 60 inches, is light gray sand. In some places, the Plevna soils have a sandy surface layer.

Included with these soils in mapping are small areas of Waldeck and Lincoln soils. The somewhat poorly drained Waldeck soils and the somewhat excessively drained, sandy Lincoln soils occupy slightly higher areas. These soils make up about 5 to 30 percent of the map unit.

Both soils have a friable surface layer. Runoff is slow or very slow. Permeability above the water table is rapid in the Dillwyn soils and moderately rapid in the Plevna soils. Available water capacity and natural fertility are low in the Dillwyn soils. Available water capacity is moderate and natural fertility is medium in the Plevna soils. Shrink-swell potential is low in both soils. Reaction is slightly acid or neutral in the surface layer and subsoil and slightly acid to mildly alkaline in the substratum for the Dillwyn soils. It is neutral to moderately alkaline for the

Plevna soils. The water table ranges from near the surface to a depth of about 5 feet.

This map unit is almost all rangeland. A few areas are used for hay. Potential is good for rangeland and fair for openland, wetland, and rangeland wildlife habitat. It is poor for crops, windbreaks, and most engineering uses.

These soils are best suited to rangeland. They are well suited to native grass. The water table is high enough to be within the reach of native grass roots. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the plant community. Under these conditions the taller, more desirable grasses are replaced by less productive grasses. Proper stocking rates, uniform grazing distribution, and a planned grazing system help keep the range in good condition. Sites for pit ponds are numerous (fig. 10).

Areas that are used for hay need to be cut early enough for the grasses to maintain plant vigor.

These soils have a severe limitation for dwellings, septic tank absorption fields, and sewage lagoons because of wetness and flooding. These soils are in capability subclass Vw.

Fa—Farnum sandy loam, 0 to 2 percent slopes. This deep, nearly level, well drained soil is on ridges on uplands. In some places, it is gently sloping. Individual areas range from 10 acres to a few thousand acres.

Typically, the surface layer is brown sandy loam about 9 inches thick, and the subsurface layer is dark grayish brown sandy loam about 7 inches thick. The subsoil is firm clay loam about 34 inches thick. It is dark grayish brown in the upper part and brown in the lower part. The substratum, to a depth of about 60 inches, is brown, mottled sandy clay loam. In some places, the surface layer is loam or loamy fine sand or the subsoil is redder.

Included with this soil in mapping are small areas of somewhat poorly drained Carwile soils that have a mottled clayey subsoil and are in concave areas. These soils make up about 5 percent of the map unit.

The surface layer is friable, and tilth is good. Permeability is moderately slow. Runoff is slow. Available water capacity is high. Natural fertility is medium. Shrink-swell potential is moderate. Reaction ranges from medium acid to neutral in the surface layer and from neutral to moderately alkaline in the subsoil.

This soil is almost entirely cultivated to wheat, sorghum, and alfalfa. Some areas are rangeland. Potential is good for crops, rangeland, openland wildlife habitat, and windbreaks. It is fair for most engineering uses.

This soil is well suited to growing small grains, sorghum, and legumes. If the soil is used for cultivated crops, soil blowing is a hazard. Returning crop residue to the soil and stripcropping help control soil blowing and conserve moisture. In some areas there is a hazard of water erosion. Terracing and contour farming help control erosion in these areas.

The use of this soil for rangeland is also effective in controlling soil blowing. Proper stocking rates, uniform grazing distribution, and a planned grazing system help keep the range in good condition.

This soil is well suited to trees grown as windbreaks and environmental plantings. Planting suitable species and preparing the site to control competing vegetation are necessary for success.

This soil has a moderate limitation for dwellings because of low strength and moderate shrink-swell potential. Using properly designed and reinforced foundations, installing foundation drains, and backfilling with porous material help prevent structural damage caused by shrinking and swelling of the soil. This soil has a severe limitation for local roads and streets because of low strength. This limitation can be lessened by strengthening or replacing the base material. This soil has a severe limitation for septic tank absorption fields because of the moderately slow permeability. Increasing the size of the absorption field helps improve the function of the septic tank system. This soil is well suited to sewage lagoons. It is in capability subclass IIe.

Fb—Farnum loam, 0 to 1 percent slopes. This deep, nearly level, well drained soil is on uplands. It occurs on ridges. Individual areas range from 20 acres to a few hundred acres.

Typically, the surface layer is grayish brown loam about 9 inches thick. The subsurface layer is dark grayish brown loam about 6 inches thick. The subsoil is about 42 inches thick. The upper part is dark grayish brown, firm loam; the middle part is brown, firm clay loam; and the lower part is light brown, friable sandy clay loam. The substratum, to a depth of about 60 inches, is light brown sandy loam. In some places, the surface layer is sandy loam or the subsoil is redder.

Included with this soil in mapping are small areas of Blanket and Carwile soils. Blanket soils have a clayey subsoil. The somewhat poorly drained Carwile soils have a mottled, clayey subsoil and are in concave areas. These soils make up about 7 percent of the map unit.

The surface layer is friable, and tilth is good. Permeability is moderately slow. Runoff is slow. Available water capacity is high. Natural fertility is medium. Shrink-swell potential is moderate. Reaction ranges from medium acid to neutral in the surface layer and from neutral to moderately alkaline in the subsoil.

This soil is almost entirely cultivated to wheat, sorghum, and alfalfa. Potential is good for crops, rangeland, openland wildlife habitat, and windbreaks. Potential is fair for most engineering uses.

This soil is well suited to growing small grains, sorghum, and legumes. Returning crop residue to the soil and minimum tillage improve fertility and conserve moisture.

This soil is well suited to rangeland. Overgrazing or grazing when the soil is wet causes soil compaction and poor tilth. Proper stocking rates, uniform grazing distribution, a planned grazing system, and restricted use during wet periods help keep the range and soil in good condition.

This soil is well suited to trees grown as windbreaks and environmental plantings. Planting suitable species and preparing the site to control competing vegetation are necessary for success.

This soil has a moderate limitation for dwellings because of moderate shrink-swell potential. Using properly designed and reinforced foundations, installing foundation drains, and backfilling with porous material help prevent structural damage caused by shrinking and swelling of the soil. This soil has a severe limitation for local roads and streets because of low strength. This limitation can be lessened by strengthening or replacing the base material. This soil has a severe limitation for septic tank absorption fields because of moderately slow permeability. Increasing the size of the absorption field helps improve the function of the septic tank system. This soil is well suited to sewage lagoons. It is in capability subclass IIc.

Fc—Farnum loam, 1 to 3 percent slopes. This deep, gently sloping, well drained soil is on uplands. It is on ridges and side slopes. Individual areas range from 10 acres to a few thousand acres.

Typically, the surface layer is grayish brown loam about 9 inches thick. The subsurface layer is dark grayish brown loam about 4 inches thick. The subsoil is about 39 inches thick. The upper part is dark grayish brown, firm loam; the middle part is brown, firm clay loam; and the lower part is light brown, friable sandy clay loam. The substratum, to a depth of about 60 inches, is light brown sandy loam. In some places, the subsoil is redder or calcareous.

Included with this soil in mapping are small areas of Blanket soils. Blanket soils have a clayey subsoil and are on the upper parts of the slopes. These soils make up about 5 percent of the map unit.

The surface layer is friable, and tilth is good. Permeability is moderately slow. Runoff is medium. Available water capacity is high. Natural fertility is medium. Shrink-swell potential is moderate. Reaction ranges from medium acid to neutral in the surface layer and from neutral to moderately alkaline in the subsoil.

This soil is almost entirely cultivated to wheat, sorghum, and alfalfa. Potential is good for crops, rangeland, openland wildlife habitat, and windbreaks. It is fair for most engineering uses.

This soil is well suited to small grains, sorghum, and legumes. If the soil is used for cultivated crops, erosion is a hazard. Terracing, contour farming, and returning crop residue to the soil help control erosion and conserve moisture.

The use of this soil for rangeland is also effective in controlling erosion. Overgrazing or grazing when the soil is wet causes soil compaction and poor tilth. Proper stocking rates, uniform grazing distribution, a planned grazing system, and restricted use during wet periods help keep the range and soil in good condition.

This soil is well suited to trees grown as windbreaks and environmental plantings. Planting suitable species and preparing the site to control competing vegetation are necessary for success.

This soil has a moderate limitation for dwellings because of moderate shrink-swell potential. Using properly designed and reinforced foundations, installing foundation drains, and backfilling with porous material help prevent structural damage caused by shrinking and swelling of the soil. This soil has a severe limitation for local roads and streets because of low strength. This limitation can be lessened by strengthening or replacing the base material. This soil has a severe limitation for septic tank absorption fields because of the moderately slow permeability. Increasing the size of the absorption field helps improve the function of the septic tank system. This soil has a moderate limitation for sewage lagoons because of slope. It is in capability subclass IIe.

Fd—Farnum loam, 3 to 6 percent slopes. This deep, sloping, well drained soil is on uplands. It is on side slopes. Individual areas range from 5 to 100 acres.

Typically, the surface layer is grayish brown loam about 11 inches thick. The subsoil is about 36 inches thick. The upper part is grayish brown, firm loam; the middle part is brown, firm clay loam; and the lower part is light brown, friable sandy clay loam. The substratum, to a depth of about 60 inches, is light brown sandy loam. In some places, the subsoil is redder.

Included with this soil in mapping are small areas of Blanket and Clark soils. Blanket soils have a clayey subsoil and are on the upper parts of the slopes. The calcareous Clark soils are in convex areas. These soils make up about 10 percent of the map unit.

The surface layer is friable, and tilth is good. Permeability is moderately slow. Runoff is medium. Available water capacity is high. Natural fertility is medium. Shrink-swell potential is moderate. Reaction ranges from medium acid to neutral in the surface layer and from neutral to moderately alkaline in the subsoil.

This soil is mostly cultivated to wheat, sorghum, and alfalfa. About one-fourth is rangeland. Potential is good for rangeland, openland wildlife habitat, and windbreaks. It is fair for crops and most engineering uses.

This soil is moderately well suited to small grains, sorghum, and legumes. If the soil is used for cultivated crops, erosion is a hazard. Terracing, contour farming, and returning crop residue to the soil help control erosion and conserve moisture.

The use of this soil for rangeland is also effective in controlling erosion. Overgrazing or grazing when the soil is wet causes soil compaction and poor tilth. Proper stocking rates, uniform grazing distribution, a planned grazing system, and restricted use during wet periods help keep the range and soil in good condition.

This soil is well suited to trees grown as windbreaks and environmental plantings. Planting suitable species, preparing the site to control competing vegetation, and controlling erosion are necessary for success.

This soil has a moderate limitation for dwellings because of moderate shrink-swell potential. Using properly designed and reinforced foundations, installing foundation drains, and backfilling with porous material help prevent structural damage caused by shrinking and swelling of the soil. This soil has a severe limitation for local roads and streets because of low strength. This limitation can be lessened by strengthening or replacing the base material. This soil has a severe limitation for septic tank absorption fields because of moderately slow permeability. Increasing the size of the absorption field helps improve the function of the septic tank system. This soil has a moderate limitation for sewage lagoons because of slope. It is in capability subclass IIIe.

Fe—Farnum clay loam, 2 to 6 percent slopes, eroded. This deep, sloping, well drained soil is on uplands. It is on side slopes. Individual areas range from 5 to 200 acres.

Typically, the surface layer is brown clay loam about 8 inches thick. It is as thick as the plowing depth. It includes material that was formerly part of the subsoil. The subsoil is brown, firm clay loam about 32 inches thick. The substratum, to a depth of about 60 inches, is brown sandy loam. In some places, the surface layer is loam. Most areas mapped in the northwestern part of the county have a grayish clay subsoil. Also, in some places, the subsoil is redder.

Included with this soil in mapping are small areas of Case soils. The calcareous Case soils occupy convex areas and make up about 10 percent of the unit.

The surface layer is firm, and tilth is fair. Permeability is moderately slow. Runoff is medium. Available water capacity is high. Natural fertility is medium. Shrink-swell potential is moderate. Reaction ranges from medium acid to neutral in the surface layer and from neutral to moderately alkaline in the subsoil.

This soil is cultivated to wheat. Some sorghum and alfalfa are grown. Potential is good for rangeland and openland wildlife habitat. It is fair for crops, windbreaks, and most engineering uses.

This soil is moderately well suited to small grains, sorghum, and legumes. If the soil is used for cultivated crops, further erosion damage is a hazard. Terracing, contour farming, minimum tillage, and returning crop residue to the soil help control erosion, conserve moisture, and improve tilth.

The use of this soil for rangeland is also effective in controlling erosion. Overgrazing or grazing when the soil is wet causes soil compaction and poor tilth. Proper stocking rates, uniform grazing distribution, a planned grazing system, and restricted use during wet periods help keep the range and soil in good condition.

This soil is moderately well suited to trees grown as windbreaks and environmental plantings. Planting suitable species, preparing the site to control competing vegetation, and controlling erosion are necessary for success.

This soil has a moderate limitation for dwellings because of moderate shrink-swell potential. Using properly designed and reinforced foundations, installing foundation drains, and backfilling with porous material help prevent structural damage caused by shrinking and swelling of the soil. This soil has a severe limitation for local roads and streets because of low strength. This limitation can be lessened by strengthening or replacing the base material. This soil has a severe limitation for septic tank absorption fields because of moderately slow permeability. Increasing the size of the absorption field helps improve the function of the septic tank system. This soil has a moderate limitation for sewage lagoons because of slope. It is in capability subclass IVe.

Ff—Farnum-Natrustolls complex, 0 to 1 percent slopes. This map unit consists of deep, nearly level, well drained and somewhat poorly drained soils on uplands. Vegetation is patchy; plant growth is good in areas affected by sodium and is stunted in areas affected by salts or sodium. Individual areas range from 20 acres to a few hundred acres. The map unit consists of 50 to 70 percent Farnum loam and 10 to 30 percent Natrustolls. Because the two soils are so intricately mixed, it is not practical to separate them in mapping. Areas of Natrustolls are roughly circular in shape, 50 to 500 feet in diameter, and are slightly to severely limited by soluble salts.

Typically, the Farnum soil has a grayish brown loam surface layer about 9 inches thick. The subsurface layer is dark grayish brown, friable loam about 6 inches thick. The subsoil is about 42 inches thick. The upper part is dark grayish brown, firm loam; the middle part is brown, firm clay loam; and the lower part is light brown, friable sandy clay loam. The substratum, to a depth of about 60 inches, is light brown sandy loam.

Natrustolls have a light-colored, hard, loam or clay loam surface layer 1/2 inch to 2 inches thick. The subsurface layer is grayish brown, hard loam or clay loam about 6 inches thick. The subsoil is dark gray or brown, very hard clay or clay loam, which has prismatic or blocky structure. The substratum, to a depth of about 60 inches, is brown or light brown clay loam, sandy clay loam, or sandy loam. When dry, the surface forms a crust. The soil is ponded after heavy rain.

Included with these soils in mapping are small areas of Shellabarger and Blanket soils. The well drained Shellabarger soils have a sandy clay loam subsoil and are in convex areas. The well drained Blanket soils have a clayey subsoil and are near the Farnum soil on the landscape. The included soils make up about 5 to 20 percent of the map unit.

Runoff is slow in both soils. The Farnum soil has a friable surface layer, and tilth is good. In the Farnum soil, permeability is moderately slow, available water capacity is high, and natural fertility is medium. Shrink-swell potential is moderate. Reaction ranges from medium acid to neutral in the surface layer and from neutral to moderately alkaline in the subsoil.

Natrustolls have a hard, crusty surface layer, and tilth is poor. In Natrustolls, permeability is very slow, available water capacity is moderate, and natural fertility is low. Shrink-swell potential is high. Reaction ranges from medium acid to neutral in the surface layer and from neutral to strongly alkaline in the subsoil. Natrustolls are slightly to moderately limited by soluble salts and also have excess exchangeable sodium (fig. 11).

This map unit is mostly cultivated to wheat. Some areas are rangeland. Potential is good for rangeland and openland wildlife habitat and fair for crops. In the Farnum soil, it is good for windbreaks and fair for most engineering uses. Potential of Natrustolls is poor for windbreaks and most engineering uses.

This map unit is moderately well suited to small grains, sorghum, and legumes. If the soils are used for cultivated crops, crop growth is poor in the salt-affected areas, and it is difficult to obtain an even stand. Adding manure and gypsum and keeping crop residue on or near the surface improve these areas. Minimum tillage and returning crop residue to the soil improve fertility and conserve moisture.

The major concern of range management is variability of the growth and species of grass because of the varying amount of salts in the soils. Overgrazing or grazing when the soils are wet causes soil compaction and poor tilth. Proper stocking rates, uniform grazing distribution, a planned grazing system, and restricted use during wet periods help keep the range and soil in good condition.

The Farnum soil is well suited to windbreaks; however, trees do not grow well on Natrustolls. Planting suitable species, preparing the site to control competing vegetation, and avoiding areas of Natrustolls are necessary for success.

The Farnum soil has a moderate limitation for dwellings because of moderate shrink-swell potential. Using properly designed and reinforced foundations, installing foundation drains, and backfilling with porous material help prevent structural damage caused by the shrinking and swelling of the soil. Natrustolls should not be used as sites for dwellings because of the shrink-swell potential and wetness. They are highly corrosive to steel and concrete. Limitations for septic tank absorption fields are severe because the Farnum soil has moderately slow permeability and Natrustolls have very slow permeability. Placing the absorption field in the Farnum soil and increasing the size of the absorption field help improve the function of the septic tank system. These soils are well suited to sewage lagoons. They are in capability subclass IVs.

Ka—Kaski loam. This deep, nearly level, well drained soil is on flood plains. It is along streams and is occasionally flooded. Individual areas range from 5 to 300 acres.

Typically, the surface layer is dark grayish brown loam about 18 inches thick. The subsurface layer is grayish brown loam about 10 inches thick. The next layer is brown, friable loam about 14 inches thick. The substratum, to a depth of about 60 inches, is brown loam. Some areas in the western part of the county are calcareous throughout. Some areas in the eastern part of the county are reddish brown to red loam or silt loam below the surface layer. Some places are sandy below a depth of 20 inches.

Included with this soil in mapping are small areas of Zenda and Canadian soils. The somewhat poorly drained Zenda soil is clay loam and is in slightly lower areas. The Canadian soil is fine sandy loam, is rarely flooded, and is in slightly higher areas. These soils make up about 10 percent of the map unit.

The surface layer is friable, and tilth is good. Permeability is moderate. Runoff is slow. Available water capacity is high. Natural fertility is medium. Shrink-swell potential is low. Reaction ranges from slightly acid to mildly alkaline in the upper part of the soil and from neutral to moderately alkaline in the substratum.

This soil is mostly cultivated to wheat and sorghum. Some narrow areas are rangeland. Potential is good for crops, rangeland, windbreaks, and openland and rangeland wildlife habitat. It is poor for most engineering uses.

This soil is well suited to small grains, sorghum, and legumes. If the soil is used for cultivated crops, damage to crops by flooding is a hazard. Most floods are of short duration. Planting and harvesting are delayed occasionally because of flooding. Minimum tillage and returning crop residue to the soil help maintain fertility and tilth.

This soil is well suited to rangeland. This soil receives extra moisture as runoff from adjacent upland soils. Overgrazing or grazing when the soil is wet causes soil compaction and poor tilth. Proper stocking rates, uniform grazing distribution, a planned grazing system, and restricted use during wet periods help keep the range and soil in good condition.

This soil is well suited to trees grown as windbreaks and environmental plantings. Planting suitable species and preparing the site to control competing vegetation are necessary for success.

This soil has a severe limitation for dwellings, local roads and streets, septic absorption fields, and sewage lagoons because of the hazard of flooding. Protection from flooding by dikes, levees, or other structures lessens this hazard. This soil is in capability subclass IIw.

Kb—Kingman silty clay loam. This deep, nearly level, poorly drained soil is on flood plains. It is occasionally flooded. Individual areas range from 5 to 100 acres.

Typically, the surface layer is gray, calcareous silty clay loam about 18 inches thick. The subsoil is gray, firm, mottled, calcareous silty clay loam about 30 inches thick. The substratum, to a depth of about 60 inches, is light gray, weakly calcareous silty clay loam. In some places, sandy layers are at a depth of 18 to 40 inches. In other places, the texture throughout is fine sandy loam.

Included with this soil in mapping are small areas of Zenda soils. The somewhat poorly drained Zenda soils are clay loam and are in higher, convex areas. They make up about 5 percent of the map unit.

Permeability is moderately slow, and available water capacity is high. Runoff is slow. Natural fertility is medium. The water table is at or near the surface at some time during most years and drops to 2 to 4 feet during late summer.

This soil is used for rangeland and hay meadows. Potential is good for rangeland and fair for openland, wetland, and rangeland wildlife habitat. It is poor for crops and most engineering uses.

This soil is best suited to rangeland. It is well suited to native grass. The water table is high enough to be within the reach of native grass roots. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the plant community. Under these conditions the taller, more desirable grasses are replaced by less productive grasses. Grazing when the soil is too wet causes soil compaction and poor tilth. Proper stocking rates, uniform grazing distribution, a planned grazing system, and restricted use during wet periods help keep the range and soil in good condition.

In areas that are used for hay, grasses need to be cut early enough to maintain plant vigor.

This soil has a severe limitation for dwellings, septic tank absorption fields, and sewage lagoons because of wetness and flooding. It is in capability subclass Vw.

La—Lincoln loamy sand. This deep, nearly level, somewhat excessively drained soil is on flood plains and is occasionally flooded for very brief periods. Individual areas range from 10 acres to a few hundred acres.

Typically, the surface layer is grayish brown loamy sand about 10 inches thick. The substratum, to a depth of about 60 inches, is light yellowish brown sand. In some places, the surface layer is dark colored sandy loam or loam.

Included with this soil in mapping are small areas of Canadian, Dillwyn, and Waldeck soils. The well drained Canadian soils are less sandy than the Lincoln soil and are on higher areas. Dillwyn and Waldeck soils are somewhat poorly drained. Included soils make up about 15 percent of the map unit.

Permeability is rapid, and runoff is slow. Available water capacity and fertility are low. Reaction is slightly acid or neutral in the surface layer and slightly acid to mildly alkaline in the substratum. The water table is below a depth of 5 feet, except during periods when the stream is high.

This soil is almost entirely used for rangeland. Potential is good for rangeland and fair for cropland, openland wildlife habitat, and rangeland wildlife habitat. It is poor for windbreaks and most engineering uses.

This soil is moderately well suited to small grains, sorghum, and legumes. If the soil is used for cultivated crops, the major management problems are a hazard of soil blowing, low available water capacity, low fertility, and occasional flooding. Returning crop residue to the soil and stripcropping help control soil blowing.

This soil is best suited to rangeland. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the plant community. Under these conditions the taller, more desirable grasses are replaced by less productive short grasses or by weeds. Proper stocking rates, uniform grazing distribution, and a planned grazing system help keep the range in good condition.

This soil has a severe limitation for dwellings, local roads and streets, septic tank absorption fields, and sewage lagoons because of the hazard of flooding. It is in capability subclass IVs.

Ma—McLain silt loam. This deep, nearly level, well drained soil is on terraces and is rarely flooded for short periods. Individual areas range from 20 to 250 acres.

Typically, the surface layer is brown silt loam about 14 inches thick. The subsoil is about 28 inches thick. The upper part is brown, firm silty clay loam; the middle part is reddish brown, very firm silty clay; and the lower part is reddish brown, firm silty clay loam. The substratum, to a depth of about 60 inches, is reddish brown, calcareous loam. In some places, the subsoil is less red.

Included with this soil in mapping are small areas of Kaski soils and soils that are shallower to shale. The Kaski soils are loam and are along intermittent drainageways. Some areas have shale within 60 inches and are adjacent to the uplands. Included areas make up about 20 percent of the map unit.

The surface layer is friable, and tilth is good. Permeability and runoff are slow. Available water capacity is high, and natural fertility is medium. Shrink-swell potential is high. Reaction is slightly acid or neutral in the surface layer and ranges from slightly acid to mildly alkaline in the subsoil.

This soil is almost entirely cultivated to wheat, sorghum, and alfalfa. Potential is good for crops, rangeland, openland wildlife habitat, and wetland wildlife habitat and is fair for windbreaks. It is poor for most engineering uses.

This soil is well suited to small grains, sorghum, and legumes. Using minimum tillage and returning crop residue to the soil improve fertility and conserve moisture.

This soil is well suited to rangeland. Overgrazing or grazing when the soil is wet causes soil compaction and poor tilth. Proper stocking rates, uniform grazing distribution, a planned grazing system, and restricted use during wet periods help keep the range and soil in good condition.

This soil is moderately well suited to trees grown as windbreaks and environmental plantings. Planting suitable species and preparing the site to control competing vegetation are necessary for success.

This soil has a severe limitation for dwellings because of the hazard of flooding and high shrink-swell potential. Using properly designed and reinforced foundations, installing foundation drains, and backfilling with porous material help prevent structural damage caused by shrinking and swelling of the soil. Constructing dikes or levees lessens the hazard of flooding. This soil has a severe limitation for local roads and streets because of low strength. This limitation can be lessened by strengthening or replacing the base material. This soil has a severe limitation for septic tank absorption fields because of slow permeability, but it is well suited to sewage lagoons. It is in capability subclass IIc.

Na—Nashville silt loam, 1 to 3 percent slopes. This moderately deep, gently sloping, well drained soil is on uplands. It is on ridges and side slopes. Individual areas range from about 10 acres to a few hundred acres.

Typically, the surface layer is brown silt loam about 12 inches thick. The subsoil is reddish brown, friable silt loam about 16 inches thick. Soft siltstone is at a depth of about 28 inches. In some places, the subsoil is silty clay loam and the depth to siltstone is more than 40 inches.

Included with this soil in mapping are small areas of Quinlan soils. The Quinlan soils are shallow to bedrock and are in convex areas. They make up about 10 percent of the map unit.

The surface layer is friable, and tilth is good. Permeability is moderate. Runoff is medium. Available water capacity is low. Natural fertility is medium. Shrink-swell potential is low. Reaction ranges from medium acid to neutral in the surface layer and is slightly acid or neutral in the subsoil. Depth to siltstone bedrock ranges from 20 to 40 inches.

This soil is mostly cultivated to wheat. Some areas are used for sorghum and alfalfa or are rangeland. Potential is good for crops, rangeland, and openland wildlife habitat and is fair for windbreaks. It is fair to poor for most engineering uses.

This soil is well suited to small grains. It is less suited to sorghum and alfalfa because of the low available water capacity. If the soil is used for cultivated crops, erosion is a hazard. Terracing, contour farming, minimum tillage, and returning crop residue to the soil help control erosion and conserve moisture.

The use of this soil for rangeland is also effective in controlling erosion. Overgrazing or grazing when the soil is wet causes soil compaction and poor tilth. Proper stocking rates, uniform grazing distribution, a planned grazing system, and restricted use during wet periods help keep the range and soil in good condition.

This soil is moderately well suited to trees grown as windbreaks and environmental plantings. Planting suitable species and preparing the site to control competing vegetation are necessary for success.

This soil has moderate limitations for dwellings with basements because of moderate depth to bedrock. This soil has moderate limitations for local roads and streets because of low strength. This limitation can be lessened by strengthening or replacing the base material. This soil has a severe limitation for septic tank absorption fields and a moderate limitation for sewage lagoons because of depth to bedrock. Sealing the lagoon reduces seepage. This soil is in capability subclass IIe.

Nb—Nashville-Quinlan complex, 5 to 15 percent slopes. This map unit consists of moderately deep and shallow, strongly sloping, well drained soils on uplands. Individual areas range from 20 acres to several hundred acres. The map unit consists of 50 to 60 percent Nashville silt loam and 30 to 40 percent Quinlan loam. Nashville soil is in the less sloping areas. Because the two soils are so intricately mixed, it is not practical to separate them in mapping.

Typically, the Nashville soil has a brown silt loam surface layer about 12 inches thick. The subsoil is reddish brown, friable silt loam about 16 inches thick. Soft siltstone is at a depth of about 28 inches.

Typically, the Quinlan soil has a reddish brown, calcareous loam surface layer about 8 inches thick. The subsoil is also reddish brown, calcareous loam about 5 inches thick. Fine-grained sandstone is at a depth of about 13 inches.

Included with these soils in mapping are small areas of Ruella and Owens soils. Ruella soils are deep, and the clayey Owens soils are shallow. Both soils are on lower slopes. These soils make up about 5 to 20 percent of the map unit.

The surface layer is friable in both soils. Runoff is rapid. Permeability is moderate in the Nashville soil and moderately rapid in the Quinlan soil. Available water capacity is low in the Nashville soil, and natural fertility is medium. Available water capacity is very low in the Quinlan soil, and natural fertility is low. Shrink-swell potential is low in both soils. Reaction ranges from medium acid to neutral in the Nashville soil and is mildly alkaline or moderately alkaline in the Quinlan soil.

These soils are used for rangeland. Potential is fair for rangeland and is good to fair for openland wildlife habitat. It is poor for crops, windbreaks, and most engineering uses.

This map unit is best suited to rangeland. The main concerns of range management are low and very low available water capacity and erosion. Adequate vegetative cover must be maintained to prevent erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the plant community. Under these conditions the taller, more desirable grasses are replaced by less productive short grasses or by weeds. Grazing when the soil is wet causes soil compaction and poor tilth. Proper stocking rates, uniform grazing distribution, a planned grazing system, and restricted use during wet periods help keep the range and soil in good condition. Range seeding is needed to restore productivity and control erosion on areas that have been used for crops.

These soils have a moderate limitation for dwellings without basements because of slope and depth to rock. Excavating for basements is difficult because of moderate or shallow depth to bedrock. These soils have a moderate limitation for local roads and streets because of low strength, slope, and depth to rock. These soils have severe limitations for septic tank absorption fields and sewage lagoons because of depth to bedrock and slope. Sewage lagoons can be built on the less sloping areas of Nashville soil, and sealing the lagoon helps reduce seepage. These soils are in capability subclass VIe.

Oa—Owens clay loam, 1 to 4 percent slopes. This shallow, gently sloping, well drained soil is on uplands. It is on side slopes. Individual areas range from 10 to 200 acres.

Typically, the surface layer is reddish brown clay loam about 6 inches thick. The subsoil is reddish brown, very firm clay about 10 inches thick. Clayey shale is at a depth of about 16 inches.

Included with this soil in mapping are small areas of moderately deep soils that are on the upper parts of the slopes. These soils make up about 10 percent of the map unit.

The surface layer is very firm, and tilth is poor. Permeability is very slow. Runoff is medium. Available water capacity is very low. Natural fertility is low. Shrink-swell potential is high. Reaction is moderately alkaline in the surface layer and subsoil. Depth to shale ranges from 10 to 20 inches.

This soil is mostly cultivated to wheat. Some areas are rangeland. Potential is fair for crops and rangeland. It is poor for other uses.

This soil is moderately well suited to small grains. It is poorly suited to sorghum and alfalfa because of the very low available water capacity. If the soil is used for cultivated crops, erosion is a hazard. Terracing, contour farming, minimum tillage, and returning crop residue to the soil help control erosion and conserve moisture.

The use of this soil for rangeland is also effective in controlling erosion. The main concerns of range management are the very low available water capacity and the hazard of erosion. Overgrazing or grazing when the soil is wet causes soil compaction and poor tilth. Proper stocking rates, uniform grazing distribution, a planned grazing system, and restricted use during wet periods help keep the range and soil in good condition.

This soil has a severe limitation for dwellings because of high shrink-swell potential. Using properly designed and reinforced foundations, installing foundation drains, and backfilling with porous material help prevent structural damage caused by shrinking and swelling of the soil. Excavating for basements or foundations and digging trenches for utilities are difficult because of the shallow depth to shale. This soil has a severe limitation for local roads and streets because of high shrink-swell potential and low strength. These limitations can be lessened by strengthening or replacing the base material. This soil has a severe limitation for septic tank absorption fields because of very slow permeability. It has a moderate limitation for sewage lagoons because of the slope. This soil is in capability subclass IVe.

Pa—Pond Creek silt loam, 1 to 3 percent slopes. This deep, gently sloping, well drained soil is on uplands. It is on ridges and side slopes. Individual areas range from 20 to 200 acres.

Typically, the surface layer is brown silt loam about 10 inches thick. The subsoil is brown and is about 42 inches thick. The upper part is friable silt loam, the middle part is firm silty clay loam, and the lower part is friable silty clay loam. The substratum, to a depth of about 60 inches, is brown silty clay loam. In some places, the subsoil is clay loam or silty clay. Also, in some areas, the subsoil is reddish brown or depth to bedrock is less than 40 inches.

The surface layer is friable, and tilth is good. Permeability is moderately slow. Runoff is medium. Available water capacity is high. Natural fertility is medium. Shrink-swell potential is moderate. Reaction ranges from medium acid to neutral in the surface layer and is slightly acid or neutral in the subsoil.

This soil is almost entirely cultivated to wheat. Some sorghum and alfalfa are grown. Potential is good for crops, rangeland, windbreaks, and openland wildlife habitat. It is fair for most engineering uses.

This soil is well suited to small grains, sorghum, and legumes. If the soil is used for cultivated crops, erosion is a hazard. Terracing, contour farming, minimum tillage, and returning crop residue to the soil help control erosion and conserve moisture.

The use of this soil for rangeland is also effective in controlling erosion. Overgrazing or grazing when the soil is wet causes soil compaction and poor tilth. Proper stocking rates, uniform grazing distribution, a planned grazing system, and restricted use during wet periods help keep the range and soil in good condition.

This soil is well suited to trees grown as windbreaks and environmental plantings. Planting suitable species and preparing the site to control competing vegetation are necessary for success.

This soil has a moderate limitation for dwellings because of moderate shrink-swell potential and low strength. Using properly designed and reinforced foundations, installing foundation drains, and backfilling with porous material help prevent structural damage caused by shrinking and swelling of the soil. This soil has a severe limitation for local roads and streets because of low strength. This limitation can be lessened by strengthening or replacing the base material. This soil has a severe limitation for septic tank absorption fields because of moderately slow permeability. Increasing the size of the absorption field helps improve the function of the septic tank system. This soil has a moderate limitation for sewage lagoons because of slope. It is in capability subclass IIe.

Pb—Pratt loamy fine sand, undulating. This deep, undulating, well drained soil is on uplands. Individual areas range from 10 to 500 acres.

Typically, the surface layer is pale brown loamy fine sand about 12 inches thick. The subsoil is light yellowish brown, very friable loamy fine sand about 24 inches thick. The substratum, to a depth of about 60 inches, is light yellowish brown loamy fine sand. In some places, the subsoil is fine sandy loam.

Included with this soil in mapping are small areas of Carwile and Farnum soils. The somewhat poorly drained Carwile soils have a mottled clayey subsoil and are in concave areas. The Farnum soils have a clay loam subsoil and are nearly level. Included soils make up about 15 percent of the map unit.

The surface layer is very friable, and tilth is good. Permeability is rapid. Runoff is slow. Available water capacity and natural fertility are low. Shrink-swell potential is low. Reaction is medium acid to neutral throughout.

This soil is mostly cultivated to wheat and sorghum. Some areas are used for alfalfa or are rangeland. Potential is fair for crops, windbreaks, openland wildlife habitat, and rangeland wildlife habitat. It is good for rangeland and most engineering uses.

This soil is moderately well suited to small grains, sorghum, and legumes. If the soil is used for cultivated crops, soil blowing is a hazard. Returning crop residue to the soil, stripcropping, and stubble mulch tillage help control soil blowing and conserve moisture.

The use of this soil for rangeland is also effective in controlling soil blowing. Proper stocking rates, uniform grazing distribution, and a planned grazing system help keep the range in good condition.

This soil is moderately well suited to trees grown as windbreaks and environmental plantings. Planting suitable species and preparing the site to control competing vegetation and soil blowing are necessary for success.

This soil is well suited to dwellings, local roads and streets, and septic tank absorption fields. It has a severe limitation for sewage lagoons because of seepage. Sealing the lagoon reduces seepage. This soil is in capability subclass IIIe.

Pc—Pratt-Carwile complex, undulating. This map unit consists of deep, undulating, well drained and somewhat poorly drained soils on uplands. Individual areas range from 20 acres to a few thousand acres. The map unit consists of 50 to 60 percent Pratt loamy fine sand and 30 to 40 percent Carwile fine sandy loam. The Pratt soil is on convex ridges, and the Carwile soil is on plane or slightly concave areas between the ridges. Because the two soils are so intricately mixed, it is not practical to separate them in mapping.

Typically, the Pratt soil has a pale brown loamy fine sand surface layer about 12 inches thick. The subsoil is light yellowish brown, very friable loamy fine sand about 24 inches thick. The substratum, to a depth of about 60 inches, is light yellowish brown loamy fine sand. In some places, the subsoil is fine sandy loam.

Typically, the Carwile soil has a grayish brown fine sandy loam surface layer about 10 inches thick. The subsoil is about 35 inches thick. The upper part is very dark grayish brown, friable clay loam; the middle part is light brownish gray, very firm, mottled clay; the lower part is mottled light brownish gray and strong brown, firm sandy clay loam. The substratum, to a depth of about 60 inches, is strong brown, mottled sandy clay loam. In some places, the surface layer is loamy fine sand.

Included with these soils in mapping are small areas of Farnum soils. The well drained Farnum soils have a less clayey subsoil than the Carwile soil and are nearly level. They make up about 2 to 10 percent of the map unit.

Both soils have a very friable surface layer. Runoff is slow. Permeability is rapid in the Pratt soil and slow in the Carwile soil. Available water capacity and natural fertility are low in the Pratt soil. Available water capacity is high and natural fertility is medium in the Carwile soil. Shrink-swell potential is low in the Pratt soil, but it is high in the Carwile soil. Reaction is medium acid or neutral in the Pratt soil and is slightly acid or neutral in the surface layer and subsoil of the Carwile soil.

This map unit is almost entirely cultivated to wheat and sorghum. A few areas are rangeland. Potential is good for rangeland and good to fair for crops, windbreaks, openland wildlife habitat, and rangeland wildlife habitat. It is good to poor for most engineering uses.

This map unit is moderately well suited to small grains, sorghum, and legumes. If the soils are used for cultivated crops, soil blowing is a hazard. The Carwile soils have a hazard of excess wetness, so planting and harvesting could be delayed in low areas. Returning crop residue to the soil, stripcropping, and stubble mulch tillage help control soil blowing, conserve moisture, and increase water infiltration. Installing surface drains reduces wetness.

The use of these soils for rangeland is also effective in controlling soil blowing. Proper stocking rates, uniform grazing distribution, and a planned grazing system help keep the range in good condition.

This map unit is moderately well suited to trees grown as windbreaks and environmental plantings. Planting suitable species, preparing the site to control competing vegetation and soil blowing, and providing adequate drainage in low areas are necessary for success.

The Pratt soil is well suited to dwellings, local roads and streets, and septic tank absorption fields. It is poorly suited to sewage lagoons. The Carwile soil is poorly suited to dwellings, local roads and streets, and septic tank absorption fields because of wetness. It is well suited, however, to sewage lagoons. Onsite investigation is essential to evaluate and plan the development of specific sites. This map unit is in capability subclass IIIe.

Pd—Pratt-Tivoli loamy fine sands, rolling. This map unit consists of deep, rolling, well drained and excessively drained soils on uplands. It consists of 40 to 50 percent Pratt loamy fine sand and 40 to 50 percent Tivoli loamy fine sand. Because the two soils are so intricately mixed, it is not practical to separate them in mapping. Tivoli loamy fine sand occurs on the ridges, and Pratt loamy fine sand is on the lower side slopes.

Typically, the Pratt soil has a surface layer of pale brown loamy fine sand about 12 inches thick. The subsoil is light yellowish brown, very friable loamy fine sand about 24 inches thick. The substratum, to a depth of about 60 inches, is light yellowish brown loamy fine sand.

Typically, the Tivoli soil has a surface layer of grayish brown loamy fine sand about 8 inches thick. The substratum, to a depth of about 60 inches, is light yellowish brown fine sand. In some places, the Tivoli soil has a surface layer of fine sand.

Included with these soils in mapping are small areas of Farnum and Carwile soils. These soils have a more clayey subsoil and are in concave areas. They make up about 5 to 20 percent of the map unit.

The Pratt and Tivoli soils absorb most of the precipitation, and no drainage pattern has been established. Permeability is rapid throughout both soils. Available water capacity is low in the Pratt soil, and runoff is slow. Available water capacity is very low and runoff is very slow in the Tivoli soil.

These soils are used for rangeland. Potential is good for rangeland and poor for crops. It is fair for windbreaks and most engineering uses and fair to poor for rangeland wildlife habitat.

This map unit is best suited to rangeland. Major concerns of range management are soil blowing and low and very low available water capacity. Adequate vegetative cover must be maintained to prevent soil blowing. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the plant community. Under these conditions the taller, more desirable grasses are replaced by less productive short grasses or by weeds. Proper stocking rates, uniform grazing distribution, and a planned grazing system help keep the range in good condition and prevent soil blowing.

These soils are moderately well suited to trees that are grown as windbreaks and environmental plantings. Planting suitable species and preparing the site to control competing vegetation and soil blowing are necessary for success.

These soils have a moderate limitation for dwellings, local roads and streets, and septic tank absorption fields because of slope. Septic tank absorption fields can pollute shallow ground water. These soils have a severe limitation for sewage lagoons because of seepage. Sealing the lagoon reduces seepage. This map unit is in capability subclass VIe.

Qa—Quinlan loam, 1 to 3 percent slopes. This shallow, gently sloping, well drained soil is on uplands. It is on ridges and side slopes. Individual areas range from 10 acres to several hundred acres.

Typically, the surface layer is reddish brown, calcareous loam about 8 inches thick. The subsoil is reddish brown, calcareous, friable loam about 5 inches thick. Fine-grained sandstone is at a depth of about 13 inches. In some places, depth to bedrock is more than 20 inches.

The surface layer is friable, and tilth is good. Permeability is moderately rapid. Runoff is medium. Available water capacity is very low. Natural fertility is low. Shrink-swell potential is low. Reaction is mildly alkaline or moderately alkaline. Depth to bedrock ranges from 10 to 20 inches.

This soil is mostly cultivated to wheat. Some areas are used for sorghum or are rangeland. Potential is fair for crops, rangeland, and openland wildlife habitat. It is poor for windbreaks and fair to poor for most engineering uses.

This soil is moderately well suited to small grains. It is poorly suited to sorghum and alfalfa because of the very low available water capacity. If the soil is used for cultivated crops, erosion is a hazard. Minimum tillage, terracing, contour farming, and returning crop residue to the soil help control erosion.

The use of this soil for rangeland is also effective in controlling erosion. Overgrazing or grazing when the soil is wet causes soil compaction and poor tilth. Proper stocking rates, uniform grazing distribution, a planned grazing system, and restricted use during wet periods help keep the range and soil in good condition.

This soil has a moderate limitation for dwellings without basements because of depth to rock. Excavating for basements or foundations and digging trenches for utilities are difficult. This soil has a severe limitation for septic tank absorption fields and sewage lagoons because of depth to rock. It is in capability subclass IIIe.

Qb—Quinlan loam, 3 to 5 percent slopes. This shallow, sloping, well drained soil is on uplands. It is on side slopes. Individual areas range from 10 to 200 acres.

Typically, the surface layer is reddish brown, calcareous loam about 8 inches thick. The subsoil is reddish brown, calcareous, friable loam about 5 inches thick. Fine-grained sandstone is at a depth of about 13 inches. In some places, depth to bedrock is more than 20 inches.

The surface layer is friable, and tilth is good. Permeability is moderately rapid. Runoff is rapid. Available water capacity is very low. Natural fertility is low. Shrink-swell potential is low. Reaction is mildly alkaline or moderately alkaline. Depth to bedrock ranges from 10 to 20 inches.

About one-half of the acreage is cultivated, and the rest is rangeland. Potential is fair for crops, rangeland, and openland wildlife habitat. It is poor for windbreaks and fair to poor for most engineering uses.

This soil is moderately well suited to small grains. It is poorly suited to sorghum and alfalfa because of the very low available water capacity. If the soil is used for cultivated crops, erosion is a hazard. Minimum tillage, terracing, contour farming, and returning crop residue to the soil help control erosion.

The use of this soil for rangeland is also effective in controlling erosion. Overgrazing or grazing when the soil is wet causes soil compaction and poor tilth. Proper stocking rates, uniform grazing distribution, a planned grazing system, and restricted use during wet periods help keep the range and soil in good condition.

This soil has a moderate limitation for dwellings without basements because of depth to rock. Excavating for basements or foundations and digging trenches for utilities are difficult. This soil has a severe limitation for septic tank absorption fields and sewage lagoons because of depth to rock. It is in capability subclass IVe.

Ra—Renfrow clay loam. This deep, gently sloping, well drained soil is on uplands. It is on ridges and side slopes. Individual areas range from 20 acres to several thousand acres.

Typically, the surface layer is brown clay loam about 8 inches thick. The subsoil is about 42 inches thick. The upper part is brown, friable clay loam, and the lower part is reddish brown, very firm clay. Clayey shale is at a depth of about 50 inches. In some places, the surface layer is sandy loam or loam or the depth to clayey shale is less than 40 inches.

Included with this soil in mapping are small areas of the Owens soils. The shallow Owens soils are on the lower part of slopes or convex knobs. They make up about 10 percent of the map unit.

The surface layer is friable, and tilth is fair. Permeability is very slow. Runoff is medium. Available water capacity is moderate. Natural fertility is medium. Shrink-swell potential is high. Reaction is slightly acid or neutral in the surface layer and ranges from slightly acid to moderately alkaline in the subsoil. Depth to shale is more than 40 inches.

This soil is mostly cultivated to wheat. Some areas are used for sorghum or are rangeland. Potential is fair for crops, rangeland, and windbreaks and is good for openland wildlife habitat. It is poor for most engineering uses.

This soil is moderately well suited to small grains, sorghum, and legumes. If the soil is used for cultivated crops, erosion is a hazard. Terracing, contour farming, minimum tillage, and returning crop residue to the soil help control erosion, conserve moisture, and improve tilth.

The use of this soil for rangeland is also effective in controlling erosion. Overgrazing or grazing when the soil is wet causes soil compaction and poor tilth. Proper stocking rates, uniform grazing distribution, a planned grazing system, and restricted use during wet periods help keep the range and soil in good condition.

This soil is moderately well suited to trees grown as windbreaks and environmental plantings. Planting suitable species, preparing the site to control competing vegetation, and controlling erosion are necessary for success.

This soil has a severe limitation for dwellings because of high shrink-swell potential and low strength. Using properly designed and reinforced foundations and pavements, installing foundation drains, and backfilling with porous material help prevent structural damage caused by shrinking and swelling of the soil. This soil has a severe limitation for local roads and streets because of low strength and high shrink-swell potential. This limitation can be lessened by strengthening or replacing the base material. This soil has a severe limitation for septic tank absorption fields because of very slow permeability. It is well suited to sewage lagoons. It is in capability subclass IIIe.

Rb—Ruella clay loam, 1 to 4 percent slopes. This deep, gently sloping, well drained soil is on uplands. It is on ridges. Individual areas range from 10 to 500 acres.

Typically, the surface layer is reddish brown, calcareous clay loam about 10 inches thick. The subsoil is reddish brown, calcareous, firm clay loam about 20 inches thick. The substratum, to a depth of about 60 inches, is reddish brown, calcareous clay loam.

Included with this soil in mapping are small areas of Renfrow and Owens soils. The Renfrow soils have a clayey subsoil and are in concave areas. The shallow Owens soils have a clayey subsoil and are on convex side slopes. These soils make up about 15 percent of the map unit.

The surface layer is friable, and tilth is fair. Permeability is moderate. Runoff is medium. Available water capacity is high. Natural fertility is low. Shrink-swell potential is low. Reaction is mildly alkaline or moderately alkaline throughout.

This soil is mostly cultivated to wheat. Potential is good for crops, rangeland, windbreaks, and openland wildlife habitat. It is fair for most engineering uses.

This soil is well suited to small grains, sorghum, and legumes. If the soil is used for cultivated crops, erosion is a hazard. Terracing, contour farming, minimum tillage, and returning crop residue to the soil help control erosion, conserve moisture, and improve tilth.

The use of this soil for rangeland is also effective in controlling erosion. Overgrazing or grazing when the soil is wet causes soil compaction and poor tilth. Proper stocking rates, uniform grazing distribution, a planned grazing system, and restricted use during wet periods help keep the range and soil in good condition.

This soil is well suited to trees grown as windbreaks and environmental plantings. Planting suitable species and preparing the site to control competing vegetation are necessary for success.

This soil is well suited to dwellings and septic tank absorption fields. It has a moderate limitation for local roads and streets because of low strength. This limitation can be lessened by strengthening or replacing the base material. This soil has a moderate limitation for sewage lagoons because of slope and seepage. Sealing the lagoon reduces seepage. This soil is in capability subclass IIe.

Rc—Ruella-Rock outcrop complex, 3 to 40 percent slopes. This map unit consists of deep, sloping, well drained soils and steep Rock outcrop. It is on uplands. Individual areas range from 10 to 200 acres. The map unit consists of 30 to 60 percent Ruella soils and 20 to 65 percent Rock outcrop (fig. 12). Because the areas are so intricately mixed, it is not practical to separate them in mapping. Ruella soils are on ridges. In some places, vertical banks range from 2 to 15 feet in height.

Typically, the Ruella soils have a reddish brown, calcareous clay loam surface layer about 10 inches thick. The subsoil is reddish brown, firm, calcareous clay loam about 20 inches thick. The substratum, to a depth of about 60 inches, is reddish brown, calcareous clay loam.

Rock outcrop consists of massive, reddish shale. These sediments are stratified with grayish clayey shale and thin beds of gypsum.

Included in mapping are areas of Owens soils. The shallow, clayey Owens soils are on lower slopes. These soils make up 5 to 30 percent of the map unit.

Permeability is moderate in the Ruella soils, and runoff is medium. Available water capacity is high and natural fertility is low in the Ruella soils. Rock outcrop has rapid runoff. Permeability is very slow, and available water capacity is very low.

This map unit is mostly used for rangeland. A few small areas are idle. Potential is fair for rangeland and poor for other uses.

This map unit is best suited to rangeland. Grass grows well on Ruella soils. Rock outcrop is subject to geologic erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the plant community. Under these conditions the taller, more desirable grasses are replaced by less productive short grasses or by weeds. Grazing when the soil is wet causes soil compaction and poor tilth. Proper stocking rates, uniform grazing distribution, a planned grazing system, and restricted use during wet periods help keep the range and soils in good condition.

This map unit is poorly suited to windbreaks. Ruella soils are well suited to trees.

Ruella soils are well suited to dwellings and septic tank absorption fields. They have a moderate limitation for local roads and streets because of low strength. This limitation can be lessened by strengthening or replacing the base material. Ruella soils also have a moderate limitation for sewage lagoons because of slope and seepage. Sealing the lagoon reduces the seepage. The shale outcrop is poorly suited to most engineering uses because of steep slopes and because it is shallow to bedrock. This map unit is in capability subclass VIIs.

Sa—Shellabarger loamy sand, 0 to 3 percent slopes. This deep, nearly level to undulating, well drained soil is on uplands. It occurs on ridges. Individual areas range from 10 to 100 acres.

Typically, the surface layer is grayish brown loamy sand about 12 inches thick. The subsoil is about 26 inches thick. The upper part is brown, friable sandy loam; the middle part is reddish brown, firm sandy clay loam; and the lower part is reddish yellow, friable sandy loam. The substratum, to a depth of about 60 inches, is reddish yellow sandy loam. In some places, the surface layer is sandy loam or the subsoil is clay loam. In some areas, the surface layer is thicker.

Included with this soil in mapping are small areas of Pratt soils. The well drained Pratt soils have a loamy fine sand subsoil. They are higher on the landscape than the Shellabarger soil and are in convex areas. They make up about 5 percent of the map unit.

The surface layer is very friable, and tilth is good. Permeability is moderate. Runoff is slow. Available water capacity is moderate, and natural fertility is medium. Shrink-swell potential is low. Reaction is medium acid or slightly acid in the surface layer and is slightly acid or neutral in the subsoil.

About one-half of this soil is cultivated to wheat and sorghum, and the rest is rangeland. Potential is good for rangeland, windbreaks, openland wildlife habitat, and most engineering uses. It is fair for crops.

This soil is moderately well suited to small grains, sorghum, and alfalfa. If the soil is used for cultivated crops, soil blowing is a hazard. Returning crop residue to the soil, stripcropping, and stubble mulch tillage help control soil blowing and conserve moisture.

The use of this soil for rangeland is also effective in controlling soil blowing. Proper stocking rates, uniform grazing distribution, and a planned grazing system help keep the range in good condition.

This soil is well suited to trees grown as windbreaks and environmental plantings. Planting suitable species and preparing the site to control competing vegetation and soil blowing are necessary for success.

This soil is well suited to dwellings. It has a moderate limitation for local roads and streets because of low strength. This limitation can be lessened by strengthening or replacing the base material. This soil is well suited to septic tank absorption fields. It has a moderate limitation for sewage lagoons because of seepage. Sealing the lagoon reduces the seepage. This soil is in capability subclass IIIe.

Sb—Shellabarger sandy loam, 1 to 3 percent slopes. This deep, gently sloping, well drained soil is on uplands. It occurs on ridges and side slopes. Individual areas range from 10 acres to several thousand acres.

Typically, the surface layer is grayish brown sandy loam about 10 inches thick. The subsoil is about 35 inches thick. The upper part is brown, friable sandy loam; the middle part is reddish brown, firm sandy clay loam; and the lower part is reddish yellow, friable sandy loam. The substratum, to a depth of about 60 inches, is reddish yellow sandy loam. In some places, the surface layer is loamy sand or the subsoil is clay loam. Also, in some places, the subsoil is sandy loam throughout and the substratum is sand. In places, depth to bedrock is less than 40 inches.

The surface layer is very friable, and tilth is good. Permeability is moderate. Runoff is medium. Available water capacity is moderate, and natural fertility is medium. Shrink-swell potential is low. Reaction is medium acid or slightly acid in the surface layer and is slightly acid or neutral in the subsoil.

This soil is mostly cultivated to wheat and sorghum. Some areas are used for alfalfa or are rangeland. Potential is good for crops, rangeland, windbreaks, openland wildlife habitat, and most engineering uses.

This soil is well suited to small grains, sorghum, and legumes. If it is used for cultivated crops, water erosion and soil blowing are hazards. Terracing, contour farming, minimum tillage, and returning crop residue to the soil help control erosion and soil blowing and help conserve moisture. The undulating areas are not well suited to terraces and contour farming because of the irregular slopes. Stripcropping, minimum tillage, and returning crop residue to the soil, however, help control soil blowing on undulating soils.

The use of this soil for rangeland is also effective in controlling erosion and soil blowing. Proper stocking rates, uniform grazing distribution, and a planned grazing system help keep the range in good condition.

This soil is well suited to trees grown as windbreaks and environmental plantings. Planting suitable species and preparing the site to control competing vegetation are necessary for success.

This soil is well suited to dwellings and septic tank absorption fields. It has a moderate limitation for local roads and streets because of low strength. This limitation can be lessened by strengthening or replacing the base material. This soil has a moderate limitation for sewage lagoons because of seepage. Sealing the lagoon reduces the seepage. This map unit is in capability subclass IIe.

Sc—Shellabarger sandy loam, 3 to 6 percent slopes. This deep, sloping, well drained soil is on uplands. It occurs on side slopes. Individual areas range from 5 acres to several hundred acres.

Typically, the surface layer is grayish brown sandy loam about 9 inches thick. The subsoil is about 31 inches thick. The upper part is brown, friable sandy loam; the middle part is reddish brown, firm sandy clay loam; and the lower part is reddish yellow, friable sandy loam. The substratum, to a depth of about 60 inches, is reddish yellow sandy loam. In some areas, the subsoil is sandy loam throughout and the substratum is sand. In places, depth to bedrock is less than 40 inches.

The surface layer is very friable, and tilth is good. Permeability is moderate. Runoff is medium. Available water capacity is moderate, and natural fertility is medium. Shrink-swell potential is low. Reaction is medium acid or slightly acid in the surface layer and is slightly acid or neutral in the subsoil.

This soil is mostly cultivated to wheat and sorghum. Some areas are used for alfalfa or are rangeland. Potential is good for rangeland, windbreaks, openland wildlife habitat, and most engineering uses. It is fair for crops.

This soil is moderately well suited to small grains, sorghum, and legumes. If the soil is used for cultivated crops, water erosion and soil blowing are hazards. Terracing, contour farming, minimum tillage, and returning crop residue to the soil help control erosion and soil blowing and help conserve moisture.

The use of this soil for rangeland is also effective in controlling erosion and soil blowing. Proper stocking rates, uniform grazing distribution, and a planned grazing system help keep the range in good condition.

This soil is well suited to trees grown as windbreaks and environmental plantings. Planting suitable species and preparing the site to control competing vegetation are necessary for success.

This soil is well suited to dwellings and septic tank absorption fields. It has a moderate limitation for local roads and streets because of low strength. This limitation can be lessened by strengthening or replacing the base material. This soil has a moderate limitation for sewage lagoons because of seepage. Sealing the lagoon reduces the seepage. This map unit is in capability subclass IIIe.

Sd—Shellabarger sandy loam, 3 to 6 percent slopes, eroded. This deep, sloping, well drained soil is on uplands. It occurs on side slopes. Individual areas range from 5 acres to a few hundred acres.

Typically, the surface layer is brown sandy loam about 7 inches thick. It is as thick as the depth of plowing. It includes material that was formerly part of the subsoil. The subsoil is about 29 inches thick. The upper part is reddish brown, firm sandy clay loam. The lower part is reddish yellow, friable sandy loam. The substratum, to a depth of about 60 inches, is reddish yellow sandy loam. In some places, the surface layer is more than 10 inches thick. Also, in some areas, the subsoil is sandy loam throughout and the substratum is sand.

The surface layer is friable, and tilth is good. Permeability is moderate. Runoff is medium. Available water capacity is moderate, and natural fertility is low. Shrink-swell potential is low. Reaction is medium acid or slightly acid in the surface layer and is slightly acid or neutral in the subsoil.

This soil is cultivated to wheat and sorghum. Potential is good for rangeland, windbreaks, openland wildlife habitat, and most engineering uses. It is fair for crops.

This soil is moderately well suited to small grains, sorghum, and legumes. If the soil is used for cultivated crops, further erosion damage and soil blowing are hazards. Terracing, contour farming, minimum tillage, and returning crop residue to the soil help control erosion and soil blowing and help conserve moisture.

The use of this soil for rangeland is also effective in controlling erosion and soil blowing. Proper stocking rates, uniform grazing distribution, and a planned grazing system help keep the range in good condition.

This soil is well suited to trees grown as windbreaks and environmental plantings. Planting suitable species and preparing the site to control competing vegetation are necessary for success.

This soil is well suited to dwellings and septic tank absorption fields. It has a moderate limitation for local roads and streets because of low strength. This limitation can be lessened by strengthening or replacing the base material. This soil has a moderate limitation for sewage lagoons because of seepage. Sealing the lagoon reduces the seepage. This soil is in capability subclass IIIe.

Ta—Tivoli fine sand, hilly. This deep, hilly, excessively drained soil is on uplands (fig. 13). Individual areas range from 10 to 300 acres.

Typically, the surface layer is brown fine sand about 7 inches thick. The substratum, to a depth of about 60 inches, is pale brown fine sand. In some places, the surface layer is loamy fine sand.

Included with this soil in mapping are small areas of Pratt, Dillwyn, and Plevna soils. These soils occupy concave areas. The Pratt and Dillwyn soils are loamy fine sand throughout. The Pratt soils are well drained, and the Dillwyn soils are somewhat poorly drained. The poorly drained Plevna soils are fine sandy loam throughout. These soils make up about 5 percent of the map unit.

Permeability is rapid, and available water capacity is very low. Runoff is very slow, and natural fertility is low. Reaction ranges from slightly acid to mildly alkaline. The shrink-swell potential is low.

Most areas of this soil remain in native grass and are used for grazing. Potential is fair for rangeland. It is poor for crops, windbreaks, openland and rangeland wildlife habitat, and most engineering uses.

This soil is best suited to rangeland. Major concerns in range management are soil blowing and very low available water capacity. Adequate vegetative cover must be maintained to prevent soil blowing. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the plant community. Under these conditions the taller, more desirable grasses are replaced by less productive short grasses or by weeds. Proper stocking rates, uniform grazing distribution, and a planned grazing system help keep the range in good condition and prevent soil blowing.

This soil has a moderate limitation for dwellings, local roads and streets, and septic tank absorption fields because of slope. Septic tank absorption fields can pollute shallow ground water. This soil has a severe limitation for sewage lagoons because of seepage. Sealing the lagoon reduces the seepage. This map unit is in capability subclass VIIe.

Wa—Waldeck fine sandy loam. This deep, nearly level, somewhat poorly drained soil is on low terraces or high flood plains. It is occasionally flooded. Individual areas range from 5 acres to a few hundred acres.

Typically, the surface layer is grayish brown, calcareous fine sandy loam about 12 inches thick. The next layer is light brownish gray, very friable, calcareous fine sandy loam about 11 inches thick. The upper part of the substratum, to a depth of 36 inches, is light gray, mottled, calcareous fine sandy loam. The lower part, to a depth of about 60 inches, is very pale brown sand. In some places, the soil material is loam.

Included with this soil in mapping are small areas of Canadian, Dillwyn, and Plevna soils. The well drained Canadian soils are fine sandy loam and are slightly higher than the Waldeck soil. The somewhat poorly drained, sandy Dillwyn soils are on the same part of the landscape as the Waldeck soil. The poorly drained Plevna soils are fine sandy loam and are in concave areas. Included soils make up about 15 percent of the map unit.

The surface layer is very friable, and tilth is good. Permeability is moderately rapid. Runoff is slow. Available water capacity is moderate, and natural fertility is medium. Shrink-swell potential is low. Reaction is mildly alkaline or moderately alkaline throughout. Depth to the water table ranges from about 2 to 6 feet. Depth to sand ranges from 20 to 40 inches.

This soil is mostly cultivated to wheat and sorghum. Some areas are used for alfalfa or are rangeland. Potential is good for rangeland, windbreaks, and openland and rangeland wildlife habitat. It is fair for crops and poor for most engineering uses.

This soil is moderately well suited to small grains, sorghum, and legumes. If the soil is used for cultivated crops, wetness is a hazard. Drainage is generally not feasible. Returning crop residue to the soil and minimum tillage help maintain tilth and improve penetration of moisture into the soil.

This soil is well suited to rangeland. The water table is high enough to be within reach of native grass roots. Proper stocking rates, uniform grazing distribution, and a planned grazing system help keep the range in good condition.

This soil is well suited to trees grown as windbreaks and environmental plantings. Planting suitable species and preparing the site to control competing vegetation are necessary for success.

This soil has a severe limitation for dwellings, septic tank absorption fields, and sewage lagoons because of the hazard of flooding. Protection from flooding by dikes, levees, or other structures lessens this hazard. Septic tank absorption fields can pollute shallow ground water. This soil has a moderate limitation for local roads and streets because of flooding and wetness. This map unit is in capability subclass IIIw.

Za—Zenda clay loam. This deep, nearly level, somewhat poorly drained soil is on low terraces. It is occasionally flooded. Individual areas range from 5 acres to a few hundred acres.

Typically, the surface layer is dark gray, calcareous clay loam about 13 inches thick. The upper part of the substratum is grayish brown, calcareous clay loam. The middle part is grayish brown, mottled, calcareous clay loam. The lower part, to a depth of about 60 inches, is light gray and strong brown, calcareous clay loam. In some places, the soil material is fine sandy loam.

Included with this soil in mapping are small areas of Kaski soils. The well drained Kaski soils are less clayey and are higher than the Zenda soil. These soils make up about 5 percent of the map unit.

The surface layer is friable, and tilth is good. Permeability is moderate. Runoff is slow. Available water capacity is high, and natural fertility is medium. Shrink-swell potential is moderate. Reaction is neutral to moderately alkaline in the surface layer and is mildly alkaline or moderately alkaline in the substratum. Depth to the water table ranges from about 2 to 6 feet.

This soil is mostly cultivated to wheat and sorghum. Some areas are used for alfalfa or are rangeland. Potential is good for crops, rangeland, windbreaks, and rangeland wildlife habitat. It is poor for engineering uses.

This soil is well suited to small grains, sorghum, and legumes. If the soil is used for cultivated crops, wetness is a hazard. Drainage is generally not feasible. Returning crop residue to the soil and minimum tillage help maintain tilth and improve penetration of moisture into the soil.

This soil is well suited to rangeland. The water table is high enough to be within the reach of native grass roots. Overgrazing or grazing when the soil is wet causes soil compaction and poor tilth. Proper stocking rates, uniform grazing distribution, a planned grazing system, and restricted use during wet periods help keep the range and soil in good condition.

This soil is well suited to trees grown as windbreaks and environmental plantings. Planting suitable species and preparing the site to control competing vegetation are necessary for success.

This soil has a severe limitation for dwellings, septic tank absorption fields, and sewage lagoons because of the hazard of flooding. Protection from flooding by dikes, levees, or other structures decreases this hazard. This soil has a severe limitation for local roads and streets because of low strength and wetness. This limitation can be lessened by strengthening or replacing the base material. This soil is in capability subclass IIw.

Use and management of the soils

The soil survey is a detailed inventory and evaluation of the most basic resource of the survey area—the soil. It is useful in adjusting land use, including urbanization, to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in uses of the land.

While a soil survey is in progress, soil scientists, conservationists, engineers, and others keep extensive notes about the nature of the soils and about unique aspects of behavior of the soils. These notes include data on erosion, drought damage to specific crops, yield estimates, flooding, the functioning of septic tank disposal systems, and other factors affecting the productivity, potential, and limitations of the soils under various uses and management. In this way, field experience and measured data on soil properties and performance are used as a basis for predicting soil behavior.

Information in this section is useful in planning use and management of soils for crops, pasture, and rangeland; as sites for buildings, highways and other transportation systems, sanitary facilities, and parks and other recreation facilities; and for wildlife habitat. From the data presented, the potential of each soil for specified land uses can be determined, soil limitations to these land uses can be identified, and costly failures in houses and other structures, caused by unfavorable soil properties, can be avoided. A site where soil properties are favorable can be selected, or practices that will overcome the soil limitations can be planned.

Planners and others using the soil survey can evaluate the impact of specific land uses on the overall productivity of the survey area or other broad planning area and on the environment. Productivity and the environment are closely related to the nature of the soil. Plans should maintain or create a land use pattern in harmony with the natural soil.

Contractors can find information that is useful in locating sources of sand and gravel, roadfill, and topsoil. Other information indicates the presence of bedrock, wetness, or very firm soil horizons that cause difficulty in excavation.

Health officials, highway officials, engineers, and many other specialists also can find useful information in this soil survey. The safe disposal of wastes, for example, is closely related to properties of the soil. Pavements, sidewalks, campsites, playgrounds, lawns, and trees and shrubs are influenced by the nature of the soil.

Crops and pasture

Earl J. Bondy, conservation agronomist, Soil Conservation Service, assisted in preparing this section.

The major management concerns in the use of the soils for crops and pasture are described in this section. In addition, the crops or pasture plants best suited to the soil are discussed; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are presented for each soil.

This section provides information about the overall agricultural potential of the survey area and about the management practices that are needed. The information is useful to equipment dealers, land improvement contractors, fertilizer companies, processing companies, planners, conservationists, and others. For each kind of soil, information about management is presented in the section "Soil maps for detailed planning." Planners of management systems for individual fields or farms should also consider the detailed information given in the description of each soil.

Approximately 65 percent of the acreage in Kingman County was used for crops in 1967, according to the Kansas Conservation Needs Inventory. From 1965 to 1975, wheat was produced on approximately 70 percent of this cropland. Sorghum was produced on 13 percent. The remaining acreage was in summer fallow, or in small areas of oats, barley, rye, corn, and alfalfa. Also, a limited acreage was used as tame pasture.

The acreage cultivated to wheat has increased by 25 percent over the past 10 years compared to the previous 10 years. Acreage used for alfalfa and tame pasture grasses has increased, but it has decreased for all other crops.

Water erosion is a major problem on about 75 percent of the cropland in the county. It is a hazard on slopes of more than 1 percent. Soil blowing is an additional hazard on the sandier soils, such as Pratt, Albion, Farnum, and Shellabarger.

Loss of the surface layer through erosion is especially damaging on soils that have a clayey subsoil, such as Blanket and Renfrow soils. Control of erosion minimizes the pollution of streams by sediment and improves the quality of water.

If protective surface cover is used to control erosion, runoff is reduced and infiltration is increased. A cropping system that keeps plant cover on the soil for extended periods reduces soil erosion and preserves the productive capacity of the soils.

Terraces and diversions reduce the length of slopes and reduce runoff and erosion. They are most practical on deep, well drained soils that have uniform, regular slopes. They are suitable for nearly all of the soils in the county.

Contour tillage should generally be used in combination with terraces. Contour tillage is best suited to those soils that have smooth, uniform slopes and are suitable for terracing.

Leaving crop residue on the surface, either by minimum tillage or stubble mulching, helps to increase infiltration and reduce runoff and the hazard of water erosion. The extra cover is essential to help prevent wind erosion. These practices are becoming more common in Kingman County.

Information on the design of erosion control practices is available in the Soil Conservation Service county offices. The latest information and suggestions for growing crops can be obtained from the Cooperative Extension Service or the Soil Conservation Service.

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. Absence of an estimated yield indicates that the soil is not suited to the crop or the crop is not commonly grown on the soil.

The estimated yields were based mainly on the experience and records of farmers, conservationists, and extension agents. Results of field trials and demonstrations and available yield data from nearby counties were also considered.

The yields were estimated assuming that the latest soil and crop management practices were used. Hay and pasture yields were estimated for the most productive varieties of grasses and legumes suited to the climate and the soil. A few farmers may be obtaining average yields higher than those shown in table 5.

The management needed to achieve the indicated yields of the various crops depends on the kind of soil and the crop. Such management provides drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate tillage practices, including time of tillage and seedbed preparation and tilling when soil moisture is favorable; 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 residues, barnyard manure, and green-manure crops; harvesting crops with the smallest possible loss; and timeliness of all fieldwork.

The estimated yields reflect the productive capacity of the soils 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 included because the acreage of these crops is small. The local offices of the Soil Conservation Service and the Cooperative Extension Service can provide information about the management concerns and productivity of the soils for these crops.

Capability classes and subclasses

Capability classes and subclasses show, in a general way, the suitability of soils for most kinds of field crops. The soils are classed according to their limitations when they are used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops that require special management. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for forest trees, or for engineering purposes.

In Kingman County, all kinds of soil are grouped at two levels: capability class and subclass. They are defined in the following paragraphs. A survey area may not have soils of all classes.

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 landforms 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 too cold or too 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, though they have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability subclass is identified in the description of each soil map unit in the section "Soil maps for detailed planning."

Rangeland

Lynn Gibson, range conservationist, Soil Conservation Service, assisted in preparing this section.

About 35 percent of Kingman County is range. More than 40 percent of the farm income is derived from livestock, principally cattle. Cow-calf and stocker operations are about equal in the county. About one-third of the rangeland is ranches of 1,000 acres or larger. Most of the remaining rangeland is farming units.

On most livestock units, the forage produced on rangeland is supplemented by crop stubble and small grain. In winter, the native forage is supplemented by hay and various sources of protein.

Soils strongly influence the natural vegetation. Around the town of Murdock, shallow red-bed soils dominate. These soils support short and mid grasses. The remainder of the county is dominated by deep, loamy soils supporting mid and tall grasses.

Along major streams, soils that have a high water table have a high potential for producing tall grasses. These soils are becoming increasingly important as hay meadows and sources of water for livestock. In recent years, numerous dugout ponds have been installed in these areas to collect and store seep water for livestock.

Where climate and topography are about the same, differences in the kind and amount of vegetation that rangeland can produce are related closely to the kind of soil. Effective management is based on the relationships among soils, vegetation, and water.

Table 6 shows, for each kind of soil, the name of the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the expected percentage of each species in the composition of the potential natural plant community. Soils not listed cannot support a natural plant community that is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. The following are explanations of column headings in table 6.

A *range site* is a distinctive kind of rangeland that differs from other kinds of rangeland in its ability to produce a characteristic natural plant community. Soils that produce a similar kind, amount, and proportion of range plants are grouped into range sites. For those areas where the relationship between soils and vegetation has been established, range sites can be interpreted directly from the soil map. Properties that determine the capacity of the soil to supply moisture 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 refers to the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. 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 are such that growing conditions are substantially better than average; in a normal year these conditions are about average for the area; in an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight refers to the total air-dry vegetation produced per acre each year by the potential natural plant community. Vegetation that is highly palatable to livestock and vegetation that is unpalatable are included. Some of the vegetation can also be grazed extensively by wildlife.

Characteristic species of grasses, grasslike plants, forbs, and shrubs that make up most of the potential natural plant community on each soil are listed by common name. Under *Composition*, the expected proportion of each species is presented as the percentage, in air-dry weight, of the total annual production of herbaceous and woody plants. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season. Generally all of the vegetation produced is not used.

Range management requires, in addition to knowledge of the kinds of soil and the potential natural plant community, an evaluation of the present condition of the range vegetation in relation to its potential. 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. 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 maximum production of vegetation, 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.

The major concern on most rangeland is to control grazing so that the kinds and amounts of plants that make up the potential natural plant community are reestablished or maintained. The amount of forage is considerably less than that originally produced, because the natural vegetation in parts of the survey area has deteriorated by continued overgrazing. Much of the acreage that has always been grassland is now threatened by the invasion of woody species.

Reducing undesirable brush species and minimizing erosion are important management concerns. Sound range management based on soil survey information, other rangeland inventory information, and a grazing plan is the basis for maintaining or improving forage production.

Windbreaks and environmental plantings

Windbreaks are established to protect livestock, buildings, and yards from wind and snow. Windbreaks also help protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broad-leaved and coniferous species 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 depending on erodibility of the soil. They protect cropland and crops from wind, hold 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. A healthy planting stock of suitable species planted properly on a well prepared site and maintained in good condition can insure a high degree of plant survival.

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

Engineering

This section provides information about the use of soils for building sites, sanitary facilities, construction material, and water management. Among those who can benefit from this information are engineers, landowners, community planners, town and city managers, land developers, builders, contractors, and farmers and ranchers.

The ratings in the engineering tables are based on test data and estimated data in the "Soil properties" section. The ratings were determined jointly by soil scientists and engineers of the Soil Conservation Service using known relationships between the soil properties and the behavior of soils in various engineering uses.

Among the soil properties and site conditions identified by a soil survey and used in determining the ratings in this section were grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock that is within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure or aggregation, in-place soil density, and geologic origin of the soil material. Where pertinent, data about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of absorbed cations were also considered.

On the basis of information assembled about soil properties, ranges of values can be estimated for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, shear strength, compressibility, slope stability, and other factors of expected soil behavior in engineering uses. As appropriate, these values can be applied to each major horizon of each soil or to the entire profile.

These factors of soil behavior affect construction and maintenance of roads, airport runways, pipelines, foundations for small buildings, ponds and small dams, irrigation projects, drainage systems, sewage and refuse disposal systems, and other engineering works. The ranges of values can be used to (1) select potential residential, commercial, industrial, and recreational areas; (2) make preliminary estimates pertinent to construction in a particular area; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for location of sanitary landfills, onsite sewage disposal systems, and other waste disposal facilities; (5) plan detailed onsite investigations of soils and geology; (6) find sources of gravel, sand, clay, and topsoil; (7) plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; (8) relate performance of structures already built to the properties of the kinds of soil on which they are built so that performance of similar structures on the same or a similar soil in other locations can be predicted; and (9) predict the trafficability of soils for cross-country movement of vehicles and construction equipment.

Data presented in this section are useful for land use planning and for choosing alternative practices or general designs that will overcome unfavorable soil properties and minimize soil-related failures. Limitations to the use of these data, however, should be well understood. First, the data are generally not presented for soil material below a depth of 5 or 6 feet. Also, because of the scale of the detailed map in this soil survey, small areas of soils that differ from the dominant soil may be included in mapping. Thus, these data do not eliminate the need for onsite investigations, testing, and analysis by personnel having expertise in the specific use contemplated.

The information is presented mainly in tables. Table 8 shows, for each kind of soil, the degree and kind of limitations for building site development. Table 9 shows the degree and kind of limitations for sanitary facilities. Table 11 shows the kind of limitations for water management. Table 10 shows the suitability of each kind of soil as a source of construction materials.

The information in the tables, along with the soil map, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations and to construct interpretive maps for specific uses of land.

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

Building site development

The degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets are indicated in table 8. A *slight* limitation indicates that soil properties generally are favorable for the specified use; any limitation is minor and easily overcome. A *moderate* limitation indicates that soil properties and site features are unfavorable for the specified use, but the limitations can be overcome or minimized by special planning and design. A *severe* limitation indicates that one or more soil properties or site features are so unfavorable or difficult to overcome that a major increase in construction effort, special design, or intensive maintenance is required. For some soils rated severe, such costly measures may not be feasible.

Shallow excavations are made for pipelines, sewerlines, communications and power transmission lines, basements, open ditches, and cemeteries. Such digging or trenching is influenced by soil wetness caused by a seasonal high water table; the texture and consistence of soils; the tendency of soils to cave in or slough; and the presence of very firm, dense soil layers, bedrock, or large stones. In addition, excavations are affected by slope of the soil and the probability of flooding. Ratings do not apply to soil horizons below a depth of 6 feet unless otherwise noted.

In the soil series descriptions, the consistence of each soil horizon is given, and the presence of very firm or extremely firm horizons, usually difficult to excavate, is indicated.

Dwellings and *small commercial buildings* referred to in table 8 are built on undisturbed soil and have foundation loads of a dwelling no more than three stories high. Separate ratings are made for small commercial buildings without basements and for dwellings with and without basements. For such structures, soils should be sufficiently stable that cracking or subsidence of the structure from settling or shear failure of the foundation does not occur. These ratings were determined from estimates of the shear strength, compressibility, and shrink-swell potential of the soil. Soil texture, plasticity and in-place density, soil wetness, and depth to a seasonal high water table were also considered. Soil wetness and depth to a seasonal high water table indicate potential difficulty in providing adequate drainage for basements, lawns, and gardens. Depth to bedrock, slope, and large stones in or on the soil are also important considerations in the choice of sites for these structures and were considered in determining the ratings. Susceptibility to flooding is a serious hazard.

Local roads and streets referred to in table 8 have an all-weather surface that can carry light to medium traffic all year. They consist of a subgrade of the underlying soil material; a base of gravel, crushed rock fragments, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. The roads are graded with soil material at hand, and most cuts and fills are less than 6 feet deep.

The load supporting capacity and the stability of the soil as well as the quantity and workability of fill material available are important in design and construction of roads and streets. The classifications of the soil and the soil texture, density, and shrink-swell potential are indicators of the traffic supporting capacity used in making the ratings. Soil wetness, flooding, slope, depth to hard rock or very compact layers, and content of large stones affect stability and ease of excavation.

Sanitary facilities

Favorable soil properties and site features are needed for proper functioning of septic tank absorption fields, sewage lagoons, and sanitary landfills. The nature of the soil is important in selecting sites for these facilities and in identifying limiting soil properties and site features to be considered in design and installation. Also, those soil properties that affect ease of excavation or installation of these facilities will be of interest to contractors and local officials. Table 9 shows the degree and kind of limitations of each soil for such uses and for use of the soil as daily cover for landfills. It is important to observe local ordinances and regulations.

If the degree of soil limitation is expressed as *slight*, soils are generally favorable for the specified use and limitations are minor and easily overcome; if *moderate*, soil properties or site features are unfavorable for the specified use, but limitations can be overcome by special planning and design; and if *severe*, soil properties or site features are so unfavorable or difficult to overcome that major soil reclamation, special designs, or intensive maintenance is required. Soil suitability is rated by the terms *good*, *fair*, or *poor*, which mean about the same as *slight*, *moderate*, and *severe*.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into the natural soil. Only the soil horizons between depths of 18 and 72 inches are evaluated for this use. The soil properties and site features considered are those that affect the absorption of the effluent and those that affect the construction of the system.

Properties and features that affect absorption of the effluent are permeability, depth to seasonal high water table, depth to bedrock, and susceptibility to flooding. Stones, boulders, and shallowness to bedrock interfere with installation. Excessive slope can cause lateral seepage and surfacing of the effluent. Also, soil erosion and soil slippage are hazards if absorption fields are installed on sloping soils.

In some soils, loose sand and gravel or fractured bedrock is less than 4 feet below the tile lines. In these soils the absorption field does not adequately filter the effluent, and ground water in the area may be contaminated.

On many of the soils that have moderate or severe limitations for use as septic tank absorption fields, a system to lower the seasonal water table can be installed or the size of the absorption field can be increased so that performance is satisfactory.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons have a nearly level floor and cut slopes or embankments of compacted soil material. Aerobic lagoons generally are designed to hold 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.

Soils that are very high in content of organic matter and those that have cobbles, stones, or boulders are not suitable. Unless the soil has very slow permeability, contamination of ground water is a hazard where the seasonal high water table is above the level of the lagoon floor. In soils where the water table is seasonally high, seepage of ground water into the lagoon can seriously reduce the lagoon's capacity for liquid waste. Slope, depth to bedrock, and susceptibility to flooding also affect the suitability of sites for sewage lagoons or the cost of construction. Shear strength and permeability of compacted soil material affect the performance of embankments.

Sanitary landfill is a method of disposing of solid waste by placing refuse in successive layers either in excavated trenches or on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil material. Landfill areas are subject to heavy vehicular traffic. Risk of polluting ground water and trafficability affect the suitability of a soil for this use. The best soils have a loamy or silty texture, have moderate to slow permeability, are deep to a seasonal water table, and are not subject to flooding. Clayey soils are likely to be sticky and difficult to spread. Sandy or gravelly soils generally have rapid permeability, which might allow noxious liquids to contaminate ground water. Soil wetness can be a limitation, because operating heavy equipment on a wet soil is difficult. Seepage into the refuse increases the risk of pollution of ground water.

Ease of excavation affects the suitability of a soil for the trench type of landfill. A suitable soil is deep to bedrock and free of large stones and boulders. If the seasonal water table is high, water will seep into trenches.

Unless otherwise stated, the limitations in table 9 apply only to the soil material within a depth of about 6 feet. If the trench is deeper, a limitation of slight or moderate may not be valid. Site investigation is needed before a site is selected.

Daily cover for landfill should be soil that is easy to excavate and spread over the compacted fill in wet and dry periods. Soils that are loamy or silty and free of stones or boulders are better than other soils. Clayey soils may be sticky and difficult to spread; sandy soils may be subject to soil blowing.

The soils selected for final cover of landfills should be suitable for growing plants. Of all the horizons, the A horizon in most soils has the best workability, more organic matter, and the best potential for growing plants. Thus, for either the area- or trench-type landfill, stockpiling material from the A horizon for use as the surface layer of the final cover is desirable.

If it is necessary to bring in soil material for daily or final cover, thickness of suitable soil material available and depth to a seasonal high water table in soils surrounding the sites should be evaluated. Other factors to be evaluated are those that affect reclamation of the borrow areas. These factors include slope, erodibility, and potential for plant growth.

Construction materials

The suitability of each soil as a source of roadfill, sand, gravel, and topsoil is indicated in table 10 by ratings of good, fair, or poor. The texture, thickness, and organic-matter content of each soil horizon are important factors in rating soils for use as construction material. Each soil is evaluated to the depth observed, generally about 6 feet.

Roadfill is soil material used in embankments for roads. Soils are evaluated as a source of roadfill for low embankments, which generally are less than 6 feet high and less exacting in design than high embankments. The ratings reflect the ease of excavating and working the material and the expected performance of the material where it has been compacted and adequately drained. The performance of soil after it is stabilized with lime or cement is not considered in the ratings, but information about some of the soil properties that influence such performance is given in the descriptions of the soil series.

The ratings apply to the soil material between the A horizon and a depth of 5 to 6 feet. It is assumed that soil horizons will be mixed during excavation and spreading. Many soils have horizons of contrasting suitability within their profile. The estimated engineering properties in table 14 provide specific information about the nature of each horizon. This information can help determine the suitability of each horizon for roadfill.

Soils rated *good* are coarse grained. They have low shrink-swell potential and few cobbles and stones. They are at least moderately well drained and have slopes of 15 percent or less. Soils rated *fair* have a plasticity index of less than 15 and have other limiting features, such as moderate shrink-swell potential, moderately steep slopes, wetness, or many stones. If the thickness of suitable material is less than 3 feet, the entire soil is rated *poor*.

Sand and *gravel* are used in great quantities in many kinds of construction. The ratings in table 10 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in table 14.

Topsoil is used in areas where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material in preparing a seedbed and by the ability of the soil material to support plantlife. Also considered is the damage that can result at the area from which the topsoil is taken.

The ease of excavation is influenced by the thickness of suitable material, wetness, slope, and amount of stones. The ability of the soil to support plantlife is determined by texture, structure, and the amount of soluble salts or toxic substances. Organic matter in the A1 or Ap horizon greatly increases the absorption and retention of moisture and nutrients. Therefore, the soil material from these horizons should be carefully preserved for later use.

Soils rated *good* have at least 16 inches of friable loamy material at their surface. They are free of stones and cobbles, are low in content of gravel, and have gentle slopes. They are low in soluble salts that can limit or prevent plant growth. They are naturally fertile or respond well to fertilizer. They are not so wet that excavation is difficult during most of the year.

Soils rated *fair* are loose sandy soils or firm loamy or clayey soils in which the suitable material is only 8 to 16 inches thick or soils that have appreciable amounts of gravel, stones, or soluble salt.

Soils rated *poor* are very sandy soils and very firm clayey soils; soils with suitable layers less than 8 inches thick; soils having large amounts of gravel, stones, or soluble salt; steep soils; and poorly drained soils.

Although a rating of *good* is not based entirely on high content of organic matter, a surface horizon is generally preferred for topsoil because of its organic-matter content. This horizon is designated as A1 or Ap in the soil series descriptions. The absorption and retention of moisture and nutrients for plant growth are greatly increased by organic matter.

Water management

Many soil properties and site features that affect water management practices have been identified in this soil survey. In table 11 the soil and site features that affect use are indicated for each kind of soil. This information is significant in planning, installing, and maintaining water-control structures.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have a low seepage potential, which is determined by permeability and the depth to fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material that is resistant to seepage, erosion, and piping and has favorable stability, shrink-swell potential, shear strength, and compaction characteristics. Large stones and organic matter in a soil downgrade the suitability of a soil for use in embankments, dikes, and levees.

Drainage of soil is affected by such soil properties as permeability; texture; depth to bedrock, hardpan, or other layers that affect the rate of water movement; depth to the water table; slope; stability of ditchbanks; susceptibility to flooding; salinity and alkalinity; and availability of outlets for drainage.

Irrigation is affected by such features as slope, susceptibility to flooding, hazards of water erosion and soil blowing, texture, presence of salts and alkali, depth of root zone, rate of water intake at the surface, permeability of the soil below the surface layer, available water capacity, need for drainage, and depth to the water table.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to intercept runoff. They allow water to soak into the soil or flow slowly to an outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock, hardpan, or other unfavorable material; large stones; permeability; ease of establishing vegetation; and resistance to water erosion, soil blowing, soil slipping, and piping.

Grassed waterways are constructed to channel runoff to outlets at a nonerosive velocity. Features that affect the use of soils for waterways are slope, permeability, erodibility, wetness, and suitability for permanent vegetation.

Recreation

Robert J. Higgins, biologist, Soil Conservation Service, assisted in preparing this section.

Kingman County has several areas of scenic, geologic, and historic significance. Cheney Reservoir, Kingman State Fishing Lake, farm ponds, and the Ninnescah and Chikaskia Rivers provide opportunities for water-based recreation on both private and publicly-owned lands.

The soils of the survey area are rated in table 12 according to limitations that affect their suitability for recreation uses. The ratings are based on such restrictive soil features as flooding, wetness, slope, and texture of the surface layer. Not considered in these ratings, but important in evaluating a site, are location and accessibility of the area, size and shape of the area and its scenic quality, the ability of the soil to support vegetation, access to water, potential water impoundment sites available, and either access to public sewerlines or capacity of the soil to absorb septic tank effluent. Soils subject to flooding are limited, in varying degree, for recreation use by the duration and intensity of flooding and the season when flooding occurs. Onsite assessment of height, duration, intensity, and frequency of flooding is essential in planning recreation facilities.

The degree of the limitation of the soils is expressed as slight, moderate, or severe. *Slight* means that the soil properties are generally favorable and that the limitations are minor and easily overcome. *Moderate* means that the 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 12 can be supplemented by information in other parts of this survey. Especially helpful are interpretations for septic tank absorption fields, given in table 9, and interpretations for dwellings without basements and for local roads and streets, given in table 8.

Camp areas require such site preparation as shaping and leveling for 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 for this use 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 camping sites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for use as 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 will 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 or boulders, is firm after rains, and is not dusty when dry. If shaping is required to obtain a uniform grade, the depth of the soil over bedrock or hardpan should be enough to allow necessary grading.

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

Wildlife habitat

Robert J. Higgins, biologist, Soil Conservation Service, assisted in preparing this section.

The primary game species in Kingman County are the pheasant, bobwhite quail, mourning dove, cottontail rabbit, fox squirrel, white-tailed and mule deer, and several species of waterfowl.

Nongame species of wildlife within the county are numerous because of the diverse number of habitat types. Cropland, woodland, and grassland are interspersed throughout the county, creating a desirable effect that is conducive to many species. Each of these habitat types provide a home for a particular group of species.

Furbearers are common along the Ninnescah and Chikaskia Rivers and their tributaries. Trapping is done on a limited basis.

Lakes, ponds, and streams provide good to excellent fishing. Species common to the county are bass, channel catfish and flathead catfish, bluegill, and carp.

In developing a specific habitat for wildlife, the plant cover should be a kind that the soils can support, and it should be properly located. Onsite technical assistance in planning wildlife areas and in determining suitable species of vegetation for planting can be obtained from the Soil Conservation Service; the Kansas Fish and Game Commission; and the Cooperative Extension Service.

Soils directly affect the kind and amount of vegetation that is available to wildlife as food and cover, and they affect the construction of water impoundments. The kind and abundance of wildlife that populate an area depend largely on the amount and distribution of food, cover, and water. If any one of these elements is missing, is inadequate, or is inaccessible, wildlife either are scarce or do not inhabit the area.

If the soils have the potential, wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by helping the natural establishment of desirable plants.

In table 13, the soils in the survey area are rated according to their potential to support the main kinds of wildlife habitat in the area. This information can be used in planning for parks, wildlife refuges, nature study areas, and other developments for wildlife; selecting areas that are suitable for wildlife; selecting soils that are suitable for creating, improving, or maintaining specific elements of wildlife habitat; and 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* means that the element of wildlife habitat or the kind of habitat is easily created, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected if the soil is used for the designated purpose. A rating of *fair* means that the element of wildlife habitat or kind of habitat can be created, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* means that limitations are severe for the designated element or kind of wildlife habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* means that restrictions for the element of wildlife habitat or kind of habitat are very severe and that unsatisfactory results can be expected. Wildlife habitat is impractical or even impossible to create, improve, or maintain on soils having such a rating.

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

Grain and seed crops are seed-producing annuals used by wildlife. The major soil properties 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, oats, barley, and grain sorghum.

Grasses and legumes are domestic perennial grasses and herbaceous legumes that are planted for wildlife food and cover. Major soil properties 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, that provide food and cover for wildlife. Major soil properties 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 bluestems, indiangrass, switchgrass, wheatgrass, grama, sand lovegrass, ragweed, prairieclover, and partridgepea.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, or foliage used by wildlife or that provide cover and shade for some species of wildlife. Major soil properties that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and moisture. Examples of shrubs are sumacs, American plum, buckbrush, and prairie rose.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites, exclusive of submerged or floating aquatics. They produce food or cover for wildlife that use wetland as habitat. Major soil properties affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, saltgrass, cattails, cordgrass, buttonbush, indigobush, rushes, sedges, and reeds.

Shallow water areas are bodies of water that have an average depth of less than 5 feet and that are useful to wildlife. They can be naturally wet areas, or they can be created by dams or levees or by water-control structures in marshes or streams. Major soil properties affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. The availability of a dependable water supply is important if water areas are to be developed. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The kinds of wildlife habitat are briefly described in the following paragraphs.

Openland habitat 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 kinds of wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail rabbit, and red fox.

Wetland habitat consists of open, marshy or swampy, shallow water areas where water-tolerant plants grow. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, beaver, and redwinged blackbirds.

Rangeland habitat consists of areas of wild herbaceous plants and shrubs. Wildlife attracted to rangeland include prairie dogs, coyotes, badger, jackrabbits, mule deer, hawks, and meadowlark.

Soil properties

Extensive data about soil properties are summarized on the following pages. The two main sources of these data are the many thousands of soil borings made during the course of the survey and the laboratory analyses of selected soil samples from typical profiles.

In making soil borings during field mapping, soil scientists can identify several important soil properties. They note the seasonal soil moisture condition or the presence of free water and its depth. For each horizon in the profile, they note the thickness and color of the soil material; the texture or amount of clay, silt, sand, and gravel or other coarse fragments; the structure, or the natural pattern of cracks and pores in the undisturbed soil; and the consistence of the soil material in place under the existing soil moisture conditions. They record the depth of plant roots, determine the pH, or reaction, of the soil, and identify any free carbonates.

Samples of soil material are analyzed in the laboratory to verify the field estimates of soil properties and to determine all major properties of key soils, especially properties that cannot be estimated accurately by field observation. Laboratory analyses are not conducted for all soil series in the survey area, but laboratory data for many soil series not tested are available from nearby survey areas.

The available field and laboratory data are summarized in tables. The tables give the estimated range of engineering properties, the engineering classifications, and the physical and chemical properties of each major horizon of each soil in the survey area. They also present data about pertinent soil and water features.

Engineering properties

Table 14 gives estimates of engineering properties and classifications for the major horizons of each soil in the survey area.

Most soils have, within the upper 5 or 6 feet, horizons of contrasting properties. Table 14 gives information for each of these contrasting horizons in a typical profile. *Depth* to the upper and lower boundaries of each horizon is indicated. More information about the range in depth and about other properties in each horizon is given for each soil series in the section "Soil series and morphology."

Texture is described in table 14 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 soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loam." Other texture terms are defined in the Glossary.

The two systems commonly used in classifying soils for engineering use are the Unified Soil Classification System (Unified) (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO) (*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, plasticity index, liquid limit, and organic-matter content. Soils are grouped into 15 classes—eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes have a dual classification symbol, for example, CL-ML.

The *AASHTO* system classifies soils according to those properties that affect their use in highway construction and maintenance. In this system a mineral soil is classified in one of seven basic groups ranging from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines. At the other extreme, in group A-7, are fine-grained soils. Highly organic soils are classified in group A-8 on the basis of visual inspection.

When laboratory data are available, the A-1, A-2, and A-7 groups are further classified as follows: A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6. As an additional refinement, the desirability of soils as subgrade material can be indicated by a group index number. These numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The estimated classification, without group index numbers, is given in table 14. Also in table 14 the percentage, by weight, of rock fragments more than 3 inches in diameter is estimated for each major horizon. These estimates are determined mainly by observing volume percentage in the field and then converting that, by formula, to weight percentage.

Percentage of the soil material less than 3 inches in diameter that passes each of four sieves (U.S. standard) is estimated for each major horizon. The estimates are based on tests of soils that were sampled in the survey area and in nearby areas and on field estimates from many borings made during the survey.

Liquid limit and *plasticity index* indicate the effect of water on the strength and consistence of soil. These indexes are used in both the Unified and AASHTO soil classification systems. They are also used as indicators in making general predictions of soil behavior. Range in liquid limit and in plasticity index is estimated on the basis of test data from the survey area or from nearby areas and on observations of the many soil borings made during the survey.

In some surveys, the estimates are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterburg limits extend a marginal amount across classification boundaries (1 or 2 percent), the classification in the marginal zone is omitted.

Physical and chemical properties

Table 15 shows estimated values for several soil characteristics and features that affect behavior of soils in engineering uses. These estimates are given for each major horizon, at the depths indicated, in the typical pedon of each soil. The estimates are based on field observations and on test data for these and similar soils.

Permeability is estimated on the basis of known relationships among the soil characteristics observed in the field—particularly soil structure, porosity, and gradation or texture—that influence the downward movement of water in the soil. The estimates are for vertical water movement when the soil is saturated. Not considered in the estimates is lateral seepage or such transient soil features as plowpans and surface crusts. Permeability of the soil is an important factor to be considered in planning and designing drainage systems, in evaluating the potential of soils for septic tank systems and other waste disposal systems, and in many other aspects of land use and management.

Available water capacity is rated on the basis of soil characteristics that influence the ability of the soil to hold water and make it available to plants. Important characteristics are content of organic matter, soil texture, and soil structure. Shallow-rooted plants are not likely to use the available water from the deeper soil horizons. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design of irrigation systems. It is commonly expressed as inches of water per inch of soil.

Soil reaction is expressed as a range in pH values. The range in pH of each major horizon is based on many field checks. For many soils, the values have been verified by laboratory analyses. Soil reaction is important in selecting the crops, ornamental plants, or other plants to be grown; in evaluating soil amendments for fertility and stabilization; and in evaluating the corrosivity of soils.

Salinity 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 the nonirrigated soils. The salinity of individual irrigated fields is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of individual fields can differ greatly from the value given in table 15. Salinity affects the suitability of a soil for crop production, its stability when used as a construction material, and its potential to corrode metal and concrete.

Shrink-swell potential depends mainly on the amount and kind of clay in the soil. Laboratory measurements of the swelling of undisturbed clods were made for many soils. For others the swelling was estimated on the basis of the kind and amount of clay in the soil and on measurements of similar soils. The size of the load and the magnitude of the change in soil moisture content also influence the swelling of soils. Shrinking and swelling of some soils can cause damage to building foundations, basement walls, roads, and other structures unless special designs are used. A high shrink-swell potential indicates that special design and added expense may be required if the planned use of the soil will not tolerate large volume changes.

Erosion factors are used to predict the erodibility of a soil and its tolerance to erosion in relation to specific kinds of land use and treatment. The soil erodibility factor (K) is a measure of the susceptibility of the soil to erosion by water. Soils having the highest K values are the most erodible. K values range from 0.10 to 0.64. To estimate annual soil loss per acre, the K value of a soil is modified by factors representing plant cover, grade and length of slope, management practices, and climate. The soil-loss tolerance factor (T) is the maximum rate of soil erosion, whether from rainfall or soil blowing, that can occur without reducing crop production or environmental quality. The rate is expressed in tons of soil loss per acre per year.

Wind erodibility groups are made up of soils that have similar properties that affect their resistance to soil blowing if cultivated. The groups are used to predict the susceptibility of soil to blowing and the amount of soil lost as a result of blowing. Soils are grouped according to the following distinctions:

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

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible, but 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, but 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, but 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, but 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, but 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, and 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, and crops can easily be grown.

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

Soil and water features

Table 16 contains information helpful in planning land uses and engineering projects that are likely to be affected by soil and water features.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are placed in one of four groups on the basis of the intake of water after the soils have been wetted and have received 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 chiefly of deep, well drained to excessively drained sands or gravels. 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 that have a layer that impedes the downward movement of water or soils that have 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 clay soils 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 is the temporary covering of soil with water from overflowing streams, with runoff from adjacent slopes, and by tides. Water standing for short periods after rains or after snow melts is not considered flooding, nor is water in swamps and marshes. Flooding is rated in general terms that describe the frequency and duration of flooding and the time of year when flooding is most likely. The ratings are based on evidence in the soil profile of the effects of flooding, namely thin strata of gravel, sand, silt, or, in places, clay deposited by floodwater; irregular decrease in organic-matter content with increasing depth; and absence of distinctive soil horizons that form in soils of the area that are not subject to flooding. The ratings are also based on local information about floodwater levels in the area and the extent of flooding and on information that relates the position of each soil on the landscape to historic floods.

The generalized description of flood hazards is of value in land use planning and provides a valid basis for land use restrictions. The soil data are less specific, however, than those provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table is the highest level of a saturated zone more than 6 inches thick for a continuous period of more than 2 weeks during most years. The depth to a seasonal high water table applies to undrained soils. Estimates are based mainly on the relationship between grayish colors or mottles in the soil and the depth to free water observed in many borings made during the course of the soil survey. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table, that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. Only saturated zones above a depth of 5 or 6 feet are indicated.

Information about the seasonal high water table helps in assessing the need for specially designed foundations, the need for specific kinds of drainage systems, and the need for footing drains to insure dry basements. Such information is also needed to decide whether or not construction of basements is feasible and to determine how septic tank absorption fields and other underground installations will function. Also, a seasonal high water table affects ease of excavation.

Depth to bedrock is shown for all soils that are underlain by bedrock at a depth of 5 to 6 feet or less. For many soils, the limited depth to bedrock is a part of the definition of the soil series. The depths shown are based on measurements made in many soil borings and on other observations made during the mapping of the soils. The kind of bedrock and its hardness as related to ease of excavation are also shown. Rippable bedrock can be excavated with a single-tooth ripping attachment on a 200-horsepower tractor, but hard bedrock generally requires blasting.

Risk of corrosion pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to soil moisture, particle-size distribution, total acidity, and electrical conductivity of the soil material. The rate of corrosion of concrete is based mainly on the sulfate content, texture, and acidity of the soil. Protective measures for steel or more resistant concrete help to avoid or minimize damage resulting from the corrosion. Uncoated steel intersecting soil boundaries or soil horizons is more susceptible to corrosion than an installation that is entirely within one kind of soil or within one soil horizon.

Soil series and morphology

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

Characteristics of the soil and the material in which it formed are discussed for each series. The soil is then compared to similar soils and to nearby soils of other series. Then a pedon, a small three-dimensional area of soil that is typical of the soil series in the survey area, is described. The detailed descriptions of each soil horizon follow standards in the Soil Survey Manual (*6*). Unless otherwise noted, matrix colors described are for dry soil.

Following the pedon description is the range of important characteristics of the soil series in this survey area. Phases, or map units, of each soil series are described in the section "Soil maps for detailed planning."

Albion series

The Albion series consists of well drained soils on uplands. These soils are moderately deep over sand and gravel. They formed in loamy and sandy old alluvium. They have moderately rapid permeability. Slope ranges from 0 to 15 percent.

Albion soils are similar to Canadian, Pratt, and Shellabarger soils and are commonly near Clark, Farnum, and Shellabarger soils on the landscape. Canadian and Clark soils do not have an argillic horizon. The Clark soils are fine loamy and calcareous. Pratt soils are sandy. Farnum and Shellabarger soils are fine loamy.

Typical pedon of Albion sandy loam, 1 to 3 percent slopes, (fig. 14) 2,440 feet east and 125 feet south of the northwest corner of sec. 9, T. 27 S., R. 10 W.

A1—0 to 8 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; medium acid; clear smooth boundary.

B21t—8 to 12 inches; grayish brown (10YR 5/2) sandy loam, dark brown (10YR 3/3) moist; moderate medium granular structure; hard, friable; slightly acid; clear smooth boundary.

B22t—12 to 16 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; moderate medium granular structure; hard, friable; slightly acid; gradual smooth boundary.

B3—16 to 26 inches; light yellowish brown (10YR 6/4) coarse sandy loam, yellowish brown (10YR 5/4) moist; weak medium granular structure; slightly hard, friable; slightly acid; gradual smooth boundary.

IIC—26 to 60 inches; light yellowish brown (10YR 6/4) sand, yellowish brown (10YR 5/4) moist; single grained; loose; neutral.

Thickness of the solum and depth to sand or sand and gravel range from 20 to 40 inches. Rounded pebbles that range in diameter from 2 mm to 2 inches are 0 to 25 percent, by volume, throughout the soil. The A horizon is sandy loam or fine sandy loam 6 to 12 inches thick. Reaction is medium acid or slightly acid. Hue is 10YR or 7.5YR, value is 4 or 5 (3 moist), and chroma is 2 or 3. The B2t horizon has hue of 10YR to 5YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 6. It is slightly acid or neutral. The IIC horizon is mostly sand, coarse sand, or gravelly sand. It has hue of 10YR to 5YR, value of 4 to 6 (4 or 5 moist), and chroma of 3 to 8. The IIC horizon ranges from slightly acid to moderately alkaline.

Albion sandy loam, 0 to 1 percent slopes, is outside the range of the Albion series because it lacks an argillic horizon. This difference does not alter the usefulness or behavior of this soil.

Blanket series

The Blanket series consists of deep, well drained soils on uplands. These soils formed in old alluvium or loess or both. Permeability is moderately slow. Slope ranges from 0 to 4 percent.

Blanket soils are similar to McLain, Farnum, and Pond Creek soils and are commonly near Case, Clark, Farnum, and Pond Creek soils on the landscape. McLain soils have a redder argillic horizon. Case and Clark soils do not have an argillic horizon and are calcareous. Farnum soils are fine loamy; Pond Creek soils are fine silty.

Typical pedon of Blanket silt loam, 1 to 3 percent slopes, 2,165 feet north and 100 feet west of the southeast corner of sec. 2, T. 29 S., R. 10 W.

A1—0 to 12 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak medium granular structure; slightly hard, friable; slightly acid; clear smooth boundary.

B1—12 to 18 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; hard, firm; neutral; clear smooth boundary.

B21t—18 to 30 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate medium blocky structure; very hard, very firm; mildly alkaline; clear smooth boundary.

B22t—30 to 42 inches; grayish brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) moist; moderate medium blocky structure; very hard, very firm; strong effervescence; moderately alkaline; gradual smooth boundary.

B3—42 to 50 inches; grayish brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) moist; weak medium blocky structure; very hard, very firm; common small calcium carbonate concretions; violent effervescence; moderately alkaline; gradual smooth boundary.

C—50 to 60 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 5/3) moist; massive; very hard, firm; few small calcium carbonate concretions; violent effervescence; moderately alkaline.

The solum ranges from about 40 to 70 inches in thickness. The A horizon is silt loam, silty clay loam, or clay loam 8 to 20 inches thick. It has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 2 or 3. Reaction is slightly acid or neutral. The B2t horizon is silty clay, clay, or clay loam. Hue is 10YR or 7.5YR, value is 3 to 5 (2 to 4 moist), and chroma is 2 or 3. Reaction ranges from slightly acid to moderately alkaline. In most pedons, the lower part of the B2t horizon is calcareous. The C horizon is silty clay loam or clay loam. It has hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4.

Blanket silty clay loam, 1 to 4 percent slopes, eroded, is a taxadjunct to the Blanket series because either the surface layer is thinner than the defined range of the series or the mollic epipedon is less than 20 inches thick or both. These differences do not alter the usefulness or behavior of the soil.

Canadian series

The Canadian series consists of deep, well drained soils on low terraces. These soils formed in loamy alluvium. Permeability is moderately rapid. Slope ranges from 0 to 1 percent.

Canadian soils are similar to Albion soils and are commonly near Kaski, Lincoln, and Waldeck soils on the landscape. Albion soils have an argillic horizon. Waldeck soils are more poorly drained. Lincoln soils are sandy. Kaski soils are fine loamy and have a mollic epipedon more than 20 inches thick.

Typical pedon of Canadian fine sandy loam, 2,080 feet north and 375 feet east of the southwest corner of sec. 25, T. 28 S., R. 6 W.

A1—0 to 16 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, very friable; slightly acid; clear smooth boundary.

B2—16 to 32 inches; brown (10YR 5/3) fine sandy loam, dark grayish brown (10YR 4/2) moist; moderate medium granular structure; slightly hard, very friable; slightly acid; gradual smooth boundary.

C—32 to 60 inches; brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) moist; massive; slightly hard, very friable; neutral.

The solum ranges from 20 to 40 inches in thickness. The A horizon is fine sandy loam or sandy loam from 8 to 20 inches thick. It has hue of 10YR or 7.5YR, value of 3 to 5 (2 or 3 moist), and chroma of 2 or 3. It is slightly acid or neutral. The B2 horizon is fine sandy loam or sandy loam. It has hue of 10YR or 7.5YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 6. It is slightly acid or neutral. The C horizon is fine sandy loam or sandy loam. Hue is 10YR or 7.5YR, value is 5 to 7 (4 to 6 moist), and chroma is 3 to 6. Reaction ranges from slightly acid to mildly alkaline. In some pedons, loamy fine sand is below a depth of 40 inches.

Carwile series

The Carwile series consists of deep, somewhat poorly drained soils on uplands. These soils formed in either old alluvium or loamy eolian sediments. Permeability is slow. Slope ranges from 0 to 1 percent.

Carwile soils are near Farnum, Pratt, Shellabarger, and Tivoli soils on the landscape. These nearby soils are better drained than Carwile soils. Farnum and Shellabarger soils are fine loamy, and Pratt and Tivoli soils are sandy.

Typical pedon of Carwile fine sandy loam, 600 feet north and 225 feet east of the southwest corner of sec. 20, T. 27 S., R. 5 W.

A1—0 to 10 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable; slightly acid; clear smooth boundary.

B1—10 to 18 inches; very dark grayish brown (10YR 3/2) clay loam, very dark brown (10YR 2/2) moist; few fine faint yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; hard, friable; slightly acid; clear smooth boundary.

B2t—18 to 36 inches; light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; common medium distinct strong brown (7.5YR 5/6) mottles; weak medium blocky structure; very hard, very firm; neutral; gradual smooth boundary.

B3—36 to 45 inches; mottled light brownish gray (10YR 6/2) and strong brown (7.5YR 5/6) sandy clay loam, grayish brown (10YR 5/2) and strong brown (7.5YR 5/6) moist; weak medium blocky structure; very hard, firm; neutral; gradual smooth boundary.

C—45 to 60 inches; strong brown (7.5YR 5/6) sandy clay loam, strong brown (7.5YR 5/6) moist; common fine distinct light brownish gray (10YR 6/2) mottles; massive; hard, friable; moderately alkaline.

The solum ranges from 30 to 60 inches in thickness. The A horizon is 8 to 20 inches thick. It has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. It is slightly acid or neutral. The B2t horizon is clay or clay loam. It has hue of 10YR, value of 4 to 6 (3 to 5 moist), and chroma of 1 or 2. The B2t, B3, and C horizons have few to many, fine or medium, distinct, brown, red, or gray mottles. The B2t horizon is slightly acid or neutral. The C horizon is sandy clay loam, clay, or fine sandy loam. Hue is 10YR, 7.5YR, or 2.5Y, value is 4 to 6 (4 or 5 moist), and chroma is 2 to 6. In some pedons, the C horizon is calcareous and contains accumulations of lime.

Case series

The Case series consists of deep, well drained soils on uplands. These soils formed in loamy, calcareous old alluvium. Permeability is moderate. Slope ranges from 2 to 15 percent.

Case soils are similar to Clark and Ruella soils and are commonly near Albion, Blanket, Clark, and Farnum soils on the landscape. Clark soils have a mollic epipedon. Ruella soils have redder hue, and they contain less carbonates than the Case soil. Albion, Blanket, and Farnum soils have a mollic epipedon and argillic horizon and are deeper to calcareous material than Case soils. In addition, Albion soils are coarse loamy, and Blanket soils are fine.

Typical pedon of Case clay loam from an area of Case-Clark clay loams, 2 to 6 percent slopes, 1,500 feet north and 120 feet east of the southwest corner of sec. 2, T. 28 S., R. 10 W.

Ap—0 to 8 inches; pale brown (10YR 6/3) clay loam, brown (10YR 4/3) moist; weak medium granular structure; hard, friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

C1ca—8 to 22 inches; very pale brown (10YR 8/3) clay loam, pale brown (10YR 6/3) moist; moderate medium granular structure; hard, friable; violent effervescence; moderately alkaline; gradual smooth boundary.

C2ca—22 to 60 inches; very pale brown (10YR 7/4) clay loam, light yellowish brown (10YR 6/4) moist; weak medium granular structure; hard, friable; violent effervescence; moderately alkaline.

The solum or the A horizon ranges from 3 to 8 inches in thickness. The soil material is calcareous, and reaction is mildly alkaline or moderately alkaline throughout. The A horizon is dominantly clay loam, but in some places it is loam. It has hue of 10YR or 7.5YR, value of 4 to 7 (3 to 6 moist), and chroma of 1 to 4. The C horizon is clay loam or loam. It has hue of 10YR or 7.5YR, value of 5 to 8 (4 to 6 moist), and chroma of 2 to 6.

Clark series

The Clark series consists of deep, well drained soils on uplands. These soils formed in loamy, calcareous old alluvium (fig. 15). Permeability is moderate. Slope ranges from 0 to 8 percent.

Clark soils are similar to Case and Ruella soils and are commonly near Albion, Blanket, Case, and Farnum soils on the landscape. Case and Ruella soils lack a mollic epipedon. Albion, Blanket, and Farnum soils have an argillic horizon. In addition, Albion soils are coarse loamy, and Blanket soils are fine.

Typical pedon of Clark clay loam, 1 to 4 percent slopes, 900 feet east and 150 feet north of the southwest corner of sec. 6, T. 29 S., R. 9 W.

A1—0 to 11 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, friable; strong effervescence; moderately alkaline; clear smooth boundary.

AC—11 to 16 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; moderate medium granular structure; hard, friable; violent effervescence; moderately alkaline; gradual smooth boundary.

Cca—16 to 60 inches; light yellowish brown (10YR 6/4) clay loam, yellowish brown (10YR 5/4) moist; weak medium granular structure; hard, friable; violent effervescence; about 40 percent by volume masses of calcium carbonate; moderately alkaline.

The solum ranges from 10 to 24 inches in thickness. Reaction in all horizons is mildly alkaline or moderately alkaline. The A horizon is dominantly clay loam, but in some places it is loam. It ranges from 4 to 14 inches in thickness. Hue is 10YR or 7.5YR, value is 3 to 5 (2 or 3 moist), and chroma is 1 to 3. The AC horizon is dominantly clay loam, but in some places it is loam. It has hue of 10YR or 7.5YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 4. The C horizon is dominantly clay loam, but in some places it is loam. It has hue of 10YR, 7.5YR, or 5YR; value of 5 to 7 (4 to 6 moist); and chroma of 2 to 8.

Dillwyn series

The Dillwyn series consists of deep, somewhat poorly drained soils on flood plains. These soils formed in sandy alluvium or eolian deposits. Permeability is rapid. Slope ranges from 0 to 1 percent.

Dillwyn soils are similar to Lincoln, Plevna, Pratt, Tivoli, and Waldeck soils and are commonly near these soils on the landscape. Lincoln, Pratt, and Tivoli soils are not mottled within 40 inches of the surface. Plevna and Waldeck soils have a mollic epipedon and are coarse loamy.

Typical pedon of Dillwyn loamy fine sand from an area of Dillwyn-Plevna complex, 1,450 feet north and 160 feet east of the southwest corner of sec. 30, T. 27 S., R. 10 W.

A1—0 to 8 inches; grayish brown (10YR 5/2) loamy fine sand, very dark brown (10YR 2/2) moist; weak fine and medium granular structure; soft, very friable; many fine roots; neutral; clear smooth boundary.

AC—8 to 20 inches; pale brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) moist; common fine faint brownish yellow (10YR 6/6) mottles; weak fine granular structure; soft, very friable; few fine roots; neutral; gradual smooth boundary.

C—20 to 60 inches; very pale brown (10YR 7/3) loamy fine sand, pale brown (10YR 6/3) moist; common medium faint brownish yellow (10YR 6/6) mottles; single grained; loose both dry and moist; neutral.

The solum ranges from 14 to 35 inches in thickness. The A horizon is typically loamy fine sand, and less commonly fine sandy loam or fine sand. It ranges from 4 to 10 inches in thickness. It has hue of 10YR, value of 3 to 5 (2 to 4 moist), and chroma of 2 or 3. It is slightly acid or neutral. The AC horizon is loamy fine sand or fine sand. It has hue of 10YR, value of 5 or 6 (4 or 5 moist), and chroma of 2 to 4. It has common, fine or medium, faint or distinct mottles with chroma that is higher than the matrix. It is slightly acid or neutral. The C horizon is loamy fine sand or fine sand. Hue is 10YR, value is 5 to 7 (4 to 6 moist), and chroma is 3 or 4. Reaction ranges from slightly acid to mildly alkaline. In some pedons, the lower part of the C horizon is not mottled.

Farnum series

The Farnum series consists of deep, well drained soils on uplands. These soils formed in loamy old alluvium that has been modified by wind. Permeability is moderately slow. Slope ranges from 0 to 6 percent.

Farnum soils are similar to Blanket, Pond Creek, and Shellabarger soils and are commonly near Albion, Blanket, Carwile, and Shellabarger soils on the landscape. Albion soils are coarse loamy. Blanket and Carwile soils are fine, and Carwile soils have mottles in the upper argillic horizon. Pond Creek soils are fine silty. Shellabarger soils have a mollic epipedon less than 20 inches thick.

Typical pedon of Farnum loam, 1 to 3 percent slopes, 665 feet east and 150 feet south of the northwest corner of sec. 3, T. 29 S., R. 7 W.

Ap—0 to 9 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, friable; medium acid; clear smooth boundary.

A12—9 to 13 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable; slightly acid; clear smooth boundary.

B1—13 to 18 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, firm; neutral; clear smooth boundary.

B21t—18 to 32 inches; brown (10YR 4/3) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate fine blocky; very hard, firm; continuous clay films on faces of peds; neutral; gradual smooth boundary.

B22t—32 to 45 inches; brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) moist; moderate medium prismatic structure parting to moderate fine blocky; very hard, firm; patchy clay films on faces of peds; neutral; gradual smooth boundary.

B3—45 to 52 inches; light brown (7.5YR 6/4) sandy clay loam, brown (7.5YR 5/4) moist; weak medium subangular blocky structure; hard, friable; neutral; gradual smooth boundary.

C—52 to 60 inches; light brown (7.5YR 6/4) sandy loam, brown (7.5YR 5/4) moist; massive; slightly hard, very friable; neutral.

The solum ranges from 30 inches to more than 60 inches in thickness. The A horizon is loam, fine sandy loam, or sandy loam 8 to 20 inches thick. It has hue of 10YR or 7.5YR, value of 3 to 5 (2 or 3 moist), and chroma of 2 or 3. It ranges from medium acid to neutral. The B2t horizon is clay loam, sandy clay loam, or loam. Hue is 10YR or 7.5YR, value is 4 to 6 (3 to 5 moist), and chroma is 2 to 4. Reaction ranges from neutral to moderately alkaline. The C horizon is loam, clay loam, sandy clay loam, or sandy loam. It has hue of 10YR, 7.5YR, or 5YR; value of 4 to 6 (3 to 5 moist); and chroma of 3 or 4. It ranges from neutral to moderately alkaline. In some pedons, the B and C horizons have mottles with chroma of more than 2.

Farnum clay loam, 2 to 6 percent slopes, eroded, is a taxadjunct to the Farnum series because the surface layer is thinner than the defined range of the series or the mollic epipedon is less than 20 inches thick, or both. These differences do not alter the usefulness or behavior of the soil.

Kaski series

The Kaski series consists of deep, well drained soils on flood plains. These soils formed in loamy alluvium. Permeability is moderate. Slope ranges from 0 to 1 percent.

Kaski soils are similar to Waldeck and Zenda soils and are commonly near Canadian, Farnum, Shellabarger, Waldeck, and Zenda soils on the landscape. Canadian soils are coarse loamy. Farnum and Shellabarger soils have an argillic horizon. Waldeck and Zenda soils have a mollic epipedon less than 20 inches thick and are more poorly drained. In addition, Waldeck soils are coarse loamy.

Typical pedon of Kaski loam, 150 feet east and 425 feet north of the southwest corner of sec. 30, T. 28 S., R. 9 W.

A11—0 to 18 inches; dark grayish brown (10YR 4/2) loam, black (10YR 2/1) moist; weak medium granular structure; slightly hard, friable; slightly acid; gradual smooth boundary.

A12—18 to 28 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, friable; neutral; gradual smooth boundary.

AC—28 to 42 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; weak medium granular structure; hard, friable; mildly alkaline; gradual smooth boundary.

C—42 to 60 inches; brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; massive; slightly hard, friable; mildly alkaline.

The solum ranges from 30 to 50 inches in thickness. Depth to free carbonates ranges from 15 inches to more than 60 inches, and typically it is more than 30 inches. The A horizon typically is loam, and less commonly clay loam. It ranges from 15 to 36 inches in thickness. It has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 to 3. Reaction is slightly acid or neutral. The AC horizon is loam or clay loam. Hue is 7.5YR or 10YR, value is 3 to 6 (2 to 4 moist), and chroma is 1 to 3. Reaction ranges from slightly acid to mildly alkaline. The C horizon is loam, clay loam, or sandy loam. It has hue of 7.5YR or 10YR, value of 5 or 6 (4 or 5 moist), and chroma of 2 to 4. Reaction ranges from neutral to moderately alkaline.

Kingman series

The Kingman series consists of deep, poorly drained soils on flood plains. These soils formed in loamy alluvium. Permeability is moderately slow. Slopes range from 0 to 2 percent.

Kingman soils are similar to Plevna, Waldeck, and Zenda soils and commonly are near Farnum, Shellabarger, Waldeck, and Zenda soils on the landscape. Farnum and Shellabarger soils are well drained and on adjacent uplands. They have an argillic horizon and are fine loamy. Plevna and Waldeck soils are coarse loamy. Zenda soils are fine loamy.

Typical pedon of Kingman silty clay loam, 1,180 feet south and 100 feet west of the northeast corner of sec. 2, T. 28 S., R. 9 W.

A1—0 to 18 inches; gray (10YR 5/1) silty clay loam, black (10YR 2/1) moist; moderate medium granular structure; hard, friable; many roots; strong effervescence; moderately alkaline; clear smooth boundary.

B2g—18 to 30 inches; gray (10YR 5/l) silty clay loam, dark gray (N 4/0) moist; common medium distinct brown (7.5YR 5/4) mottles; moderate medium granular structure; hard, firm; common roots; violent effervescence; moderately alkaline; gradual smooth boundary.

B3g—30 to 48 inches; gray (10YR 6/1) silty clay loam, dark gray (N 4/0) moist; common fine distinct light olive brown (2.5Y 5/4) mottles; weak medium granular structure; hard, firm; few roots; common soft spots of lime; violent effervescence; moderately alkaline; gradual smooth boundary.

C—48 to 60 inches; light gray (10YR 6/1) silty clay loam, dark gray (10YR 4/1) moist; massive; hard, friable; slight effervescence; moderately alkaline.

The solum ranges from 36 to 60 inches in thickness. These soils typically are calcareous throughout, and they are mildly alkaline or moderately alkaline. The A horizon is 12 to 24 inches thick. It has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. In some pedons, the lower part of the A horizon is mottled. The Bg horizon has hue of 10YR, 2.5Y, or N; value of 5 to 7 (4 or 5 moist); and chroma of 2 or less. It is faintly to prominently mottled. The C horizon has hue of 10YR to 5Y, value of 5 to 7 (4 or 5 moist), and chroma of 1 or 2. In some pedons, sandy layers extend downward below 40 inches.

Lincoln series

The Lincoln series consists of deep, somewhat excessively drained soils on flood plains. These soils formed in sandy alluvium. Permeability is rapid. Slope ranges from 0 to 2 percent.

These soils are taxadjuncts to the Lincoln series because they are noncalcareous, are more acid than the range in the series, and lack strata finer than loamy fine sand in the 10 to 40 inch control section. These differences do not alter the usefulness or behavior of the soils.

Lincoln soils are similar to Tivoli soils and are commonly near Dillwyn, Plevna, Pratt, Tivoli, and Waldeck soils on the landscape. Pratt soils have an argillic horizon. Plevna and Waldeck soils are coarse loamy. Dillwyn, Plevna, and Waldeck soils have mottles within 30 inches of the surface. Tivoli soils formed in eolian sands and commonly contain finer sand.

Typical pedon of Lincoln loamy sand, 1,900 feet east and 150 feet north of the southwest corner of sec. 23, T. 27 S., R. 6 W.

A1—0 to 10 inches; grayish brown (10YR 5/2) loamy sand, dark grayish brown (10YR 4/2) moist; weak medium granular structure; soft, very friable; many fine roots; slightly acid; clear smooth boundary.

C—10 to 60 inches; light yellowish brown (10YR 6/4) sand, yellowish brown (10YR 5/4) moist; single grained; loose; slightly acid.

The A horizon is typically loamy sand and less commonly sand, loamy fine sand, or sandy loam. It ranges from 6 to 15 inches in thickness. It has hue of 10YR or 7.5YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 4. Reaction is slightly acid or neutral. The C horizon is loamy sand or sand and contains 0 to 10 percent, by volume, particles larger than 2 mm. Hue is 10YR, 7.5YR, or 5YR; value is 5 to 7 (4 to 6 moist); and chroma is 2 to 6. The C horizon ranges from slightly acid to mildly alkaline.

McLain series

The McLain series consists of deep, well drained soils on terraces. These soils formed in loamy alluvium. Permeability is slow. Slope ranges from 0 to 1 percent.

McLain soils are similar to Blanket soils and are commonly near Kaski, Owens, and Renfrow soils on the landscape. Blanket soils are less red in the B2t horizon. Renfrow soils have a mollic epipedon less than 20 inches thick. Kaski and Owens soils lack an argillic horizon. In addition, Owens soils have shale at less than 20 inches, and Kaski soils are fine loamy.

Typical pedon of McLain silt loam, 1,990 feet south and 200 feet west of the northeast corner of sec. 7, T. 28 S., R. 5 W.

A1—0 to 14 inches; brown (7.5YR 4/2) silt loam, dark brown (7.5YR 3/2) moist; weak medium granular structure; hard, friable; slightly acid; clear smooth boundary.

B1—14 to 22 inches; brown (7.5YR 4/2) silty clay loam, very dark brown (7.5YR 2/2) moist; moderate medium subangular blocky structure; very hard, firm; slightly acid; gradual smooth boundary.

B2t—22 to 36 inches; reddish brown (5YR 5/4) silty clay, reddish brown (5YR 4/4) moist; moderate medium blocky structure; very hard, very firm; continuous clay films on faces of peds; neutral; gradual smooth boundary.

B3—36 to 42 inches; reddish brown (5YR 5/4) silty clay loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; very hard, firm; mildly alkaline; gradual smooth boundary.

C—42 to 60 inches; reddish brown (5YR 5/4) loam, reddish brown (5YR 4/4) moist; massive; hard, friable; weak effervescence; moderately alkaline.

The solum ranges from 30 inches to more than 60 inches in thickness. The A horizon is primarily silt loam, but in some places it is silty clay loam or clay loam. It ranges from 7 to 22 inches in thickness. It has hue of 7.5YR or 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 2 or 3. The A horizon is slightly acid or neutral. The B2t horizon is silty clay loam, clay loam, silty clay, or clay. Hue is 5YR, value is 3 to 5 (2 to 4 moist), and chroma is 2 through 4. Reaction ranges from slightly acid to mildly alkaline. The C horizon is loam, clay loam, silt loam, or silty clay loam. It has hue of 5YR or 2.5YR, value of 4 to 6 (3 to 5 moist), and chroma of 4 to 8. Reaction ranges from neutral to moderately alkaline.

Nashville series

The Nashville series consists of moderately deep, well drained soils on uplands. These soils formed in loamy residuum weathered from siltstone. Permeability is moderate. Slope ranges from 1 to 12 percent.

Nashville soils are similar to Pond Creek soils, and are commonly near Pond Creek and Quinlan soils. Pond Creek soils have an argillic horizon and depth to bedrock is more than 40 inches. Quinlan soils lack a mollic epipedon and depth to bedrock is less than 20 inches.

Typical pedon of Nashville silt loam, 1 to 3 percent slopes, 925 feet east and 125 feet north of the southwest corner of sec. 20, T. 29 S., R. 7 W.

A1—0 to 12 inches; brown (7.5YR 5/3) silt loam, dark brown (7.5YR 3/2) moist; weak medium granular structure; slightly hard, friable; medium acid; clear smooth boundary.

B2—12 to 28 inches; reddish brown (5YR 5/4) silt loam, dark reddish brown (5YR 3/4) moist; moderate medium granular structure; slightly hard, friable; neutral; clear smooth boundary.

Cr—28 to 60 inches; soft siltstone.

The solum and depth to siltstone range from 20 to 40 inches. The A1 horizon is 7 to 20 inches thick. It has hue of 7.5YR or 5YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It ranges from medium acid to neutral. The B2 horizon has hue of 5YR or 2.5YR, value of 4 or 5 (3 or 4 moist), and chroma of 3 to 6. It is slightly acid or neutral.

Owens series

The Owens series consists of shallow, well drained soils on uplands. These soils formed in clayey residuum from shale. Permeability is very slow. Slope ranges from 1 to 4 percent.

Owens soils are commonly near Renfrow and Ruella soils on the landscape. Renfrow and Ruella soils are more than 20 inches deep to shale. In addition, the Renfrow soils have a mollic epipedon and an argillic horizon. Ruella soils are fine loamy.

Typical pedon of Owens clay loam, 1 to 4 percent slopes, (fig. 16) 1,175 feet north and 125 feet east of the southwest corner of sec. 7, T. 28 S., R. 5 W.

A1—0 to 6 inches; reddish brown (5YR 5/4) clay loam, dark reddish brown (5YR 3/4) moist; weak medium granular structure; very hard, very firm; moderately alkaline; clear smooth boundary.

B2—6 to 16 inches; reddish brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) moist; weak medium blocky structure; extremely hard, very firm; weak effervescence; moderately alkaline; gradual smooth boundary.

Cr—16 to 60 inches; clayey shale.

The solum and depth to clayey shale range from 10 to 20 inches. The solum is moderately alkaline throughout. The A horizon is clay loam or clay 3 to 10 inches thick. It has hue of 7.5YR, 5YR, or 2.5YR; value of 4 or 5 (3 or 4 moist); and chroma of 2 to 4. The B2 horizon has hue of 5YR or 2.5YR, value of 4 to 6 (3 to 5 moist), and chroma of 4.

Plevna series

The Plevna series consists of deep, poorly drained soils on flood plains. These soils formed in loamy and sandy alluvium. Permeability is moderately rapid. Slope ranges from 0 to 1 percent.

Plevna soils are similar to Dillwyn, Waldeck, and Zenda soils and are commonly near Dillwyn, Lincoln, Waldeck, and Zenda soils on the landscape. Dillwyn and Lincoln soils are sandy. In addition, the Lincoln soils are not mottled within a depth of 40 inches. Waldeck and

Zenda soils are better drained than Plevna soils. Zenda soils are also fine loamy.

Typical pedon of Plevna fine sandy loam from an area of Dillwyn-Plevna complex, 700 feet south and 100 feet east of the northwest corner of sec. 35, T. 27 S., R. 8 W.

A11—0 to 11 inches; dark gray (10YR 4/1) fine sandy loam, very dark gray (10YR 3/1) moist; weak medium granular structure; slightly hard, very friable; neutral; clear smooth boundary.

A12—11 to 19 inches; grayish brown (10YR 5/2) fine sandy loam; very dark grayish brown (10YR 3/2) moist; few fine faint yellowish brown (10YR 5/6) mottles; moderate medium granular structure; slightly hard, very friable; mildly alkaline; gradual smooth boundary.

B2g—19 to 36 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; common fine distinct strong brown (7.5YR 5/6) mottles; weak medium granular structure; slightly hard, very friable; moderately alkaline; gradual smooth boundary.

IIC—36 to 60 inches; light gray (10YR 7/2) sand, light brownish gray (10YR 6/2) moist; single grained; loose both dry and moist; moderately alkaline.

The solum ranges from 30 to 60 inches in thickness. Reaction of the solum ranges from neutral to moderately alkaline. The A horizon is typically fine sandy loam or sandy loam and less commonly loamy fine sand and ranges from 10 to 24 inches in thickness. The A horizon has hue of 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. The Bg horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 1 or 2. The IIC horizon is fine sand or sand. Hue is 10YR or 2.5Y, value is 5 to 7 (4 to 6 moist), and chroma is 1 to 4.

Pond Creek series

The Pond Creek series consists of deep, well drained soils on uplands. These soils formed in loess or old alluvium or both. Permeability is moderately slow. Slope ranges from 1 to 3 percent.

Pond Creek soils are similar to Blanket, Farnum, and Nashville soils and are commonly near Blanket, Farnum, Nashville, and Quinlan soils on the landscape. Blanket soils are fine. Farnum soils are fine loamy. Nashville soils do not have an argillic horizon and are less than 40 inches deep to bedrock. Quinlan soils also do not have an argillic horizon but are less than 20 inches deep to bedrock.

Typical pedon of Pond Creek silt loam, 1 to 3 percent slopes, 2,015 feet north and 175 feet west of the southeast corner of sec. 15, T. 28 S., R. 10 W.

A1—0 to 10 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak fine granular structure; slightly hard, friable; medium acid; clear smooth boundary.

B1—10 to 19 inches; brown (10YR 4/3) silt loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; hard, friable; slightly acid; clear smooth boundary.

B2t—19 to 42 inches; brown (7.5YR 4/3) silty clay loam, dark brown (7.5YR 3/3) moist; moderate medium subangular blocky structure; hard, firm; neutral; gradual smooth boundary.

B3—42 to 52 inches; brown (7.5YR 5/3) silty clay loam, dark brown (7.5YR 3/3) moist; weak medium subangular blocky structure; hard, friable; mildly alkaline; gradual smooth boundary.

C—52 to 60 inches; brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/4) moist; massive; hard, friable; weak effervescence; common soft accumulations of lime; mildly alkaline.

The solum ranges from 40 inches to more than 60 inches in thickness. The A horizon ranges from 8 to 20 inches in thickness. It has hue of 10YR or 7.5YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It ranges from medium acid to neutral. The B2t horizon is silt loam or silty clay loam. Hue is 10YR, 7.5YR, or 5YR; value is 4 or 5 (3 or 4 moist); and chroma is 2 to 4. Reaction is slightly acid or neutral. The C horizon is silt loam or silty clay loam. Hue is 7.5YR or 5YR, value is 4 or 5 (3 or 4 moist), and chroma is 3 to 6. Reaction ranges from neutral to moderately alkaline.

Pratt series

The Pratt series consists of deep, well drained soils on uplands. These soils formed in sandy eolian deposits. Permeability is rapid. Slope ranges from 2 to 12 percent.

Pratt soils are similar to Tivoli soils and are commonly near Carwile, Shellabarger, and Tivoli soils on the landscape. Carwile soils are fine. Shellabarger soils are fine loamy. Tivoli soils do not have an argillic horizon.

Typical pedon of Pratt loamy fine sand, undulating, 570 feet south and 130 feet west of the northeast corner of sec. 6, T. 30 S., R. 10 W.

A1—0 to 12 inches; pale brown (10YR 6/3) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; slightly acid; clear smooth boundary.

B2t—12 to 36 inches; light yellowish brown (10YR 6/4) loamy fine sand, brown (10YR 4/3) moist; weak coarse subangular blocky structure; slightly hard, very friable; slightly acid; gradual smooth boundary.

C—36 to 60 inches; light yellowish brown (10YR 6/4) loamy fine sand, yellowish brown (10YR 5/4) moist; single grained; loose both dry and moist; neutral.

The solum ranges from 24 to 50 inches in thickness. The A horizon is loamy fine sand or fine sand 8 to 20 inches thick. It has hue of 10YR or 7.5YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 or 3. It is medium acid to neutral. The B2t horizon has hue of 10YR or 7.5YR, value of 4 to 6 (4 or 5 moist), and chroma of 2 to 4. It is medium acid to neutral. The C horizon is loamy fine sand or fine sand. Hue is 10YR or 7.5YR, value is 5 or 6 (4 or 5 moist), and chroma is 3 or 4. Reaction is slightly acid or neutral.

Quinlan series

The Quinlan series consists of shallow, well drained soils on uplands. These soils formed in residuum from sandstone or siltstone. Permeability is moderately rapid. Slope ranges from 1 to 15 percent.

Quinlan soils are commonly near Nashville and Pond Creek soils. Pond Creek soils have a mollic epipedon, and an argillic horizon. Nashville soils have a mollic epipedon and depth to bedrock is 20 to 40 inches.

Typical pedon of Quinlan loam, 1 to 3 percent slopes, 200 feet east and 100 feet south of the northwest corner of sec. 33, T. 29 S., R. 7 W.

A1—0 to 8 inches; reddish brown (5YR 5/4) loam, dark reddish brown (5YR 3/4) moist; weak medium granular structure; slightly hard, friable; weak effervescence; moderately alkaline; clear smooth boundary.

B2—8 to 13 inches; reddish brown (5YR 5/4) loam, reddish brown (5YR 4/4) moist; weak medium granular structure; slightly hard, friable; a few pieces of soft sandstone; strong effervescence; moderately alkaline; clear smooth boundary.

Cr—13 to 60 inches; fine grained sandstone.

Thickness of the solum and depth to bedrock range from 10 to 20 inches. Typically, the soil is calcareous throughout, but some pedons are noncalcareous. Reaction is mildly alkaline or moderately alkaline. The A and B horizons are silt loam or loam. The A horizon is 4 to 10 inches thick. Hue is 7.5YR, 5YR, or 2.5YR; value is 4 to 6 (3 to 5 moist); and chroma is 3 to 6. The B horizon has hue of 7.5YR, 5YR, or 2.5YR; value of 4 to 6 (3 to 5 moist); and chroma of 4 to 6.

Renfrow series

The Renfrow series consists of deep, well drained soils on uplands. These soils formed in residuum weathered from shale or clay. Permeability is very slow. Slope ranges from 1 to 3 percent.

Renfrow soils are commonly near McLain, Owens, and Ruella soils. McLain soils have a mollic epipedon more than 20 inches thick. Owens soils lack a mollic epipedon and an argillic horizon. Their depth to shale is less than 20 inches. Ruella soils are fine loamy.

Typical pedon of Renfrow clay loam, 2,000 feet south and 125 feet east of the northwest corner of sec. 7, T. 28 S., R. 5 W.

A1—0 to 8 inches; brown (7.5YR 4/3) clay loam, dark brown (7.5YR 3/2) moist; weak medium granular structure; hard, friable; slightly acid; clear smooth boundary.

B1—8 to 12 inches; brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure; hard, friable; slightly acid; clear smooth boundary.

B21t—12 to 24 inches; reddish brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) moist; moderate medium blocky structure; very hard, very firm; neutral; gradual smooth boundary.

B22t—24 to 50 inches; reddish brown (2.5YR 4/5) clay, dark reddish brown (2.5YR 3/5) moist; moderate coarse blocky structure; extremely hard, very firm; few fine calcareous concretions; moderately alkaline; gradual smooth boundary.

Cr—50 to 60 inches; clayey shale.

Thickness of the solum and depth to clayey shale are more than 40 inches. The A horizon is typically clay loam, but in some places it is silty clay loam. It ranges from 5 to 12 inches in thickness. It has hue of 7.5YR or 5YR, value of 3 to 5 (2 or 3 moist), and chroma of 2 or 3. It is slightly acid to neutral. The B2t horizon is clay, silty clay, or clay loam. Hue is 5YR or 2.5YR, value is 4 to 6 (3 to 5 moist), and chroma is 3 to 6. The B2t horizon ranges from slightly acid to moderately alkaline. In a few pedons, thin B3 and C horizons are above the Cr horizon.

Ruella series

The Ruella series consists of deep, well drained soils on uplands. These soils appear to have formed in loess of local origin. Permeability is moderate. Slope ranges from 1 to 6 percent.

Ruella soils are similar to Case, Nashville, and Quinlan soils and are commonly near Owens and Renfrow soils on the landscape. Case soils contain more calcium carbonate and have a thinner solum. Nashville soils have bedrock at depths of 20 to 40 inches. Owens soils are shallow to shale and are more clayey. Renfrow soils have a mollic epipedon and an argillic horizon. They are more clayey than Ruella soils.

Typical pedon of Ruella clay loam, 1 to 4 percent slopes, 1,915 feet east and 150 feet south of the northwest corner of sec. 30, T. 28 S., R. 5 W.

A1—0 to 10 inches; reddish brown (2.5YR 4/4) clay loam, dark reddish brown (2.5YR 3/4) moist; weak medium granular structure; hard, friable; slight effervescence; moderately alkaline; clear smooth boundary.

B2—10 to 30 inches; reddish brown (2.5YR 4/4) clay loam, dark reddish brown (2.5YR 3/4) moist; weak medium subangular blocky structure; hard, firm; slight effervescence; moderately alkaline; gradual smooth boundary.

C—30 to 60 inches; reddish brown (2.5YR 4/4) clay loam, dark reddish brown (2.5YR 3/4) moist; massive; hard, friable; strong effervescence; moderately alkaline.

The solum ranges from 24 to 50 inches in thickness. The soil is mildly alkaline or moderately alkaline. The A1 horizon is from 4 to 15 inches thick. Hue is 7.5YR, 5YR, or 2.5YR; value is 4 or 5 (3 or 4 moist); and chroma is 4 to 6. The B2 horizon is clay loam or loam. It has hue of 2.5YR or 5YR, value of 4 to 6 (3 to 5 moist), and chroma of 4 to 6. The C horizon is clay loam or loam. It has the same colors as the B2 horizon. In some pedons, clayey material is below a depth of 40 inches.

Shellabarger series

The Shellabarger series consists of deep, well drained soils on uplands. These soils formed in loamy old alluvium. Permeability is moderate. Slope ranges from 0 to 6 percent.

Shellabarger soils are similar to Albion and Farnum soils and are near Albion, Farnum, and Pratt soils. Albion soils are coarse loamy. Farnum soils have a mollic epipedon more than 20 inches thick. Pratt soils are sandy.

Typical pedon of Shellabarger sandy loam, 1 to 3 percent slopes, 1,020 feet south and 100 feet east of the northwest corner of sec. 27, T. 27 S., R. 8 W.

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

B1—10 to 16 inches; brown (7.5YR 4/2) sandy loam, dark brown (7.5YR 3/2) moist; weak medium subangular blocky structure; slightly hard, friable; slightly acid; clear smooth boundary.

B2t—16 to 34 inches; reddish brown (5YR 4/4) sandy clay loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; hard, firm; slightly acid; gradual smooth boundary.

B3—34 to 45 inches; reddish yellow (5YR 6/6) sandy loam, yellowish red (5YR 5/6) moist; weak medium subangular blocky structure; slightly hard, friable; slightly acid; gradual smooth boundary.

C—45 to 60 inches; reddish yellow (7.5YR 6/6) sandy loam, strong brown (7.5YR 5/6) moist; massive; soft, very friable; slightly acid.

The solum ranges from about 30 to 60 inches in thickness. The A horizon typically is sandy loam or fine sandy loam and is less commonly loamy sand or loamy fine sand. It ranges from 6 to 18 inches in thickness. It has hue of 10YR or 7.5YR, value of 3 to 5 (2 or 3 moist), and chroma of 2 or 3. It is medium acid or slightly acid. The B2t horizon has hue of 5YR, value of 4 to 6 (3 to 5 moist), and chroma of 3 to 6. It is slightly acid or neutral. The C horizon is sandy loam, fine sandy loam, or loamy sand. Hue is 5YR or 7.5YR, value is 4 to 6 (4 to 6 moist), and chroma is 4 to 6. Reaction ranges from slightly acid to moderately alkaline.

Shellabarger sandy loam, 3 to 6 percent slopes, eroded, is a taxadjunct to the Shellabarger series because it does not have the mollic epipedon that is common to the series. This difference does not alter the usefulness or behavior of the soil.

Tivoli series

The Tivoli series consists of deep, excessively drained, rapidly permeable soils on uplands. They formed in sandy eolian materials. Slopes range from 5 to 30 percent.

Tivoli soils are similar to Pratt and Lincoln soils and are commonly near Dillwyn, Lincoln, Plevna, and Pratt soils on the landscape. Pratt soils have an argillic horizon. Lincoln soils formed in alluvium and commonly contain coarser sand. Dillwyn and Plevna soils are more poorly drained and are mottled within a depth of 30 inches.

Typical pedon of Tivoli fine sand, hilly, 600 feet south and 450 feet west of the northeast corner of sec. 26, T. 30 S., R. 6 W.

A1—0 to 7 inches; brown (10YR 5/3) fine sand, dark brown (10YR 4/3) moist; single grained; loose; many fine roots; slightly acid; gradual smooth boundary.

C—7 to 60 inches; pale brown (10YR 6/3) fine sand, yellowish brown (10YR 5/4) moist; single grained; loose; common fine roots in upper 6 inches, few below that depth; slightly acid.

Reaction throughout the pedon is slightly acid to mildly alkaline. The A horizon is loamy fine sand or fine sand 4 to 10 inches thick. It has hue of 10YR or 7.5YR, value of 4 to 6 (4 or 5 moist), and chroma of 2 to 4. The C horizon has hue of 10YR or 7.5YR, value of 5 to 7 (4 to 6 moist), and chroma of 3 to 6.

Waldeck series

The Waldeck series consists of deep, somewhat poorly drained soils on low terraces or high flood plains. They formed in moderately coarse textured alluvium that grades to coarse textured alluvium at depths of 2 to 4 feet. Permeability is moderately rapid. Slope ranges from 0 to 1 percent.

Waldeck soils are similar to Kaski, Plevna, and Zenda soils and are commonly near Canadian, Dillwyn, Kaski, Plevna, and Zenda soils on the landscape. Canadian soils are well drained. Dillwyn soils are sandy. Kaski soils are well drained, have a mollic epipedon more than 20 inches thick, and are fine loamy. Plevna soils are poorly drained. Zenda soils are fine loamy.

Typical pedon of Waldeck fine sandy loam, 125 feet south and 140 feet west of the northeast corner of sec. 2, T. 28 S., R. 10 W.

A1—0 to 12 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; slight effervescence; moderately alkaline; clear smooth boundary.

AC—12 to 23 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; slightly hard, very friable; strong effervescence; moderately alkaline; gradual smooth boundary.

C1—23 to 36 inches; light gray (10YR 7/2) fine sandy loam, grayish brown (10YR 5/2) moist; common fine strong brown (7.5YR 5/6) mottles; massive; slightly hard, very friable; strong effervescence; moderately alkaline; gradual smooth boundary.

C2—36 to 60 inches; very pale brown (10YR 7/3) sand, pale brown (10YR 6/3) moist; single grained; loose; moderately alkaline.

The solum ranges from 18 to 30 inches in thickness. Depth to free carbonates ranges from 0 to 12 inches. Reaction throughout the profile is mildly alkaline or moderately alkaline. Depth to distinct mottles ranges from 20 to 30 inches. The A horizon typically is fine sandy loam or sandy loam from 10 to 20 inches thick. It has hue of 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 to 3. The AC and C1 horizons are fine sandy loam or sandy loam. Hue is 10YR, value is 5 or 6 (4 or 5 moist), and chroma is 2 or 3. The C2 horizon is sand or fine sand. It has hue of 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4.

Zenda series

The Zenda series consists of deep, somewhat poorly drained soils on low terraces. These soils formed in loamy alluvium. Permeability is moderate. Slope ranges from 0 to 1 percent.

Zenda soils are similar to Kaski, Plevna, and Waldeck soils and are commonly near Canadian, Dillwyn, Kaski, Plevna, and Waldeck soils on the landscape. Canadian soils are well drained and are coarse loamy. Dillwyn soils are sandy. Kaski soils are well drained and have a thicker mollic epipedon than the Zenda soils. Plevna and Waldeck soils are coarse loamy.

Typical pedon of Zenda clay loam, 1,150 feet west and 150 feet south of the northeast corner of sec. 20, T. 27 S., R. 5 W.

A1—0 to 13 inches; dark gray (10YR 4/1) clay loam, black (10YR 2/1) moist; weak medium granular structure; hard, friable; strong effervescence; moderately alkaline; clear smooth boundary.

C1—13 to 23 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate coarse granular structure; hard, friable; many fine soft lime accumulations; violent effervescence; moderately alkaline; gradual smooth boundary.

C2—23 to 46 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; common fine distinct strong brown (7.5YR 5/6) mottles; weak coarse granular structure; very hard, firm; many fine soft lime accumulations; violent effervescence; moderately alkaline; gradual smooth boundary.

C3—46 to 60 inches; light gray (2.5Y 7/2) and strong brown (7.5YR 5/6) clay loam, light gray (2.5Y 7/2) and strong brown (7.5YR 5/6) moist; massive; very hard, firm; weak effervescence; moderately alkaline.

The solum and A horizon range from 10 to 20 inches in thickness. The A horizon is typically clay loam, but in some pedons it is loam or sandy loam. Hue is 10YR, value is 4 or 5 (2 or 3 moist), and chroma is 1 to 3. Reaction ranges from neutral to moderately alkaline. In some pedons, the A horizon is noncalcareous. The C horizon is clay loam or loam. It has hue of 7.5YR, 10YR, or 2.5Y; value of 5 to 7 (4 to 6 moist); and chroma of 2 to 4. In some pedons, strata of sandy loam or loamy sand are below a depth of 40 inches.

Classification of the soils

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Readers interested in further details about the system should refer to "Soil taxonomy" (*7*).

The system of classification has six categories. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. In this system the classification is based on the different soil properties that can be observed in the field or those that can be inferred either from other properties that are observable in the field or from the combined data of soil science and other disciplines. The properties selected for the higher categories are the result of soil genesis or of factors that affect soil genesis. In table 17, the soils of the survey area are classified according to the system.

Categories of the system are discussed in the following paragraphs.

ORDER. Ten soil orders are recognized as classes in the system. The properties used to differentiate among orders are those that reflect the kind and degree of dominant soil-forming processes that have taken place. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders based primarily on properties that influence soil genesis and are important to plant growth or that are selected to reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquoll (*Aqu*, meaning water, 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 expression of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and a prefix that suggests something about the properties of the soil. An example is Argiaquolls (*Argi*, meaning argillic horizons, plus *aquoll*, the suborder of Mollisols that have an aquic moisture regime).

SUBGROUP. Each great group may be divided into three kinds of subgroup: the central (typic) concept of the great group, which is not necessarily the most extensive subgroup; the intergrades, or transitional forms to other orders, suborders, or great groups; and the extragrades, which have some properties that are 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 *Typic* identifies the subgroup that is thought to typify the great group. An example is Typic Argiaquolls.

FAMILY. Families are established within a subgroup on the basis of similar physical and chemical properties that affect management. Among the properties considered in horizons of major biological activity below plow depth are particle-size distribution, mineral content, temperature regime, thickness of the soil penetrable by roots, consistence, moisture equivalent, soil slope, and permanent cracks. A family name consists of the name of a subgroup and a series of adjectives. The adjectives are the class names for the soil properties used as family differentiae. An example is fine, mixed, thermic, Typic Argiaquolls.

SERIES. The series consists of soils that formed in a particular kind of material and have horizons that, except for texture of the surface soil or of the underlying substratum, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineral and chemical composition.

Formation of the soils

This section discusses the factors of soil formation, relates them to the formation of soils in the survey area, and explains the processes of soil formation.

Factors of soil formation

The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief, or lay of the land, and (5) the length of time that the forces of soil formation have acted on the soil material.

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

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

Parent material

Parent material, the unconsolidated material from which a soil forms, is a result of the weathering of rocks through the processes of freezing and thawing, soil blowing and erosion, and the grinding away of rocks by rivers and glaciers. It also forms as a result of chemical processes.

The oldest geologic formations furnishing parent material in Kingman County are the Ninnescah Shale and the Harper Siltstone formations of the Permian System (fig. 17). The Ninnescah Shale is composed of beds of brownish red shale, silty shale, and siltstone, and a few thin beds of gray-green silty shale. It crops out along the South and North Forks of Ninnescah River and the Chikaskia River and their other tributaries in the eastern third of the county. These outcrops form a low relief (*4*). Soils over the Ninnescah Shale, and formed wholly or in part from it, are the Owens and Renfrow soils.

The Harper Siltstone formation in Kingman County consists of beds of brownish red argillaceous siltstone and silty shale and a few beds of silty sandstone. The formation is well exposed along the valleys of the South Fork of Ninnescah River and the Chikaskia River in central Kingman County. Here, the beds form steep valley walls (*4*). Soils over the Harper Siltstone, and formed wholly or in part from it, are the Nashville and Quinlan soils.

During the Pleistocene Epoch streams deposited sediments that ranged from sand and gravel to clay. Some of these outwash sediments were reworked by wind before vegetation became established. Other areas were covered by varying thicknesses of windblown materials, or loess. Albion, Blanket, Carwile, Case, Clark, Farnum, Pond Creek, and Shellabarger soils formed in these materials.

Several areas of typical dune topography in Kingman County are over deposits of fine to medium sand and some silt. The largest area of sand dunes in the county is in the southwest corner. Another large tract of dunes is along the northern side of the Chikaskia River (*4*). Soils in Kingman County that formed from these sands are the Pratt and Tivoli soils. Carwile, Farnum, and Shellabarger soils appear to have formed partly from eolian deposits in some places.

Deposits of recent alluvium are present in and adjacent to the channels of the South Fork of Ninnescah River, Chikaskia River, and their other major tributaries in Kingman County. The alluvium is composed of silt, sand, and fine gravel derived from older Pleistocene deposits. Where it is above Permian bedrock, the alluvium contains abundant fragments of these rocks (*4*). Soils that formed in these sediments are the Canadian, Dillwyn, Kaski, Kingman, Lincoln, Plevna, Waldeck, and Zenda soils.

Climate

Climate has played an important role in the development of soils in Kingman County. Precipitation, temperature, and wind each have an effect on the type of soil profile that develops from parent material.

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

Variations in temperature affect soils in several ways. Alternate freezing and thawing break up soil aggregates and change soil structure. As temperature increases, more evaporation takes place and less moisture is available for plant growth. The growth of organisms generally increases as temperature increases. Another factor that increases with a rise in temperature is the rate at which chemicals react and affect the weathering of minerals and decomposition of organic material.

Wind also has its effect on soil formation. Most of the precipitation in Kingman County falls in summer. The hot summer wind, however, evaporates moisture rapidly. It blows the fine particles from the surface layer, thus decreasing soil fertility, and increasing sand content. Wind also blows particles of soil material from one area to another and thus changes the texture of the surface layer.

Plant and animal life

Animal life and vegetation are indispensable in soil development. Burrowing animals, insects, and worms help to mix the soil. Bacteria, fungi, and other microorganisms help to weather rock and decompose organic material. Plant and animal life also influence the chemical and biological processes that take place in the soil.

Plants are the main source of organic matter, which causes the dark color of soils. The soils of Kingman County formed under tall and mid grasses, which supply soil with enormous amounts of roots that decay and add organic matter. Organic matter from decayed roots accounts for the dark-colored surface layer of the soils of Kingman County.

Relief

Relief, or lay of the land, influences formation of soils through its effect on drainage, erosion, temperature, and plant cover. Because of its effect on soil moisture and soil temperature, relief also affects the kinds of plants and animals that live on and in the soil. Runoff becomes excessive where slopes are moderate and steep, because the soil is unable to absorb all the moisture from rainfall. In the more sloping areas where runoff is rapid, the soil material is likely to be washed away before distinct horizons can form.

Soils in low-lying areas, where surface drainage is poor, are likely to have a grayish or mottled subsoil. In Kingman County the Carwile soils are an example. Many of the soils along the streams are somewhat poorly drained or poorly drained. These include the Dillwyn, Kingman, Plevna, Waldeck, and Zenda soils.

Many soils have more than one kind of relief, but some have only one kind. For example, Carwile soils are only in nearly level or depressional areas on uplands. Albion soils range from nearly level to strongly sloping.

Time

Time is needed for soils to form from parent material. Some soils form rapidly, and others form slowly. The length of time required for a particular soil to form depends on the other factors involved. As water moves downward through the soil, soluble material and fine particles are leached from the surface layer and deposited in the subsoil. How long this process takes depends chiefly on how long the soil material has been in place and how much water penetrates it.

Some soils lack horizon development because they formed in material that is highly resistant to weathering. Tivoli soils are an example. Other soils, such as Kaski, Waldeck, and Zenda soils show little horizon development, because they are young. Genetic horizons have had insufficient time to develop. Blanket soils have been exposed to soil-forming processes for thousands of years and have well-defined horizons.

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Glossary

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.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

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

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

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

	Incnes
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	More than 9

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

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

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

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

Calcareous soil. A soil containing enough calcium carbonate (commonly with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid. A soil having measurable amounts of calcium carbonate or magnesium carbonate.

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.

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 coat, clay skin.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures is difficult.

Complex, soil. A map unit of two or more kinds of soil occurring in such an intricate pattern that they cannot be shown separately on a soil map at the selected scale of mapping and publication.

Compressible. Excessive decrease in volume of soft soil under load.

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 (or contour farming). 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 40 or 80 inches (1 or 2 meters).

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cutbanks cave. Unstable walls of cuts made by earth-moving equipment. The soil sloughs easily.

Deferred grazing. A delay in grazing until range plants have reached a specified stage of growth. Grazing is deferred in order to increase the vigor of forage and to allow desirable plants to produce seed. Contrasts with continuous grazing and rotation grazing.

Depth to rock. Bedrock at a depth that adversely affects the specified use.

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 for 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, as for example in "hillpeats" and "climatic moors."

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

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 running 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 a bare surface.

Excess fines. Excess silt and clay. The soil does not provide a source of gravel or sand for construction purposes.

Fast intake. The rapid movement of water into the soil.

Favorable. Favorable soil features for the specified use.

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.

Flooding. The temporary covering of soil with water from overflowing streams, runoff from adjacent slopes, and tides. Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of 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. Water standing for short periods after rainfall or commonly covering swamps and marshes is not considered flooding.

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

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 7.5 centimeters) in diameter. An individual piece is a pebble.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table, which is the upper limit of saturation.

Habitat. The natural abode of a plant or animal; refers to the kind of environment in which a plant or animal normally lives, as opposed to the range or geographical distribution.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. The major horizons of mineral soil are as follows:

O horizon.—An organic layer, fresh and decaying plant residue, at the surface of a mineral soil.

A horizon.—The mineral horizon, formed or forming at or near the surface, in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon most of which was originally part of a B horizon.

A2 horizon.—A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

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 A or B horizon. The material of a C horizon may be either like or unlike that from which the solum is presumed to have formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

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

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.

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. Inadequate strength for supporting loads.

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

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).

Parent material. The great variety of unconsolidated organic and mineral material in which soil forms. Consolidated bedrock is not yet parent material by this concept.

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.

Percs slowly. The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality that enables the soil to transmit water or air, measured as the number of inches per hour that water moves through the soil. Terms describing permeability are *very slow* (less than 0.06 inch), *slow* (0.06 to 0.20 inch), *moderately slow* (0.2 to 0.6 inch), *moderate* (0.6 to 2.0 inches), *moderately rapid* (2.0 to 6.0 inches), *rapid* (6.0 to 20 inches), and *very rapid* (more than 20 inches).

Phase, soil. A subdivision of a soil series or other unit in the soil classification system based on differences in the soil that affect its management. A soil series, for example, may be divided into phases on the basis of differences in slope, stoniness, thickness, or some other characteristic that affects management. These differences are too small to justify separate series.

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

Piping. Moving water forms subsurface tunnels or pipelike cavities in 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 a semisolid to a plastic state.

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

Range (or rangeland). Land that, for the most part, produces native plants suitable for grazing by livestock; includes land supporting some forest trees.

Range condition. The health or productivity of forage plants on a given range, in terms of the potential productivity under normal climate and the best practical management. Condition classes generally recognized are—*excellent, good, fair,* and *poor*. The classification is based on the percentage of original, or assumed, climax vegetation on a site, as compared to what has been observed to grow on it when well managed.

Range site. An area of range where climate, soil, and relief are sufficiently uniform to produce a distinct kind and amount of native vegetation.

Reaction, soil. The degree 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.

Rooting depth. Shallow root zone. The soil is shallow over a layer that greatly restricts roots. See Root zone.

Runoff. The precipitation discharged in stream channels from a drainage area. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground 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.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Seepage. The rapid movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils, formed from a particular type of parent material, having horizons that, except for the texture of the A or surface horizon, are similar in all profile characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineralogical and chemical composition.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

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.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

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.

Slow intake. The slow movement of water into the soil.

Soil. A natural, three-dimensional body at the earth's surface that 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: *very coarse sand* (2.0 millimeters to 1.0 millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter).

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

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 that are separated from adjoining 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, to provide protection 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 profile below plow depth.

Substratum. The part of the soil below the solum.

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."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use or management.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it can soak into the soil or flow slowly to a prepared outlet without harm. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geology). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. A stream terrace is frequently called a second bottom, in contrast with a flood plain, and is seldom subject to overflow. A marine terrace, generally wide, was deposited by 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, silt loam, 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. Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The condition of the soil, especially the soil structure, as related to the growth of plants. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil (engineering). Presumably a fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

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

Water table. The upper limit of the soil or underlying rock material that is wholly saturated with water.

Water table, apparent. A thick zone of free water in the soil. An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Water table, artesian. A water table under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

Water table, perched. A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

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

ILLUSTRATIONS

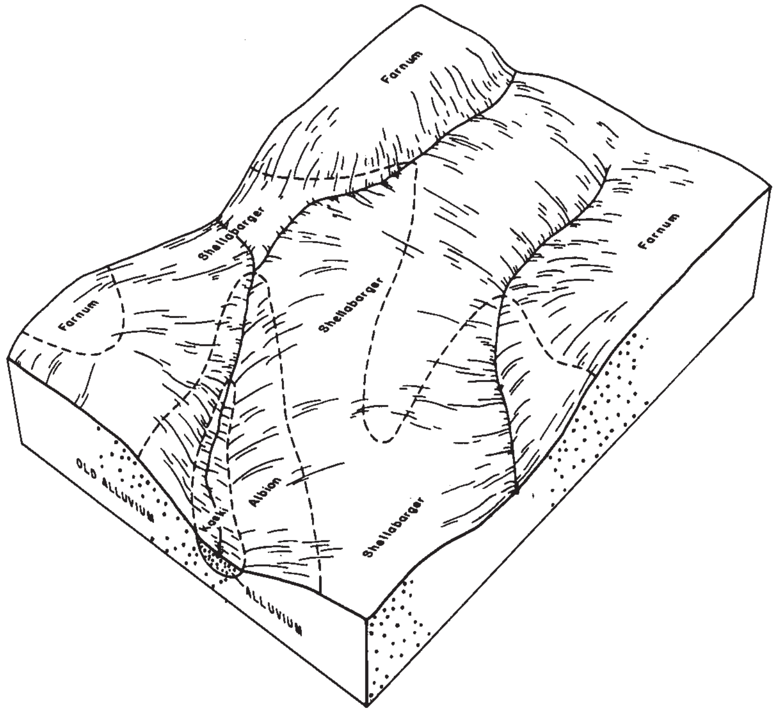

Figure 1.—Typical pattern of soils in the Farnum-Shellabarger map unit.

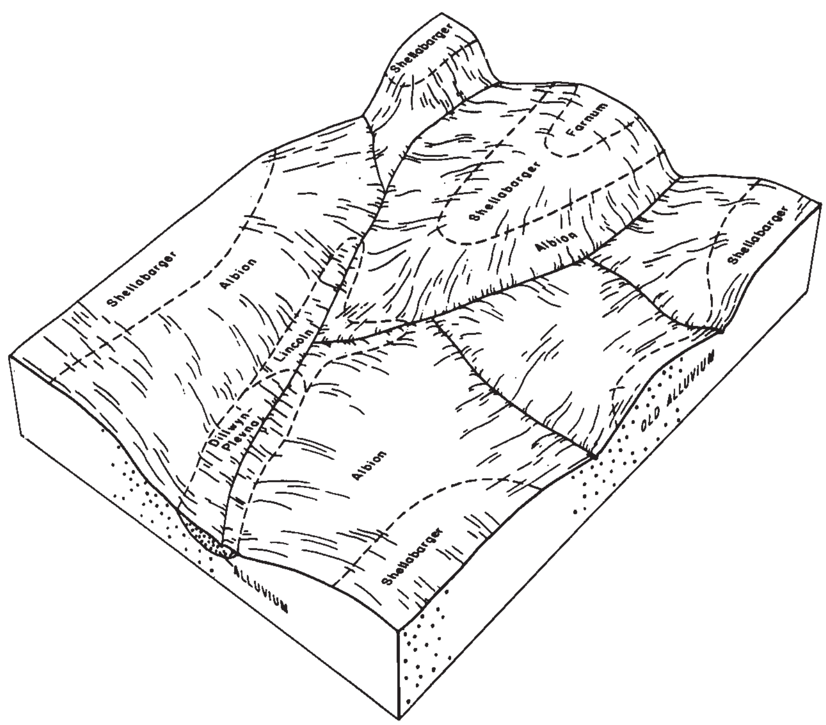

Figure 2.—Typical pattern of soils in the Albion-Shellabarger map unit.

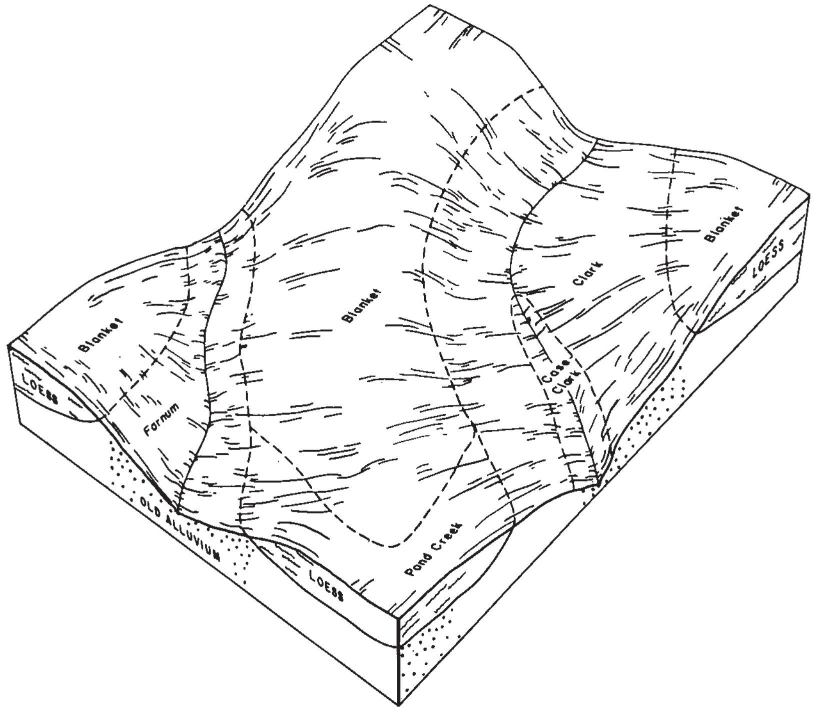

Figure 3.—Typical pattern of soils in the Blanket-Clark-Farnum map unit.

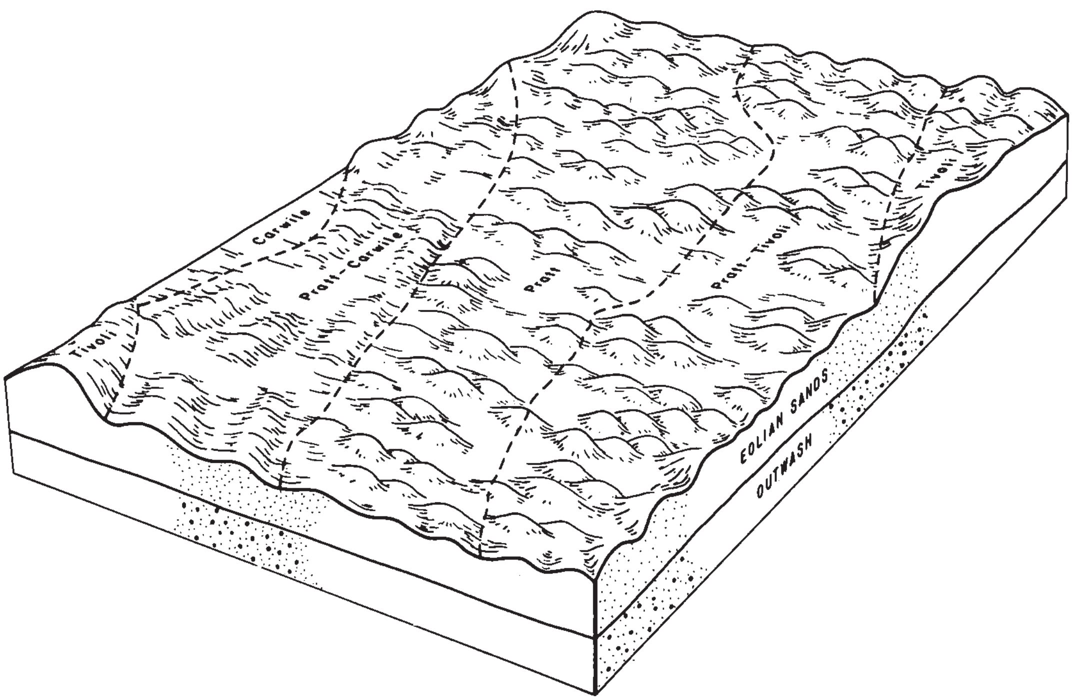

Figure 4.—Typical pattern of soils in the Pratt-Carwile map unit.

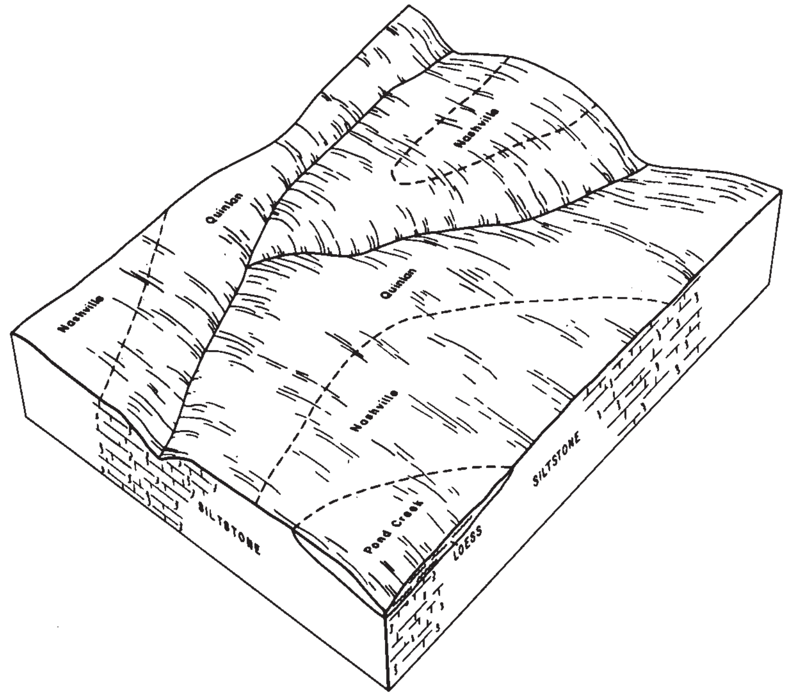

Figure 5.—Typical pattern of soils in the Quinlan-Nashville map unit.

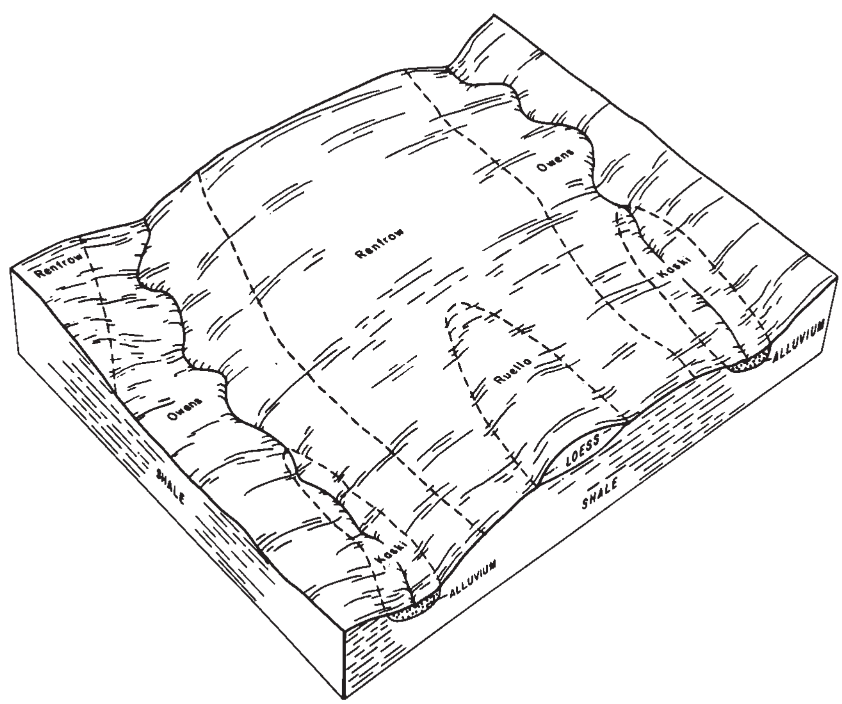

Figure 6.—Typical pattern of soils in the Renfrow-Owens map unit.

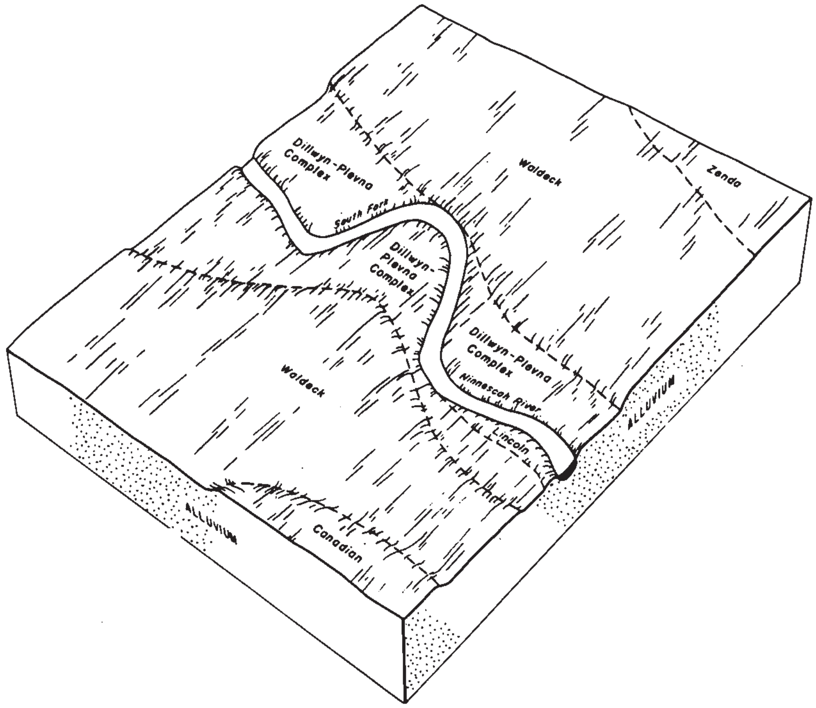

Figure 7.—Typical pattern of soils in the Waldeck-Dillwyn-Plevna map unit.

Figure 8.—Landscape of Case-Clark clay loams, 2 to 6 percent slopes. The light-colored areas are Case clay loam, and the dark-colored areas are Clark clay loam.

Figure 9.—Wheat planted on the contour with terracing on Case-Clark clay loams, 2 to 6 percent slopes.

Figure 10.—Pit pond dug on Dillwyn-Plevna complex.

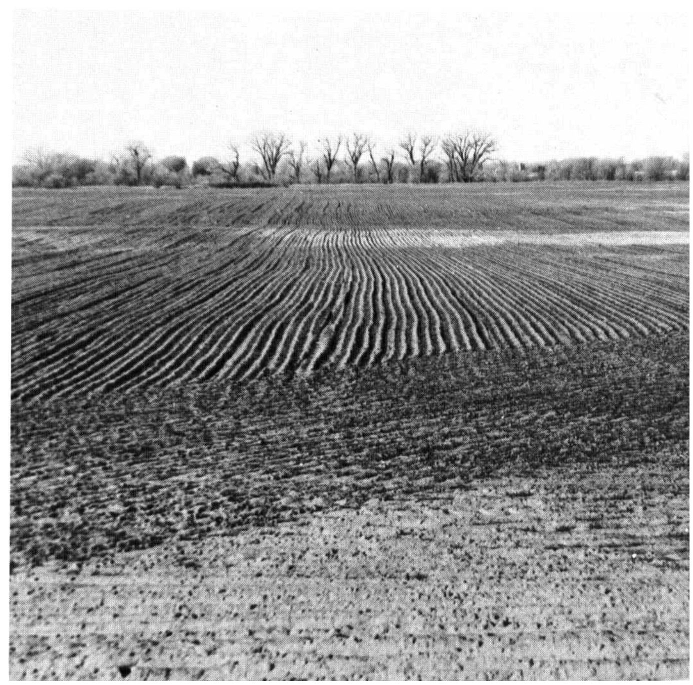

Figure 11.—Wheat growning on Farnum-Natrustolls complex, 0 to 1 percent slopes. The light-colored areas are affected by salts.

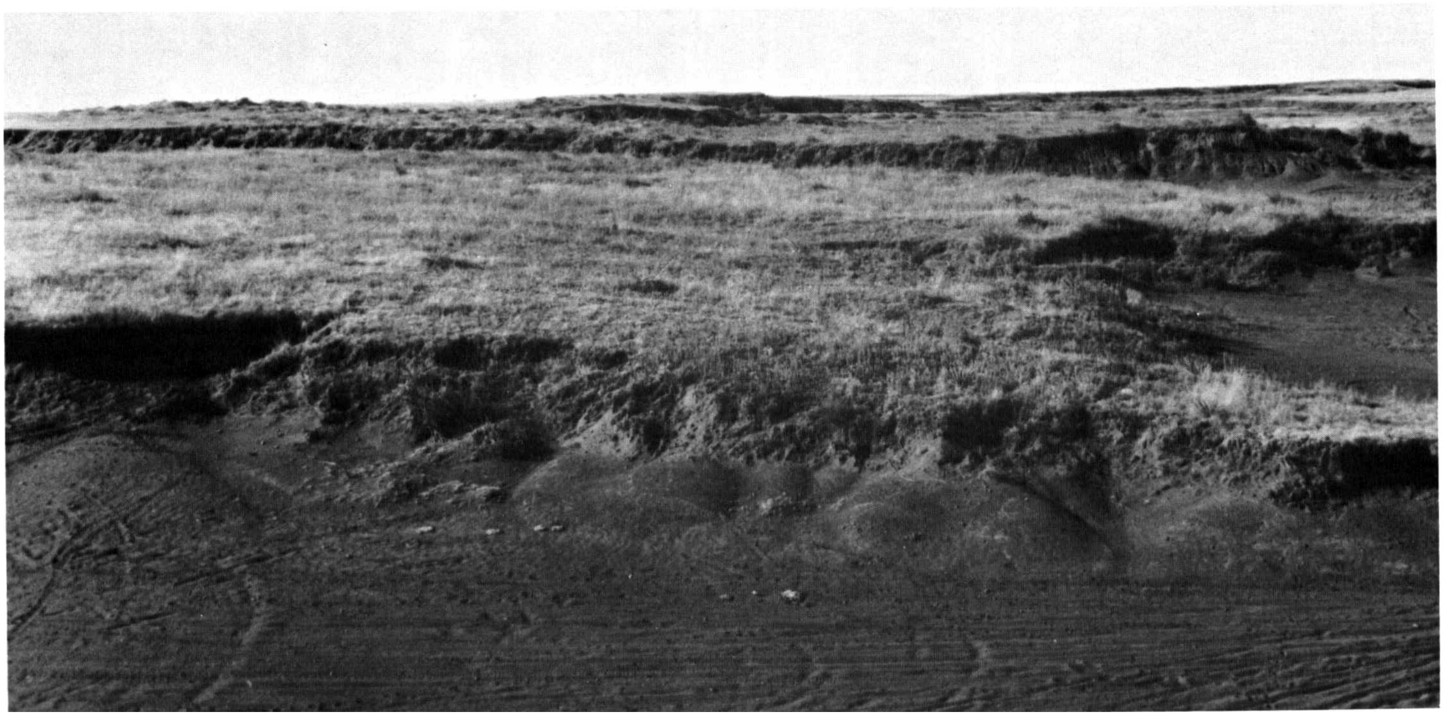

Figure 12.—Landscape of Ruella-Rock outcrop complex, 3 to 40 percent slopes. Grassed areas are Ruella clay loam. Rock outcrop, in the foreground, is shale.

Figure 13.—Typical landscape of Tivoli fine sand, hilly.

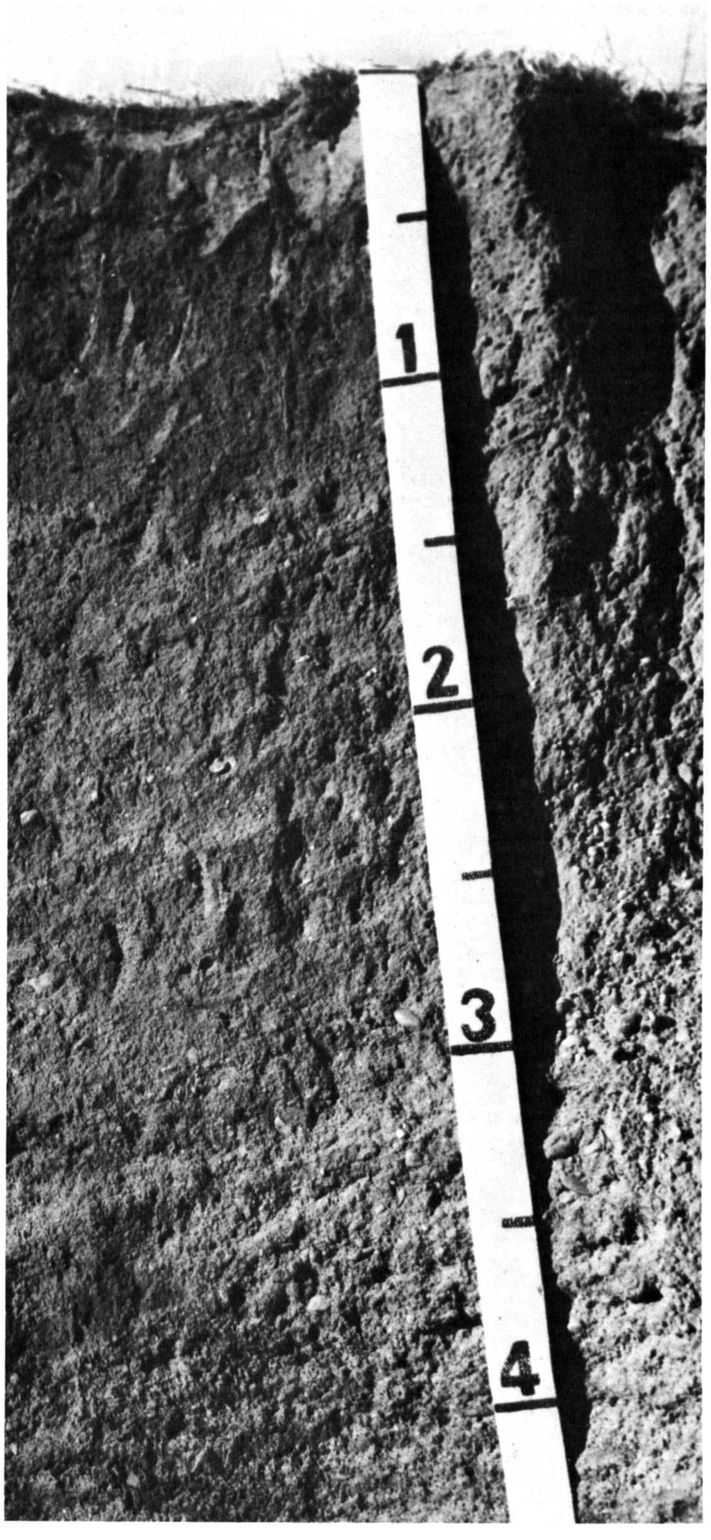

Figure 14.—Profile of Albion sandy loam, 1 to 3 percent slopes. Sand is at a depth of 26 inches.

Figure 15.—Surface of Clark clay loam showing lime concretions.

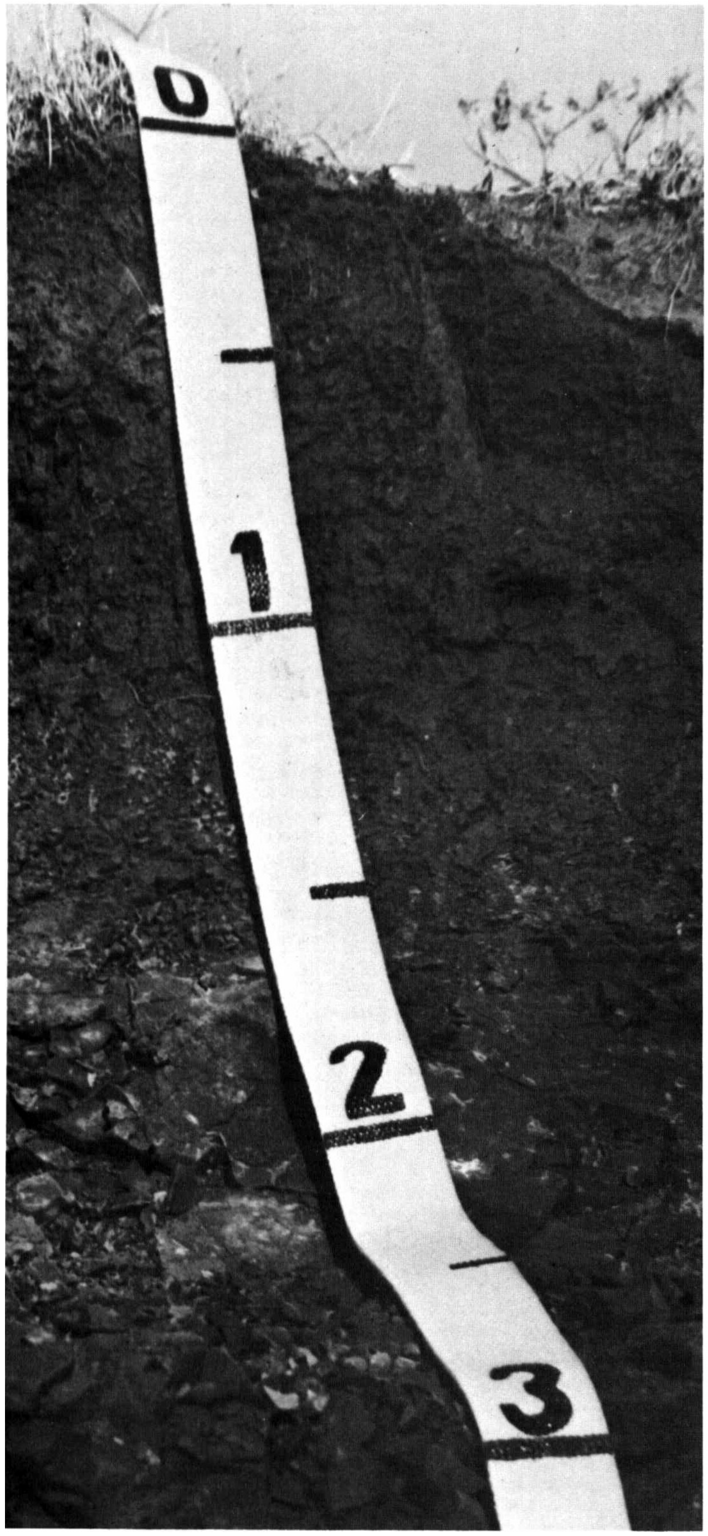

Figure 16.—Profile of Owens clay loam, 1 to 4 percent slopes. Shale is at a depth of 16 inches.

Figure 17.—Siltstone and silty shale of the Harper Siltstone formation of the Permian System.

TABLES

TABLE 1.--TEMPERATURE AND PRECIPITATION DATA

Month	Temperature[1]					Precipitation[1]				
	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----	43.8	20.2	32.0	72	-8	0.68	0.23	1.06	1	4.0
February---	49.4	25.1	37.3	80	0	0.96	0.37	1.56	2	3.8
March------	56.9	31.1	44.0	86	5	1.39	0.33	2.13	2	3.8
April------	70.2	44.0	57.1	94	24	2.48	0.88	4.32	4	0.3
May--------	79.5	54.3	66.9	100	33	3.69	1.77	5.34	6	0.0
June-------	88.6	63.6	76.1	106	44	4.39	1.67	6.64	7	0.0
July-------	93.9	68.5	81.2	106	52	3.28	1.52	5.28	5	0.0
August-----	93.3	66.6	80.0	110	49	3.04	1.15	4.60	5	0.0
September--	83.9	58.0	71.0	102	39	3.45	0.75	5.29	6	0.0
October----	73.1	46.3	59.7	94	27	2.41	0.66	4.09	4	0.3
November---	57.0	32.9	45.0	79	8	1.19	0.07	2.02	2	1.7
December---	46.4	23.8	35.1	72	-4	0.97	0.24	1.50	2	4.
Year-----	69.7	44.5	57.1	110	-8	27.93	21.74	34.20	46	18.0

[1]Recorded in the period 1941-70 at Kingman, Kansas.

TABLE 2.--FREEZE DATES IN SPRING AND FALL

Probability	Minimum temperature[1]		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 10	April 17	April 29
2 years in 10 later than--	April 5	April 12	April 24
5 years in 10 later than--	March 27	April 2	April 14
First freezing temperature in fall:			
1 year in 10 earlier than--	November 1	October 22	October 12
2 years in 10 earlier than--	November 5	October 27	October 16
5 years in 10 earlier than--	November 15	November 6	October 26

[1]Recorded in the period 1931-60 at Kingman, Kansas.

TABLE 3.--GROWING SEASON LENGTH

Probability	Daily minimum temperature during growing season[1]		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	210	200	175
8 years in 10	218	206	182
5 years in 10	233	218	195
2 years in 10	248	230	208
1 year in 10	256	236	214

[1]Recorded in the period 1931-60 at Kingman, Kansas.

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

Map symbol	Soil name	Acres	Percent
Aa	Albion sandy loam, 0 to 1 percent slopes	1,100	0.2
Ab	Albion sandy loam, 1 to 3 percent slopes	15,800	2.9
Ac	Albion sandy loam, 3 to 6 percent slopes	11,900	2.1
Ad	Albion sandy loam, 6 to 15 percent slopes	58,000	10.5
Ba	Blanket silt loam, 0 to 1 percent slopes	7,100	1.3
Bb	Blanket silt loam, 1 to 3 percent slopes	9,400	1.7
Bc	Blanket silty clay loam, 1 to 4 percent slopes, eroded	1,200	0.2
Ca	Canadian fine sandy loam	4,700	0.8
Cb	Carwile fine sandy loam	6,400	1.2
Cc	Case-Clark clay loams, 2 to 6 percent slopes	8,100	1.5
Cd	Case-Clark clay loams, 6 to 15 percent slopes	3,400	0.6
Ce	Clark clay loam, 0 to 1 percent slopes	1,600	0.3
Cf	Clark clay loam, 1 to 4 percent slopes	15,200	2.7
Da	Dillwyn-Plevna complex	29,000	5.2
Fa	Farnum sandy loam, 0 to 2 percent slopes	27,000	4.9
Fb	Farnum loam, 0 to 1 percent slopes	19,400	3.5
Fc	Farnum loam, 1 to 3 percent slopes	61,000	11.0
Fd	Farnum loam, 3 to 6 percent slopes	4,100	0.7
Fe	Farnum clay loam, 2 to 6 percent slopes, eroded	6,600	1.2
Ff	Farnum-Natrustolls complex, 0 to 1 percent slopes	3,700	0.7
Ka	Kaski loam	13,100	2.4
Kb	Kingman silty clay loam	670	0.1
La	Lincoln loamy sand	13,600	2.5
Ma	McLain silt loam	2,200	0.4
Na	Nashville silt loam, 1 to 3 percent slopes	9,000	1.6
Nb	Nashville-Quinlan complex, 5 to 15 percent slopes	15,300	2.8
Oa	Owens clay loam, 1 to 4 percent slopes	5,200	0.9
Pa	Pond Creek silt loam, 1 to 3 percent slopes	4,200	0.8
Pb	Pratt loamy fine sand, undulating	8,600	1.6
Pc	Pratt-Carwile complex, undulating	3,500	0.6
Pd	Pratt-Tivoli loamy fine sands, rolling	4,500	0.8
Qa	Quinlan loam, 1 to 3 percent slopes	5,500	1.0
Qb	Quinlan loam, 3 to 5 percent slopes	7,500	1.4
Ra	Renfrow clay loam	18,200	3.3
Rb	Ruella clay loam, 1 to 4 percent slopes	1,500	0.3
Rc	Ruella-Rock outcrop complex, 3 to 40 percent slopes	2,000	0.4
Sa	Shellabarger loamy sand, 0 to 3 percent slopes	3,100	0.6
Sb	Shellabarger sandy loam, 1 to 3 percent slopes	91,000	16.4
Sc	Shellabarger sandy loam, 3 to 6 percent slopes	20,000	3.6
Sd	Shellabarger sandy loam, 3 to 6 percent slopes, eroded	7,600	1.4
Ta	Tivoli fine sand, hilly	1,300	0.2
Wa	Waldeck fine sandy loam	11,900	2.1
Za	Zenda clay loam	6,400	1.2
	Water	3,030	0.4
	Total	553,600	100.0

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE

[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	Winter wheat	Grain sorghum	Alfalfa hay	Smooth bromegrass
	Bu	Bu	Ton	AUM*
Aa: Albion	22	35	2.0	4.0
Ab: Albion	20	30	2.0	4.0
Ac: Albion	18	25	1.5	3.5
Ad: Albion	---	---	---	---
Ba: Blanket	32	65	3.0	6.5
Bb: Blanket	30	60	3.0	6.0
Bc: Blanket	26	50	2.5	5.0
Ca: Canadian	30	50	4.0	7.5
Cb: Carwile	24	30	3.5	6.0
Cc: Case	22	32	2.5	2.5
Cd: Case	---	---	---	2.0
Ce: Clark	26	40	3.0	---
Cf: Clark	24	36	3.0	---
Da: Dillwyn	---	---	---	---
Fa: Farnum	28	47	3.5	4.5
Fb: Farnum	34	50	3.5	4.5
Fc: Farnum	32	48	3.5	4.5
Fd: Farnum	28	44	3.0	4.0
Fe: Farnum	24	40	2.5	3.5
Ff: Farnum	18	30	2.5	---
Ka: Kaski	34	55	4.0	6.5
Kb: Kingman	---	---	---	---

See footnote at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Winter wheat	Grain sorghum	Alfalfa hay	Smooth bromegrass
	Bu	Bu	Ton	AUM*
La----------------------- Lincoln	16	25	---	---
Ma----------------------- McLain	36	50	4.5	7.0
Na----------------------- Nashville	24	36	---	5.5
Nb----------------------- Nashville	---	---	---	---
Oa----------------------- Owens	12	20	---	1.5
Pa----------------------- Pond Creek	30	50	3.5	7.0
Pb----------------------- Pratt	24	40	---	2.0
Pc----------------------- Pratt	24	38	---	---
Pd----------------------- Pratt	---	---	---	---
Qa----------------------- Quinlan	14	25	---	---
Qb----------------------- Quinlan	12	20	---	---
Ra----------------------- Renfrow	22	34	---	3.0
Rb----------------------- Ruella	24	42	3.0	5.0
Rc----------------------- Ruella	---	---	---	---
Sa, Sb------------------- Shellabarger	24	46	3.0	4.5
Sc----------------------- Shellabarger	22	42	2.5	4.0
Sd----------------------- Shellabarger	20	38	2.5	4.0
Ta----------------------- Tivoli	---	---	---	---
Wa----------------------- Waldeck	24	44	3.5	7.0
Za----------------------- Zenda	26	48	4.0	7.0

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

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
Aa, Ab, Ac, Ad----- Albion	Sandy	Favorable	4,000	Sand bluestem	35
		Normal	3,000	Little bluestem	20
		Unfavorable	2,000	Indiangrass	10
				Switchgrass	10
				Sand lovegrass	5
Ba, Bb, Bc--------- Blanket	Loamy Upland	Favorable	5,500	Little bluestem	25
		Normal	4,000	Indiangrass	15
		Unfavorable	2,500	Big bluestem	20
				Sideoats grama	10
				Tall dropseed	5
Ca----------------- Canadian	Sandy Terrace	Favorable	7,000	Big bluestem	25
		Normal	5,500	Indiangrass	15
		Unfavorable	4,000	Switchgrass	15
				Little bluestem	10
				Tall dropseed	5
				Beaked panicum	5
				Sedge	5
Cb----------------- Carwile	Sandy	Favorable	5,000	Switchgrass	25
		Normal	3,800	Little bluestem	15
		Unfavorable	3,000	Indiangrass	10
				Sand bluestem	5
				Scribner panicum	5
				Canada wildrye	5
				Sideoats grama	5
Cc*, Cd*:					
Case---------------	Limy Upland	Favorable	4,000	Little bluestem	30
		Normal	3,000	Big bluestem	20
		Unfavorable	2,000	Sideoats grama	10
				Indiangrass	5
				Switchgrass	5
				Leadplant	5
				Tall dropseed	5
				Western wheatgrass	5
Clark--------------	Limy Upland	Favorable	5,000	Little bluestem	30
		Normal	4,000	Big bluestem	20
		Unfavorable	3,000	Sideoats grama	10
				Indiangrass	5
				Switchgrass	5
				Leadplant	5
				Tall dropseed	5
				Western wheatgrass	5
Ce, Cf------------- Clark	Limy Upland	Favorable	5,000	Little bluestem	30
		Normal	4,000	Big bluestem	20
		Unfavorable	3,000	Sideoats grama	10
				Indiangrass	5
				Switchgrass	5
				Leadplant	5
				Tall dropseed	5
				Western wheatgrass	5

See footnote at end of table.

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

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
Da*:					
Dillwyn	Subirrigated	Favorable	9,000	Indiangrass	15
		Normal	8,000	Big bluestem	15
		Unfavorable	7,000	Eastern gamagrass	10
				Switchgrass	10
				Prairie cordgrass	10
				Sedge	10
				Little bluestem	5
				Alkali sacaton	5
				Western wheatgrass	5
				Meadow dropseed	5
Plevna	Subirrigated	Favorable	9,000	Big bluestem	15
		Normal	8,000	Indiangrass	15
		Unfavorable	7,000	Prairie cordgrass	10
				Switchgrass	10
				Eastern gamagrass	10
				Western wheatgrass	5
				Little bluestem	5
				Alkali sacaton	5
				Meadow dropseed	5
				Sedge	10
Fa Farnum	Sandy	Favorable	5,500	Sand bluestem	35
		Normal	4,000	Little bluestem	20
		Unfavorable	3,000	Indiangrass	10
				Switchgrass	10
				Sand lovegrass	5
Fb, Fc, Fd, Fe Farnum	Loamy Upland	Favorable	5,500	Big bluestem	25
		Normal	4,000	Little bluestem	25
		Unfavorable	3,000	Indiangrass	10
				Switchgrass	10
				Sideoats grama	5
Ff*:					
Farnum	Loamy Upland	Favorable	5,500	Big bluestem	25
		Normal	4,000	Little bluestem	25
		Unfavorable	3,000	Indiangrass	10
				Switchgrass	10
				Sideoats grama	5
Natrustolls	Saline Lowland.				
Ka Kaski	Loamy Lowland	Favorable	7,000	Big bluestem	30
		Normal	6,000	Indiangrass	15
		Unfavorable	4,500	Little bluestem	10
				Switchgrass	10
				Tall dropseed	5
				Sedge	5
				Prairie cordgrass	5
				Eastern gamagrass	5
Kb Kingman	Subirrigated	Favorable	9,000	Big bluestem	15
		Normal	8,000	Indiangrass	15
		Unfavorable	7,000	Eastern gamagrass	10
				Prairie cordgrass	10
				Switchgrass	10
				Little bluestem	5
				Western wheatgrass	5
				Alkali sacaton	5
				Meadow dropseed	5
				Sedge	5
				Maximillian sunflower	5
				Wholeleaf rosinweed	5

See footnote at end of table.

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
La: Lincoln	Sandy Lowland	Favorable	4,000	Switchgrass	20
		Normal	3,000	Sand bluestem	15
		Unfavorable	2,000	Indiangrass	15
				Little bluestem	10
				Purpletop	5
				Maximilian sunflower	5
				Goldenrod	5
Ma: McLain	Loamy Lowland	Favorable	7,500	Big bluestem	20
		Normal	5,600	Switchgrass	15
		Unfavorable	4,500	Indiangrass	15
				Little bluestem	10
				Tall dropseed	5
				Sedge	5
				Eastern gamagrass	5
Na: Nashville	Loamy Upland	Favorable	5,000	Big bluestem	25
		Normal	4,000	Little bluestem	25
		Unfavorable	2,500	Indiangrass	10
				Switchgrass	10
				Tall dropseed	5
				Sideoats grama	5
				Blue grama	5
Nb*:					
Nashville	Loamy Upland	Favorable	5,000	Big bluestem	25
		Normal	4,000	Little bluestem	25
		Unfavorable	2,500	Indiangrass	10
				Switchgrass	10
				Tall dropseed	5
				Sideoats grama	5
				Blue grama	5
Quinlan	Shallow Prairie	Favorable	2,500	Little bluestem	30
		Normal	1,800	Big bluestem	15
		Unfavorable	1,300	Indiangrass	5
				Switchgrass	5
				Tall dropseed	5
				Sideoats grama	5
Oa: Owens	Red Clay Prairie	Favorable	3,000	Sideoats grama	30
		Normal	2,500	Little bluestem	15
		Unfavorable	1,500	Big bluestem	10
				Switchgrass	10
				Blue grama	10
				Hairy grama	5
				Indiangrass	5
Pa: Pond Creek	Loamy Upland	Favorable	5,500	Little bluestem	25
		Normal	4,000	Big bluestem	20
		Unfavorable	2,500	Indiangrass	10
				Switchgrass	10
				Sideoats grama	5
				Blue grama	5
				Tall dropseed	5
Pb: Pratt	Sands	Favorable	4,500	Sand bluestem	25
		Normal	3,500	Little bluestem	20
		Unfavorable	2,500	Indiangrass	10
				Sand lovegrass	10
				Switchgrass	5
				Blue grama	5
				Texas bluegrass	5
				Sand dropseed	5

See footnote at end of table.

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

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
Pc*:					
Pratt	Sands	Favorable	4,500	Sand bluestem	25
		Normal	3,500	Little bluestem	20
		Unfavorable	2,500	Indiangrass	10
				Sand lovegrass	10
				Switchgrass	5
				Blue grama	5
				Texas bluegrass	5
				Sand dropseed	5
Carwile	Sandy	Favorable	5,000	Switchgrass	25
		Normal	3,800	Little bluestem	15
		Unfavorable	3,000	Indiangrass	10
				Sand bluestem	5
				Scribner panicum	5
				Canada wildrye	5
				Sideoats grama	5
Pd*:					
Pratt	Sands	Favorable	4,500	Sand bluestem	25
		Normal	3,500	Little bluestem	20
		Unfavorable	2,500	Indiangrass	10
				Sand lovegrass	10
				Switchgrass	5
				Blue grama	5
				Texas bluegrass	5
				Sand dropseed	5
Tivoli	Sands	Favorable	4,000	Little bluestem	20
		Normal	3,000	Sand bluestem	20
		Unfavorable	2,000	Big sandreed	10
				Sand lovegrass	5
				Scribner panicum	5
				Sand dropseed	5
				Lespedeza	5
Qa, Qb: Quinlan	Shallow Prairie	Favorable	2,500	Little bluestem	30
		Normal	1,800	Big bluestem	15
		Unfavorable	1,300	Indiangrass	5
				Switchgrass	5
				Tall dropseed	5
				Sideoats grama	5
Ra: Renfrow	Clay Upland	Favorable	4,500	Little bluestem	25
		Normal	3,500	Big bluestem	20
		Unfavorable	2,500	Switchgrass	10
				Sideoats grama	15
				Blue grama	10
				Buffalograss	5
Rb: Ruella	Loamy Upland	Favorable	5,000	Big bluestem	30
		Normal	4,000	Little bluestem	25
		Unfavorable	3,000	Indiangrass	10
				Switchgrass	10
Rc*:					
Ruella	Loamy Upland	Favorable	5,000	Big bluestem	30
		Normal	4,000	Little bluestem	25
		Unfavorable	3,000	Indiangrass	10
				Switchgrass	10
Rock outcrop.					
Sa, Sb, Sc, Sd: Shellabarger	Sandy	Favorable	4,500	Sand bluestem	35
		Normal	3,200	Little bluestem	25
		Unfavorable	2,500	Indiangrass	10
				Switchgrass	15

See footnote at end of table.

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

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
Ta: Tivoli	Choppy Sands	Favorable	4,000	Little bluestem	30
		Normal	3,000	Sand bluestem	25
		Unfavorable	2,000	Big sandreed	10
				Sand lovegrass	10
				Scribner panicum	5
				Sand dropseed	5
				Lespedeza	5
Wa: Waldeck	Subirrigated	Favorable	9,000	Big bluestem	15
		Normal	8,000	Indiangrass	15
		Unfavorable	7,000	Switchgrass	10
				Eastern gamagrass	10
				Prairie cordgrass	10
				Little bluestem	5
				Alkali sacaton	5
				Meadow dropseed	5
				Western wheatgrass	5
				Sedge	5
Za: Zenda	Subirrigated	Favorable	9,000	Big bluestem	15
		Normal	8,000	Indiangrass	15
		Unfavorable	7,000	Switchgrass	10
				Eastern gamagrass	10
				Prairie cordgrass	10
				Little bluestem	5
				Alkali sacaton	5
				Meadow dropseed	5
				Western wheatgrass	5
				Sedge	5

*See description of the map unit for compositon 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
Aa, Ab, Ac, Ad----Albion	Lilac, chokecherry, American plum, aromatic sumac.	---	Eastern redcedar, ponderosa pine, osageorange.	Honeylocust, green ash, Siberian elm, Austrian pine.	Eastern cottonwood.
Ba, Bb, Bc--------Blanket	Lilac, chokecherry.	Autumn-olive, Amur maple.	Green ash, hackberry, honeylocust, eastern redcedar.	Austrian pine, ponderosa pine.	---
Ca----------------Canadian	American plum, aromatic sumac, lilac, chokecherry.	---	White mulberry, green ash, honeylocust, hackberry.	Eastern redcedar, Austrian pine, Siberian elm.	Eastern cottonwood.
Cb----------------Carwile	American plum, aromatic sumac, lilac, chokecherry.	---	Eastern redcedar	Green ash, honeylocust, hackberry.	Eastern cottonwood.
Cc*, Cd*:					
Case--------------	Aromatic sumac.	---	Eastern redcedar, white mulberry, osageorange, ponderosa pine, honeylocust, Russian-olive.	Common hackberry, Siberian elm.	---
Clark------------	Aromatic sumac.	---	Eastern redcedar, osageorange, ponderosa pine, Russian-olive.	White mulberry, honeylocust, common hackberry, Siberian elm.	---
Ce, Cf------------Clark	Aromatic sumac.	---	Eastern redcedar, osageorange, ponderosa pine, Russian-olive.	White mulberry, honeylocust, common hackberry, Siberian elm.	---
Da*---------------Dillwyn-Plevna	American plum, chokecherry.	Russian-olive-----	Green ash, hackberry.	Sycamore----------	Eastern cottonwood.
Fa, Fb, Fc, Fd, Fe---------------Farnum	Aromatic sumac, lilac, chokecherry, Amur honeysuckle.	White mulberry, Amur maple.	Eastern redcedar, ponderosa pine, common hackberry, honeylocust, osageorange.	Siberian elm.	---
Ff*:					
Farnum-----------	Aromatic sumac, lilac, chokecherry, Amur honeysuckle.	White mulberry----	Eastern redcedar, ponderosa pine, common hackberry, honeylocust, osageorange.	Siberian elm.	---
Natrustolls.					
Ka----------------Kaski	Amur honeysuckle, Tatarian honeysuckle, chokecherry.	Autumn-olive------	Russian-olive-----	Eastern redcedar, honeylocust, common hackberry.	Plains cottonwood, Siberian elm.
Kb----------------Kingman	Grey dogwood, American plum.	Chokecherry-------	Eastern redcedar, Austrian pine, Scotch pine.	Silver maple, eastern cottonwood, sycamore.	---

See footnote at end of table.

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
La. Lincoln					
Ma----------------- McLain	Lilac, American plum, aromatic sumac.	White mulberry----	Eastern redcedar, green ash, Austrian pine, hackberry.	Siberian elm.	---
Na----------------- Nashville	Lilac, American plum, choke-cherry.	Autumn-olive, Amur maple.	Eastern redcedar, Austrian pine, Russian-olive, osageorange.	Siberian elm.	---
Nb*: Nashville--------	Lilac, American plum, choke-cherry.	Autumn-olive, Amur maple.	Eastern redcedar, Austrian pine, Russian-olive, osageorange.	Siberian elm.	---
Quinlan----------	---	Eastern redcedar	---	---	---
Oa. Owens					
Pa----------------- Pond Creek	Lilac, choke-cherry, aromatic sumac.	Autumn-olive, amur maple.	Austrian pine, eastern redcedar.	Siberian elm.	Eastern cottonwood.
Pb----------------- Pratt	Lilac, choke-cherry, aromatic sumac.	Osageorange-------	Eastern redcedar, ponderosa pine, white mulberry.	---	---
Pc*: Pratt------------	Lilac, choke-cherry, aromatic sumac.	Osageorange-------	Eastern redcedar, ponderosa pine, white mulberry.	---	---
Carwile----------	Amur honeysuckle, lilac, American plum, choke-cherry.	---	Eastern redcedar, ponderosa pine, hackberry.	Green ash, honeylocust.	Eastern cottonwood.
Pd*---------------- Pratt-Tivoli	---	Osageorange-------	Eastern redcedar, ponderosa pine, white mulberry.	---	---
Qa, Qb------------ Quinlan	---	Eastern redcedar	---	---	---
Ra----------------- Renfrow	Siberian peashrub, aromatic sumac.	Eastern redcedar, Russian-olive.	Siberian elm, hackberry.	---	---
Rb----------------- Ruella	Lilac, aromatic sumac, American plum, choke-cherry, honeysuckle.	Amur maple, autumn-olive.	Eastern redcedar, Austrian pine, Russian-olive, osageorange.	Siberian elm.	---
Rc*: Ruella-----------	Lilac, aromatic sumac, American plum, choke-cherry, honey-suckle.	Amur maple, autumn-olive.	Eastern redcedar, Austrian pine, Russian-olive, osageorange.	Siberian elm.	---
Rock outcrop.					

See footnote at end of table.

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
Sa, Sb, Sc, Sd---- Shellabarger	Lilac, aromatic sumac, choke-cherry.	---	Eastern redcedar, ponderosa pine, white mulberry, osageorange.	Honeylocust, Siberian elm.	Eastern cottonwood.
Ta. Tivoli	---	---	---	---	---
Wa----------------- Waldeck	Lilac, American plum.	Chokecherry, Russian-olive.	Osageorange-------	Eastern redcedar, white mulberry, common hackberry, ponderosa pine.	Eastern cottonwood, Siberian elm.
Za----------------- Zenda	American plum, lilac, dogwood.	Chokecherry, buffaloberry.	Bur oak, osageorange, Austrian pine, white mulberry.	Eastern redcedar, common hackberry.	Eastern cottonwood, Siberian elm.

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

TABLE 8.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Aa, Ab Albion	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
Ac Albion	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
Ad Albion	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Ba, Bb, Bc Blanket	Moderate: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: low strength.
Ca Canadian	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods, low strength.
Cb Carwile	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, shrink-swell.
Cc*:					
Case	Moderate: too clayey.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: slope, low strength, shrink-swell.	Severe: low strength.
Clark	Moderate: too clayey.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell, slope.	Severe: low strength.
Cd*:					
Case	Moderate: too clayey, slope.	Moderate: low strength, slope, shrink-swell.	Moderate: low strength, slope, shrink-swell.	Severe: slope.	Severe: low strength.
Clark	Moderate: too clayey, slope.	Moderate: low strength, shrink-swell, slope.	Moderate: low strength, shrink-swell, slope.	Moderate: low strength, shrink-swell, slope.	Severe: low strength.
Ce, Cf Clark	Moderate: too clayey.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Severe: low strength.
Da*:					
Dillwyn	Severe: wetness, cutbanks cave, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Moderate: wetness, floods.
Plevna	Severe: floods, wetness, cutbanks cave.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.
Fa, Fb, Fc Farnum	Moderate: too clayey.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Severe: low strength.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Fd, Fe: Farnum	Moderate: too clayey.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell, slope.	Severe: low strength.
Ff*:					
Farnum	Moderate: too clayey.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Severe: low strength.
Natrustolls.					
Ka: Kaski	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
Kb: Kingman	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.
La: Lincoln	Severe: floods, cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
Ma: McLain	Severe: too clayey.	Severe: floods, shrink-swell, low strength.	Severe: floods, shrink-swell, low strength.	Severe: floods, shrink-swell, low strength.	Severe: low strength, shrink-swell.
Na: Nashville	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Slight	Moderate: low strength.
Nb*:					
Nashville	Moderate: depth to rock, slope.	Moderate: slope.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: low strength, slope.
Quinlan	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: slope, depth to rock.
Oa: Owens	Severe: too clayey, depth to rock.	Severe: shrink-swell.	Severe: shrink-swell, depth to rock.	Severe: shrink-swell.	Severe: shrink-swell.
Pa: Pond Creek	Moderate: too clayey.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: low strength.
Pb: Pratt	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
Pc*:					
Pratt	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
Carwile	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, shrink-swell.
Pd*:					
Pratt	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Tivoli	Severe: cutbanks cave, too sandy.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Qa, Qb------------ Quinlan	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Moderate: low strength, depth to rock.
Ra---------------- Renfrow	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
Rb---------------- Ruella	Moderate: too clayey.	Slight-----------	Slight-----------	Slight------------	Moderate: low strength.
Rc*:					
Ruella-----------	Moderate: too clayey.	Slight-----------	Slight-----------	Moderate: slope.	Moderate: low strength.
Rock outcrop.					
Sa, Sb------------ Shellabarger	Severe: cutbanks cave.	Slight-----------	Slight-----------	Slight------------	Slight.
Sc, Sd------------ Shellabarger	Severe: cutbanks cave.	Slight-----------	Slight-----------	Moderate: slope.	Slight.
Ta---------------- Tivoli	Severe: cutbanks cave, too sandy.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Wa---------------- Waldeck	Severe: floods, wetness, cutbanks cave.	Severe: floods.	Severe: floods, wetness.	Severe: floods.	Severe: floods.
Za---------------- Zenda	Severe: floods, wetness.	Severe: floods.	Severe: floods, wetness.	Severe: floods.	Severe: low strength.

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

TABLE 9.--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. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Aa, Ab, Ac: Albion	Slight	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Fair: too sandy, small stones.
Ad: Albion	Moderate: slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Fair: too sandy, small stones, slope.
Ba: Blanket	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey.
Bb, Bc: Blanket	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Ca: Canadian	Moderate: floods.	Severe: seepage, floods.	Severe: seepage.	Severe: seepage.	Good.
Cb: Carwile	Severe: percs slowly, wetness.	Slight	Severe: too clayey.	Severe: wetness.	Poor: too clayey.
Cc*:					
Case	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Clark	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Cd*:					
Case	Moderate: percs slowly, slope.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: too clayey, slope.
Clark	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Ce: Clark	Moderate: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
Cf: Clark	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Da*:					
Dillwyn	Severe: wetness, floods.	Severe: wetness, seepage, floods.	Severe: wetness, seepage, too sandy, floods.	Severe: wetness, seepage, floods.	Fair: too sandy.
Plevna	Severe: floods, wetness.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Poor: wetness.
Fa, Fb: Farnum	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey.
Fc, Fd, Fe: Farnum	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey.

See footnote at end of table.

TABLE 9.--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
Ff*:					
Farnum	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey.
Natrustolls.					
Ka: Kaski	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Good.
Kb: Kingman	Severe: wetness, floods, percs slowly.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Poor: wetness.
La: Lincoln	Severe: floods.	Severe: seepage, floods.	Severe: floods, seepage.	Severe: floods, seepage.	Fair: too sandy.
Ma: McLain	Severe: percs slowly.	Slight	Severe: too clayey.	Moderate: floods.	Poor: too clayey.
Na: Nashville	Severe: depth to rock.	Moderate: depth to rock, slope, seepage.	Severe: depth to rock.	Moderate: depth to rock.	Poor: area reclaim.
Nb*:					
Nashville	Severe: depth to rock.	Severe: slope.	Severe: depth to rock.	Moderate: slope, depth to rock.	Poor: area reclaim.
Quinlan	Severe: depth to rock.	Severe: seepage, slope, depth to rock.	Severe: depth to rock.	Severe: seepage, depth to rock.	Poor: area reclaim.
Oa: Owens	Severe: percs slowly.	Moderate: slope.	Severe: too clayey, depth to rock.	Slight	Poor: too clayey, area reclaim.
Pa: Pond Creek	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Pb: Pratt	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
Pc*:					
Pratt	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
Carwile	Severe: percs slowly, wetness.	Slight	Severe: too clayey.	Severe: wetness.	Poor: too clayey.
Pd*:					
Pratt	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: too sandy, slope.
Tivoli	Moderate: slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
Qa, Qb: Quinlan	Severe: depth to rock.	Severe: seepage.	Severe: depth to rock.	Severe: seepage, depth to rock.	Poor: area reclaim.

See footnote at end of table.

TABLE 9.--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
Ra------------------ Renfrow	Severe: percs slowly.	Slight-----------	Severe: too clayey.	Slight-----------	Poor: too clayey.
Rb------------------ Ruella	Slight-----------	Moderate: slope, seepage.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
Rc*:					
Ruella-------------	Slight-----------	Moderate: slope, seepage.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
Rock outcrop.					
Sa------------------ Shellabarger	Slight-----------	Moderate: seepage.	Slight-----------	Slight-----------	Fair: too sandy.
Sb, Sc, Sd---------- Shellabarger	Slight-----------	Moderate: seepage.	Slight-----------	Slight-----------	Good.
Ta------------------ Tivoli	Moderate: slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
Wa------------------ Waldeck	Severe: floods, wetness.	Severe: floods, seepage, wetness.	Severe: floods, seepage, wetness.	Severe: floods, seepage, wetness.	Good.
Za------------------ Zenda	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Fair: too clayey, wetness.

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

TABLE 10.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and "poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Aa, Ab, Ac Albion	Good	Fair: excess fines.	Fair: excess fines.	Good.
Ad Albion	Good	Fair: excess fines.	Fair: excess fines.	Fair: slope.
Ba, Bb Blanket	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Bc Blanket	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
Ca Canadian	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Cb Carwile	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer.
Cc*:				
Case	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
Clark	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
Cd*:				
Case	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey, slope.
Clark	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
Ce, Cf Clark	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
Da*:				
Dillwyn	Poor: wetness.	Fair: excess fines.	Unsuited: excess fines.	Fair: too sandy.
Plevna	Poor: wetness.	Fair: excess fines.	Unsuited: excess fines.	Poor: wetness.
Fa, Fb, Fc, Fd, Fe Farnum	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Ff*:				
Farnum	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Natrustolls.				
Ka Kaski	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Kb Kingman	Poor: wetness.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: wetness.
La Lincoln	Good	Fair: excess fines.	Unsuited: excess fines.	Poor: too sandy.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ma: McLain	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Na: Nashville	Poor: area reclaim, thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: area reclaim.
Nb*:				
Nashville	Poor: area reclaim, thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: slope, area reclaim.
Quinlan	Poor: area reclaim.	Unsuited: excess fines, thin layer.	Unsuited: excess fines.	Fair: area reclaim, slope.
Oa: Owens	Poor: shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
Pa: Pond Creek	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Pb: Pratt	Good	Fair: excess fines.	Unsuited: excess fines.	Fair: too sandy.
Pc*:				
Pratt	Good	Fair: excess fines.	Unsuited: excess fines.	Fair: too sandy.
Carwile	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer.
Pd*:				
Pratt	Good	Fair: excess fines.	Unsuited: excess fines.	Fair: too sandy.
Tivoli	Good	Fair: excess fines.	Unsuited: excess fines.	Poor: too sandy.
Qa, Qb: Quinlan	Poor: area reclaim.	Unsuited: excess fines, thin layer.	Unsuited: excess fines.	Fair: thin layer, area reclaim.
Ra: Renfrow	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey, thin layer.
Rb: Ruella	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
Rc*:				
Ruella	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
Rock outcrop.				
Sa: Shellabarger	Fair: low strength.	Fair: excess fines.	Unsuited: excess fines.	Fair: too sandy.
Sb, Sc, Sd: Shellabarger	Fair: low strength.	Fair: excess fines.	Unsuited: excess fines.	Good.
Ta: Tivoli	Good	Fair: excess fines.	Unsuited: excess fines.	Poor: too sandy.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Wa: Waldeck	Fair: wetness.	Good	Unsuited: excess fines.	Good.
Za: Zenda	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.

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

TABLE 11.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Aa----------------- Albion	Seepage---------	Seepage---------	Not needed-----	Droughty, soil blowing.	Not needed-----	Droughty.
Ab, Ac------------- Albion	Seepage---------	Seepage---------	Not needed-----	Droughty, soil blowing.	Soil blowing---	Droughty.
Ad----------------- Albion	Slope, seepage.	Seepage---------	Not needed-----	Droughty, soil blowing, slope.	Soil blowing---	Slope, droughty.
Ba, Bb, Bc--------- Blanket	Favorable------	Piping, hard to pack.	Not needed-----	Favorable------	Favorable------	Favorable.
Ca----------------- Canadian	Seepage---------	Seepage, piping.	Not needed-----	Fast intake----	Not needed-----	Erodes easily.
Cb----------------- Carwile	Favorable------	Hard to pack.	Percs slowly, poor outlets.	Percs slowly, wetness.	Not needed-----	Percs slowly, wetness.
Cc*:						
Case--------------	Seepage---------	Favorable------	Not needed-----	Favorable------	Favorable------	Favorable.
Clark-------------	Seepage---------	Favorable------	Not needed-----	Favorable------	Favorable------	Favorable.
Cd*:						
Case--------------	Slope, seepage.	Favorable------	Not needed-----	Slope-----------	Favorable------	Slope.
Clark-------------	Seepage, slope.	Favorable------	Not needed-----	Slope-----------	Favorable------	Favorable.
Ce----------------- Clark	Seepage---------	Favorable------	Not needed-----	Favorable------	Not needed-----	Favorable.
Cf----------------- Clark	Seepage---------	Favorable------	Not needed-----	Favorable------	Favorable------	Favorable.
Da*:						
Dillwyn-----------	Seepage---------	Seepage, wetness.	Floods----------	Wetness, floods, soil blowing, droughty.	Not needed-----	Wetness, droughty.
Plevna------------	Seepage---------	Wetness---------	Floods----------	Floods, wetness, soil blowing.	Not needed-----	Wetness.
Fa----------------- Farnum	Favorable------	Favorable------	Not needed-----	Soil blowing---	Not needed-----	Favorable.
Fb----------------- Farnum	Favorable------	Favorable------	Not needed-----	Favorable------	Not needed-----	Favorable.
Fc, Fd------------- Farnum	Favorable------	Favorable------	Not needed-----	Favorable------	Favorable------	Favorable.
Fe----------------- Farnum	Favorable------	Favorable------	Not needed-----	Favorable------	Favorable------	Favorable.
Ff*:						
Farnum------------	Favorable------	Favorable------	Not needed-----	Favorable------	Not needed-----	Favorable.
Natrustolls.						
Ka----------------- Kaski	Seepage---------	Piping----------	Not needed-----	Floods----------	Not needed-----	Favorable.

See footnote at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Kb: Kingman	Favorable	Wetness	Floods	Wetness, floods.	Not needed	Wetness.
La: Lincoln	Seepage	Seepage, piping.	Floods	Seepage, fast intake.	Not needed	Favorable.
Ma: McLain	Favorable	Hard to pack, piping.	Not needed	Percs slowly.	Not needed	Slow intake.
Na: Nashville	Depth to rock, seepage.	Piping, thin layer.	Not needed	Rooting depth.	Favorable	Depth to rock.
Nb*:						
Nashville	Slope, depth to rock, seepage.	Piping, thin layer.	Not needed	Rooting depth, slope.	Favorable	Slope, depth to rock.
Quinlan	Depth to rock	Thin layer	Not needed	Droughty, slope, rooting depth.	Depth to rock, slope.	Droughty, slope, rooting depth.
Oa: Owens	Depth to rock	Hard to pack, thin layer.	Not needed	Droughty, percs slowly.	Rooting depth, percs slowly.	Droughty, erodes easily.
Pa: Pond Creek	Seepage	Piping	Not needed	Slope	Favorable	Favorable.
Pb: Pratt	Seepage	Seepage, piping.	Not needed	Soil blowing, fast intake.	Soil blowing	Favorable.
Pc*:						
Pratt	Seepage	Seepage, piping.	Not needed	Soil blowing, fast intake.	Soil blowing	Favorable.
Carwile	Favorable	Hard to pack.	Percs slowly, poor outlets.	Percs slowly, wetness.	Not needed	Percs slowly, wetness.
Pd*:						
Pratt	Seepage, slope.	Seepage, piping.	Not needed	Fast intake, soil blowing, slope.	Soil blowing, slope.	Slope.
Tivoli	Seepage	Seepage, piping.	Not needed	Slope, droughty, soil blowing.	Soil blowing, slope.	Droughty, slope.
Qa, Qb: Quinlan	Depth to rock	Thin layer	Not needed	Droughty, rooting depth.	Depth to rock.	Droughty, rooting depth.
Ra: Renfrow	Favorable	Hard to pack.	Not needed	Erodes easily, percs slowly.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
Rb: Ruella	Seepage	Favorable	Not needed	Favorable	Favorable	Favorable.
Rc*:						
Ruella	Seepage	Favorable	Not needed	Favorable	Favorable	Favorable.
Rock outcrop.						
Sa: Shellabarger	Seepage	Favorable	Not needed	Fast intake, soil blowing.	Not needed	Favorable.
Sb, Sc, Sd: Shellabarger	Seepage	Favorable	Not needed	Soil blowing	Soil blowing	Favorable:

See footnote at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Ta------------------ Tivoli	Seepage--------	Seepage, piping.	Not needed-----	Slope, droughty, soil blowing.	Too sandy, slope, soil blowing.	Droughty, slope.
Wa------------------ Waldeck	Seepage--------	Seepage, wetness.	Floods---------	Wetness, soil blowing, floods.	Not needed-----	Favorable.
Za------------------ Zenda	Favorable------	Wetness--------	Floods---------	Floods, wetness.	Not needed-----	Favorable.

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

TABLE 12.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Aa: Albion	Slight	Slight	Slight	Slight.
Ab, Ac: Albion	Slight	Slight	Moderate: slope.	Slight.
Ad: Albion	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Ba: Blanket	Moderate: percs slowly.	Slight	Moderate: percs slowly.	Slight.
Bb: Blanket	Moderate: percs slowly.	Slight	Moderate: slope, percs slowly.	Slight.
Bc: Blanket	Moderate: percs slowly.	Slight	Moderate: slope, percs slowly, too clayey.	Slight.
Ca: Canadian	Severe: floods.	Moderate: floods.	Moderate: floods.	Slight.
Cb: Carwile	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Cc*:				
Case	Slight	Slight	Moderate: too clayey, slope.	Slight.
Clark	Slight	Slight	Moderate: slope, too clayey.	Slight.
Cd*:				
Case	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Clark	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Ce: Clark	Slight	Slight	Moderate: too clayey.	Slight.
Cf: Clark	Slight	Slight	Moderate: slope, too clayey.	Slight.
Da*:				
Dillwyn	Severe: wetness, floods.	Moderate: wetness, too sandy.	Severe: wetness.	Moderate: wetness, too sandy.
Plevna	Severe: floods, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Fa, Fb: Farnum	Moderate: percs slowly.	Slight	Moderate: percs slowly.	Slight.

See footnote at end of table.

TABLE 12.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Fc, Fd, Fe: Farnum	Moderate: percs slowly.	Slight	Moderate: percs slowly, slope.	Slight.
Ff*:				
Farnum	Moderate: percs slowly.	Slight	Moderate: percs slowly.	Slight.
Natrustolls.				
Ka: Kaski	Severe: floods.	Moderate: floods.	Moderate: floods.	Slight.
Kb: Kingman	Severe: wetness, floods.	Severe: wetness.	Severe: wetness.	Severe: wetness.
La: Lincoln	Severe: floods.	Moderate: floods.	Moderate: floods.	Moderate: floods.
Ma: McLain	Severe: floods.	Moderate: floods.	Moderate: floods, percs slowly.	Slight.
Na: Nashville	Slight	Slight	Moderate: slope, depth to rock.	Slight.
Nb*:				
Nashville	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Quinlan	Moderate: slope.	Moderate: slope.	Severe: depth to rock, slope.	Slight.
Oa: Owens	Severe: too clayey, percs slowly.	Severe: too clayey.	Severe: too clayey, percs slowly.	Severe: too clayey.
Pa: Pond Creek	Moderate: percs slowly.	Slight	Moderate: percs slowly, slope.	Slight.
Pb: Pratt	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.
Pc*:				
Pratt	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.
Carwile	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Pd*:				
Pratt	Moderate: too sandy, slope.	Moderate: too sandy, slope.	Severe: slope.	Moderate: too sandy.
Tivoli	Severe: too sandy, dusty.	Severe: too sandy, dusty.	Severe: too sandy, dusty.	Severe: too sandy, dusty.
Qa, Qb: Quinlan	Slight	Slight	Severe: depth to rock.	Slight.

See footnote at end of table.

TABLE 12.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Ra: Renfrow	Severe: percs slowly.	Slight	Severe: percs slowly.	Slight.
Rb: Ruella	Slight	Slight	Moderate: slope, too clayey.	Slight.
Rc*:				
Ruella	Slight	Slight	Moderate: slope, too clayey.	Slight.
Rock outcrop.				
Sa: Shellabarger	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
Sb, Sc, Sd: Shellabarger	Slight	Slight	Moderate: slope.	Slight.
Ta: Tivoli	Severe: too sandy, dusty.	Severe: too sandy, dusty.	Severe: too sandy, dusty.	Severe: too sandy, dusty.
Wa: Waldeck	Severe: floods.	Moderate: wetness.	Moderate: floods, wetness.	Moderate: wetness.
Za: Zenda	Severe: floods.	Moderate: wetness.	Moderate: too clayey, wetness, floods.	Moderate: wetness.

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

TABLE 13.--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						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
Aa, Ab, Ac------ Albion	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Ad------ Albion	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Ba, Bb------ Blanket	Good	Good	Fair	Good	Poor	Very poor	Good	Very poor	Fair.
Bc------ Blanket	Fair	Good	Fair	Good	Poor	Very poor	Fair	Very poor	Fair.
Ca------ Canadian	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
Cb------ Carwile	Fair	Good	Good	Good	Good	Fair	Good	Fair	Good.
Cc*:									
Case------	Fair	Good	Fair	Poor	Poor	Very poor	Fair	Very poor	Poor.
Clark------	Fair	Good	Fair	Poor	Poor	Very poor	Fair	Very poor	Poor.
Cd*:									
Case------	Poor	Fair	Fair	Poor	Poor	Very poor	Fair	Very poor	Poor.
Clark------	Fair	Good	Fair	Poor	Poor	Very poor	Fair	Very poor	Poor.
Ce------ Clark	Good	Good	Fair	Poor	Poor	Very poor	Fair	Very poor	Poor.
Cf------ Clark	Fair	Good	Fair	Poor	Poor	Very poor	Fair	Very poor	Poor.
Da*:									
Dillwyn------	Poor	Fair	Good	Fair	Fair	Good	Fair	Fair	Fair.
Plevna------	Poor	Fair	Fair	Fair	Good	Good	Fair	Good	Fair.
Fa, Fb, Fc------ Farnum	Good	Good	Good	Fair	Fair	Poor	Good	Poor	Fair.
Fd, Fe------ Farnum	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Ff*:									
Farnum------	Good	Good	Good	Fair	Fair	Poor	Good	Poor	Fair.
Natrustolls.									
Ka------ Kaski	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
Kb------ Kingman	Poor	Fair	Good	Fair	Fair	Fair	Fair	Fair	Fair.
La------ Lincoln	Fair	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Ma------ McLain	Good	Good	Fair	Fair	Good	Good	Good	Good	Fair.

See footnote at end of table.

TABLE 13.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
Na: Nashville	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Nb*:									
Nashville	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Quinlan	Poor	Poor	Fair	Poor	Very poor	Very poor	Fair	Very poor	Poor.
Oa: Owens	Fair	Fair	Fair	Poor	Very poor	Very poor	Fair	Very poor	Poor.
Pa: Pond Creek	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Pb: Pratt	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Pc*:									
Pratt	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Carwile	Fair	Good	Good	Good	Good	Fair	Good	Fair	Good.
Pd*:									
Pratt	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Tivoli	Poor	Poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Poor.
Qa, Qb: Quinlan	Poor	Poor	Fair	Poor	Poor	Very poor	Fair	Very poor	Poor.
Ra: Renfrow	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
Rb: Ruella	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
Rc*:									
Ruella	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Rock outcrop.									
Sa, Sb: Shellabarger	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Sc, Sd: Shellabarger	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Ta: Tivoli	Poor	Poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Poor.
Wa: Waldeck	Fair	Good	Good	Good	Fair	Fair	Good	Fair	Good.
Za: Zenda	Fair	Good	Good	Good	Fair	Fair	Good	Fair	Good.

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

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS

[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: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Aa, Ab, Ac, Ad------ Albion	0-8	Sandy loam------	SM, ML	A-2, A-4	0	100	70-100	60-90	25-55	<30	NP-5
	8-16	Sandy loam------	SM, ML, GM	A-2, A-4	0	50-100	45-100	45-90	30-55	20-35	NP-10
	16-26	Coarse sandy loam, loamy sand.	SM, GM	A-2, A-1	0	50-100	45-90	40-70	15-30	<30	NP-5
	26-60	Loamy sand, gravelly sand, sand.	SP-SM, GP-GM, SM, GM	A-2, A-1, A-3	0-5	40-100	40-90	30-70	5-30	<30	NP-5
Ba, Bb------------- Blanket	0-18	Silt loam, silty clay loam.	CL	A-6	0	95-100	95-100	90-100	60-80	28-40	12-24
	18-50	Clay loam, clay, silty clay.	CL, CH	A-7	0	95-100	95-100	85-100	70-90	41-55	20-35
	50-60	Clay loam, clay, silty clay loam.	CL	A-6, A-7	0	85-100	80-100	70-90	51-85	30-45	15-30
Bc----------------- Blanket	0-5	Silty clay loam	CL	A-6	0	95-100	95-100	90-100	60-80	28-40	12-24
	5-40	Clay loam, clay, silty clay.	CL, CH	A-7	0	95-100	95-100	85-100	70-90	41-55	20-35
	40-60	Clay loam, clay, silty clay loam.	CL	A-6, A-7	0	85-100	80-100	70-90	51-85	30-45	15-30
Ca----------------- Canadian	0-32	Fine sandy loam	SM, ML, SC, CL	A-4	0	100	98-100	94-100	36-85	<31	NP-10
	32-60	Fine sandy loam, loam, sandy loam.	SM, ML, SC, CL	A-4, A-2	0	100	98-100	90-100	15-85	<31	NP-10
Cb----------------- Carwile	0-10	Fine sandy loam	ML, CL, CL-ML, SM	A-4	0	100	98-100	94-100	36-85	<30	NP-10
	10-18	Clay loam, sandy clay loam.	CL, SC	A-6, A-7	0	100	100	90-100	36-90	35-50	14-26
	18-36	Clay loam, clay, sandy clay.	CL, CH, SC	A-6, A-7	0	100	100	90-100	40-95	35-70	14-38
	36-45	Clay loam, sandy clay loam, clay.	CL, CH, SC	A-4, A-6, A-7	0	100	100	90-100	36-95	25-70	7-38
	45-60	Fine sandy loam, sandy clay loam, clay.	CL, CH, SC, CL-ML	A-4, A-6, A-7	0	100	98-100	90-100	36-95	22-70	4-38
Cc*, Cd*:											
Case---------------	0-8	Clay loam-------	CL, CL-ML	A-4, A-6	0	100	95-100	90-100	65-85	20-40	5-15
	8-60	Clay loam, loam	CL	A-6	0	100	95-100	90-100	65-85	25-40	10-25
Clark-------------	0-11	Clay loam-------	CL-ML, CL	A-4, A-6	0	100	95-100	90-100	50-90	20-40	5-20
	11-60	Loam, clay loam	CL	A-6	0	100	95-100	90-100	55-90	25-40	10-25
Ce, Cf------------- Clark	0-11	Clay loam-------	CL-ML, CL	A-4, A-6	0	100	95-100	90-100	50-90	20-40	5-20
	11-60	Loam, clay loam	CL	A-6	0	100	95-100	90-100	55-90	25-40	10-25
Da*:											
Dillwyn-----------	0-8	Loamy fine sand	SM, SP-SM	A-2, A-3	0	100	95-100	70-100	5-35	---	NP
	8-60	Loamy fine sand, fine sand.	SM, SP-SM	A-2, A-3	0	100	95-100	70-100	5-35	---	NP
Plevna------------	0-11	Fine sandy loam	SM, SM-SC	A-2, A-4	0	100	95-100	70-100	20-50	<26	NP-6
	11-36	Fine sandy loam, sandy loam.	SM, SM-SC	A-2, A-4	0	100	95-100	70-100	30-50	<26	NP-6
	36-60	Fine sand, sand	SM, SP	A-2, A-3	0	100	90-100	50-90	4-35	---	NP

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
Fa----------------- Farnum	0-16	Sandy loam------	SM, ML	A-4, A-2	0	100	100	80-100	30-55	<30	NP-5
	16-60	Clay loam, sandy clay loam, loam.	SC, CL	A-6, A-7-6	0	100	100	65-100	45-80	35-50	15-30
Fb, Fc, Fd--------- Farnum	0-13	Loam------------	CL-ML, CL	A-4, A-6	0	100	100	95-100	65-85	<30	5-15
	13-60	Clay loam, sandy clay loam, loam.	SC, CL	A-6, A-7-6	0	100	100	65-100	45-80	35-50	15-30
Fe----------------- Farnum	0-8	Clay loam-------	CL-ML, CL	A-4, A-6	0	100	100	95-100	65-85	<30	5-15
	8-60	Clay loam, sandy clay loam, loam.	SC, CL	A-6, A-7-6	0	100	100	65-100	45-80	35-50	15-30
Ff*:											
Farnum------------	0-13	Loam------------	CL-ML, CL	A-4, A-6	0	100	100	95-100	65-85	<30	5-15
	13-60	Clay loam, sandy clay loam, loam.	SC, CL	A-6, A-7-6	0	100	100	65-100	45-80	35-50	15-30
Natrustolls.											
Ka----------------- Kaski	0-28	Loam------------	CL, CL-ML	A-4, A-6, A-7	0	100	100	85-100	60-85	20-45	5-25
	28-42	Clay loam, loam, sandy loam.	CL, CL-ML, SC, SM-SC	A-4, A-6, A-7	0	100	95-100	85-100	45-85	20-45	5-25
	42-60	Clay loam, sandy loam, loam.	CL, ML, SM, SC	A-2, A-4, A-6	0	100	95-100	60-100	30-80	<35	NP-20
Kb----------------- Kingman	0-18	Silty clay loam	CL	A-6, A-7-6	0	100	100	95-100	90-100	35-50	13-26
	18-48	Silty clay loam	CL	A-6, A-7-6	0	100	100	95-100	90-100	35-50	13-26
	48-60	Sandy loam, clay loam, silty clay loam.	CL, SM-SC, CL-ML, SC	A-6, A-4	0	100	95-100	90-100	40-90	<40	5-20
La----------------- Lincoln	0-10	Loamy sand------	SM, SM-SP	A-2, A-3	0	90-100	85-100	75-100	8-35	---	NP
	10-60	Sand, loamy sand	SM, SM-SP	A-2, A-3	0	90-100	85-100	75-100	8-35	---	NP
Ma----------------- McLain	0-14	Silt loam-------	CL, ML	A-4, A-6	0	100	100	96-100	65-97	30-37	8-14
	14-42	Silty clay loam, clay loam, silty clay.	CL, CH, MH, ML	A-6, A-7	0	100	100	96-100	80-99	37-70	15-38
	42-60	Silt loam, loam, silty clay loam.	CL, ML, CH, MH	A-4, A-6, A-7	0	100	95-100	95-100	65-99	27-70	7-38
Na----------------- Nashville	0-28	Silt loam-------	ML, CL-ML, CL	A-4	0	100	100	95-100	85-100	20-35	2-10
	28	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Nb*:											
Nashville---------	0-28	Silt loam-------	ML, CL-ML, CL	A-4	0	100	100	95-100	85-100	20-35	2-10
	28	Weathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Nb*:											
Quinlan-----------	0-13	Loam------------	ML, CL, CL-ML	A-4, A-6	0	100	95-100	90-100	55-97	<37	NP-14
	13	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Oa--------------- Owens	0-6	Clay loam-------	CL, CH	A-7-6	0-5	95-100	95-100	85-100	75-95	45-60	22-32
	6-16	Clay, clay loam	CL, CH	A-7-6	0-5	95-100	90-100	85-100	75-95	45-60	22-32
	16	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Pa--------------- Pond Creek	0-10	Silt loam-------	ML, CL, CL-ML	A-4, A-6	0	100	100	96-100	65-97	22-37	3-14
	10-60	Silty clay loam, clay loam, silt loam.	CL, ML	A-4, A-6, A-7	0	100	100	96-100	65-98	30-43	8-20
Pb--------------- Pratt	0-12	Loamy fine sand	SM	A-2	0	100	95-100	70-100	15-35	---	NP
	12-36	Loamy fine sand, loamy sand, fine sandy loam.	SM, SM-SC	A-2, A-4	0	100	95-100	90-100	15-40	<20	NP-6
	36-60	Loamy fine sand, fine sand.	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-35	---	NP
Pc*:											
Pratt-------------	0-12	Loamy fine sand	SM	A-2	0	100	95-100	70-100	15-35	---	NP
	12-36	Loamy fine sand, loamy sand, fine sandy loam.	SM, SM-SC	A-2, A-4	0	100	95-100	90-100	15-40	<20	NP-6
	36-60	Loamy fine sand, fine sand.	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-35	---	NP
Carwile-----------	0-10	Fine sandy loam	ML, CL, CL-ML, SM	A-4	0	100	98-100	94-100	36-85	<30	NP-10
	10-18	Clay loam, sandy clay loam.	CL, SC	A-6, A-7	0	100	100	90-100	36-90	35-50	14-26
	18-36	Clay loam, clay, sandy clay.	CL, CH, SC	A-6, A-7	0	100	100	90-100	40-95	35-70	14-38
	36-45	Clay loam, sandy clay loam, clay.	CL, CH, SC	A-4, A-6, A-7	0	100	100	90-100	36-95	25-70	7-38
	45-60	Fine sandy loam, sandy clay loam, clay.	CL, CH, SC, CL-ML	A-4, A-6, A-7	0	100	98-100	90-100	36-95	22-70	4-38
Pd*:											
Pratt-------------	0-12	Loamy fine sand	SM	A-2	0	100	95-100	70-100	15-35	---	NP
	12-36	Loamy fine sand, loamy sand, fine sandy loam.	SM, SM-SC	A-2, A-4	0	100	95-100	90-100	15-40	<20	NP-6
	36-60	Loamy fine sand, fine sand.	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-35	---	NP
Tivoli------------	0-8	Loamy fine sand	SM, SP-SM	A-2, A-3	0	100	98-100	80-100	5-35	---	NP
	8-60	Fine sand, sand	SM, SP-SM	A-2, A-3	0	100	98-100	80-98	5-20	---	NP
Qa, Qb------------ Quinlan	0-13	Loam------------	ML, CL, CL-ML	A-4, A-6	0	100	95-100	90-100	55-97	<37	NP-14
	13	Weathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--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	
Ra: Renfrow	0-8	Clay loam	CL	A-6, A-7	0	100	100	96-100	80-98	33-49	12-26
	8-12	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	96-100	80-98	37-49	15-26
	12-50	Clay, silty clay, silty clay loam.	ML, CL, CH, MH	A-6, A-7	0	100	100	96-100	80-99	37-70	15-38
	50	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Rb: Ruella	0-60	Clay loam, loam.	CL, CL-ML	A-4, A-6	0	100	100	85-100	65-85	25-35	5-15
Rc*:											
Ruella	0-60	Clay loam, loam	CL, CL-ML	A-4, A-6	0	100	100	85-100	65-85	25-35	5-15
Rock outcrop.											
Sa: Shellabarger	0-12	Loamy sand	SM	A-2	0	95-100	95-100	70-100	15-35	---	NP
	12-38	Sandy clay loam, sandy loam, fine sandy loam.	SC	A-4, A-6	0	95-100	95-100	70-90	35-50	25-40	8-20
	38-60	Sandy loam, fine sandy loam, loamy sand.	SC, SM, SP-SM, SM-SC	A-2, A-4	0	70-100	70-100	50-80	10-40	<30	NP-10
Sb, Sc, Sd: Shellabarger	0-10	Sandy loam	SM, ML	A-4, A-2	0	95-100	95-100	75-100	30-55	<30	NP-5
	10-45	Sandy clay loam, sandy loam, fine sandy loam.	SC	A-4, A-6	0	95-100	95-100	70-90	35-50	25-40	8-20
	45-60	Sandy loam, fine sandy loam, loamy sand.	SC, SM, SP-SM, SM-SC	A-2, A-4	0	70-100	70-100	50-80	10-40	<30	NP-10
Ta: Tivoli	0-7	Fine sand	SM, SP-SM	A-2, A-3	0	100	98-100	80-100	5-35	---	NP
	7-60	Fine sand, sand	SM, SP-SM	A-2, A-3	0	100	98-100	80-98	5-20	---	NP
Wa: Waldeck	0-12	Fine sandy loam	SM, SM-SC, ML, CL-ML	A-2, A-4	0	100	95-100	75-100	25-55	<25	NP-5
	12-36	Fine sandy loam, sandy loam.	SM, SM-SC	A-2, A-4	0	100	95-100	70-100	30-50	<25	NP-5
	36-60	Fine sand, sand	SM, SP	A-1, A-2, A-3	0	90-100	80-100	40-60	1-35	---	NP
Za: Zenda	0-13	Clay loam	CL-ML, CL	A-4, A-6	0	100	95-100	85-100	55-80	25-40	5-20
	13-60	Loam, clay loam	CL	A-6	0	100	95-100	85-100	55-80	25-40	10-25

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

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" 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	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	mmhos/cm				
Aa, Ab, Ac, Ad---	0-8	2.0-6.0	0.13-0.20	5.6-6.5	<2	Low-------	0.20	3	3
Albion	8-16	2.0-6.0	0.12-0.18	6.1-8.4	<2	Low-------	0.20		
	16-26	2.0-6.0	0.09-0.12	6.1-8.4	<2	Low-------	0.20		
	26-60	6.0-20	0.03-0.10	6.1-8.4	<2	Low-------	0.15		
Ba, Bb-----------	0-18	0.6-2.0	0.15-0.20	6.1-7.8	<2	Moderate	0.32	5	6
Blanket	18-50	0.2-0.6	0.12-0.18	6.1-8.4	<2	Moderate	0.37		
	50-60	0.6-2.0	0.12-0.18	7.9-8.4	<2	Moderate	0.43		
Bc---------------	0-5	0.6-2.0	0.15-0.20	6.1-7.8	<2	Moderate	0.32	5	6
Blanket	5-40	0.2-0.6	0.12-0.18	6.1-8.4	<2	Moderate	0.37		
	40-60	0.6-2.0	0.12-0.18	7.9-8.4	<2	Moderate	0.43		
Ca---------------	0-32	2.0-6.0	0.11-0.20	5.6-8.4	<2	Low-------	0.20	5	3
Canadian	32-60	2.0-20	0.07-0.20	6.1-8.4	<2	Low-------	0.20		
Cb---------------	0-10	0.6-2.0	0.11-0.20	5.1-7.3	<2	Low-------	0.24	5	3
Carwile	10-18	0.2-2.0	0.12-0.20	5.1-7.3	<2	Moderate	0.37		
	18-36	0.06-0.2	0.12-0.20	6.1-8.4	<2	High------	0.37		
	36-45	0.2-2.0	0.12-0.20	6.6-8.4	<2	High------	0.32		
	45-60	0.2-2.0	0.11-0.18	7.9-8.4	<2	High------	0.24		
Cc*, Cd*:									
Case-------------	0-8	0.6-2.0	0.17-0.22	7.4-8.4	<2	Low-------	0.32	5	4L
	8-60	0.6-2.0	0.15-0.19	7.4-8.4	<2	Moderate	0.32		
Clark-----------	0-11	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	0.28	5	4L
	11-60	0.6-2.0	0.15-0.19	7.4-8.4	<2	Moderate	0.28		
Ce, Cf-----------	0-11	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	0.28	5	4L
Clark	11-60	0.6-2.0	0.15-0.19	7.4-8.4	<2	Moderate	0.28		
Da*:									
Dillwyn---------	0-8	6.0-20	0.08-0.12	5.6-7.3	<2	Low-------	0.17	5	2
	8-60	6.0-20	0.06-0.10	5.6-7.8	<2	Low-------	0.17		
Plevna----------	0-11	2.0-6.0	0.14-0.18	6.6-8.4	<2	Low-------	0.20	5	3
	11-36	2.0-6.0	0.12-0.16	6.6-8.4	<2	Low-------	0.20		
	36-60	2.0-6.0	0.05-0.07	6.6-8.4	<2	Low-------	0.20		
Fa---------------	0-16	0.6-2.0	0.13-0.21	5.6-7.3	<2	Low-------	0.20	5	3
Farnum	16-60	0.2-0.6	0.14-0.21	6.1-8.4	<2	Moderate	0.28		
Fb, Fc, Fd-------	0-13	0.6-2.0	0.20-0.22	5.6-7.3	<2	Low-------	0.28	5	6
Farnum	13-60	0.2-0.6	0.14-0.21	6.1-8.4	<2	Moderate	0.28		
Fe---------------	0-8	0.6-2.0	0.20-0.22	5.6-7.3	<2	Low-------	0.28	5	6
Farnum	8-60	0.2-0.6	0.14-0.21	6.1-8.4	<2	Moderate	0.28		
Ff*:									
Farnum----------	0-13	0.6-2.0	0.20-0.22	5.6-7.3	<2	Low-------	0.28	5	6
	13-60	0.2-0.6	0.14-0.21	6.1-8.4	<2	Moderate	0.28		
Natrustolls.									
Ka---------------	0-28	0.6-2.0	0.18-0.22	5.6-7.3	<2	Low-------	0.28	5	6
Kaski	28-42	0.6-2.0	0.13-0.19	5.6-7.8	<2	Low-------	0.28		
	42-60	0.6-2.0	0.13-0.19	5.6-8.4	<2	Low-------	0.28		
Kb---------------	0-18	0.2-0.6	0.21-0.23	7.4-8.4	<2	Moderate	0.32	5	4L
Kingman	18-48	0.2-0.6	0.18-0.20	7.4-8.4	<2	Moderate	0.32		
	48-60	0.2-2.0	0.12-0.19	7.4-8.4	<2	Low-------	0.32		

See footnote at end of table.

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

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	mmhos/cm				
La----------------- Lincoln	0-10	6.0-20	0.05-0.10	6.1-7.3	<2	Low--------	0.17	5	2
	10-60	6.0-20	0.05-0.10	6.1-7.8	<2	Low--------	0.17		
Ma----------------- McLain	0-14	0.2-0.6	0.15-0.24	6.1-8.4	<2	Low--------	0.37	5	6
	14-42	0.06-0.2	0.12-0.22	6.1-8.4	<2	High-------	0.37		
	42-60	0.06-0.6	0.12-0.24	6.6-8.4	---	High-------	0.43		
Na----------------- Nashville	0-28	0.6-2.0	0.20-0.24	5.6-7.3	<2	Low--------	0.32	4	6
	28	---	---	---	---	-----------	---		
Nb*:									
Nashville--------	0-28	0.6-2.0	0.20-0.24	5.6-7.3	<2	Low--------	0.32	4	6
	28	---	---	---	---	-----------	---		
Quinlan----------	0-13	2.0-6.0	0.15-0.20	7.4-8.4	<2	Low--------	0.32	2	4L
	13	---	---	---	---	-----------	---		
Oa----------------- Owens	0-6	<0.06	0.13-0.17	7.9-8.4	<2	High-------	0.32	2	4L
	6-16	<0.06	0.13-0.17	7.9-8.4	<2	High-------	0.32		
	16	---	---	---	---	---	---		
Pa----------------- Pond Creek	0-10	0.6-2.0	0.15-0.20	5.6-7.3	<2	Low--------	0.37	5	6
	10-60	0.2-0.6	0.15-0.22	6.1-8.4	<2	Moderate	0.37		
Pb----------------- Pratt	0-12	6.0-20	0.10-0.13	5.6-7.3	<2	Low--------	0.17	5	2
	12-36	6.0-20	0.09-0.16	5.6-7.3	<2	Low--------	0.17		
	36-60	6.0-20	0.08-0.12	6.1-7.3	<2	Low--------	0.17		
Pc*:									
Pratt------------	0-12	6.0-20	0.10-0.13	5.6-7.3	<2	Low--------	0.17	5	2
	12-36	6.0-20	0.09-0.16	5.6-7.3	<2	Low--------	0.17		
	36-60	6.0-20	0.08-0.12	6.1-7.3	<2	Low--------	0.17		
Carwile----------	0-10	0.6-2.0	0.11-0.20	5.1-7.3	<2	Low--------	0.24	5	3
	10-18	0.2-2.0	0.12-0.20	5.1-7.3	<2	Moderate	0.37		
	18-36	0.06-0.2	0.12-0.20	6.1-8.4	<2	High-------	0.37		
	36-45	0.2-2.0	0.12-0.20	6.6-8.4	<2	High-------	0.32		
	45-60	0.2-2.0	0.11-0.18	7.9-8.4	<2	High-------	0.24		
Pd*:									
Pratt------------	0-12	6.0-20	0.10-0.13	5.6-7.3	<2	Low--------	0.17	5	2
	12-36	6.0-20	0.09-0.16	5.6-7.3	<2	Low--------	0.17		
	36-60	6.0-20	0.08-0.12	6.1-7.3	<2	Low--------	0.17		
Tivoli-----------	0-8	6.0-20.0	0.05-0.11	6.1-7.8	<2	Low--------	0.17	5	2
	8-60	6.0-20.0	0.02-0.06	6.1-8.4	<2	Low--------	0.17		
Qa, Qb------------ Quinlan	0-13	2.0-6.0	0.15-0.20	7.4-8.4	<2	Low--------	0.32	2	4L
	13	---	---	---	---	-----------	---		
Ra----------------- Renfrow	0-8	0.2-0.6	0.15-0.22	6.1-7.8	<2	Moderate	0.43	4	6
	8-12	0.2-0.6	0.15-0.22	6.1-7.8	<2	Moderate	0.43		
	12-50	<0.06	0.12-0.22	6.1-8.4	<2	High-------	0.43		
	50	---	---	---	---	---			
Rb----------------- Ruella	0-60	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low--------	0.32	5	4L
Rc*:									
Ruella-----------	0-60	0.6-2.0	0.18-0.22	7.4-8.4	<2	Low--------	0.32	5	4L
Rock outcrop.									
Sa----------------- Shellabarger	0-12	6.0-20	0.10-0.13	5.6-6.5	<2	Low--------	0.20	5	2
	12-38	0.6-2.0	0.16-0.18	6.1-7.3	<2	Low--------	0.28		
	38-60	0.6-20	0.05-0.16	6.1-8.4	<2	Low--------	0.28		

See footnote at end of table.

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

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group
							K	T	
	In	In/hr	In/in	pH	mmhos/cm				
Sb, Sc, Sd--------	0-10	0.6-2.0	0.13-0.21	5.6-6.5	<2	Low--------	0.20	5	3
Shellabarger	10-45	0.6-2.0	0.16-0.18	6.1-7.3	<2	Low--------	0.28		
	45-60	0.6-20	0.05-0.16	6.1-8.4	<2	Low--------	0.28		
Ta----------------	0-7	6.0-20.0	0.05-0.11	6.1-7.8	<2	Low--------	0.17	5	1
Tivoli	7-60	6.0-20.0	0.02-0.06	6.1-8.4	<2	Low--------	0.17		
Wa----------------	0-12	2.0-6.0	0.14-0.18	7.4-8.4	<2	Low--------	0.20	5	3
Waldeck	12-36	2.0-6.0	0.12-0.17	7.4-8.4	<2	Low--------	0.20		
	36-60	6.0-20	0.05-0.07	7.4-8.4	<2	Low--------	0.15		
Za----------------	0-13	0.6-2.0	0.17-0.22	6.6-8.4	<2	Moderate	0.28	5	6
Zenda	13-60	0.6-2.0	0.15-0.19	7.4-8.4	<2	Moderate	0.24		

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

TABLE 16.--SOIL AND WATER FEATURES

[The definitions of "flooding" and "water table" in the Glossary explain terms such as "rare," "brief," "apparent," and "perched." The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In			
Aa, Ab, Ac, Ad: Albion	B	None	---	---	>6.0	---	---	>60	---	Low	Moderate.
Ba, Bb, Bc: Blanket	C	None	---	---	>6.0	---	---	>60	---	High	Low.
Ca: Canadian	B	Rare	---	---	>6.0	---	---	>60	---	Low	Low.
Cb: Carwile	D	None	---	---	0-2.0	Apparent	Oct-Apr	>60	---	High	Moderate.
Cc*, Cd*:											
Case	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low.
Clark	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low.
Ce, Cf: Clark	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low.
Da*:											
Dillwyn	A	Occasional	Brief	Mar-Oct	1.0-3.0	Apparent	Jan-Dec	>60	---	Low	Low.
Plevna	D	Occasional	Brief	Mar-Oct	0-2.0	Apparent	Jan-Dec	>60	---	High	Low.
Fa, Fb, Fc, Fd, Fe: Farnum	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low.
Ff*:											
Farnum	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low.
Natrustolls.											
Ka: Kaski	B	Occasional	Very brief	Mar-Aug	>6.0	---	---	>60	---	Low	Low.
Kb: Kingman	D	Occasional	Very brief	Jan-Dec	0-2.0	Apparent	Dec-Mar	>60	---	High	Low.
La: Lincoln	A	Occasional	Very brief to brief.	Apr-Oct	5.0-8.0	Apparent	Nov-May	>60	---	Low	Low.
Ma: McLain	C	Rare	Very brief	Apr-Aug	>6.0	---	---	>60	---	High	Low.
Na: Nashville	B	None	---	---	>6.0	---	---	20-40	Rip-pable	Low	Low.
Nb*:											
Nashville	B	None	---	---	>6.0	---	---	20-40	Rip-pable	Low	Low.
Quinlan	C	None	---	---	>6.0	---	---	10-20	Rip-pable	Moderate	Low.
Oa: Owens	D	None	---	---	>6.0	---	---	10-20	Rip-pable	High	Low.
Pa: Pond Creek	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate.
Pb: Pratt	A	None	---	---	>6.0	---	---	>60	---	Low	Moderate.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard-ness	Uncoated steel	Concrete
					Ft			In			
Pc*:											
Pratt	A	None	---	---	>6.0	---	---	>60	---	Low	Moderate.
Carwile	D	None	---	---	0-2.0	Apparent	Oct-Apr	>60	---	High	Moderate.
Pd*:											
Pratt	A	None	---	---	>6.0	---	---	>60	---	Low	Moderate.
Tivoli	A	None	---	---	>6.0	---	---	>60	---	Low	Low.
Qa, Qb Quinlan	C	None	---	---	>6.0	---	---	10-20	Rip-pable	Moderate	Low.
Ra Renfrow	D	None	---	---	>6.0	---	---	>40	Rip-pable	High	Low.
Rb Ruella	B	None	---	---	>6.0	---	---	>60	---	Low	Low.
Rc*:											
Ruella	B	None	---	---	>6.0	---	---	>60	---	Low	Low.
Rock outcrop.											
Sa, Sb, Sc, Sd Shellabarger	B	None	---	---	>6.0	---	---	>60	---	Low	Moderate.
Ta Tivoli	A	None	---	---	>6.0	---	---	>60	---	Low	Low.
Wa Waldeck	C	Occasional	Brief	Mar-Oct	1.5-3.0	Apparent	Oct-Apr	>60	---	Moderate	Low.
Za Zenda	C	Occasional	Very brief	Apr-Sep	1.5-3.0	Apparent	Oct-Apr	>60	---	High	Low.

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

TABLE 17.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series]

Soil name	Family or higher taxonomic class
Albion	Coarse-loamy, mixed, thermic Udic Argiustolls
Blanket	Fine, mixed, thermic Pachic Argiustolls
Canadian	Coarse-loamy, mixed, thermic Udic Haplustolls
Carwile	Fine, mixed, thermic Typic Argiaquolls
Case	Fine-loamy, mixed, thermic Typic Ustochrepts
Clark	Fine-loamy, mixed, thermic Typic Calciustolls
Dillwyn	Mixed, thermic Aquic Ustipsamments
Farnum	Fine-loamy, mixed, thermic Pachic Argiustolls
Kaski	Fine-loamy, mixed, thermic Cumulic Haplustolls
Kingman	Fine-silty, mixed (calcareous), thermic Fluvaquentic Haplaquolls
*Lincoln	Sandy, mixed, thermic Typic Ustifluvents
McLain	Fine, mixed, thermic Pachic Argiustolls
Nashville	Fine-silty, mixed, thermic Udic Haplustolls
Owens	Clayey, mixed, thermic, shallow Typic Ustochrepts
Plevna	Coarse-loamy, mixed, thermic Fluvaquentic Haplaquolls
Pond Creek	Fine-silty, mixed, thermic Pachic Argiustolls
Pratt	Sandy, mixed, thermic Psammentic Haplustalfs
Quinlan	Loamy, mixed, thermic, shallow Typic Ustochrepts
Renfrow	Fine, mixed, thermic Udertic Paleustolls
Ruella	Fine-loamy, mixed, thermic Typic Ustochrepts
Shellabarger	Fine-loamy, mixed, thermic Udic Argiustolls
Tivoli	Mixed, thermic Typic Ustipsamments
Waldeck	Coarse-loamy, mixed, thermic Fluvaquentic Haplustolls
Zenda	Fine-loamy, mixed, thermic Fluvaquentic Haplustolls

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