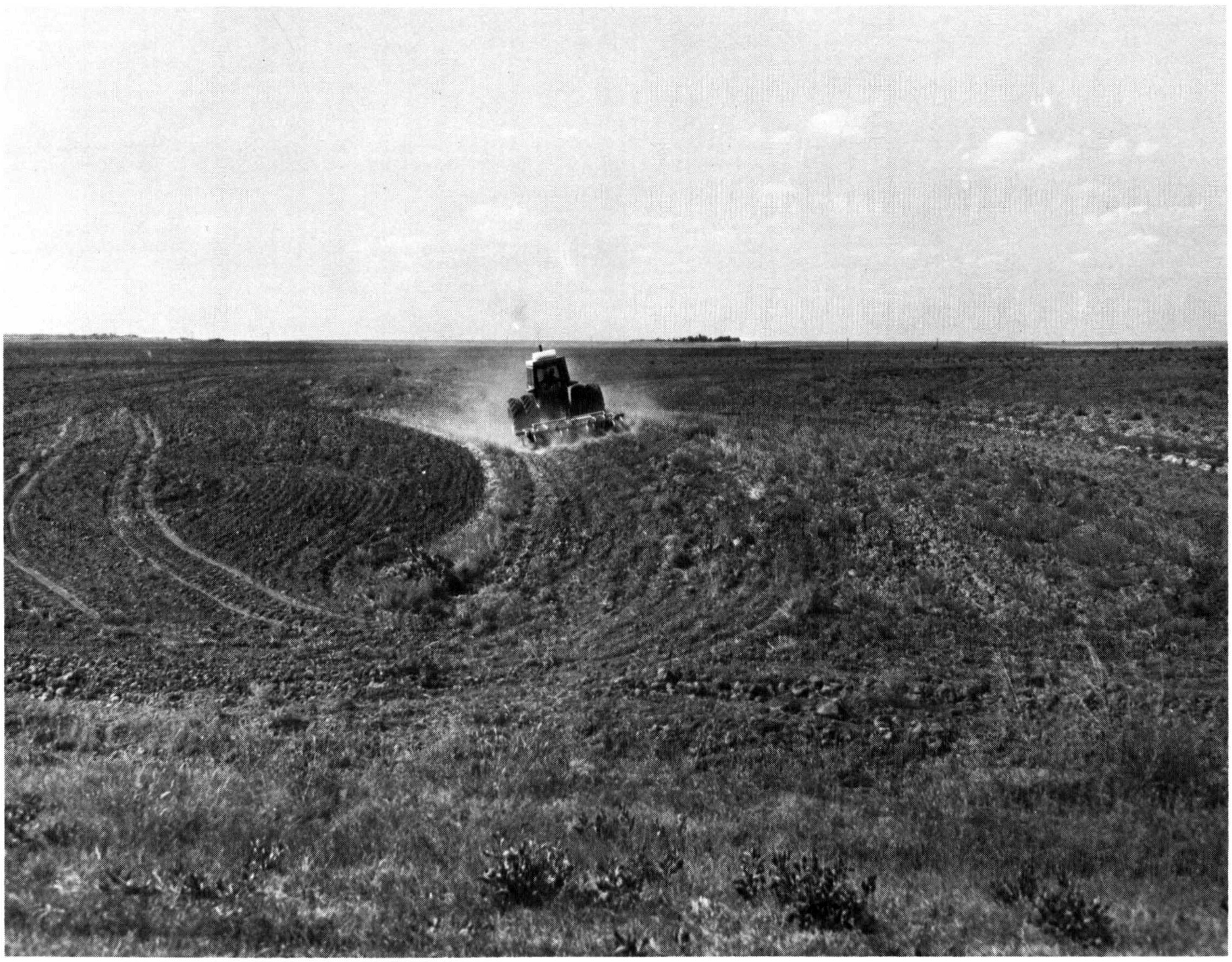
SOIL SURVEY OF

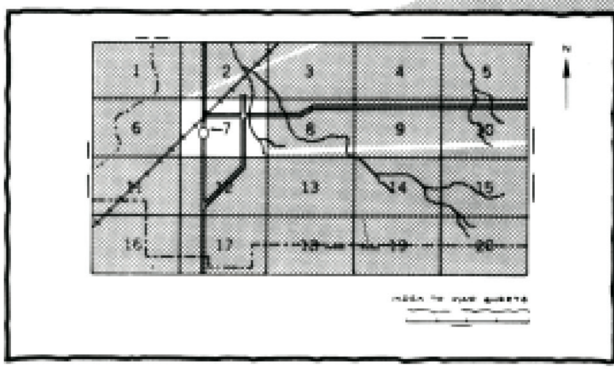
Pawnee County, Kansas

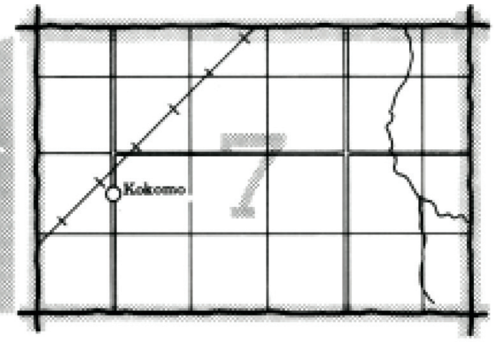


United States Department of Agriculture
Soil Conservation Service
In cooperation with
Kansas Agricultural Experiment Station

HOW TO USE

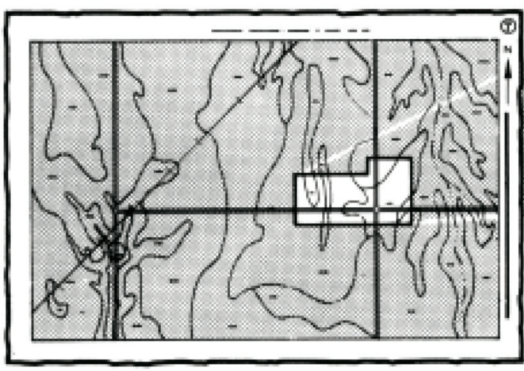
1. Locate your area of interest on the "Index to Map Sheets"

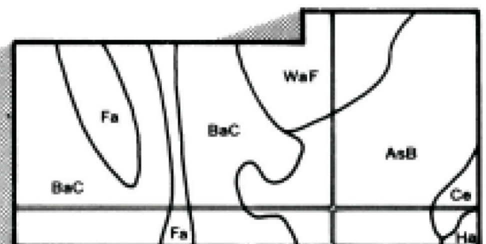




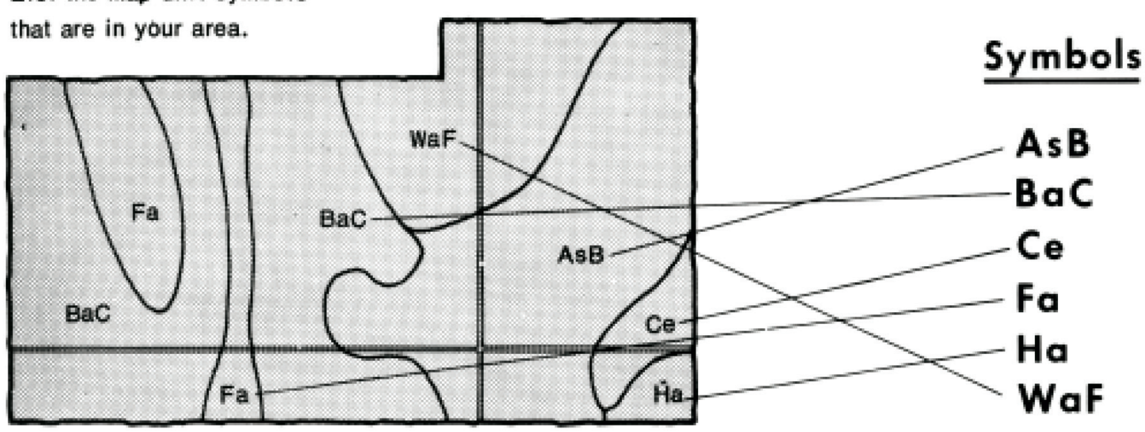
2. Note the number of the map sheet and turn to that sheet.

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



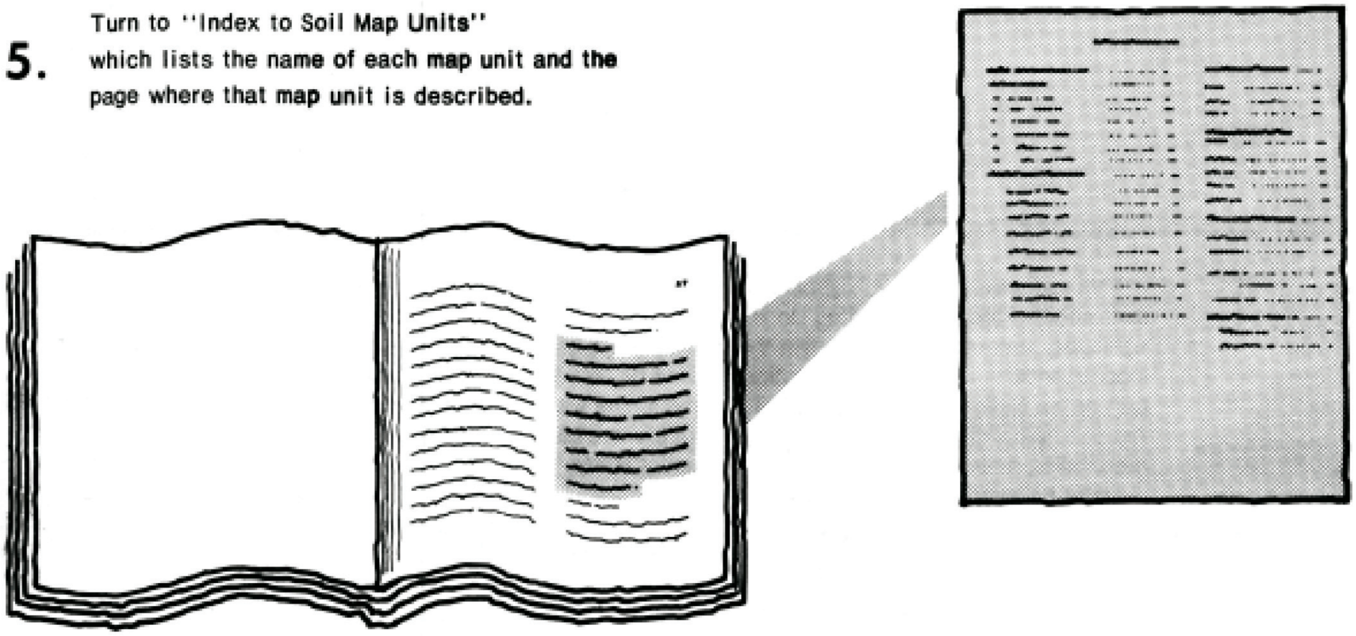


4. List the map unit symbols that are in your area.

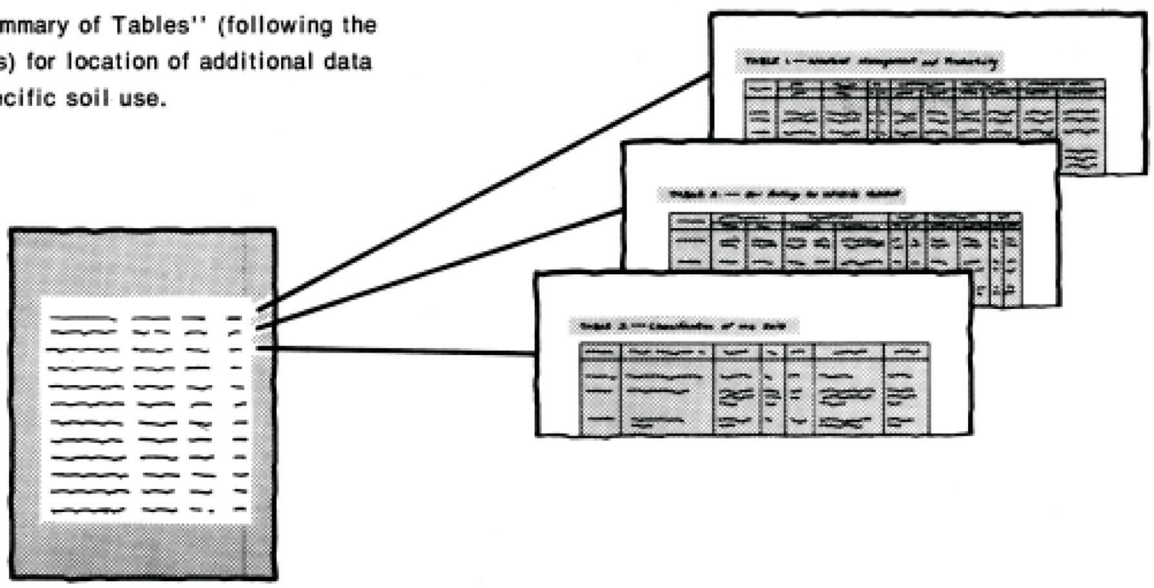


THIS SOIL SURVEY

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 1964-75. Soil names and descriptions were approved in 1976. Unless otherwise indicated, statements in the publication refer to conditions in the survey area in 1975. 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 Pawnee County Conservation District.

Soil maps in this survey may be copied without permission, but any enlargement of these maps can 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: Fallow land tilled on the contour prior to planting winter wheat on Uly silt loam, 3 to 6 percent slopes.

Contents

Issued October 1978

Index to soil map units

Summary of Tables

Foreword

The Soil Survey of Pawnee 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.

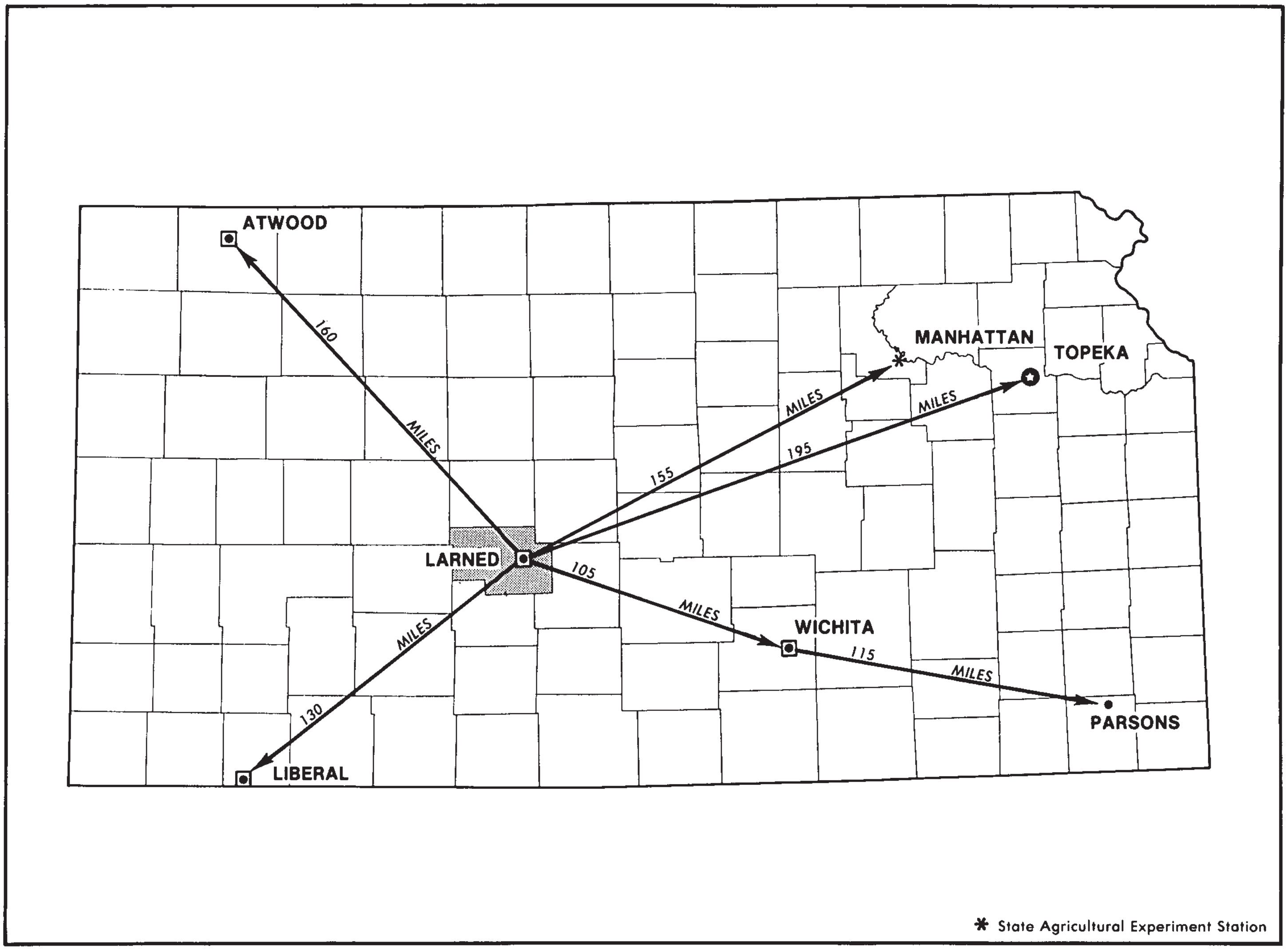
This soil survey has been prepared for many different users. Farmers, ranchers, foresters, and agronomists can use it to determine the potential of the soil and the management practices required for food and fiber production. Planners, community officials, engineers, developers, builders, and homebuyers 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 Pawnee County in Kansas.

SOIL SURVEY OF PAWNEE COUNTY, KANSAS

By Darold A. Dodge and William E. Roth, Soil Conservation Service

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

PAWNEE COUNTY is in the south-central part of Kansas (see facing page). It has an area of 755 square miles, or 483,200 acres. Larned is the county seat. In 1975, the county had a population of 8,068. Slightly more than half of the population lives in Larned. The rest lives in Garfield, Burdett, Rozel, Sanford, Zook, Frizell, and Ash Valley and on farms throughout the county.

The farm income of the county is derived mainly from the sale of winter wheat, corn, grain sorghum, and livestock and livestock products. Important grain and feed crops are irrigated corn and alfalfa. Much of the alfalfa is marketed through alfalfa mills or is fed to livestock in local feedlots. Much of the corn grain and silage is also fed to livestock in these feedlots. Irrigated soybeans are also grown in some areas.

According to the U.S. Bureau of Census, Pawnee County had 694 farms and about 420,000 acres of farmland in 1969. In 1974, these farms produced 4,378,800 bushels of wheat, most of it dryland; 1,195,700 bushels of grain sorghum; 15,000 tons of silage sorghum; 4,650 tons of forage sorghum; 1,752,660 bushels of grain corn, most of it irrigated; 45,110 tons of silage corn; 7,000 bushels of oats; 8,600 bushels of barley; and 4,600 bushels of rye (*3*). Also produced were 39,700 bushels of soybeans and 91,500 tons of alfalfa hay. In 1973, about 136,800 pounds of alfalfa seed was produced.

General nature of the county

This section gives general information concerning the county. It describes settlement, natural resources, farming, and climate.

Settlement

SAM HOUF, district conservationist, Soil Conservation Service, helped prepare this section.

Recent excavations of Indian campsites near Larned indicate that various Indian tribes used the vicinity of what is now Pawnee County as their wintering grounds for hundreds of years. Other tribes hunted buffalo on the vast prairie.

The Santa Fe Trail skirted northward around the big bend of the Arkansas River and entered the northeastern part of the county near Pawnee Rock. The trail paralleled the Arkansas River and at one time forded the Pawnee River at a point near the site of the Larned State Hospital. The marking of the Santa Fe Trail was authorized by Congress in 1824, and Fort Larned was established in 1859. As a result, many settlers entered the county.

Pawnee County was organized on November 4, 1872, and was named after the Pawnee Indians. The city of Larned was also organized in 1872 and soon was established as the county seat. The city of Garfield was settled in 1873. The first train of the Atchinson, Topeka, and Santa Fe Railroad entered the county on July 20, 1872.

Natural resources

SAM HOUF, district conservationist, Soil Conservation Service, helped prepare this section.

Soil is the most important natural resource of the county. Grain and forage crops and the livestock that consume these crops are marketable products that are affected by the soil. Water of good quality and sufficient quantity for domestic, municipal, and irrigation use is also an important natural resource. Natural gas and oil are produced in a few isolated locations. Strip mined gravel and sand is a minor natural resource along the Arkansas River.

Generally, adequate quantities of underground water are available for domestic and livestock use. The upland areas north of Highway 156 are generally not suitable for irrigation because the quantity of good-quality water is limited. Along the flood plain of the Pawnee River, along Ash Creek, and in the area south of Highway 156, underground water is available in sufficient quantities for irrigation. Some surface water is available from Pawnee Creek and the Arkansas River.

Pawnee County is underlain by thick deposits of sedimentary rock consisting of shale, limestone, sandstone, clay, silt, sand and gravel, and smaller amounts of salts, anhydrite, and gypsum (*4*). These deposits are mainly at a great depth and are poor sources of ground water. Greenhorn and Graneros Formations are near the surface in some small areas in the northwestern part of the county and are part of the soils. Some deep water is stored in these underlying rock formations, but the main water storage is in the alluvium of the Pawnee and Arkansas Rivers and the Meade Formation.

The Meade Formation ranges in thickness from 50 to more than 300 feet. It is the major source of ground water in the area south of the Arkansas River (*4*). Yields in this formation range from a few gallons per minute to more than 1,000 gallons per minute in some irrigation wells (*4*). The Dakota Formation yields small quantities of water, about 125 to 150 gallons per minute (*4*). In an area near Larned some wells almost 700 feet deep were drilled but produced saltwater (*4*). At this depth, the source material probably was Permian rocks; Permian material was encountered about 300 to 400 feet beneath the surface (*4*).

Farming

SAM HOUF, district conservationist, Soil Conservation Service, helped prepare this section.

The first settlers in Pawnee County were ranchers. The first two ranches were established in 1864 and 1867. In 1870, the State Board of Agriculture indicated that the county was 75 percent upland and 25 percent bottom land.

By 1874, about 1,400 acres was cropped. Of this acreage, about 1,300 acres was planted to corn and the rest was planted to wheat, oats, potatoes, and millet. From 1875 to 1910, the acreage in wheat increased from about 750 acres to more than 209,000 acres. Slightly more than 299,000 acres was cultivated in 1910. Only a small acreage was planted to corn. Larger acreages were broken out of sod and planted mainly to winter wheat during and after the First World War.

Until the severe drought of the 1930's, the cropping system consisted mainly of continuous winter wheat for grain and forage sorghum for livestock. After the 1930's, the cropping system was mainly a winter wheat-fallow system and some forage sorghum for livestock. The fallow period was used to accumulate soil moisture for the following crop. Alfalfa was grown on the bottom land where extra soil moisture was available from the water table and, in some small areas, from runoff from upland slopes. During the 1950's, when hybrid grain sorghum was developed, the common cropping systems were winter wheat-fallow or winter wheat-sorghum-fallow. At present, the principal dryland crops are winter wheat, sorghum, and alfalfa.

The Pawnee County Conservation District was organized in March 1940, and through its efforts and the efforts of other cooperating agencies about 60 percent of the cultivated land has been adequately treated to control erosion.

About 88 percent of the county is cropland, and 12 percent is native grassland used as range. The grassland acreage is decreasing, and the irrigated acreage increasing. The potential for dryland grain crops is good and is closely related to the control of soil blowing and water erosion and the availability of fertilizer.

The potential for irrigated crops is also good, but it depends on an adequate supply of good-quality water. At present, about 60,000 acres is irrigated. The major crops are corn, sorghum, and alfalfa. Most of the alfalfa is processed for market in three dehydrating plants and one pelleting plant. Some is stacked or baled as hay. Two commercial livestock feed yards and several other feed yards use much of the irrigated corn, sorghum, and alfalfa.

Climate

By L. DEAN BARK, climatologist, Kans. Agricultural Experiment Station, Manhattan, Kans.

The climate of Pawnee County is a typical continental type, as would be expected of a location in the interior of a large land mass in the middle latitudes. Such a climate is characterized by large daily and annual variations in temperature. Winter is cold because air frequently moves in from the polar regions from December through February. Warm summer temperatures last for about 6 months every year, and the transition seasons, spring and fall, are short. The warm weather provides a long growing season for crops in the county.

Pawnee County is generally to the west of the flow of moisture-laden air from the Gulf of Mexico. It is to the east of the strong rain-shadow effect of the Rocky Mountains. As a result, the annual precipitation is marginal for continuous cropping. Precipitation falls in the form of showers and thunderstorms that can be extremely heavy at times. Winds are high and can result in significant soil loss and crop damage in dry years. Conservation practices are necessary to conserve moisture and prevent excessive soil loss.

Table 1 gives data on temperature and precipitation for Pawnee County, as recorded at Larned 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 33.7 degrees F, and the average daily minimum is 21.8 degrees. The lowest temperature on record, which occurred at Larned on February 13, 1905, is minus 24 degrees. In summer the average temperature is 78.1 degrees, and the average daily maximum is 90.9 degrees. The highest recorded temperature, which occurred on July 11, 1954, August 13, 1936, and July 31, 1934, is 114 degrees.

The average annual precipitation for the period 1941 through 1970 is 23.60 inches. Of this total, 18.00 inches, or 76 percent, usually falls during the period 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 12.97 inches. The heaviest 1-day rainfall was 4.58 inches at Larned on July 20, 1925.

Average annual snowfall is 21.7 inches. The greatest snow depth at any one time during the period of record was 43 inches, during the winter of 1959-60. On the average, 20 days have at least 1 inch of snow on the ground. The snow usually does not stay on the ground more than 3 days in succession.

The prevailing wind is from the south. Average annual windspeed is 14 miles per hour; it is highest, 16 miles per hour, in March and April. The percent of possible sunshine averages 76 in summer and 62 in winter.

Severe windstorms and occasional tornadoes accompany well developed thunderstorms in this area, but they are infrequent and are local in extent. Losses from hail are a more severe hazard, but they are not so great as they are to the west of Pawnee 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 soils 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 and woodland, 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. Harney-Uly

Deep, nearly level to sloping, well drained soils that have a silt loam or silty clay loam subsoil

This map unit is on uplands that are dissected by drainageways and small streams. Areas along the drainageways are gently sloping to sloping and in places are eroded.

This map unit makes up about 49 percent of the county. It is about 85 percent Harney soils, 13 percent Uly soils, and 2 percent minor soils (fig. 1).

Harney soils are nearly level to sloping. They formed in loess. The surface layer is dark grayish brown silt loam about 12 inches thick. The subsoil is about 23 inches thick. The upper part is grayish brown, very firm silty clay loam, and the lower part is brown, firm, calcareous silty clay loam. The underlying material to a depth of 60 inches is pale brown, calcareous silt loam. Available water capacity is high, and permeability is moderately slow.

Uly soils are gently sloping to sloping. They formed in loess. The surface layer is typically grayish brown silt loam about 10 inches thick. The subsoil is about 8 inches of brown, friable, calcareous silt loam. The underlying material to a depth of 60 inches is pinkish gray, calcareous silt loam. Available water capacity is high, and permeability is moderate.

Minor in this map unit are Roxbury, Wakeen, Holdrege, and Ness soils. Roxbury soils are in the drainageways and are frequently flooded. Wakeen soils occur as small areas intermingled with areas of sloping Uly soils. Ness soils are in nearly level shallow depressions and in broad areas of Harney soils.

Most of this map unit is used for dryland crops, mainly winter wheat, sorghum, and alfalfa. Small areas are in native grasses. The unit is well suited to all crops and grasses commonly grown in the county.

The main management need of this map unit is control of soil blowing and water erosion. Overgrazing is the main concern of management on rangeland.

2. Harney-Wakeen

Deep and moderately deep, nearly level to strongly sloping, well drained soils that have a silty clay loam subsoil

This map unit is on uplands that are dissected by drainageways and small streams. Areas along small streams and the larger drainageways are sloping to strongly sloping and in many places are eroded. In these places rock outcrops are common.

This map unit makes up about 3 percent of the county. It is about 40 percent Harney soils, 35 percent Wakeen soils, and 25 percent minor soils (fig. 2).

Harney soils are deep and nearly level to sloping. They formed in loess. The surface layer is dark grayish brown silt loam about 12 inches thick. The subsoil is about 23 inches thick. The upper part is grayish brown, very firm silty clay loam, and the lower part is brown, firm, calcareous silty clay loam. The underlying material to a depth of 60 inches is pale brown, calcareous silt loam. Available water capacity is high, and permeability is moderately slow.

Wakeen soils are moderately deep and gently sloping to strongly sloping. They formed in loess and in residuum derived from chalky shale and limestone. The surface layer is dark grayish brown silt loam about 10 inches thick. The subsoil is friable silty clay loam about 26 inches thick. The upper part is grayish brown, and the lower part is pale brown. Very pale brown, soft, chalky silty shale and limestone are at a depth of about 36 inches. Available water capacity and permeability are moderate.

Minor in this map unit are Nibson, Roxbury, and Uly soils. Nibson soils are on strongly sloping valley sides where some rocks crop out. Roxbury soils are in the drainageways and are frequently flooded. Uly soils are in gently sloping and sloping areas intermingled with Harney and Wakeen soils.

Most of this map unit is used as cropland. The unit is well suited to the dryland crops and grasses commonly grown in the county. Small areas of Wakeen and Nibson soils are used as rangeland.

The main management needs of this map unit are controlling water erosion, protecting the soils against soil blowing, conserving moisture, and maintaining fertility and tilth. Proper stocking rates and a planned grazing system are needed in the areas used as rangeland.

3. New Cambria-Bridgeport-Hord

Deep, nearly level, well drained and moderately well drained soils that have a silt loam to silty clay subsoil

This map unit is along all of the major streams of the county but the Arkansas River.

This map unit makes up about 9 percent of the county. It is about 40 percent New Cambria soils, 36 percent Bridgeport soils, and 24 percent Hord soils (fig. 3).

New Cambria soils formed in alluvium on low terraces. The surface layer is dark gray and gray silty clay loam about 14 inches thick. The subsoil is silty clay about 21 inches thick. The upper part is gray and very firm, and the lower part is grayish brown and firm. The underlying material to a depth of 60 inches is grayish brown silty clay loam. New Cambria soils are moderately well drained. Available water capacity is high, and permeability is slow.

Bridgeport soils formed in alluvium on low terraces near the stream channel. The surface layer is dark grayish brown silt loam about 11 inches thick. The subsoil is grayish brown, friable silt loam about 7 inches thick. The underlying material to a depth of 60 inches is pale brown silt loam. Bridgeport soils are well drained. Available water capacity is high, and permeability is moderate.

Hord soils formed in alluvium on terraces some distance from the stream channel. The surface layer is silt loam about 12 inches thick. The upper part is grayish brown, and the lower part is dark grayish brown. The subsoil is firm silty clay loam about 30 inches thick. The upper part is dark grayish brown, and the lower part is brown. The underlying material to a depth of 60 inches is pale brown silt loam. Hord soils are well drained. Available water capacity is high, and permeability is moderate.

Nearly all of this map unit is used as cropland. The unit is well suited to all dryland and irrigated crops and grasses commonly grown in the county. Only very small areas are used as rangeland.

The main management needs of this map unit are protecting the soils against soil blowing, conserving moisture, and maintaining fertility.

4. Waldeck-Kaski-Zenda

Deep, nearly level, somewhat poorly drained and well drained soils that have a fine sandy loam or loam underlying material

This map unit is on flood plains and terraces along the Arkansas River. The soils are more frequently flooded and channeled near the river.

This map unit makes up 9 percent of the county. It is about 22 percent Waldeck soils, 18 percent Kaski soils, 18 percent Zenda soils, and 42 percent minor soils (fig. 4).

Waldeck soils formed in alluvium on flood plains. The surface layer is dark grayish brown fine sandy loam about 12 inches thick. The next layer is grayish brown, very friable fine sandy loam about 8 inches thick. The underlying material is about 20 inches of light brownish gray fine sandy loam over 20 inches of very pale brown fine sand. Waldeck soils are somewhat poorly drained. Available water capacity is moderate, and permeability is moderately rapid above the water table.

Kaski soils formed in alluvium on stream terraces. The surface layer is loam about 18 inches thick. The upper part is grayish brown, and the lower part is dark grayish brown. The next layer is dark grayish brown, friable loam about 10 inches thick. The underlying material to a depth of 60 inches is very pale brown fine sandy loam. Kaski soils are well drained. Available water capacity is high, and permeability is moderate.

Zenda soils formed in alluvium on low stream terraces. The surface layer is dark grayish brown loam about 12 inches thick. The next layer is grayish brown and dark grayish brown, friable loam about 8 inches thick. The underlying material to a depth of 60 inches is pale brown, calcareous clay loam. Zenda soils are somewhat poorly drained. Available water capacity is high, and permeability is moderate.

Minor in this map unit are nearly level Platte, Hord, Lesho, and Canadian soils. Platte soils are in somewhat channeled areas near the Arkansas River. Hord soils are on terraces some distance from the river. Lesho soils are on flood plains near the river and are intermingled with Platte soils. Canadian soils are on stream terraces and near old channel areas some distance from the Arkansas River.

Except for Platte soils and the nearby Lesho soils, all of this map unit is used as cropland. The unit is moderately well suited to all dryland and irrigated crops commonly grown in the county, mainly winter wheat, sorghum, and alfalfa. Some irrigated corn is grown. Platte and Lesho soils are used mainly for rangeland, windbreaks, and wildlife habitat.

The main management needs of this unit are protecting the soils against soil blowing, conserving moisture, and maintaining fertility. Proper stocking rates and a planned grazing system are needed in the areas used as rangeland. Management of wildlife habitat is needed in wooded areas along the Arkansas River.

5. Pratt-Tivoli

Deep, undulating to hilly, well drained and excessively drained soils that have a loamy fine sand or fine sand subsoil or underlying material

This map unit occupies short and medium-length slopes on complex, wind-modified uplands.

This map unit makes up 2 percent of the county. It is about 53 percent Pratt soils, 46 percent Tivoli soils, and 1 percent minor soils (fig. 5).

Pratt soils are undulating to rolling. They formed in sandy eolian sediments. The surface layer is grayish brown loamy fine sand about 11 inches thick. The subsoil is brown, very friable loamy fine sand about 21 inches thick. The underlying material to a depth of 60 inches is brown loamy fine sand. Pratt soils are well drained. Permeability is rapid, and available water capacity is low.

Tivoli soils are undulating to hilly. They formed in sandy eolian sediments. The surface layer is brown fine sand about 6 inches thick. The underlying material to a depth of 60 inches is light yellowish brown fine sand. Tivoli soils are excessively drained. Permeability is rapid, and available water capacity is low.

Most of the acreage of minor soils is Carwile soils, but a small acreage is low, wet areas. Carwile soils are in somewhat depressional and nearly level areas intermingled with Pratt soils.

About 80 percent of the acreage of this map unit is used as rangeland, and 20 percent is used as cropland. The part used as rangeland is well suited to the native grasses commonly grown in the county. The part used as cropland is poorly suited to dryland crops, but small areas are moderately well suited to irrigated crops.

The main management needs of this map unit are proper range management on native grassland and protection against soil blowing in cultivated areas.

6. Attica-Pratt-Carwile

Deep, nearly level to rolling, well drained and somewhat poorly drained soils that have a loamy fine sand, fine sandy loam, or clay loam subsoil

This map unit is mainly undulating to gently rolling, but in the many complex, wind-modified areas it is nearly level to slightly depressional.

This map unit makes up 11 percent of the county. It is about 56 percent Attica soils, 30 percent Pratt soils, 11 percent Carwile soils, and 3 percent minor soils (fig. 6).

Attica soils are undulating. They formed in loamy and sandy eolian sediments. The surface layer is grayish brown sandy loam about 12 inches thick. The subsoil is brown, friable fine sandy loam about 24 inches thick. The underlying material to a depth of 60 inches is pale brown fine sandy loam. Attica soils are well drained. Permeability is moderately rapid, and available water capacity is moderate.

Pratt soils are undulating to rolling. They formed in sandy eolian sediments. The surface layer is grayish brown loamy fine sand about 11 inches thick. The subsoil is brown, very friable loamy fine sand about 21 inches thick. The underlying material to a depth of 60 inches is brown loamy fine sand. Pratt soils are well drained. Permability is rapid, and available water capacity is low.

Carwile soils are nearly level to slightly depressional. They formed in loamy eolian sediments and loamy and clayey old alluvium. The surface layer is dark grayish brown fine sandy loam about 12 inches thick. The subsoil is clay loam about 28 inches thick. The upper part is grayish brown and firm; the next part is light brownish gray and very firm; and the lower part is light gray and firm. The underlying material to a depth of 60 inches is light brownish gray clay loam. Carwile soils are somewhat poorly drained. Permeability is slow, and available water capacity is high.

Most of the acreage of minor soils is Naron soils, but some small areas of nearly level Farnum soils are intermingled with the Carwile soils.

Nearly all of this unit is used as cropland. The unit is well suited to the dryland and irrigated crops and grasses grown in the county. Small areas of Pratt and Attica soils are used as rangeland.

The main management needs of this map unit are protecting the soil against soil blowing, conserving moisture, and maintaining fertility and tilth. Proper range management is needed in the areas used as rangeland.

7. Farnum-Lubbock

Deep, nearly level to gently sloping, well drained soils that have a clay loam or silty clay loam subsoil

This map unit is mostly nearly level but is gently sloping in places. It is dissected by shallow, indefinite drainageways, mainly Pickle Creek and Hubbard Creek.

This map unit makes up 6 percent of the county. It is about 49 percent Farnum soils, 26 percent Lubbock soils, and 25 percent minor soils (fig. 7).

Farnum soils are nearly level to gently sloping. Most of the gentle slopes are along drainageways. These soils formed in loamy old alluvium. The surface layer is dark grayish brown loam about 11 inches thick. The subsoil is clay loam about 29 inches thick. The upper part is dark grayish brown and friable; the next part is dark grayish brown and firm; and the lower part is brown and firm. The underlying material to a depth of 60 inches is pale brown clay loam. Available water capacity is high, and permeability is moderately slow.

Lubbock soils are nearly level. They formed in loamy old alluvium and have been reworked by wind in places. The surface layer is grayish brown silt loam about 11 inches thick. The subsoil is silty clay loam about 25 inches thick. The upper part is dark grayish brown and very firm; the next part is grayish brown and very firm; and the lower part is grayish brown, firm, and calcareous. The underlying material to a depth of 60 inches is light gray, calcareous silty clay loam. Available water capacity is high, and permeability is moderately slow.

Minor in this map unit are Naron, Carwile, and Tabler soils. The deep, nearly level and gently sloping Naron soils are in short and medium-length, convex areas. The deep, nearly level Carwile and Tabler soils are in short and medium-length, slightly depressional areas.

Nearly all of this map unit is used as cropland. The unit is well suited to all dryland and irrigated crops commonly grown in the county. Some small areas are used as rangeland.

The main management needs of this map unit are protecting the soil against soil blowing, conserving moisture, and maintaining fertility. Proper range management is needed in the areas used as rangeland.

8. Naron-Carwile

Deep, nearly level to gently sloping, well drained and somewhat poorly drained soils that have a fine sandy loam, sandy clay loam, or clay loam subsoil

This map unit is mostly nearly level but is gently sloping to undulating in areas along indefinite drainageways and in areas of sandy soils.

This map unit makes up about 11 percent of the county. It is about 59 percent Naron soils, 16 percent Carwile soils, and 25 percent minor soils (fig. 8).

Naron soils are nearly level to gently sloping. They are on medium-length and long, convex ridges and in broad, convex areas. They formed in loamy and sandy eolian material. The surface layer is dark grayish brown fine sandy loam about 11 inches thick. The subsoil is about 42 inches thick. The upper part is brown, firm sandy clay loam, and the lower part is brown, friable fine sandy loam. The underlying material to a depth of 60 inches is pale brown fine sandy loam. Naron soils are well drained. Available water capacity is high, and permeability is moderate.

Carwile soils are nearly level to slightly depressional. They occur as low areas near Tabler and Farnum soils. They formed in loamy eolian sediments and clayey old alluvium. The surface layer is dark grayish brown fine sandy loam about 12 inches thick. The subsoil is clay loam about 28 inches thick. The upper part is grayish brown and firm; the next part is light brownish gray and very firm; and the lower part is light gray and firm. The underlying material to a depth of 60 inches is light brownish gray clay loam. Carwile soils are somewhat poorly drained. Available water capacity is high, and permeability is slow.

Minor in this map unit are Attica, Farnum, Pratt, and Tabler soils. The gently sloping Attica soils are in convex areas near the gently rolling Pratt soils but at a slightly lower level. The nearly level Farnum soils are near Carwile soils but are at a slightly higher level. Tabler soils occupy low areas.

Nearly all of this map unit is used as cropland. The unit is well suited to the dryland and irrigated crops and grasses grown in the county. Small areas are used as rangeland.

The main management needs of this map unit are protecting the soils against soil blowing, controlling water erosion, conserving moisture, and maintaining fertility. Proper range management is needed in the areas used as 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 Ness series, for example, was named for Ness City in Ness 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, Harney silt loam, 1 to 3 percent slopes, is one of several phases within the Harney 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. Harney-Uly complex, 3 to 6 percent slopes, eroded, 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.

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.

At—Attica sandy loam, 1 to 4 percent slopes. This deep, gently sloping, well drained soil is on medium-length, convex slopes on uplands. Individual areas are irregular in shape and range from 20 to 300 acres in size.

Typically, the surface layer is grayish brown sandy loam about 12 inches thick. The subsoil is brown, friable fine sandy loam about 24 inches thick. The underlying material to a depth of 60 inches is pale brown fine sandy loam. In some nearly level and concave areas, the surface layer is very dark grayish brown. In small areas where slopes are steep and convex, the subsoil is less than 10 percent clay.

Included with this soil in mapping are small areas of somewhat poorly drained Carwile soils in nearly level to slightly depressional areas. These soils make up about 5 percent of the unit.

Water and air move through this soil at a moderately rapid rate, and surface runoff is slow. Natural fertility is medium. The surface layer is friable and is easily tilled. Available water capacity is moderate. The shrink-swell potential is low.

Most areas of this soil are in cultivated wheat and sorghum. The soil has good potential for cultivated crops, pasture, and range and for trees in windbreaks. It has good to fair potential for most engineering uses.

This soil is well suited to the dryland and irrigated crops and the native or tame grasses commonly grown in the county. The main concerns of management are controlling soil blowing, conserving moisture, and maintaining tilth and fertility. Wind stripcropping and minimum tillage are effective in controlling soil blowing and conserving moisture.

This soil is also well suited to range. Proper stocking rates, timely deferment of grazing, and rotation grazing maintain or improve desirable grasses.

Trees grown as windbreaks are suited to this soil. Considerable care is needed if young trees are to become established and grow well. Cultivating young windbreaks to control weeds reduces the competition for soil moisture.

This soil is suitable for building site development and for onsite waste disposal if proper design and proper installation procedures are used. In some areas there is a hazard of polluting water supplies if the soil is used as a septic tank filter field. This soil is a good source of roadfill material.

This soil is suited to irrigation if an adequate supply of water is available. Erosion control is needed if the gently sloping areas are irrigated. Capability unit IIe-1 dryland and irrigated; Sandy range site.

Br—Bridgeport silt loam. This is a deep, nearly level, well drained soil on low terraces. It occupies long, convex areas adjacent to all the major streams but the Arkansas River. Flooding is occasional and very brief. Individual areas are irregular in shape and range from 50 to several hundred acres in size.

Typically, the surface layer is dark grayish brown silt loam about 11 inches thick. The subsoil is grayish brown, friable silt loam about 7 inches thick. The underlying material to a depth of 60 inches is pale brown silt loam. In some areas the dark grayish brown surface layer is thicker, and in places the depth to limy material is more than 15 inches. Some small, narrow areas along creek banks and drainageways are frequently flooded.

Included with this soil in mapping are small areas of New Cambria soils in depressions. These soils make up about 5 percent of the unit. They are more clayey than this Bridgeport soil.

Permeability is moderate, and available water capacity is high. Runoff is slow. Fertility is high. The surface layer is very friable and is easily tilled. The shrink-swell potential is low.

Most areas of this soil are farmed. Winter wheat, sorghum, and alfalfa are the principal crops. Small areas are used for range. This soil has good potential for cultivated crops, tame pasture, range, and openland wildlife habitat and for trees in windbreaks. It has poor potential for most engineering and recreational uses.

This soil is well suited to the dryland and irrigated crops, tame or native grasses, and trees or shrubs commonly grown in the county. The main management needs are providing protection against flooding, controlling soil blowing and water erosion, and maintaining tilth and fertility. Proper use of crop residue and minimum tillage help control soil blowing, conserve moisture, and reduce the risk of erosion.

This soil is well suited to range. The major problems of range management are related to overstocking and overgrazing. If the range is overstocked and overgrazed the protective plant cover is reduced and the taller, more desirable grasses are replaced by less productive short grasses. Proper stocking rates, uniform grazing distribution, timely deferment of grazing, and a planned grazing system help keep the range and the soil in good condition.

This soil is well suited to trees in windbreaks. Considerable care is needed if young trees are to grow well. Low rainfall is likely to limit their growth. Where it is practical, irrigation aids the establishment and growth of the young trees. Cultivation of young trees controls weeds and reduces the competition for soil moisture.

Flooding, low strength, and the danger of soil piping severely limit most engineering uses of this soil. Engineering structures or buildings built on this soil should be protected against flooding. Also, construction practices that overcome the low strength and the piping are needed. Sanitation facilities do not work well on this soil because of flooding.

This soil is well suited to flood irrigation if an adequate supply of good-quality water is available. It is less well suited to sprinkler irrigation because of the puddling caused by the impact of waterdrops and the resulting increase in runoff and erosion. This soil is a good source of topsoil. Capability unit IIc-1 dryland, I-1 irrigated; Loamy Terrace range site.

Ca—Canadian fine sandy loam. This is a deep, nearly level, well drained soil on flood plains. It occupies long, convex areas along the Arkansas River. Flooding is rare and very brief. Individual areas are irregular in shape and range from 30 to 600 acres in size.

Typically, the surface layer is dark grayish brown and brown fine sandy loam about 13 inches thick. The subsoil is brown, friable fine sandy loam about 15 inches thick. The underlying material to a depth of 60 inches is pale brown fine sandy loam. In some small areas the surface layer is sandy loam or loam and coarse sand and fine gravel are at a depth of 20 to 40 inches. In other small areas the surface layer and subsoil are loam.

Included with this soil in mapping are small areas of Hord and Zenda soils. These soils make up about 5 percent of the unit. They occupy slightly lower lying areas.

Permeability is moderately rapid, and available water capacity is moderate. Runoff is slow. Fertility is medium. The surface layer is very friable and is easily tilled. The shrink-swell potential is low in the solum.

Most areas of this soil are farmed. Winter wheat, sorghum, and alfalfa are the principal crops. Small areas are used for range and windbreaks. The soil has good potential for cultivated crops and range and for trees or shrubs grown as windbreaks. The potential for most engineering uses is fair.

This soil is well suited to the dryland crops, irrigated crops, and native or tame grasses commonly grown in the county. The main concerns of management are controlling soil blowing, conserving moisture, and maintaining tilth and fertility. Wind stripcropping and minimum tillage are effective in controlling soil blowing and conserving moisture. Crop residue and the crops that provide the best cover help to protect the soil against erosion.

This soil is also well suited to range. Proper stocking rates, timely deferment of grazing, and rotation grazing maintain or improve desirable grasses.

This soil is suited to trees and shrubs in windbreaks. Much care is needed if young trees and shrubs are to become established and grow well. Cultivating the young trees and shrubs controls weeds and reduces the competition for soil moisture.

Flooding, seepage, and low strength limit most engineering uses of this soil. The soil is easily eroded in grassed waterways. It is too unstable for construction of embankments, dikes, and levees. It is a fair source of roadfill material and a good source of topsoil. Engineering structures built on this soil should be protected against flooding. Sanitation facilities do not work well because of the flooding and seepage. In some areas pollution of water supplies is a hazard if this soil is used as a septic tank filter field.

If roads, streets, or airports are built on this soil, the low strength of the subgrade material can be overcome by increasing the thickness of the overlying pavement or by replacing the subgrade with coarse grained material. Seepage can be controlled by providing an adequate drainage system. This soil is suited to irrigation if an adequate supply of good-quality water is available. Capability unit IIe-1 dryland and irrigated; Sandy Terrace range site.

Cv—Canadian Variant sandy loam. This is a deep, nearly level, somewhat excessively drained soil on flood plains. It occupies long, convex old channel areas of the Arkansas River Valley away from the present channel and at a slightly higher level. Flooding is rare and very brief. Individual areas are irregular in shape and range from 20 to 400 acres in size.

Typically, the surface layer is grayish brown and dark grayish brown sandy loam about 10 inches thick. The subsoil is brown, friable sandy loam about 14 inches thick. The underlying material to a depth of 60 inches is pale brown medium and coarse sand and fine gravel. Sand and fine gravel are at a depth of 20 to 40 inches. In some small areas the dark loam surface layer and loam subsoil are thicker. In other small areas the underlying material contains no coarse material.

Included with this soil in mapping are small areas of Hord and Zenda soils. These soils make up about 5 percent of the unit.

Permeability is moderately rapid, and available water capacity is low. Runoff is slow. Fertility is low. The surface layer is very friable and is easily tilled. The shrink-swell potential is low. The root zone is limited by the coarse material at a depth of 20 to 40 inches.

Most areas of this soil are farmed. Winter wheat and sorghum are the principal crops. Small areas are used as range. The soil has poor potential for cultivated crops; fair potential for tame pasture, recreational uses, and openland or rangeland wildlife habitat; and good potential for range. It has poor potential for engineering uses.

This soil is moderately well suited to the dryland and irrigated crops commonly grown in the county. The main concerns of management are controlling soil blowing, conserving moisture, and maintaining organic-matter content, tilth, and fertility. Wind stripcropping and minimum tillage are effective in controlling soil blowing. Crop residue and the tame and native grasses that provide the best cover help protect the soil against erosion.

This soil is well suited to range. Proper stocking rates, timely deferment of grazing, and rotation grazing maintain or improve desirable grasses.

This soil is moderately well suited to trees and shrubs in windbreaks. Much care is needed if young trees and shrubs are to become established and grow well. Cultivation of young plants is necessary to control weeds and reduce the competition for soil moisture.

Flooding and seepage limit most urban and engineering uses of this soil. Engineering structures built on this soil should be protected against flooding. Sanitation facilities do not work well because of flooding and seepage. Nearby water supplies may be polluted if the soil is used as a septic tank filter field. This soil is a good source of roadfill material, a good source of topsoil, and a fair source of sand and gravel.

If roads, streets, or airports are built on this soil, seepage should be controlled by providing an adequate drainage system. The soil is not well suited to irrigation because of the fast intake of water and droughtiness. Capability unit IIIs-1 dryland and irrigated; Sandy Lowland range site.

Cw—Carwile fine sandy loam. This is a deep, nearly level, somewhat poorly drained soil on broad, slightly depressional uplands. Individual areas are irregular in shape and range from 10 to 800 acres in size.

Typically, the surface layer is dark grayish brown fine sandy loam about 12 inches thick. The subsoil is clay loam about 28 inches thick. The upper part is grayish brown and firm; the next part is light brownish gray and very firm; and the lower part is light gray and firm. The underlying material to a depth of 60 inches is light brownish gray, calcareous clay loam. In places, the upper part of the subsoil is firm sandy clay loam and the lower part is very firm clay. In some places, the depth to the firm clay loam or clay subsoil ranges from 30 to 40 inches. In other places the dark grayish brown surface layer is loam, clay loam, or fine sandy loam more than 20 inches thick.

Included with this soil in mapping are small areas of well drained Attica and Naron soils in the higher lying areas. These soils make up about 5 percent of the unit.

Permeability is slow, and runoff is slow or ponded. The water table is seasonally high. Available water capacity is high. Natural fertility is high. The surface layer is friable and is easily tilled. The shrink-swell potential is high in the subsoil.

Most areas of this soil are farmed. The soil has good potential for cultivated crops and range and for trees in windbreaks. The potential for openland and rangeland wildlife habitat is good. The potential for most engineering uses is poor.

This soil is moderately well suited to all crops and tame grasses commonly grown in the county. Soil blowing during periods of low rainfall and wetness during periods of high rainfall are management concerns. Crusting is a severe hazard unless the soil is protected by crops, crop residue, manure, or grasses. Other concerns of management are maintaining fertility and the content of organic matter. Proper use of fertilizer and crop residue helps to maintain fertility, organic-matter content, and tilth.

This soil is well suited to range. If the range is overstocked and overgrazed, the protective plant cover is reduced and the taller, more desirable grasses are replaced by less productive short grasses. Proper stocking rates and a planned grazing system help keep the range and the soil in good condition.

This soil is suited to trees in windbreaks. Adequate moisture for trees in low areas is available during periods of high rainfall. During periods of low rainfall, however, cultivation in these low areas is needed to control weeds and reduce the competition for moisture.

The potential of this soil for building site development is poor because of the high shrink-swell potential, wetness, flooding, and low strength. Using adequate steel reinforcing in concrete structures, backfilling with sand or gravel, installing foundation drains, and installing protective waterproof seals reduce the risk of damage caused by shrinking and swelling and the high water table.

Because of wetness and the high water table, septic tank filter fields do not function properly. If protection against flooding is provided, sewage lagoons are an alternative method of onsite waste disposal. This soil is moderately well suited to irrigation (fig. 9), but permeability and surface runoff are slow and the surface is ponded in some areas. Capability unit IIw-1 dryland and irrigated; Sandy range site.

Fa—Farnum loam, 0 to 1 percent slopes. This deep, nearly level, well drained soil is on broad upland ridgetops. Individual areas are irregular in shape and range from about 10 to several hundred acres in size.

Typically, the surface layer is dark grayish brown loam about 11 inches thick. The subsoil is clay loam about 29 inches thick. The upper part is dark grayish brown and friable; the next part is dark grayish brown and firm; and the lower part is brown and firm. The underlying material to a depth of 60 inches is pale brown clay loam. In some places the subsoil contains more clay. In others it contains less clay.

Included with this soil in mapping are small areas of somewhat poorly drained Carwile soils and moderately well drained Tabler soils in small depressional areas. These soils make up about 4 percent of the unit.

Permeability is moderately slow, and available water capacity is high. Runoff is medium. Natural fertility is high. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is low in the surface layer and moderate in the subsoil.

Most areas of this soil are farmed. The soil has good potential for cultivated crops and range and for trees in windbreaks. The potential for most engineering uses is fair.

This soil is well suited to all crops and tame grasses commonly grown in the county. The main concerns of management are maintaining fertility, organic-matter content, and tilth. Proper use of fertilizer (fig. 10) and crop residue management help maintain fertility, organic matter content, and tilth.

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

This soil is well suited to trees in windbreaks. Rainfall is likely to be limited and irregular, and irrigating the trees promotes growth. Cultivating young windbreaks to control weeds reduces the competition for soil moisture.

The potential of this soil for building site development is only fair because of the moderate shrink-swell potential of the subsoil. Buildings and structures should be designed and built to prevent damage caused by shrinking and swelling. Using adequate reinforcing steel in concrete foundations, backfilling with sand or gravel, and installing foundation drains reduce the risk of damage caused by shrinking and swelling.

Septic tank filter fields do not function properly because of the moderately slow permeability. Increasing the size of the filter field is beneficial. Sewage lagoons are an alternative method of onsite waste disposal. This unit is suited to irrigation if an adequate supply of water is available. Capability unit IIc-2 dryland, I-2 irrigated; Loamy Upland range site.

Fr—Farnum loam, 1 to 3 percent slopes. This deep, gently sloping, well drained soil is on narrow, convex upland ridgetops and side slopes. Individual areas are irregular in shape and range from about 10 to 200 acres in size.

Typically, the surface layer is dark grayish brown loam about 8 inches thick. The subsoil is clay loam about 29 inches thick. The upper part is dark grayish brown and friable; the next part is dark grayish brown and firm; and the lower part is brown and firm. The underlying material to a depth of 60 inches is pale brown clay loam. In some places the subsoil is less clayey, and in others it is more clayey. In some areas the depth to free carbonates is less than 30 inches.

Included with this soil in mapping are small areas of Attica soils on convex ridgetops. These soils are fine sandy loam throughout the profile. They make up about 2 percent of the unit. Also included are small areas of somewhat poorly drained Carwile soils and moderately well drained Tabler soils in small depressions. These soils make up about 2 percent of the unit.

Permeability is moderately slow, and runoff is medium. Available water capacity is high. Natural fertility is high. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is low in the surface layer and moderate in the subsoil.

Most areas of this soil are farmed. The soil has good potential for crops and range and for trees in windbreaks. The potential for most engineering uses is fair.

This soil is well suited to most crops and tame grasses commonly grown in the county. The hazard of water erosion is moderate if the soil is cultivated and unprotected. Terracing, contour farming, proper use of fertilizer, and crop residue management help reduce the risk of erosion and maintain fertility, organic-matter content, and tilth.

This soil is well suited to range. If the range is overstocked and overgrazed, the protective plant cover is reduced and the taller, more desirable grasses are replaced by less productive short grasses. Proper stocking rates and a planned grazing system help keep the range and the soil in good condition.

This soil is well suited to trees in windbreaks. Rainfall is likely to be limited and irregular, and irrigating the trees promotes establishment and growth. Cultivating young windbreaks to control weeds reduces the competition for soil moisture.

The moderate shrink-swell potential moderately limits most engineering uses of this soil. Using adequate reinforcing steel in concrete foundations, backfilling with sand or gravel, and installing foundation drains reduce the risk of damage caused by shrinking and swelling. Because of the moderately slow permeability, this soil has severe limitations for use as a septic tank filter field. Increasing the size of the filter field is beneficial. Sewage lagoons are an alternative method of onsite waste disposal.

This soil is suited to irrigation if an adequate supply of water is available. Control of erosion is needed if the soil is irrigated. Capability unit IIe-2 dryland and irrigated; Loamy Upland range site.

Ha—Harney silt loam, 0 to 1 percent slopes. This deep, nearly level, well drained soil is on broad upland ridgetops. Individual areas are irregular in shape and range from 20 to several hundred acres in size.

Typically, the surface layer is dark grayish brown silt loam 12 inches thick. The subsoil is about 23 inches thick. The upper part is grayish brown, very firm silty clay loam, and the lower part is brown, firm, calcareous silty clay loam. The underlying material to a depth of 60 inches is pale brown, calcareous silt loam. In some places the depth to free carbonates is more than 30 inches. In others it is less than 18 inches.

Included with this soil in mapping are small areas of poorly drained Ness soils in depressional areas. These soils make up about 2 percent of the unit.

Permeability is moderately slow, and runoff is slow. Available water capacity is high. Natural fertility is high. The surface layer is very friable and is easily tilled. The shrink-swell potential is low in the surface layer and high in the subsoil.

Most areas of this soil are cultivated. The soil has good potential for cultivated crops, pasture, and range and for trees in windbreaks. It has poor potential for most engineering uses.

This soil is well suited to the dryland and irrigated crops and native or tame grasses commonly grown in the county. The main concerns of management are controlling soil blowing, conserving moisture, and maintaining tilth and fertility. Wind stripcropping and minimum tillage are effective in controling soil blowing and conserving moisture.

This soil is also well suited to range. Proper stocking rates, timely deferment of grazing, and pasture rotation maintain or improve desirable grasses.

This soil is suited to trees in windbreaks. Considerable care is needed if young trees are to become established and grow well. Cultivating young windbreaks to control weeds reduces competition for soil moisture.

The moderately slow permeability and the high shrink-swell potential of the subsoil are severe limitations for most engineering uses of this soil. Engineering structures or buildings built on this soil should be designed and constructed to prevent damage caused by shrinking and swelling. Using adequate reinforcing steel in concrete foundations, backfilling with sand or gravel, and installing foundation drains reduce the risk of damage caused by shrinking and swelling.

Because of the moderately slow permeability, septic tanks do not work well. Increasing the size of the filter field is beneficial. Sewage lagoons are an alternative method of onsite waste disposal. This soil is suited to irrigation if an adequate supply of water is available. Capability unit IIc-2 dryland, I-2 irrigated; Loamy Upland range site.

Hb—Harney silt loam, 1 to 3 percent slopes. This deep, gently sloping, well drained soil is on convex upland ridgetops and side slopes. Individual areas are irregular in shape and range from about 10 to several hundred acres in size.

Typically, the surface layer is dark grayish brown silt loam about 12 inches thick. The subsoil is about 23 inches thick. The upper part is grayish brown, very firm silty clay loam, and the lower part is brown, firm, calcareous silty clay loam. The underlying material to a depth of 60 inches is pale brown silt loam. In places the subsoil is less clayey.

Included with this soil in mapping are small areas of Uly and Wakeen soils along intermittent drainageways. Uly soils have carbonates at or near the surface and do not have a clayey subsoil, and Wakeen soils are 20 to 40 inches deep over bedrock.

Permeability is moderately slow, and runoff is medium. Available water capacity is high. Natural fertility is high. The surface layer is very friable and is easily tilled. The shrink-swell potential is high in the subsoil.

Most areas of this soil are farmed. The soil has good potential for crops and range and for trees in windbreaks. The potential for most engineering uses is poor to fair.

This soil is well suited to most crops and tame grasses commonly grown in the county. The hazard of water erosion is moderate if the soil is cultivated and unprotected. Terracing, contour farming, proper use of fertilizer, and crop residue management help reduce the risk of erosion and maintain fertility, organic-matter content, and tilth.

This soil is well suited to range. If the range is overstocked and overgrazed, the protective plant cover is reduced and the taller, more desirable grasses are replaced by less productive short grasses. Proper stocking rates and a planned grazing system help keep the range and the soil in good condition.

This soil is well suited to trees in windbreaks. Rainfall is likely to be limited and irregular, and irrigating the trees promotes establishment and growth. Cultivating young windbreaks to control weeds reduces the competition for soil moisture.

The potential of this soil for building site development is poor because of the high shrink-swell potential of the subsoil. Buildings and structures should be designed and built to prevent damage caused by shrinking and swelling. Using adequate reinforcing steel in concrete foundations, backfilling with sand or gravel, and installing foundation drains reduce the risk of damage caused by shrinking and swelling.

Because of the moderately slow permeability, septic tanks do not work well. Increasing the size of the filter field is beneficial. Sewage lagoons are an alternative method of onsite waste disposal. This soil is suited to irrigation if an adequate supply of water is available. Control of erosion is needed if the soil is irrigated. Capability unit IIe-2 dryland and irrigated; Loamy Upland range site.

Hc—Harney silty clay loam, 1 to 3 percent slopes, eroded. This deep, gently sloping, well drained soil is on uplands. It typically is on short side slopes along intermittent drainageways, but it is also in large areas on irregular side slopes. Areas range from about 5 to 100 acres in size.

Typically, the surface layer is grayish brown silty clay loam about 7 inches thick. The subsoil is about 20 inches thick. The upper part is grayish brown, very firm silty clay loam, and the lower part is brown, firm, calcareous silty clay loam. The underlying material to a depth of 60 inches is pale brown silt loam. In some places, the surface layer contains less clay and the depth to free carbonates is more than 20 inches. In others the subsoil is less clayey and the depth to free carbonates is more than 24 inches.

Included with this soil in mapping are small areas of Uly and Wakeen soils along intermittent drainageways. Uly soils do not have a clayey subsoil. Wakeen soils are 20 to 40 inches deep over bedrock. These included areas make up about 10 percent of the unit.

Permeability is moderately slow, and runoff is medium. Available water capacity is high. Natural fertility is high. Tilth is poor, and the surface tends to crust and puddle after hard rains. The shrink-swell potential is high in the subsoil.

Most areas of this soil are farmed. The soil has good potential for crops and range and for trees in windbreaks. The potential for most engineering uses is poor to fair.

This soil is moderately well suited to most cultivated crops and tame grasses commonly grown in the county. The hazard of further erosion is severe if the soil is cultivated and unprotected. Terracing, contour farming, proper use of fertilizer, and management of crop residue help reduce the risk of erosion and maintain fertility, organic-matter content, and tilth.

This soil is well suited to range. If the range is overstocked and overgrazed, the protective plant cover is reduced and the taller, more desirable grasses are replaced by less productive short grasses. Proper stocking rates and a planned grazing system help keep the range and the soil in good condition.

This soil is suited to trees, but rainfall is likely to limit the growth of windbreaks. Irrigating the trees promotes growth, but care must be taken to control erosion.

The potential of this soil for building site development is poor because of the high shrink-swell potential of the subsoil. Buildings and structures should be designed and built to prevent damage caused by shrinking and swelling. Using adequate reinforcing steel in concrete foundations, backfilling with sand or gravel, and installing foundation drains reduce the risk of damage caused by shrinking and swelling.

Because of the moderately slow permeability, septic tanks do not work well. Increasing the size of the filter field is beneficial. Sewage lagoons are an alternative method of onsite waste disposal. Capability unit IIIe-2 dryland and irrigated; Loamy Upland range site.

Hd—Harney-Uly complex, 3 to 6 percent slopes, eroded. This map unit consists of deep, sloping, well drained soils on uplands. Individual areas range from about 10 to 100 acres in size and are 60 to 70 percent Harney soils and 20 to 30 percent Uly soils. The Harney soils are on the upper and middle parts of convex side slopes. The Uly soils are on the middle and lower parts of side slopes along drainageways. The two soils are so intricately mixed or are in areas so small in size that it is not practical to separate them in mapping.

Typically, the Harney soil has a surface layer of grayish brown silty clay loam about 7 inches thick. The subsoil is about 20 inches thick. The upper part is grayish brown, very firm silty clay loam, and the lower part is brown, firm, calcareous silty clay loam. The underlying material to a depth of 60 inches is pale brown silt loam. In places the depth to free carbonates is less than 14 inches.

Typically, the Uly soil has a surface layer of grayish brown silt loam about 7 inches thick. The subsoil is about 8 inches of brown, friable silt loam. The underlying material to a depth of 60 inches is pinkish gray silt loam. In some places the subsoil contains more clay. In a few it contains some sand. In others chalky shale is at a depth of 20 to 40 inches.

Included with this unit in mapping are small areas of Roxbury soils. These soils have a thicker and darker surface layer and subsoil than Harney and Uly soils. They are on concave foot slopes and along the intermittent drainageways, generally in areas less than 125 feet wide. They are frequently flooded.

Water and air movement is moderately slow through the Harney soil and moderate through the Uly soil. Runoff is medium, and available water capacity is high. Natural fertility is high. The surface layer of the Harney soil tends to crust and puddle after hard rains. The Uly soil has a friable surface layer and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is high in the subsoil of the Harney soil and moderate in the subsoil of the Uly soil.

Most areas of this map unit are cultivated. The unit has fair potential for crops and tame grasses and for trees in windbreaks. It has good potential for range. The potential for engineering uses is poor to fair.

This map unit is moderately well suited to most crops and tame grasses commonly grown in the county. The hazard of further erosion is very severe if the soils are cultivated and unprotected. Terracing, constructing waterways, and farming on the contour help to control erosion. Proper use of fertilizer and good management of crop residue help to maintain fertility, organic-matter content, and tilth.

This map unit is well suited to range. If the range is overstocked and overgrazed, the protective plant cover is reduced and the taller, more desirable grasses are replaced by less productive short grasses. Proper stocking rates and a planned grazing system help keep the range and the soil in good condition.

This map unit is suited to trees, but the irregular rainfall is likely to limit the growth of windbreaks. Irrigating the trees promotes growth, but care must be taken to control erosion.

The potential of this map unit for most engineering uses is poor because of the moderately slow permeability and the high shrink-swell potential of the Harney soil. If the unit is used as a building site, onsite investigation is needed. The building should be located on the Uly soil. The Uly soil has slight limitations for septic tank filter fields. Capability unit IIIe-3 dryland and irrigated; Loamy Upland range site.

Ho—Holdrege silt loam, 1 to 3 percent slopes. This deep, gently sloping, well drained soil is on convex upland ridgetops and side slopes. Individual areas are irregular in shape and range from about 20 to 500 acres in size.

Typically, the surface layer is about 6 inches of grayish brown silt loam over 4 inches of dark grayish brown silty clay loam. The subsoil is brown silty clay loam about 20 inches thick. The upper part is firm, and the lower part is friable. The underlying material to a depth of 60 inches is brown silty clay loam. In some places, the subsoil is less clayey and the depth to free carbonates is less than 15 inches. In others, the subsoil is more clayey.

Permeability is moderate, and runoff is medium. Available water capacity is high. Natural fertility is high. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate.

Most areas of this soil are farmed. The soil has good potential for crops, tame pasture, and range and for trees in windbreaks. The potential for most engineering uses is good to fair.

This soil is well suited to most cultivated crops and tame pasture plants commonly grown in the county. The hazard of water erosion is moderate if the soil is cultivated and unprotected. Terracing, contour farming, proper use of fertilizer, and proper management of crop residue help to reduce the risk of erosion and to maintain fertility, organic-matter content, and tilth.

This soil is well suited to range. If the range is overstocked and overgrazed, the protective plant cover is reduced and the taller, more desirable grasses are replaced by less productive short grasses. Proper stocking rates and a planned grazing system help keep the range and the soil in good condition.

This soil is well suited to trees, but rainfall is likely to limit growth. Where it is practical, irrigation promotes the establishment and growth of the small trees. Under dryland conditions, frequent cultivation of the young trees is needed to control weeds and reduce the competition for soil moisture.

The potential of this soil for building site development is poor because of the moderate shrink-swell potential. Using adequate reinforcing steel in concrete foundations, backfilling with sand or gravel, and installing foundation drains reduce the risk of damage caused by shrinking and swelling. The soil has slight limitations for septic tanks that are designed and installed properly. It is suited to irrigation if an adequate supply of water is available. Control of erosion is needed if the soil is irrigated. Capability unit IIe-3 dryland and irrigated; Loamy Upland range site.

Hr—Hord silt loam. This is a deep, nearly level, well drained soil on smooth alluvial terraces along some of the major streams in the county. Flooding is rare. Individual areas are irregular in shape and range from about 80 to several hundred acres in size.

Typically, the surface layer is grayish brown and dark grayish brown silt loam about 12 inches thick. The subsoil is firm silty clay loam about 30 inches thick. The upper part is dark grayish brown, and the lower part is brown. The underlying material to a depth of 60 inches is pale brown silt loam. In some places free carbonates are within 15 inches of the surface. In others the dark colors of the surface layer and upper part of the subsoil are not evident below a depth of 20 inches.

Included with this soil in mapping are small areas of moderately well drained New Cambria soils and well drained Kaski soils. The Kaski soils are more sandy than this Hord soil. They occupy slightly higher areas in the Arkansas River Valley. The New Cambria soils occupy shallow depressions. Included areas make up about 10 percent of the unit.

Permeability is moderate, and available water capacity is high. Runoff is slow. Natural fertility is high. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is low.

Most areas of this soil are farmed. The soil has good potential for cultivated crops, tame pasture, and range and for trees in windbreaks. The potential for most engineering uses is only fair because of flooding and low strength.

This soil is well suited to all crops and tame pasture plants commonly grown in the county. The main concerns of management are maintaining fertility, organic-matter content, and tilth. Proper management of fertilizer and crop residue helps to maintain fertility, organic-matter content, and tilth.

This soil is well suited to range. If the range is overstocked and overgrazed, the protective plant cover is reduced and the taller, more desirable grasses are replaced by less productive short grasses. Proper stocking rates and a planned grazing system help to keep the range and the soil in good condition.

This soil is well suited to trees in windbreaks. Rainfall is likely to limit the growth of trees. Where it is practical, irrigation promotes the establishment and growth of the small trees. Under dryland conditions, cultivating young windbreaks controls weeds and reduces the competition for soil moisture.

Limitations are slight if this soil is used for building site development. They are moderate if it is used as a septic tank filter field that is protected against flooding by proper design. Local roads should be graded to shed water, and suitable subgrade material should be hauled in from outside the area. This soil is suited to irrigation if an adequate supply of water is available. Capability unit IIc-1 dryland, I-1 irrigated; Loamy Terrace range site.

Ka—Kaski loam. This is a deep, nearly level, well drained soil on flood plains. It occupies long, convex areas along the major streams. Flooding is rare and very brief. Individual areas are irregular in shape and range from 50 to 800 acres in size.

Typically, the surface layer is grayish brown and dark grayish brown loam about 18 inches thick. The next layer is dark grayish brown, friable loam about 10 inches thick. The underlying material to a depth of 60 inches is very pale brown fine sandy loam. In some small areas the dark grayish brown loam surface layer is thinner. In other small areas the surface layer and the layer just below the surface layer are fine sandy loam, and in some of these areas fine sand is between depths of 24 to 36 inches.

Included with this soil in mapping are small areas of Hord, Waldeck, and Zenda soils at a lower level on the flood plain. These soils make up about 5 percent of the unit.

Permeability is moderate, and available water capacity is high. Runoff is slow. Fertility is high. The surface layer is very friable and is easily tilled. The shrink-swell potential is low.

Most areas of this soil are farmed. Winter wheat, sorghum, and alfalfa are the principal crops. Small areas are used for range and for trees in windbreaks. This soil has good potential for cultivated crops, tame pasture, range, and openland and rangeland wildlife habitat and for trees grown as windbreaks. It has fair potential for most engineering uses.

This soil is well suited to the dryland crops, irrigated crops, and native or tame grasses commonly grown in the county. The main concerns of management are controlling soil blowing, conserving moisture, and maintaining tilth and fertility. Wind stripcropping and minimum tillage are effective in controlling soil blowing. Proper use of crops, crop residue, and fertilizer is needed to conserve moisture and maintain tilth and fertility.

This soil is well suited to range. Proper stocking rates, timely deferment of grazing, and rotation grazing maintain or improve desirable grasses.

This soil is suited to trees and shrubs in windbreaks. Much care is needed if young trees and shrubs are to become established and grow well. Cultivation of young trees and shrubs is necessary to control weeds and reduce the competition for soil moisture.

Flooding, seepage, and low strength limit many engineering uses of this soil. Engineering structures or buildings built on this soil should be protected against flooding and seepage. Sanitation facilities, such as septic tank filter fields, work moderately well, but they should be protected against flooding and seepage. Seepage can be controlled by providing an adequate drainage system.

This soil is a fair source of roadfill material and a good source of topsoil. The low strength of the subgrade material is a limitation if roads, streets, or airports are built on this soil. This limitation can be overcome by increasing the thickness of the overlying pavement or by replacing the subgrade with coarse grained material. This soil is well suited to irrigation if an adequate supply of good-quality water is available. Cabaility unit IIe-4 dryland and irrigated; Loamy Lowland range site.

Lh—Lesho clay loam. This is a deep, nearly level, somewhat poorly drained soil on flood plains. It occupies medium-length, somewhat channeled areas along the Arkansas River. Flooding is occasional and very brief. Individual areas are irregular in shape and range from 10 to 300 acres in size.

Typically, the surface layer is dark grayish brown and grayish brown clay loam about 22 inches thick. The underlying material is about 5 inches of light brownish gray loam over 33 inches of very pale brown loamy sand. In some small areas the soil has a surface layer and subsoil of loam and lacks sandy sediments to a depth of more than 40 inches. In other small areas the surface layer and subsoil are fine sandy loam.

Included with this soil in mapping are small areas of Platte soils that are less than 20 inches deep over sandy sediments. These soils make up about 10 percent of the unit. They occupy low areas in old channels.

Permeability is moderately slow above the water table, and available water capacity is moderate. Runoff is slow. Fertility is medium. The surface layer is firm and can be tilled within a fairly narrow range in moisture content. If the soil is tilled when too wet or too dry, clods form and structure is destroyed. The shrink-swell potential is moderate in the surface layer. The water table fluctuates between depths of 2 and 6 feet, depending on the season.

Nearly all areas of this soil are farmed. Winter wheat and sorghum are the principal crops. Alfalfa is grown in some small areas. Other small areas are used for range and for trees grown as windbreaks. This soil has fair potential for cultivated crops and tame pasture and for openland, rangeland, and wetland wildlife habitat. It has good potential for range and poor potential for engineering uses.

This soil is well suited to the dryland cultivated crops and native or tame grasses commonly grown in the county. It is not well suited to irrigation because of flooding and the high water table. The main concerns of management are controlling flooding and soil blowing and maintaining fertility, organic-matter content, and tilth. Proper use of fertilizer and good management of crops and crop residue help maintain fertility, organic-matter content, and tilth.

This soil is well suited to range. If the range is overstocked and overgrazed, the protective plant cover is reduced and the taller, more desirable grasses are replaced by less productive short grasses. Proper stocking rates and a planned grazing system help keep the range and the soil in good condition.

This soil is well suited to trees and shrubs grown as windbreaks and environmental plantings. Cultivating young trees and shrubs to control weeds reduces the competition for moisture until roots reach the water table.

Limitations for engineering uses are severe because of flooding, wetness, and low strength. Areas used for engineering structures or buildings must be protected against flooding and wetness. If dwellings and small buildings are constructed, basements, walls, foundations, and footings should be designed to prevent structural damage caused by shrinking and swelling and by wetness from the high water table. Basement walls should be properly backfilled and sealed. Seepage can be corrected by an adequate drainage system.

This soil is a fair source of roadfill, sand, and topsoil. It has severe limitations for all sanitary facilities. Septic tank filter fields do not function properly, and nearby water supplies may be polluted because of flooding and the wetness from the high water table. Capability unit IIIw-1 dryland and irrigated; Subirrigated range site.

Lu—Lubbock silt loam. This is a deep, nearly level, well drained soil on convex upland slopes. Individual areas are irregular in shape and range from about 10 to several hundred acres in size.

Typically, the surface layer is grayish brown silt loam about 11 inches thick. The subsoil is silty clay about 25 inches thick. The upper part is dark grayish brown and very firm; the next part is grayish brown and very firm; and the lower part is grayish brown and firm. The underlying material to a depth of 60 inches is light gray silty clay loam. In some places the subsoil contains more sand. In others it is grayer and more clayey. In places the depth to free carbonates is 12 to 18 inches.

Included with this soil in mapping are small areas of Naron soils and poorly drained Ness soils. The Naron soils have a sandy clay loam subsoil and are in areas where slopes are convex and 1 to 3 percent and where the Lubbock soil is near more sandy soils. The Ness soils are in shallow depressions. Included soils make up about 2 percent of the unit.

Permeability is moderately slow, and available water capacity is high. Runoff is slow. Natural fertility is high. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is high in the subsoil.

Most areas of this soil are farmed. The soil has good potential for cultivated crops, tame pasture, and range and for trees grown as windbreaks. The potential for most engineering uses is fair.

This soil is well suited to all crops and tame pasture plants commonly grown in the county. The main concern of management is the proper use of fertilizer and crop residue to help maintain fertility, organic-matter content, and tilth.

This soil is well suited to range. If the range is overstocked and overgrazed, the protective plant cover is reduced and the taller, more desirable grasses are replaced by less productive short grasses. Proper stocking rates and a planned grazing system help to keep the range and the soil in good condition.

This soil is well suited to trees in windbreaks. Low rainfall is likely to limit the growth of trees. Where it is practical, irrigation promotes the establishment and growth of young trees. Under dryland conditions, cultivating young windbreaks controls weeds and reduces the competition for soil moisture.

The high shrink-swell potential of the subsoil is a severe limitation if this soil is used for building site development. Buildings and structures should be designed and built to prevent damage caused by shrinking and swelling. Using adequate reinforcing steel in concrete foundations, backfilling with sand or gravel, and installing foundation drains help reduce the risk of damage caused by shrinking and swelling.

Because of the moderately slow permeability, this soil has a severe limitation for use as a septic tank filter field. Sewage lagoons are an alternative method of onsite waste disposal. This soil is suited to irrigation if an adequate supply of water is available. Capability unit IIc-2 dryland, I-2 irrigated; Loamy Upland range site.

Na—Naron fine sandy loam. This is a deep, nearly level to gently sloping, well drained soil on somewhat undulating, convex upland slopes. Individual areas are irregular in shape and range from about 20 to 500 acres in size.

Typically, the surface layer is dark grayish brown fine sandy loam about 11 inches thick. The subsoil is about 42 inches thick. The upper part is brown, firm sandy clay loam, and the lower part is brown, friable fine sandy loam. The underlying material to a depth of 60 inches is pale brown fine sandy loam. In some places the subsoil contains less clay. In others it is more clayey. In places the surface layer is dark brown.

Included with this soil in mapping are small areas of somewhat poorly drained Carwile soils in slight depressions. These soils make up about 5 percent of the unit.

Permeability is moderate, and runoff is slow. Available water capacity is high. Natural fertility is high. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is low.

Most areas of this soil are farmed. The soil has good potential for cultivated crops, tame pasture, and range and for trees grown as windbreaks. The potential for most engineering uses is good.

This soil is suited to most cultivated crops and tame pasture plants commonly grown in the county. The main concerns of management are controlling soil blowing and water erosion on the steeper slopes. Stripcropping, stubble mulching, and field windbreaks are effective in controlling soil blowing and water erosion. Limiting tillage and tilling with tools that maintain a good cover of crop residue are also helpful. Terracing and farming on the contour are not applicable in many fields because of uneven slopes. Proper use of fertilizer and crop residue helps to reduce the risk of erosion and maintain fertility, organic-matter content, and tilth.

This soil is well suited to range. If the range is overstocked and overgrazed, the protective plant cover is reduced and the taller, more desirable grasses are replaced by less productive short grasses. Proper stocking rates and a planned grazing system help keep the range and the soil in good condition.

This soil is well suited to trees grown as windbreaks. Low rainfall is likely to limit the growth of trees. Where it is practical, irrigation promotes the establishment and growth of trees. Under dryland conditions, cultivating young windbreaks controls weeds and reduces the competition for soil moisture. Care should be taken to control erosion on the steeper slopes.

If proper design and proper installation procedures are used, this soil is suitable for building site development and for onsite waste disposal. In some areas there is a hazard of polluting water supplies if the soil is used as a septic tank filter field. If a sewage lagoon is used for onsite waste disposal, excessive seepage can be controlled by special treatment to seal the bottom of the lagoon.

This soil is suited to irrigation if an adequate supply of water is available. Erosion control is needed if the gently sloping areas are irrigated. Capability unit IIe-5 dryland and irrigated; Sandy range site.

Ne—Ness clay. This is a deep, nearly level, poorly drained soil in depressions or on upland flats and in small border areas of valley floors. Flooding is frequent and long. Individual areas are round or oblong and range from 5 to 50 acres in size.

Typically, the surface layer is gray clay about 30 inches thick. The underlying material to a depth of 60 inches is pale brown silty clay loam. In some places the surface layer is silty clay loam. In others the underlying material is silt loam or loam.

Included with this soil in mapping are small areas of well drained Harney soils in nearly level areas near depressions. These soils make up about 5 percent of the unit.

Permeability is very slow, and runoff is ponded. Available water capacity is high. Fertility is high. The surface layer is very firm and can be tilled within a narrow range in moisture content. If the soil is tilled when it is too wet or too dry, clods form and natural structure is destroyed. The shrink-swell potential is very high in the surface layer.

Most areas of this soil are farmed. Winter wheat and sorghum are the principal crops. Small areas are used for range. The soil has poor potential for cultivated crops and tame pasture, recreational uses, wildlife habitat, and engineering uses.

This soil is poorly suited to dryland crops. The main concerns of management are controlling ponding and soil blowing. An open drainage system is effective in controlling ponding. Soil blowing during dry periods is effectively controlled by the proper use of native grasses, crops, and crop residue.

This soil is best suited to native range grasses. Proper stocking rates, timely deferment of grazing, and rotation grazing maintain or improve desirable grasses.

This soil is poorly suited to trees and shrubs for windbreaks or environmental plantings. Much care is needed if young trees and shrubs are to become established and grow well. An open drainage system should be established before planting trees or shrubs. During dry periods, cultivation of young plants is needed to control weeds and reduce the competition for soil moisture. The clayey surface layer is difficult to till.

The very high shrink-swell potential, the very slow permeability, and the ponding severely limit engineering uses of this soil. If engineering structures are built on this soil, an open drainage system is needed. Structures or buildings should be designed and constructed to reduce the risk of damage caused by shrinking and swelling. Using adequate reinforcing steel in concrete foundations, backfilling with sand and gravel, and installing foundation drains reduce the risk of damage caused by shrinking and swelling.

Because of the very slow permeability, septic tank filter fields do not function. If protected against flooding, sewage lagoons are an alternative method of onsite waste disposal. Capability unit VIw-1 dryland; not assigned to a range site.

Nw—New Cambria silty clay loam. This is a deep, nearly level, moderately well drained soil on terraces along all of the larger streams but the Arkansas River. Flooding is rare and very brief. Individual areas are irregular in shape and range from about 40 to 800 acres in size.

Typically, the surface layer is dark gray and gray silty clay loam about 14 inches thick. The subsoil is silty clay about 21 inches thick. The upper part is gray and very firm, and the lower part is grayish brown and firm. The underlying material to a depth of 60 inches is grayish brown silty clay loam. In some places the surface layer is silt loam and is dark to a lesser depth. In others the subsoil contains less clay.

Included with this soil in mapping are some small areas of well drained Bridgeport soils and poorly drained Ness soils. The Bridgeport soils have a less clayey subsoil than this New Cambria soil. They are in slightly higher areas next to the streams. The Ness soils have a more clayey surface layer than this New Cambria soil. They are in the smaller depressions. The Bridgeport soils make up about 5 percent of the unit and the Ness soils about 1 percent.

Permeability is slow, and available water capacity is high. Runoff is slow. Fertility is high. The surface layer is firm and can be tilled within a fairly narrow range in moisture content. If the soil is tilled when it is too wet or too dry, clods form and structure is destroyed. The shrink-swell potential is high throughout the profile.

Nearly all areas of this soil are farmed. Winter wheat, sorghum, and alfalfa are the principal crops. Some small areas are used for native range. Other small areas are used for trees in windbreaks and along stream channels. This soil has good potential for cultivated crops and tame pasture. It has good potential for openland wildlife habitat but has only fair potential for rangeland and wetland wildlife habitat. It has fair potential for recreational development. The potential for engineering uses is poor because of the high shrink-swell potential and the slow permeability.

This soil is well suited to the dryland cultivated crops and native or tame grasses commonly grown in the county. It is not well suited to irrigation because of the slow permeability. The main management needs are controlling soil blowing, protecting the soil against flooding, and maintaining tilth, fertility, and organic-matter content.

This soil is well suited to range. If the range is overstocked and overgrazed, the protective plant cover is reduced and the taller, more desirable grasses are replaced by less productive short grasses. Proper stocking rates and a planned grazing system help to keep the range and the soil in good condition.

This soil is well suited to trees grown as windbreaks and environmental plantings, but roots penetrate slowly through the dense clay subsoil. Low rainfall is likely to limit the growth of trees. Under dryland conditions, cultivation of young trees and shrubs is needed to control weeds and reduce the competition for soil moisture. Where it is practical, irrigation promotes the establishment and growth of young trees and shrubs.

The high shrink-swell potential, the slow permeability, and the flooding severely limit engineering uses of this soil. The soil is a poor source of roadfill and topsoil. If engineering structures are built on this soil, an open drainage system is needed to protect the structures against flooding. Structures or buildings should be designed and constructed to reduce the risk of damage caused by shrinking and swelling. Using adequate reinforcing steel in concrete foundations, backfilling with sand and gravel, and installing foundation drains reduce the risk of damage caused by shrinking and swelling.

Because of the slow permeability, septic tank filter fields do not work well. Sewage lagoons are an alternative method of onsite waste disposal. Capability unit IIs-1 dryland; Clay Terrace range site.

Pa—Platte soils. These are deep, nearly level, somewhat poorly drained soils on the flood plain near the Arkansas River. Flooding is occasional and brief. Individual areas are irregular in shape and range from about 10 to 400 acres in size.

Typically, the surface layer is grayish brown fine sandy loam, loam, or clay loam about 8 inches thick. The underlying material is pale brown loamy fine sand about 8 inches thick. Very pale brown very coarse to fine sand and gravel are at a depth of about 16 inches. In some places the soil is brown throughout. In others the underlying material is more clayey.

Included with these soils in mapping are small areas of Lesho soils in old channels. The Lesho soils have a more clayey surface layer than these Platte soils and are 20 to 40 inches deep over sand. They make up about 5 percent of the unit.

Permeability is moderately rapid, and runoff is slow. Available water capacity is low. Natural fertility is low. The water table fluctuates between depths of 2 and 5 feet, depending on the season. The shrink-swell potential is low.

Most areas are used for range or trees. The soils have poor potential for cultivated crops and for most engineering uses. Their best potential is for range. They have good potential for wetland wildlife habitat.

These soils are poorly suited to most cultivated crops commonly grown in the county because of the poor drainage, the low available water capacity, and the low natural fertility.

These soils are best suited to range. Overstocking and overgrazing the range reduces the protective plant cover and causes deterioration of the plant community. Under these conditions, the taller, more desirable grasses are replaced by less productive short grasses. Proper stocking rates, uniform grazing distribution, timely deferment of grazing, and a planned grazing system help to keep the range and the soil in good condition.

Flooding and wetness severely limit engineering and recreational uses of these soils. In areas along the Arkansas River, these soils are a good source of sand and gravel. Capability unit VIw-2 dryland; Subirrigated range site.

Ph—Pratt loamy fine sand, rolling. This deep, rolling, well drained soil is on upland knolls and hills having sharply rounded tops and steep sides. Individual areas are irregular in shape and range from about 10 to several hundred acres in size.

Typically, the surface layer is grayish brown loamy fine sand about 11 inches thick. The subsoil is about 21 inches of brown, very friable loamy fine sand. The underlying material to a depth of 60 inches is brown loamy fine sand. In some places the profile is less sandy. In others it is more sandy.

Included with this soil in mapping are small areas of somewhat poorly drained Carwile soils in depressions. These soils make up about 5 percent of the unit.

Permeability is rapid, and surface runoff is slow. Available water capacity is low. Natural fertility is medium. The shrink-swell potential is low.

Most areas of this soil are used as range. The soil has poor potential for crops. It has good potential for range and fair potential for trees in windbreaks. The potential for most engineering uses is fair to poor.

This soil is poorly suited to most crops commonly grown in the county. The hazard of soil blowing is severe if the soil is cultivated and unprotected. Stubble-mulch tillage, wind stripcropping, and shelterbelts help control soil blowing.

This soil is best suited to range. If the range is overstocked and overgrazed, the protective plant cover is reduced and the taller, more desirable grasses are replaced by less productive short grasses. Proper stocking rates, uniform grazing distribution, timely deferment of grazing, and a planned grazing system help keep the range and the soil in good condition.

This soil is suited to trees in windbreaks. Rainfall is likely to be limited and irregular, and irrigating the trees promotes growth. Cultivating young windbreaks to control weeds reduces the competition for soil moisture. Erosion control is needed if windbreaks are irrigated or cultivated.

Where slopes are less than 8 percent, limitations for building site development are slight. If the soil is used as a site for a septic tank filter field, there is a hazard of pollution of nearby water supplies. This soil is a good source of roadfill and a fair source of sand. Capability unit IVe-1 dryland, IIIe-1 irrigated; Sands range site.

Po—Pratt loamy fine sand, undulating. This deep, undulating, well drained soil is on convex upland slopes. Individual areas are irregular in shape and range from about 10 to several hundred acres in size.

Typically, the surface layer is grayish brown loamy fine sand about 11 inches thick. The subsoil is about 21 inches of brown, very friable loamy fine sand. The underlying material to a depth of 60 inches is brown loamy fine sand. In places the profile is more sandy.

Included with this soil in mapping are small areas of somewhat poorly drained Carwile soils in depressions. These soils make up about 5 percent of the unit.

Permeability is rapid, and surface runoff is slow. Available water capacity is low. Natural fertility is medium. The shrink-swell potential is low.

Most areas of this soil are farmed. The soil has fair potential for crops and for trees in windbreaks. It has good potential for range. The potential for most engineering uses is fair.

This soil is suited to most crops commonly grown in the county. The hazard of soil blowing is severe if the soil is cultivated and unprotected. Keeping a plant cover on the soil during critical periods when the hazard of soil blowing is most severe is most effective in controlling soil blowing and conserving soil moisture. Also effective are wind stripcropping and field windbreaks.

This soil is suited to range. If the range is overstocked and overgrazed, the protective plant cover is reduced and the taller, more desirable grasses are replaced by less productive short grasses. Proper stocking rates, uniform grazing distribution, timely deferment of grazing, and a planned grazing system help keep the range and the soil in good condition.

This soil is suited to trees in windbreaks. Rainfall is likely to be limited and irregular, and irrigating the trees promotes growth. Cultivating young windbreaks to control weeds reduces the competition for moisture. Erosion control is needed if windbreaks are irrigated or cultivated.

Limitations for building site development are slight. If the soil is used as a site for a septic tank filter field, there is a hazard of pollution of water supplies. Seepage is a severe limitation if the soil is used for sewage lagoons and sanitary landfills. This soil is a good source of roadfill and a fair source of sand. Capability IIIe-4 dryland and irrigated; Sands range site.

Pt—Pratt-Tivoli loamy fine sands, rolling. This map unit consists of deep, rolling, well drained and excessively drained soils on uplands. Individual areas range from about 10 to several hundred acres in size and are 60 to 70 percent Pratt soils and 20 to 30 percent Tivoli soils. The Pratt soils are on side slopes that range from 5 to 10 percent. Tivoli soils are on side slopes, ridgetops, and divides. The two soils are so intricately mixed or are in areas so small in size that it is not practical to separate them in mapping.

Typically, the Pratt soils have a surface layer of grayish brown loamy fine sand about 11 inches thick. The subsoil is about 21 inches of brown, very friable loamy fine sand. The underlying material to a depth of 60 inches is brown loamy fine sand.

Typically, the Tivoli soils have a surface layer of pale brown loamy fine sand about 6 inches thick. The next layer is about 5 inches of pale brown, loose loamy fine sand. The underlying material to a depth of 60 inches is light yellowish brown fine sand. In some places the entire profile is fine sand. In others, for example, in small depressions, the soil is wet and somewhat poorly drained. Wet spots are about 2 1/2 acres in size.

Permeability is rapid in both soils, and runoff is slow. Available water capacity is low. Natural fertility is medium in the Pratt soils and low in the Tivoli soils. The shrink-swell potential is low.

All areas of this map unit are used for range. The unit has poor potential for crops. It has fair potential for trees in windbreaks. The potential for most engineering uses is fair to poor.

These soils are best suited to range. If the range is overstocked and overgrazed, the protective plant cover is reduced and the taller, more desirable grasses are replaced by less productive short grasses. Proper stocking rates, uniform grazing distribution, timely deferment of grazing, and a planned grazing system help keep the range and the soil in good condition.

These soils are suited to trees in windbreaks. Considerable care is needed if young trees are to become established and grow well. Because of the low available water capacity of the soils, irrigating the trees is necessary to promote growth.

The slope moderately limits the use of these soils for building site development. Structures should be designed for steep slopes. Some septic tank filter fields do not function properly because of seepage. The filter field should be designed to operate properly on the slope. In some areas there is a hazard of polluting water supplies. In these areas, connection to a central sewer system may be the only suitable method of waste disposal. These soils are a good source of roadfill material and a fair source of sand. Capability unit VIe-1 dryland, IVe-2 irrigated; Sands range site.

Ro—Roxbury silt loam, frequently flooded. This is a deep, nearly level, well drained soil on flood plains along small creeks and drainageways. Individual areas are generally long and narrow, ranging from about 200 to 1,000 feet in width.

Typically, the surface layer is grayish brown and dark grayish brown silt loam about 14 inches thick. The subsoil is about 20 inches of dark grayish brown, friable silt loam. The underlying material to a depth of 60 inches is brown silt loam. In places colors are lighter below a depth of 20 inches.

Included with this soil in mapping are small areas of moderately well drained New Cambria soils in small depressions. These soils make up about 5 percent of the unit.

Permeability is moderate, and runoff is slow. Available water capacity is high. Natural fertility is high. The surface layer is friable and is easily tilled. The shrink-swell potential is moderate.

About half of the average of this soil is cultivated. The soil has fair potential for crops and for trees in windbreaks. It has good potential for range and tame grass pasture. The potential for most engineering uses is poor.

This soil is moderately well suited to most crops commonly grown in the county. Losses of wheat and sorghum are severe in some years because of flooding and silting. Proper use of fertilizer and good management of crop residue help maintain fertility, organic-matter content, and tilth.

This soil is well suited to range and tame grass pasture. If the range is overstocked and overgrazed, the protective plant cover is reduced and the taller, more desirable grasses are replaced by less productive short grasses. Proper stocking rates and a planned grazing system help keep the range and the soil in good condition.

This soil is well suited to trees in windbreaks. Irrigating young windbreaks promotes growth. Cultivating windbreaks to control weeds reduces the competition for soil moisture.

Flooding severely limits most engineering uses of this soil. Protection against flooding is needed. Dwellings and small buildings should be designed and constructed to prevent damage caused by shrinking and swelling of the soil. Using adequate reinforcing steel in concrete foundations, backfilling with sand or gravel, and installing foundation drains help reduce the risk of damage caused by shrinking and swelling.

This soil is a fair source of roadfill and a good source of topsoil. The low strength soil material is a limitation if the soil is used for roads or streets. Increasing the thickness of the overlying pavement or replacing the subgrade with coarse grained material helps to overcome this limitation. Capability unit IIIw-2 dryland and irrigated; Loamy Lowland range site.

Ta—Tabler clay loam. This is a deep, nearly level, moderately well drained soil on uplands. Individual areas are irregular in shape and range from about 20 to several hundred acres in size.

Typically, the surface layer is grayish brown clay loam about 8 inches thick. The subsoil is clay about 38 inches thick. The upper part is dark gray and very firm; the next part is gray and very firm; and the lower part is light gray and firm. The underlying material to a depth of 60 inches is light gray clay loam. In some places the subsoil is less gray. In others the surface layer is fine sandy loam. In a few places the dark colors are not evident below a depth of 20 inches.

Included with this soil in mapping are small areas of well drained Farnum and Naron soils on convex, sandier ridges. These soils make up about 6 percent of the unit.

Permeability is very slow, and runoff is slow. Available water capacity is high. Natural fertility is high. Tilth is poor. If the soil is worked when it is too wet or too dry, clods form and structure is destroyed. The shrink-swell potential is high in the subsoil.

Most areas of this soil are farmed. The soil has good potential for crops, range, and pasture and for trees in windbreaks. The potential for most engineering uses is poor.

This soil is moderately well suited to all crops commonly grown in the county. The main concerns of management are maintaining fertility, soil tilth, and organic-matter content. Tilling when moisture conditions are most favorable helps keep the soil in good tilth. Proper use of crop residue and fertilizer helps maintain fertility and organic-matter content.

This soil is well suited to range and to tame grass pasture. If the range is overstocked and overgrazed, the protective plant cover is reduced and the taller, more desirable grasses are replaced by less productive short grasses. Proper stocking rates and a planned grazing system help keep the range and the soil in good condition.

This soil is suited to trees in windbreaks. Irrigating the trees promotes growth. Cultivating young windbreaks to control weeds reduces the competition for moisture.

The potential for building site development is poor because of the high shrink-swell potential of the subsoil. Using adequate steel reinforcing in concrete foundations, backfilling with sand or gravel, and installing foundation drains reduce the risk of damage caused by shrinking and swelling. Because of the very slow permeability, septic tanks do not work well. Sewage lagoons are an alternative method of onsite waste disposal. This soil is moderately well suited to irrigation if an adequate supply of water is available. Capability unit IIs-2 dryland and irrigated; Clay Upland range site.

Tv—Tivoli fine sand, hilly. This is a deep, rolling to hilly, excessively drained soil on upland knolls and hills having sharply rounded tops and steep sides. Individual areas are irregular in shape and range from 20 to several hundred acres in size.

Typically, the surface layer is brown fine sand about 6 inches thick. The underlying material to a depth of 60 inches is light yellowish brown fine sand. In places the entire profile contains more clay.

Included with this soil in mapping are small areas of somewhat poorly drained Carwile soils in small depressions. These soils make up about 3 percent of the unit.

Permeability is rapid, and runoff is slow. Available water capacity is low. Natural fertility is low. The shrink-swell potential is low.

All of the acreage of this soil is in native grass and is used for grazing. The soil has poor potential for cropland and for trees in windbreaks. The potential for most engineering uses is poor.

This soil is best suited to range (fig. 11). If the range is overstocked and overgrazed, the protective plant cover is reduced and the taller, more desirable grasses are replaced by less productive grasses. Proper stocking rates, uniform grazing distribution, timely deferment of grazing, and a planned grazing system help to keep the range and the soil in good condition.

The slope is a moderate limitation for building site development. Structures should be designed for steep slopes. Some septic tank filter fields do not function properly because of seepage. The filter field should be designed to operate properly on the slope. In some areas there is a hazard of polluting water supplies. In these areas connection to a central sewer system may be the only suitable method of waste disposal. This soil is a good source of roadfill material and a fair source of sand. Capability unit VIIe-1 dryland; Choppy Sands range site.

Ub—Uly silt loam, 1 to 3 percent slopes. This deep, gently sloping, well drained soil is on convex upland ridgetops and side slopes. Individual areas are irregular in shape and range from about 20 to several acres in size.

Typically, the surface layer is grayish brown silt loam about 10 inches thick. The subsoil is about 8 inches of brown, friable silt loam. The underlying material to a depth of 60 inches is pinkish gray silt loam. In some places the subsoil is more clayey. In others chalky shale is below a depth of 20 inches.

Included with this soil in mapping are small areas of Harney soils in similar positions on the landscape. These soils have a clayey subsoil.

Permeability is moderate, and runoff is medium. Available water capacity is high. Natural fertility is high. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate.

Most areas of this soil are farmed. The soil has good potential for crops and range and for trees in windbreaks. The potential for most engineering uses is fair.

This soil is well suited to all crops commonly grown in the county. The hazard of water erosion is moderate if the soil is cultivated and unprotected. Terracing, contour farming, proper use of fertilizer, and crop residue management help reduce the risk of erosion and maintain fertility, organic-matter content, and tilth.

This soil is well suited to range and to tame grass pasture. If the range is overstocked and overgrazed, the protective plant cover is reduced and the taller, more desirable grasses are replaced by less productive short grasses. Proper stocking rates and a planned grazing system help keep the range and the soil in good condition.

This soil is well suited to trees in windbreaks. Irrigating the trees promotes growth. Cultivating young windbreaks to control weeds reduces the competition for soil moisture.

Limitations of this soil for building site development are moderate because of a limited ability to support loads and the moderate shrink-swell potential. Using adequate reinforcing steel in concrete foundations, backfilling with sand or gravel, and installing foundation drains reduce the risk of damage caused by shrinking and swelling. Limitations are slight for septic tanks that are designed and installed properly.

This soil is suited to irrigation if an adequate supply of water is available. Control of erosion is needed if the soil is irrigated. Capability unit IIe-3 dryland and irrigated; Loamy Upland range site.

Uc—Uly silt loam, 3 to 6 percent slopes. This deep, sloping, well drained soil is on convex upland slopes, generally along intermittent drainageways. Individual areas are commonly long and narrow and range from about 10 to 150 acres in size.

Typically, the surface layer is grayish brown silt loam about 10 inches thick. The subsoil is about 8 inches of brown, friable silt loam. The underlying material to a depth of 60 inches is pinkish gray silt loam. In some places the surface layer is light brownish gray. In others chalky limestone is below a depth of 20 inches. In places the subsoil is more clayey.

Included with this soil in mapping are small areas of Harney and Roxbury soils. Harney soils are more clayey. They generally are on the upper parts of the landscape where slopes are 2 to 4 percent. Roxbury soils are dark to a greater depth. They are on the bottom of the intermittent drainageways. Included soils make up about 15 percent of the unit.

Permeability is moderate, and runoff is medium. Available water capacity is high. Fertility is high. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. The shrink-swell potential is moderate.

Most areas of this soil are farmed. The soil has good potential for cropland and range and for trees in windbreaks. The potential for most engineering uses is fair.

This soil is suited to most crops commonly grown in the county. If the soil is cultivated and unprotected, the hazard of water erosion is severe. Terracing, farming on the contour, constructing waterways, stubble mulching, and planting close-grown crops rather than row crops help control erosion. Proper use of fertilizer and crop residue management help maintain fertility, organic-matter content, and tilth.

This soil is well suited to range and to tame grass pasture. If the range is overstocked and overgrazed, the protective plant cover is reduced and the taller, more desirable grasses are replaced by the less productive short grasses. Proper stocking rates and a planned grazing system help keep the range and the soil in good condition.

This soil is suited to trees in windbreaks. Irrigating the trees promotes growth. Cultivating young windbreaks to control weeds reduces the competition for soil moisture. Care should be taken to control erosion if windbreaks are irrigated or cultivated.

Limitations of this soil for building site development are moderate because of a limited ability to support loads and the moderate shrink-swell potential. Using adequate reinforcing steel and backfilling with sand or gravel reduce the risk of damage caused by shrinking and swelling. Limitations are slight for septic tank filter fields that are designed and installed properly. This soil is only moderately well suited to irrigation because of slope. Intensive erosion control is needed if the soil is irrigated. Capability unit IIIe-5 dryland and irrigated; Loamy Upland range site.

Ue—Uly silt loam, 3 to 6 percent slopes, eroded. This deep, sloping, well drained soil is on convex upland slopes, generally along intermittent drainageways. Individual areas are commonly long and narrow and range from about 10 to 100 acres in size.

Typically, the surface layer is grayish brown silt loam about 5 inches thick. The subsoil is about 8 inches of brown, friable silt loam. The underlying material to a depth of 60 inches is pinkish gray silt loam. In some places chalky shale is below a depth of 20 inches. In others the surface layer is light brownish gray. In places caliche is within 40 inches of the surface.

Included with this soil in mapping are small areas of Harney soils, generally on the upper parts of the landscape where the slope is 2 to 4 percent. These soils are more clayey than this Uly soil. They make up about 5 percent of the unit.

Permeability is moderate, and runoff is medium. Available water capacity is high. Natural fertility is high. The surface layer tends to crust and puddle after hard rains. The shrink-swell potential is moderate.

Most areas of this soil are farmed. The soil has good potential for crops, range, and pasture and for trees in windbreaks. The potential for most engineering uses is fair.

This soil is suited to most crops commonly grown in the county. If the soil is cultivated and unprotected, the hazard of further erosion is severe. Terracing, farming on the contour, constructing waterways, stubble mulching, and planting close-grown crops rather than row crops help control erosion. Proper use of fertilizer and crop residue management help maintain fertility, organic-matter content, and tilth.

This soil is well suited to range and tame grass pasture. If the range is overstocked and overgrazed, the protective plant cover is reduced and the taller, more desirable grasses are replaced by the less productive short grasses. Proper stocking rates and a planned grazing system help keep the range and the soil in good condition.

This soil is suited to trees in windbreaks. Care must be taken to control further erosion when new windbreaks are planted.

Limitations of this soil for building site development are moderate because of a limited ability to support loads and the moderate shrink-swell potential. Using adequate reinforcing steel and backfilling with sand or gravel reduce the risk of damage caused by shrinking and swelling. Limitations are slight for septic tank filter fields that are properly designed and installed. Capability unit IVe-2 dryland; Loamy Upland range site.

Wb—Wakeen silt loam, 1 to 3 percent slopes. This moderately deep, gently sloping, well drained soil is on ridgetops and tablelands in the uplands. Individual areas are irregular in shape and range from about 10 to several hundred acres in size.

Typically, the surface layer is dark grayish brown silt loam about 10 inches thick. The subsoil is friable silty clay loam about 26 inches thick. The upper part is grayish brown, and the lower part is pale brown. The underlying material to a depth of 60 inches is very pale brown, soft, chalky silty shale and limestone. In some places the depth to chalky shale is more than 40 inches. In others it is less than 20 inches.

Included with this soil in mapping are small areas of Harney soils at the highest point of the ridgetop where the slope is 1 to 2 percent. These soils have a more clayey subsoil than this Wakeen soil and are not underlain by chalky shale. They make up about 3 percent of the unit.

Permeability is moderate, and runoff is medium. Available water capacity is moderate. Natural fertility is medium. The surface layer is friable and is easily tilled. The shrink-swell potential is moderate. The depth to chalky shale or limestone bedrock ranges from 20 to 40 inches.

Most areas of this soil are farmed. The soil has fair potential for cultivated crops and for trees in windbreaks. The potential for range and tame grass pasture is good. The potential for most engineering uses is poor.

This soil is moderately well suited to cultivated crops. Water erosion is a severe hazard in cultivated areas, and soil blowing is also a hazard if the soil is bare. Terracing, constructing waterways, and farming on the contour help to control water erosion. Good management of such crop residue as stubble mulch helps control soil blowing, increases the intake of water, and maintains good tilth.

This soil is well suited to range and to tame grass pasture. If the range is overstocked and overgrazed, the plant cover is reduced and the taller, more desirable grasses are replaced by less productive short grasses. Proper stocking rates and a planned grazing system help keep the range and the soil in good condition.

This soil is moderately well suited to trees in windbreaks. Irrigating trees promotes growth. Cultivating young windbreaks to control weeds reduces the competition for soil moisture.

Limitations for most engineering uses are severe because of the depth to rock and the moderate shrink-swell potential. Using adequate reinforcing steel in concrete foundations, backfilling with sand or gravel, and installing foundation drains reduce the risk of damage caused by shrinking and swelling.

If this soil is used as a building site for dwellings with basements, provisions to excavate rock are needed or onsite investigation is needed to locate a deeper included soil. Septic tank filter fields are difficult to install and may not function properly. Onsite investigation is needed to locate a suitable site for sewage lagoons. Suitable sites can be located on the included gently sloping Harney soils on the broader ridgetops and foot slopes. Capability unit IIIe-6 dryland and irrigated; Limy Upland range site.

Wc—Wakeen silt loam, 3 to 6 percent slopes. This moderately deep, sloping, well drained soil is on knolls and ridgetops and along drainageways in the uplands. Individual areas are irregular in shape and range from about 10 to several hundred acres in size.

Typically, the surface layer is dark grayish brown silt loam about 10 inches thick. The subsoil is friable silty clay loam about 26 inches thick. The upper part is grayish brown and the lower part is pale brown. The underlying material to a depth of 60 inches is very pale brown, soft, chalky silty shale and limestone. In some places the depth to chalky shale is more than 40 inches. In others it is less than 20 inches.

Included with this soil in mapping are small areas of Harney and Roxbury soils. These soils are not limited in depth by chalky shale. Harney soils are at the highest point of the ridgetops where the slope is 1 to 3 percent. Roxbury soils are in low areas along intermittent drainageways. Included areas make up about 5 percent of the unit.

Permeability is moderate, and runoff is medium. Available water capacity is moderate. Natural fertility is medium. The surface layer is friable and is easily tilled. The shrink-swell potential is moderate. The depth to chalky shale or limestone bedrock ranges from 20 to 40 inches.

Most areas of this soil are farmed. The soil has fair potential for cultivated crops and good potential for range and for tame grass pasture. The potential for trees in windbreaks and for most engineering uses is poor.

This soil is suited to cultivated crops. Water erosion is a very severe hazard in cultivated areas, and soil blowing is also a hazard if the soil is bare. Terracing, constructing waterways, and farming on the contour help to control water erosion. Good management of such crop residue as stubble mulch helps control soil blowing, increases the intake of water, and maintains good tilth.

This soil is well suited to range and to tame grass pasture. If the range is overstocked and overgrazed, the plant cover is reduced and the taller, more desirable grasses are replaced by less productive short grasses. Proper stocking rates and a planned grazing system help keep the range and the soil in good condition.

This soil is poorly suited to building site development because of the depth to rock and the moderate shrink-swell potential. Using adequate reinforcing steel in concrete foundations, backfilling with sand or gravel, and installing foundation drains reduce the risk of damage caused by shrinking and swelling.

If this soil is used as a building site for dwellings with basements, provisions to excavate rock are needed or onsite investigation is needed to locate a deeper included soil. Septic tank filter fields are difficult to install and may not function properly. Onsite investigation is needed to locate a suitable site for sewage lagoons. Suitable sites can be located on the included gently sloping or sloping Harney soils on the broader ridgetops and foot slopes. Capability unit IVe-2 dryland; Limy Upland range site.

Wh—Wakeen-Nibson silt loams, 5 to 15 percent slopes. This map unit consists of moderately deep and shallow, sloping to strongly sloping, well drained and somewhat excessively drained soils on upland ridges and side slopes. Most areas are dissected by shallow drainageways. Individual areas range from 20 to several hundred acres in size and are 40 to 55 percent Wakeen soils and 30 to 40 percent Nibson soils.

The Wakeen soils are on the convex middle and upper parts of side slopes and on the broader ridgetops. The Nibson soils are on narrow, convex ridges, sharp slope breaks, and the upper sides of some drainageways. The two soils are so intricately mixed or are in areas so small in size that is it not practical to separate them in mapping.

Typically, the Wakeen soil has a surface layer of dark grayish brown silt loam about 10 inches thick. The subsoil is friable silty clay loam about 26 inches thick. The upper part is grayish brown, and the lower part is pale brown. Very pale brown, soft, chalky silty shale and limestone are at a depth of about 36 inches. In some places the depth to limestone is more than 40 inches. In others the soil is underlain by caliche.

Typically, the Nibson soil has a surface layer of grayish brown silt loam about 8 inches thick. The subsoil is about 6 inches of pale brown, friable silty clay loam. The underlying material is about 5 inches of very pale brown silty clay loam. Very pale brown silty shale is at a depth of 19 inches. In places, the surface layer is lighter colored and the soil is underlain by semihard caliche.

Included with these soils in mapping are small areas of Harney soils and shale and limestone outcrops. The Harney soils contain more clay in the subsoil than these soils and are deeper and less steep. They are downslope from the Nibson soils. The shale and limestone outcrops are on the steeper points, breaks, and side slopes. Included areas make up 2 to 5 percent of the unit.

Permeability is moderate in the Wakeen and Nibson soils. Available water capacity is moderate in the Wakeen soils and low in the Nibson soils. Runoff is medium to rapid. Natural fertility is medium. The shrink-swell potential is moderate. Depth to shale or limestone bedrock ranges from 20 to 40 inches in the Wakeen soils and from 10 to 20 inches in the Nibson soils.

Except for very small areas near some cultivated fields, most areas are in range that supports mid and short grasses. These soils have good potential for range. They have poor potential for cultivated crops, trees in windbreaks, and most engineering uses.

These soils are best suited to range. The major concerns of range management are related to the hazard of erosion and the low available water supply. Maintaining an adequate plant cover and ground mulch helps to prevent excessive soil losses and improves the available water capacity by reducing runoff. Overstocking and overgrazing the range reduces the protective plant cover and causes deterioration of the plant community. Proper stocking rates, uniform grazing distribution, timely deferment of grazing, and a planned grazing system help to keep the range and the soil in good condition.

The Wakeen soils that have slopes of less than about 7 percent can be farmed, but they commonly are in small areas that are intermingled with steeper and shallower soils not suited to cultivation. Intensive cropland management, including terracing and contour farming, is needed to help control erosion if these areas are farmed.

Limitations for most engineering uses are severe because of the shallowness over bedrock and the slope. Septic tank filter fields are difficult to install and may not function properly because of seepage. Onsite investigation is needed to locate suitable sites for sewage lagoons. Suitable sites can be located on the included gently sloping or sloping Harney soils on the broader ridgetops and foot slopes. Capability unit VIe-2 dryland; Limy Upland range site.

Wk—Waldeck fine sandy loam. This is a deep, nearly level, somewhat poorly drained soil on flood plains and low terraces along the Arkansas River. Flooding is occasional and brief. Areas are irregular in shape and range from about 20 to several hundred acres in size.

Typically, the surface layer is dark grayish brown fine sandy loam about 12 inches thick. The next layer is about 8 inches of grayish brown, very friable, calcareous fine sandy loam mottled with brown. The underlying material to a depth of about 60 inches is light brownish gray, calcareous fine sandy loam mottled with brown over very pale brown, calcareous fine sand. In some places the profile is more clayey. In others the surface layer is light brownish gray.

Included with this soil in mapping are small areas of Platte and Zenda soils. Platte soils are less than 20 inches deep over sand. They are mainly in old channeled areas. Zenda soils are more clayey than this Waldeck soil. They are at about the same level or are at a slightly higher level on the flood plain.

Permeability is moderately rapid, and runoff is slow. Available water capacity is moderate. Natural fertility is high. The shrink-swell potential is low. The surface layer is very friable and is easily tilled. The water table fluctuates seasonally between depths of 2 and 6 feet.

Most areas of this soil are farmed. The soil has fair potential for cultivated crops. It has good potential for range and for trees in windbreaks and poor potential for most engineering uses.

This soil is suited to most crops commonly grown in the county. The main concerns of management are controlling soil blowing and maintaining fertility. Stubble mulch and good crop residue management help control soil blowing. Proper use of fertilizer helps maintain fertility.

This soil is well suited to range and to tame grass pasture. If the range is overstocked and overgrazed, the taller, more desirable grasses are replaced by less productive short grasses. Proper stocking rates and a planned grazing system help keep the range and the soil in good condition.

This soil is suited to trees in windbreaks. Cultivating young windbreaks to control weeds reduces the competition for soil moisture.

The possibility of flooding and the high water table severely limit most engineering uses of this soil. If used as a building site, the soil should be protected against flooding. Buildings should be constructed without basements. All sanitary facilities should be connected to commercial sewers and treatment facilities. Capability unit IIIw-3 dryland and irrigated; Subirrigated range site.

Za—Zenda loam. This is a deep, nearly level, somewhat poorly drained soil on terraces along Coon Creek and the Arkansas River. Flooding is occasional and very brief. Individual areas are irregular in shape and range from about 40 to several hundred acres in size.

Typically, the surface layer is dark grayish brown loam about 12 inches thick. The next layer is grayish brown and dark grayish brown, friable loam about 8 inches thick. The underlying material to a depth of 60 inches is pale brown clay loam with yellow brown and reddish yellow mottles. In some places sand is below a depth of 20 inches. In others the profile is less sandy. In places the profile is not mottled within a depth of about 30 inches.

Included with this soil in mapping are small areas of Waldeck soils at about the same level on the landscape. These soils are sandier throughout. They make up about 3 percent of the unit.

Permeability is moderate, and runoff is slow. Available water capacity is high. Natural fertility is medium. The shrink-swell potential is moderate. The surface layer is friable and is easily tilled. The water table fluctuates between depths of 2 and 6 feet, depending on the season.

Most areas of this soil are cultivated. The soil has good potential for crops and range and for trees in windbreaks. The potential for most engineering uses is poor.

This soil is well suited to most crops commonly grown in the county. The main concerns of management are maintenance of fertility, organic-matter content, and tilth.

Proper use of fertilizer and good management of crop residue help maintain fertility, organic-matter content, and tilth.

This soil is well suited to range and to tame grass pasture. If the range is overstocked and overgrazed, the protective plant cover is reduced and the taller, more desirable grasses are replaced by less productive short grasses. Proper stocking rates and a planned grazing system help keep the range and the soil in good condition.

This soil is well suited to trees and shrubs grown as windbreaks and environmental plantings. Cultivating young trees and shrubs to control weeds reduces the competition for soil moisture.

Limitations for engineering uses of this soil are severe because of flooding, wetness, and low strength. Areas used for engineering structures or buildings must be protectd against flooding and wetness. Dwellings and small buildings should be constructed without basements, and foundations and footings should be designed to prevent structural damage caused by shrinking and swelling of the soil. Seepage can be controlled by providing an adequate drainage system.

This soil is a good source of topsoil. Embankments, dikes, and levees are easily eroded. Limitations for all sanitary facilities are severe. Septic tank filter fields do not function properly because of flooding and the wetness from the high water table. Special precautions are needed to protect septic tank filter fields, or commerical sewage facilities should be used. This soil is not well suited to irrigation. Capability unit IIw-2 dryland and irrigated; Subirrigated range site.

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 and pasture, rangeland, and woodland, 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

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, including some not commonly grown in the survey area, 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.

The potential of the soils in Pawnee County for increased production of food is good. Food production can be increased considerably by extending the latest crop production technology to all cropland in the county. This soil survey can greatly facilitate the application of such technology.

The acreage in crops and pasture has gradually decreased as more and more land is developed for urban uses. Urban development, however, has not been excessive in Pawnee County. The use of this soil survey to help make land-use decisions that will influence the future role of farming in the county is described in the section "General soil map for broad land-use planning."

Water erosion is a major concern of management if the slope is more than 1 percent. Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging on soils with a clayey subsoil, such as the Harney soils. Second, water erosion on farmland results in sediment entering streams. Control of water erosion minimizes the pollution of streams by sediment and improves the quality of water for municipal use, for recreation, and for fish and wildlife.

In many sloping fields, preparing a good seedbed and tilling are difficult on clayey spots because the original friable surface soil has been eroded away. Such spots are common in areas of the eroded Harney and Uly soils.

Erosion-control practices provide protective surface cover, reduce runoff, and increase water infiltration. A cropping system that keeps plant cover on the soil for extended periods can hold soil erosion losses to amounts that will not reduce the productive capacity of the soils. On livestock farms, which require pasture and hay, legume and grass forage crops in the cropping system not only provide nitrogen and improve tilth for the following crop, but also reduce the risk of erosion on sloping soils.

Slopes are so short and irregular that contour tillage or terracing is not practical in most areas of Pratt, Attica, and Naron soils. On these soils, wind stripcropping and minimum tillage are needed to provide substantial plant cover to help control soil blowing and water erosion. Minimizing tillage and leaving crop residue on the surface help to increase water infiltration and reduce the hazards of runoff and erosion. These practices can be adapted to most soils in the survey area, but they are less successful on the eroded soils and on the soils that have a clayey surface layer, such as Harney silty clay loam, New Cambria silty clay loam, and Ness clay. No tillage for corn, which is effective only on irrigated land, reduces the risk of erosion on sloping soils and can be adapted to most soils in the survey area where good-quality irrigation water is available. It is less successful, however, on the soils with a clayey surface layer.

Terraces and diversions reduce the length of slopes and the risks of runoff and erosion. They are most practical on deep, well drained soils that have regular slopes. Harney, Holdrege, and Uly soils are suitable for terraces. The other soils are less suitable for terraces and diversions because of irregular slopes; excessive wetness in the terrace channels; a clayey subsoil, which would be exposed in terrace channels; or bedrock within a depth of 40 inches.

Farming on the contour is a widespread erosion-control practice in the survey area. It is best suited to areas where slopes are smooth and uniform, including most "hardland" areas of the county.

Soil blowing is a concern of management throughout the county. It can damage soils in a few hours if winds are strong and the soils are dry and bare of vegetation or lacking in sufficient surface mulch. Maintaining a plant cover and surface mulch and roughening the surface through proper tillage minimize the risk of soil blowing. Windbreaks of suitable trees and shrubs are effective in reducing the hazard of soil blowing.

Information about the design of erosion-control practices for each kind of soil is contained in the Technical Guide, available in local offices of the Soil Conservation Service.

Soil drainage is a minor management need on a small acreage used for crops and pasture in Pawnee County. In some spots in the Pratt-Tivoli map unit, the soils are naturally so wet that the production of crops commonly grown in the county is generally not possible. On Carwile soils and other somewhat poorly drained soils, a surface drainage system is needed.

Soil fertility is naturally moderate to high in most soils of the uplands, except for the sandy areas south of the Arkansas River. Additions of lime are necessary only in some special areas. In all areas but the very sandy areas, the pH level is sufficient for good growth of alfalfa and other field crops commonly grown in the county. The available phosphorus level is moderate to low and the potash level moderate to high in most soils of the county. On all soils, additions of lime and fertilizer should be based on the results of soil tests, on the need of the crop, and on the expected yields. The Cooperative Extension Service laboratories can help in determining the kinds and amounts of fertilizer and lime to apply.

Soil tilth is an important factor in the germination of seeds and in the infiltration of water into the soil. Soils with good tilth are granular and porous.

North of the Arkansas River, most of the soils used for crops have a silt loam surface layer that is dark in color and have a moderate organic-matter content. Generally, the structure of the surface layer is weak to moderate and rainfall causes the formation of a crust on the surface. The crust is hard when dry, and it reduces water infiltration and increases runoff. Regular additions of crop residue, manure, and other organic material can improve soil structure and reduce the liklihood of crust formation. The natural structure of New Cambria and Ness soils can be destroyed if the soils are tilled when too wet or too dry. Most other soils can be tilled throughout a wide range of moisture content.

Field crops suited to the soils and climate of the county include many that are not commonly grown. Most corn and soybean crops are irrigated, but dryland varieties of soybeans are being developed. Sunflowers, sugar beets, peanuts, potatoes, and similar crops can be grown if economic conditions are favorable.

Winter wheat, sorghum, and alfalfa are the most common crops. Rye, barley, and oats also grow well. Tame grasses, such as bromegrass, are grown for pasture, hay, and seed crops.

Special crops grown commercially in the survey area are vegetables, small fruits, tree fruits, and nursery plants. A small acreage of sandy soil is used for melons. Sweet corn, tomatoes, peppers, and other vegetables and small fruits grow well on most of the soils in the county if good-quality irrigation water is available.

The latest information about growing special crops can be obtained from local offices of the Cooperative Extension Service and 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 crop is not suited to or not commonly grown on the soil or that a given crop is not commonly irrigated.

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 yields were estimated for the most productive varieties of 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.

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

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 the capability system, all kinds of soil are grouped at three levels: capability class, subclass, and unit. These levels 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 unit is identified in the description of each soil map unit in the section "Soil maps for detailed planning." Capability units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-3 or IIIe-6.

Rangeland

Native grassland covers about 60,000 acres, or about 12 percent of the acreage in Pawnee County.

The native vegetation in many parts of the survey area has been greatly depleted by continued excessive use. The amount of forage produced may be less than half of that originally produced. Productivity of the range can be increased by management that is effective for specific kinds of soil and range sites.

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 of 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.

Potential 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.

Common plant names of grasses, grasslike plants, forbs, and shrubs that make up most of the potential natural plant community on each soil are listed in table 6. 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 major 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. Controlling brush and minimizing soil blowing are also important. Such management, which is based on soil survey information and on rangeland inventories, 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.

In some places in the northern part of the county, the soils are moderately deep to shallow over chalky limestone and shale. These soils support mid and short grasses. The potential productivity is lower than it is for deep soils that formed in loess because of the shallow rooting depth. In much of the part of the county south of the Arkansas River, the soils are sandy or loamy. Deep soils support tall and mid grasses. In some areas on hilly sand dunes, soil blowing is a severe hazard. The potential productivity of these deep sandy soils is much greater than that of the shallower soils, but it is less than that of deep loamy soils.

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. The wildlife attracted to these areas include wild turkey, crows, thrushes, owls, woodpeckers, squirrels, raccoon, opossum, and deer.

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 uses; (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, for sanitary facilities; and table 11, 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, and open ditches. 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, potential frost action, 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, shrink-swell potential, and potential frost action 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, respectively, mean about the same as the terms *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.

Where 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 materials. 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, low potential frost action, 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 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

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, helped prepare this section.

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 wildlife 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, grain sorghum, wheat, oats, barley, and soybeans.

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, goldenrod, ragweed, pokeweed, prairieclover, and partridgepea.

Coniferous plants are cone-bearing trees, shrubs, or ground cover plants that furnish habitat or supply food in the form of browse, seeds, or fruitlike cones. Soil properties that have a major effect on the growth of coniferous plants are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are redcedar, pine, and spruce.

Shrubs are bushy woody plants that produce fruit, seeds, 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 sumac, dogwood, blackberry, 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, and indigobush and 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, salinity, 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, redwinged blackbirds, muskrat, and beaver.

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

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, and engineering test data.

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 AASHTO classification for soils tested in the survey area, with group index numbers in parentheses, is given in table 17. 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 plasticity index are 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.

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.

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.

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 during the mapping of the soils. The kind of bedrock and its hardness as related to ease of excavation is also shown. Rippable bedrock can be excavated with a single-tooth ripping attachment on a 200-horsepower tractor, but hard bedrock generally requires blasting.

Potential frost action refers to the likelihood of damage to pavements and other structures by frost heaving and low soil strength after thawing. Frost action results from the movement of soil moisture into the freezing temperature zone in the soil, which causes ice lenses to form. Soil texture, temperature, moisture content, porosity, permeability, and content of organic matter are the most important soil properties that affect frost action. It is assumed that the soil is not covered by insulating vegetation or snow and is not artificially drained. Silty and clayey soils that have a high water table in winter are most susceptible to frost action. Well drained very gravelly or sandy soils are the least susceptible.

Engineering test data

The results of analyses of engineering properties of several typical soils of the survey area are given in table 17.

The data presented are for soil samples that were collected from carefully selected sites. The soil profiles sampled are typical of the series discussed in the section "Soil series and morphology." The soil samples were analyzed by the Kansas Department of Transportation, Research and Materials Laboratory.

Except for differences noted in footnotes to table 17, the method used in obtaining the data is the AASHTO Designation, T99-57, Method A.

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 (*5*). Unless otherwise noted, 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."

Attica series

The Attica series consists of deep, well drained, moderately rapidly permeable soils on uplands. These soils formed in loamy and sandy eolian sediments. Slope ranges from 1 to 4 percent.

Attica soils are similar to Naron and Pratt soils and are near Carwile soils. Attica soils have less clay in the subsoil than Naron or Carwile soils and have a less sandy subsoil than Pratt soils.

Typical pedon of Attica sandy loam, 1 to 4 percent slopes, 2,000 feet north and 1,150 feet east of the southwest corner of sec. 14, T. 23 S., R. 17 W.

A1—0 to 12 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, friable; many fine roots; slightly acid; clear smooth boundary.

B2t—12 to 25 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; hard, friable; many fine roots; slightly acid; clear smooth boundary.

B3—25 to 36 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; moderate medium granular structure; hard, friable; few fine roots; neutral; gradual smooth boundary.

C—36 to 60 inches; pale brown (10YR 6/3) light fine sandy loam, brown (10YR 5/3) moist; massive; hard, very friable; few fine roots; mildly alkaline.

The thickness of the solum ranges from about 28 to 40 inches. The A horizon is less than 1 percent organic matter. It has color value 4 to 6 dry (3 or 4 moist) and chroma of 2 or 3. It is typically sandy loam, but in some areas it is fine sandy loam and loamy fine sand. The B2t horizon has color value 4 to 6 dry (3 to 5 moist) and chroma of 2 or 3. It is fine sandy loam that ranges from 10 to 18 percent clay. Reaction ranges from medium acid to neutral. The C horizon has color value 5 or 6 dry (4 or 5 moist) and chroma of 3 or 4. It is fine sandy loam, sandy loam, or loamy fine sand.

Bridgeport series

The Bridgeport series consists of deep, well drained, moderately permeable soils on low terraces that are occasionally flooded. These soils formed in silty alluvial sediments. Slope ranges from 0 to 2 percent.

Bridgeport soils are similar to Hord and Roxbury soils and are near New Cambria soils. Hord and Roxbury soils have mollic epipedons thicker than 20 inches. New Cambria soils have a more clayey B2 horizon than Bridgeport soils and are in small and large depressions.

Typical pedon of Bridgeport silt loam 900 feet west and 550 feet north of the southeast corner of SW1/4 sec. 21, T. 21 S., R. 19 W.

A1—0 to 11 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, very friable; many fine roots; moderately alkaline; gradual smooth boundary.

B2—11 to 18 inches; grayish brown (10YR 5/2) silt loam, dark gray brown (10YR 4/2) moist; moderate medium granular structure; hard, friable; many fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

C—18 to 60 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; weak medium granular structure to massive; slightly hard, friable; few fine roots; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 18 to 30 inches. The depth to free carbonates ranges from 8 to 14 inches. More sandy or more clayey horizons are below a depth of 40 inches. Reaction is mildly alkaline or moderately alkaline throughout.

The A horizon has color value of 3 to 5 (2 or 3 moist) and chroma of 2 or 3. The B2 horizon has color value of 5 or 6 (4 or 5 moist) and chroma of 2 or 3. It is silt loam or silty clay loam that is 27 to 35 percent clay. The C horizon has color value of 6 or 7 (5 or 6 moist) and chroma of 2 or 3.

Canadian series

The Canadian series consists of deep, well drained, moderately rapidly permeable soils on flood plains that are rarely flooded. These soils formed in loamy alluvial sediments. Slope ranges from 0 to 2 percent.

Canadian soils are similar to the Canadian Variant and to Kaski soils and are near Hord and Zenda soils. The Canadian Variant has coarse sand and fine gravel layers at a depth of 20 to 40 inches. Kaski soils have a fine-loamy control section. Hord and Kaski soils have mollic epipedons more than 20 inches thick. In addition, Hord soils have a fine-silty subsoil. Zenda soils have a fine-loamy control section, are distinctly mottled, and have visible accumulations of lime directly beneath the A horizon.

Typical pedon of Canadian fine sandy loam 3,150 feet south and 50 feet east of the northwest corner of sec. 12, T. 22 S., R. 17 W.

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable; many fibrous roots; slightly acid; gradual smooth boundary.

A12—5 to 13 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; weak fine granular structure; slightly hard, very friable; many fibrous roots; neutral; gradual smooth boundary.

B2—13 to 28 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; moderate fine and medium granular structure; slightly hard, friable; common fine roots; mildly alkaline; gradual smooth boundary.

C—28 to 60 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; massive; soft, very friable; strong effervescence; few spots and threads of soft white accumulations of carbonates; moderate alkaline.

The thickness of the solum ranges from 20 to 40 inches. The thickness of the mollic epipedon ranges from 10 to 20 inches.

The A horizon has color value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. It is typically fine sandy loam, but in some pedons it is sandy loam or loam. Reaction ranges from medium acid to neutral. The B2 horizon has color value of 4 or 5 (3 or 4 moist) and chroma of 2 or 3. It is fine sandy loam. Reaction is slightly acid to mildly alkaline. The C horizon has color value 5 to 7 (3 to 6 moist) and chroma of 3 to 6. It is fine sandy loam or sandy loam. Thin layers of loamy fine sand or fine sand are below a depth of 40 inches. Reaction ranges from slightly acid to moderately alkaline.

Canadian Variant

The Canadian Variant consists of deep, somewhat excessively drained, moderately rapidly permeable soils on flood plains that are rarely flooded. These soils formed in loamy alluvial sediments and the underlying sand and gravel. Slope ranges from 0 to 2 percent.

The Canadian Variant is similar to other Canadian soils and to Kaski and Waldeck soils and is near Hord and Zenda soils. The other Canadian soils have no sand and fine gravel within a depth of 40 inches. Kaski soils have a fine-loamy subsoil. Hord and Kaski soils have mollic epipedons more than 20 inches thick. In addition, Hord soils have a fine-silty subsoil. Zenda soils have a fine-loamy control section, are distinctly mottled, and have visible accumulations of lime directly beneath the A horizon.

Typical pedon of Canadian Variant sandy loam 250 feet east and 100 feet north of the center of sec. 11, T. 22 S., R. 17 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable; many fine fibrous roots; slightly acid; gradual smooth boundary.

A12—6 to 10 inches; dark grayish brown (10YR 4/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, very friable; common fine fibrous roots; slightly acid; gradual smooth boundary.

B2—10 to 24 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; moderate medium granular structure; hard, friable; common fine roots; neutral; gradual smooth boundary.

C1—24 to 36 inches; pale brown (10YR 6/3) medium and coarse sand, brown (10YR 4/3) moist; single grained; soft, very friable; few fine roots; neutral diffuse boundary.

C2—36 to 60 inches; pale brown (10YR 6/3) coarse sand and fine gravel, brown (10YR 5/3) moist; single grained; loose; 20 to 30 percent pebbles more than 2 millimeters and less than 30 millimeters in diameter; mildly alkaline.

The solum ranges from 20 to 40 inches in thickness. The thickness of the mollic epipedon ranges from 10 to 20 inches. Layers of sand and fine gravel are at a depth of 20 to 40 inches.

The A horizon has color value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. Reaction is slightly acid or medium acid. The B2 horizon has color value of 4 or 5 (3 or 4 moist) and chroma of 2 or 3. It is sandy loam averaging between 5 to 10 percent clay. Reaction is slightly acid to moderately alkaline. The C horizon has color value of 5 to 7 (4 to 6 moist) and chroma of 3 to 6. It is sand or coarse sand and fine gravel.

Carwile series

The Carwile series consists of deep, somewhat poorly drained, slowly permeable soils on uplands. These soils formed in stratified loamy eolian sediments or loamy and clayey old alluvium. Slopes are slightly depressional and are 0 to 1 percent.

Carwile soils are similar to Farnum and Tabler soils and are near Attica and Naron soils. Farnum and Tabler soils have a mollic epipedon more than 20 inches thick. Attica soils have a more sandy subsoil and Naron soils have a less clayey subsoil than Carwile soils.

Typical pedon of Carwile fine sandy loam 1,300 feet south and 300 feet west of the northeast corner of sec. 21, T. 23 S., R. 17 W.

A1—0 to 12 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, friable; many fine roots; slightly acid; clear smooth boundary.

B21t—12 to 18 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; few fine distinct light yellowish brown (10YR 6/4) and many fine light gray (10YR 7/1) mottles; weak medium subangular blocky structure; hard, firm; many fine roots; neutral; clear smooth boundary.

B22t—18 to 30 inches; light brownish gray (2.5Y 6/2) heavy clay loam, grayish brown (2.5Y 5/2) moist; common fine distinct light yellowish brown (10YR 6/4) and yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; very hard, very firm; few fine roots; mildly alkaline; gradual smooth boundary.

B3—30 to 40 inches; light gray (5Y 7/2) clay loam, olive gray (5Y 5/2) moist; common medium distinct yellow and yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; hard, firm; few fine roots; moderately alkaline; gradual smooth boundary.

C—40 to 60 inches; light brownish gray (2.5Y 6/2) light clay loam, grayish brown (2.5Y 5/2) moist; few medium distinct yellow mottles; massive; hard, firm; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 30 to 60 inches. The depth to material that is slightly effervescent to strongly effervescent ranges from 24 to 40 inches.

The A horizon has color value of 3 to 5 (2 or 3 moist) and chroma of 2. It is typically fine sandy loam, but in some areas it is loam. Reaction is slightly acid or neutral. The B2t horizon has color value of 4 to 6 (3 to 5 moist) and chroma of 2 or less. It ranges from clay loam to clay and averages between 35 to 50 percent clay. Reaction is neutral to moderately alkaline. The C horizon has color value of 5 to 7 (4 to 6 moist) and chroma of 1 to 6. Texture ranges from clay loam to fine sandy loam. Reaction is moderately alkaline.

Farnum series

The Farnum series consists of deep, well drained, moderately slowly permeable soils on uplands. These soils formed in stratified loamy old alluvium that has sand or clay layers in places. Slope ranges from 0 to 3 percent.

Farnum soils are similar to Lubbock and Naron soils and are near Attica, Carwile, Lubbock, and Tabler soils. Carwile, Lubbock, and Tabler soils have fine textured argillic horizons. Attica soils have a more sandy subsoil than Farnum soils, and Naron soils have a mollic epipedon less than 20 inches thick.

Typical pedon of Farnum loam, 0 to 1 percent slopes, 2,340 feet north and 250 feet west of the southeast corner of sec. 16, T. 22 S., R. 15 W.

A1—0 to 11 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; moderate medium granular structure; slightly hard, friable; many fine roots; slightly acid; gradual smooth boundary.

B1—11 to 16 inches; dark grayish brown (10YR 4/2) light clay loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure; hard, friable; many fine roots; neutral; clear smooth boundary.

B2t—16 to 30 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; hard, firm; many fine roots; moderately alkaline; gradual smooth boundary.

B3—30 to 40 inches; brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; hard, firm; few fine roots; few fine soft particles of calcareous material; moderately alkaline; gradual smooth boundary.

C—40 to 60 inches; pale brown (10YR 6/3) clay loam, dark brown (10YR 4/3) moist; massive; hard, friable; few fine soft particles of calcareous material; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 30 to 45 inches. The thickness of the mollic epipedon ranges from 22 to 58 inches.

The A horizon has color value of 3 to 5 (2 or 3 moist) and chroma of 2. It is typically loam, but it ranges to fine sandy loam. Reaction is slightly acid to neutral. The B2t horizon has color value 4 to 6 (3 to 5 moist) and chroma of 2 or 3. It is clay loam and averages between 27 and 35 percent clay. Reaction ranges from neutral to moderately alkaline. The C horizon has color value 4 to 6 (3 to 5 moist) and chroma of 3 or 4. It is typically clay loam, but it is fine sandy loam, loam, and sandy clay loam in some areas. Reaction ranges from neutral to moderately alkaline.

Harney series

The Harney series consists of deep, well drained, moderately slowly permeable soils on uplands. These soils formed in calcareous silty loess. Slope ranges from 0 to 6 percent.

Harney soils are similar to Holdrege soils and are near Uly and Wakeen soils. Holdrege and Wakeen soils have a fine-silty control section. Uly and Wakeen soils lack argillic horizons. In addition, Wakeen soils are underlain by chalky limestone and shale at a depth of 20 to 40 inches.

Typical pedon of Harney silt loam, 0 to 1 percent slopes, 1,845 feet east and 100 feet south of the northwest corner of sec. 36, T. 22 S., R. 18 W.

A1—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, very friable; many fine roots; slightly acid; clear smooth boundary.

A3—9 to 12 inches; dark grayish brown (10YR 4/2) heavy silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; hard, firm; many fine roots; neutral; clear smooth boundary.

B21t—12 to 18 inches; grayish brown (10YR 5/2) heavy silty clay loam, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; very hard, very firm; few fine roots; moderately alkaline; clear smooth boundary.

B22t—18 to 28 inches; grayish brown (10YR 5/2) heavy silty clay loam, dark grayish brown (10YR 4/2) moist; strong medium subangular blocky structure; very hard, very firm; few fine roots; moderately alkaline.

B3ca—28 to 35 inches; brown (10YR 5/3) silty clay loam, brown (10YR 4/3) moist; moderate medium subangular blocky structure; hard, firm; few fine roots; many soft accumulations of carbonates; strong effervescence; moderately alkaline; gradual smooth boundary.

C—35 to 60 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; massive; slightly hard, friable; common soft accumulations of carbonates; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 35 to 50 inches. The depth to free carbonates ranges from 15 to 35 inches.

The A horizon has color value of 4 or 5 (2 or 3 moist) and chroma of 2. It is dominantly silt loam, but it ranges to silty clay loam in some areas. Reaction is slightly acid or neutral. The B2t horizon has color value of 4 or 5 (3 or 4 moist) and chroma of 2 or 3. It is silty clay loam or silty clay and averages between 35 and 42 percent clay. Reaction is neutral to moderately alkaline. The C horizon has color value of 6 or 7 (5 or 6 moist) and chroma of 3 or 4. It is calcareous silty loess.

Harney silty clay loam, 1 to 3 percent slopes, eroded, and the Harney soil in the Harney-Uly complex lack mollic epipedons and are shallower to free carbonates than is defined as the range for the Harney series, but these differences do not alter the use or behavior of the soils.

Holdrege series

The Holdrege series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in calcareous silty loess. Slope ranges from 1 to 3 percent.

Holdrege soils are similar to Harney and Uly soils and are near Roxbury soils. Harney soils have fine textured argillic horizons. Roxbury soils have a mollic epipedon thicker than 30 inches and are in drainageways. Uly soils lack argillic horizons, are steeper than Holdrege soils, and are below Holdrege soils.

Typical pedon of Holdrege silt loam, 1 to 3 percent slopes, 1,320 feet east and 50 feet north of the southwest corner of sec. 30, T. 22 S., R. 17 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; many fine roots; slightly acid; clear smooth boundary.

A12—6 to 10 inches; dark grayish brown (10YR 4/2) light silty clay loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; slightly hard, friable; many fine roots; neutral; clear smooth boundary.

B21t—10 to 13 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; hard, firm; few fine roots; neutral; gradual smooth boundary.

B22t—13 to 20 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; hard, firm; few fine roots; neutral; gradual smooth boundary.

B3—20 to 30 inches; brown (10YR 5/3) light silty clay loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, friable; few fine roots; slight effervesence; mildly alkaline; gradual smooth boundary.

C—30 to 60 inches; brown (10YR 5/3) light silty clay loam, brown (10YR 4/3) moist; massive; slightly hard, friable; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to free carbonates range from 24 to 36 inches. The A horizon has color value of 3 to 5 (2 or 3 moist) and chroma of 2. It is dominantly silt loam, but it ranges to silty clay loam in some areas. Reaction is slightly acid or neutral. The B2t horizon has color value of 4 or 5 (3 or 4 moist) and chroma of 2 or 3. It is silty clay loam averaging between 28 and 35 percent clay. Reaction is neutral to moderately alkaline. The C horizon has color value of 5 to 7 (4 to 6 moist) and chroma of 3 or 4. It is mildly alkaline or moderately alkaline.

Hord series

The Hord series consists of deep, well drained, moderately permeable soils on terraces that are rarely flooded. These soils formed in calcareous silty alluvial sediments. Slope is 0 to 1 percent.

Hord soils are similar to Bridgeport and Roxbury soils and are near Kaski and New Cambria soils. The mollic epipedon in Bridgeport soils is less than 20 inches thick, and the depth to free carbonates is less than 15 inches. Bridgeport soils are next to the stream at a lower level than Hord or Kaski soils. Kaski soils have a fine-loamy subsoil. New Cambria soils have a more clayey subsoil than Hord soils and are in low areas. The depth to free carbonates in Roxbury soils is less than 15 inches. Roxbury soils are in drainageways.

Typical pedon of Hord silt loam 1,200 feet north and 360 feet west of the southeast corner of sec. 30, T. 23 S., R. 18 W.

Ap—0 to 8 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; fine medium granular structure; slightly hard, friable; many fine roots; neutral; clear smooth boundary.

A12—8 to 12 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable; many fine roots; neutral; gradual smooth boundary.

B2—12 to 27 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, firm; few fine roots; moderately alkaline; clear smooth boundary.

B3—27 to 42 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) moist; weak medium granular structure; hard, firm; few fine roots; many fine concretions and soft accumulations of carbonates; slight effervescence; moderately alkaline; gradual smooth boundary.

C—42 to 60 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; massive; slightly hard, friable; common fine accumulations of carbonates; slight effervesence; moderately alkaline.

The thickness of the solum ranges from 32 to 55 inches. The depth to free carbonates ranges from 15 to 30 inches. The thickness of the mollic epipedon ranges from 20 to 42 inches.

The A horizon has color value of 3 to 5 (2 or 3 moist) and chroma of 2. It is dominantly silt loam or light silty clay loam. Reaction is slightly acid or neutral. The B2 horizon has color value of 4 or 5 (3 or 4 moist) and chroma of 2 or 3. It is heavy silt loam or silty clay loam and averages between 25 and 35 percent clay. Reaction is neutral, mildly alkaline, or moderately alkaline. The C horizon has color value of 6 or 7 (5 or 6 moist) and chroma of 3 or 4. It is dominantly silt loam but is silty clay loam in some areas. Reaction is mildly alkaline or moderately alkaline.

Kaski series

The Kaski series consists of deep, well drained, moderately permeable soils on flood plains that are rarely flooded. These soils formed in loamy alluvium. Slope ranges from 0 to 2 percent.

Kaski soils are similar to Canadian soils and are near Hord, Waldeck, and Zenda soils. Hord soils have a fine-silty control section. Canadian and Waldeck soils have a coarse-loamy control section. Zenda soils have a mollic epipedon less than 20 inches thick. Also, Waldeck and

Zenda soils have a water table at a depth of 2 to 6 feet and are below Canadian, Kaski, and Hord soils on the flood plain.

Typical pedon of Kaski loam 810 feet east and 2,590 feet south of the northwest corner of sec. 12, T. 23 S., R. 18 W.

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

A12—10 to 18 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, very friable; many fine roots; slightly acid; gradual smooth boundary.

AC—18 to 28 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable; many fine roots; neutral; gradual smooth boundary.

C—28 to 60 inches; very pale brown (10YR 7/3) fine sandy loam, brown (10YR 5/3) moist; massive; soft, very friable; few fine roots; strong effervescence; moderately alkaline.

The thickness of the solum and the thickness of the mollic epipedon range from 20 to 34 inches. The depth to free carbonates ranges from 16 to 40 inches.

The A horizon has color value 3 to 5 (2 or 3 moist) and chroma of 2. It is dominantly loam but is fine sandy loam in some small areas. Reaction is slightly acid or neutral. The AC horizon has color value 4 to 6 (3 or 4 moist) and chroma of 2 or 3. It is loam and averages between 18 and 25 percent clay. Reaction ranges from slightly acid to mildly alkaline. The C horizon has color value of 5 to 7 (4 to 6 moist) and chroma of 3 or 4. It is dominantly loam, fine sandy loam, or sandy loam, but clay loam, loamy sand, or sand is below a depth of 40 inches in some areas. Reaction is mildly alkaline or moderately alkaline.

Lesho series

The Lesho series consists of deep, somewhat poorly drained, moderately slowly permeable soils on flood plains that are occasionally flooded. These soils formed in stratified loamy over sandy sediments. Slope is 0 to 1 percent.

Lesho soils are similar to Waldeck and Zenda soils and are near Platte soils. Waldeck soils have a coarse-loamy control section. Zenda soils have a fine-loamy control section and are not limited in depth by sandy sediments within 40 inches of the surface. They occupy terraces slightly above the flood plain. Platte soils have a sandy over coarse-sandy and fine-gravelly control section. They are in low areas in old channels and near the Arkansas River.

Typical pedon of Lesho clay loam 1,180 feet east and 100 feet south of the northwest corner of sec. 22, T. 22 S., R. 17 W.

A11—0 to 10 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, firm; many fine roots; strong effervescence; moderately alkaline; clear smooth boundary.

A12—10 to 22 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; few fine faint reddish yellow (7.5YR 6/6) mottles in lower part; moderate medium granular structure; hard, firm; many fine roots; strong effervescence; moderately alkaline; clear smooth boundary.

C—22 to 27 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; common fine distinct reddish yellow (7.5YR 6/6) mottles; moderate medium granular structure; hard, firm; few fine roots; violent effervescence; moderately alkaline; clear wavy boundary.

IIC—27 to 60 inches; very pale brown (10YR 7/4) loamy sand, yellowish brown (10YR 5/4) moist; singe grained; loose; violent effervescence; moderately alkaline.

The thickness of the solum and the thickness of the mollic epipedon range from 10 to 20 inches. The depth to sandy material ranges from 20 to 40 inches. Free carbonates are commonly near the surface but are at a depth of 12 inches in some small areas. The depth to faint mottles ranges from 15 to 25 inches.

The A horizon has color value of 3 to 5 (2 or 3 moist) and chroma of 2 or 3. It is clay loam. Reaction is mildly alkaline or moderately alkaline. The C horizon has color value of 5 or 6 (4 or 5 moist) and chroma of 2 or 3. It is clay loam and averages between 28 and 35 percent clay. The IIC horizon has color value 5 to 7 (4 to 6 moist) and chroma of 3 to 6. It is fine and medium sand or loamy sand.

Lubbock series

The Lubbock series consists of deep, well drained, moderately slowly permeable soils on uplands. These soils formed in loamy and clayey old alluvium and loess. Slope is 0 to 1 percent.

Lubbock soils are similar to Carwile, Farnum, Ness, and Tabler soils and are near Naron soils. Carwile soils have mottled argillic horizons and are in lower areas than Lubbock soils. Farnum and Naron soils have a fine-loamy subsoil. Also, Naron soils have a mollic epipedon less than 20 inches thick and are in the higher areas above Lubbock and Farnum soils. Tabler soils have a more clayey B2t horizon that has cracks extending from directly below the A horizon to a depth of 20 inches or more. These soils are in low areas near the clayey Ness soils that are in depressions.

Typical pedon of Lubbock silt loam 200 feet west and 900 feet north of the southeast corner of sec. 4, T. 23 S., R. 16 W.

A1—0 to 11 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable; many fine roots; neutral; clear smooth boundary.

B21t—11 to 22 inches; dark grayish brown (10YR 4/2) heavy silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium blocky structure; very hard, very firm; many fine roots; neutral; clear smooth boundary.

B22t—22 to 28 inches; grayish brown (10YR 5/2) heavy silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium blocky structure; very hard, very firm; few fine roots; moderately alkaline; gradual smooth boundary.

B3ca—28 to 36 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; hard, firm; few fine roots; many fine soft accumulations of carbonates and fine concretions; slight effervescence; moderately alkaline; gradual smooth boundary.

C—36 to 60 inches; light gray (10YR 7/2) light silty clay loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable; many fine masses of carbonates; slight effervescence; moderately alkaline.

The thickness of the solum ranges from 36 to 45 inches, and the depth to free carbonates ranges from 18 to 28 inches. The thickness of the mollic epipedon ranges from 20 to 36 inches.

The A horizon has color value 3 to 5 (2 or 3 moist) and chroma of 2. It typically is silt loam but is loam in some areas. Reaction is neutral or mildly alkaline. The B2t horizon has color value 4 to 6 (3 or 4 moist) and chroma of 2. It is silty clay loam or silty clay and averages between 35 and 45 percent clay. Reaction is neutral to moderately alkaline. The C horizon has color value 5 to 7 (4 or 5 moist) and chroma of 2. It is light silty clay loam or clay loam.

Naron series

The Naron series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in loamy and sandy eolian deposits. Slope ranges from 0 to 3 percent.

Naron soils are similar to Attica and Farnum soils and are near Carwile, Lubbock, and Tabler soils. Attica soils lack a mollic epipedon and are more sandy in the subsoil than Naron soils. They are in the higher areas with the Naron soils. Farnum, Lubbock, and Tabler soils have a mollic epipedon thicker than 20 inches. Also, Carwile, Lubbock, and Tabler soils have a fine textured argillic horizon. Farnum and Lubbock soils are in intermediate areas, whereas Tabler soils are in the lower areas.

Typical pedon of Naron fine sandy loam 2,300 feet north and 750 feet west of the southeast corner of sec. 12, T. 23 S., R. 17 W.

A1—0 to 11 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; hard, friable; many fine roots; slightly acid; gradual smooth boundary.

B2t—11 to 33 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; very hard, firm; many fine roots; mildly alkaline; clear smooth boundary.

B3—33 to 53 inches; brown (10YR 5/3) heavy fine sandy loam, dark brown (10YR 4/3) moist; weak coarse prismatic structure; hard, friable; few fine roots; mildly alkaline; gradual smooth boundary.

C—53 to 60 inches; pale brown (10YR 6/3) fine sandy loam, dark brown (10YR 4/3) moist; massive; hard, friable; slight effervescence; moderately alkaline.

The thickness of the solum ranges from 36 to 60 inches. The thickness of the mollic epipedon ranges from 10 to 20 inches.

The A horizon has color value 4 or 5 (2 or 3 moist) and chroma of 2. It is dominantly fine sandy loam, but it is loam in some areas and in some small areas it contains as much as 6 inches of loamy fine sand. Reaction ranges from medium acid to neutral. The B2t horizon has color value 4 or 5 (3 or 4 moist) and chroma of 2 or 3. It is sandy clay loam or heavy fine sandy loam and averages between 18 and 27 percent clay. Reaction ranges from slightly acid to mildly alkaline. The C horizon is fine sandy loam or loamy fine sand. Reaction ranges from slightly acid to moderately alkaline. Silty and clayey sediments are below a depth of 40 inches in some areas.

Ness series

The Ness series consists of deep, poorly drained, very slowly permeable soils in shallow depressions that are frequently flooded. These soils formed in clayey eolian or alluvial sediments overlying more silty eolian sediments. Slopes are mainly concave and are less than 1 percent.

Ness soils are near Lubbock, Harney, and Tabler soils. Lubbock, Harney, and Tabler soils are better drained than Ness soils and have argillic horizons.

Typical pedon of Ness clay 2,340 feet east and 200 feet north of the southwest corner of sec. 31, T. 21 S., R. 19 W.

A11—0 to 12 inches; gray (10YR 5/1) clay, very dark gray (10YR 3/1) moist; massive in upper 6 inches and moderate fine blocky structure in lower 6 inches; very hard, very firm; few fine roots; neutral; gradual smooth boundary.

A12—12 to 30 inches; gray (10YR 5/1) clay, very dark gray (10YR 3/1) moist; moderate medium blocky structure; very hard, very firm; few fine roots; few slickenside faces on larger peds; moderately alkaline; clear smooth boundary.

C—30 to 60 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 4/3) moist; massive; hard, firm; common soft accumulations of carbonates; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 24 to 48 inches, and the depth to free carbonates ranges from 24 to 40 inches. The A horizon has color value of 4 or 5 (2 or 3 moist) and chroma of 1. Texture is clay or silty clay averaging 50 percent or more clay. Reaction ranges from neutral to moderately alkaline. The C horizon is dominantly silty clay loam but is silt loam or loam in some areas.

New Cambria series

The New Cambria series consists of deep, moderately well drained, slowly permeable soils on terraces along the larger streams. Flooding is rare and very brief. These soils formed in calcareous silty alluvium. Slope is 0 to 1 percent.

New Cambria soils are similar to Harney and Roxbury soils and are near Bridgeport and Ness soils. Harney soils have argillic horizons and are on uplands. Roxbury and Bridgeport soils have a fine-silty control section. Also, Roxbury soils are in drainageways and are more frequently flooded than New Cambria soils. Ness soils have a clay A horizon and are in depressions.

Typical pedon of New Cambria silty clay loam 50 feet north and 75 feet east of the southwest corner of NW1/4 sec. 11, T. 22 S., R. 18 W.

Ap—0 to 6 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; moderate medium granular structure; hard, firm; many fine roots; slight effervescence; moderately alkaline; gradual smooth boundary.

A12—6 to 14 inches; gray (10YR 5/1) silty clay loam, very dark gray (10YR 3/1) moist; moderate medium granular structure; hard, firm; many fine roots; slight effervescence; moderately alkaline; clear smooth boundary.

B21—14 to 25 inches; gray (10YR 5/1) silty clay, very dark gray (10YR 3/1) moist; moderate medium blocky structure; very hard, very firm; many fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

B22—25 to 35 inches; grayish brown (10YR 5/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate medium blocky structure; very hard, firm; few fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

C1—35 to 48 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure; hard, firm; few fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

C2—48 to 60 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; massive; hard, firm; many small and medium soft lime accumulations; strong effervescence; moderately alkaline.

The thickness of the solum and the thickness of the mollic epipedon range from 24 to 40 inches. The depth to free carbonates ranges from 0 to 15 inches. Reaction is commonly moderately alkaline, but in some small areas the soil is mildly alkaline to a depth of as much as 15 inches.

The A horizon has color value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. The B horizon has color value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It is heavy silty clay loam or silty clay and averages between 35 and 50 percent clay. The C horizon has color value of 4 to 6 (4 or 5 moist) and chroma of 1 or 2. It is silty clay loam or silty clay.

Nibson series

The Nibson series consists of shallow, somewhat excessively drained, moderately permeable soils that are underlain by chalky shale and limestone. These soils are on uplands. Slope ranges from 5 to 15 percent.

Nibson soils are similar to Uly and Wakeen soils and are near Harney soils. Uly soils are not underlain by chalky shale and soft limestone. Wakeen soils are 20 to 40 inches deep over interbedded chalky shale and soft limestone. Harney soils have argillic horizons.

Typical pedon of Nibson silt loam, in an area of Wakeen-Nibson silt loams, 5 to 15 percent slopes, 1,650 feet north and 200 feet east of the southwest corner of sec. 32, T. 20 S., R. 19 W.

A1—0 to 8 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable; many fine roots; strong effervescence; moderately alkaline; clear wavy boundary.

B2—8 to 14 inches; pale brown (10YR 6/3) light silty clay loam, brown (10YR 5/3) moist; moderate medium granular structure; slightly hard, friable; many fine roots; common fine chalky shale fragments; violent effervescence; moderately alkaline; clear wavy boundary.

C—14 to 19 inches; very pale brown (10YR 7/3) light silty clay loam, pale brown (10YR 6/3) moist; weak medium granular structure; slightly hard, friable; many fine roots; many fine and medium chalky shale fragments; violent effervescence; moderately alkaline; clear wavy boundary.

Cr—19 to 60 inches; very pale brown (10YR 8/3) silty shale, very pale brown (10YR 7/3) moist; interbedded chalky shale and soft limestone; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 10 to 15 inches. The depth to chalky shale and soft limestone ranges from 10 to 20 inches.

The A horizon has color value of 4 or 5 (2 or 3 moist) and chroma of 2. It is typically silt loam, but it is light silty clay loam in some small areas. The B2 horizon has color value of 5 to 7 (4 to 6 moist) and chroma of 2 or 3. It is silt loam or silty clay loam and averages between 20 and 35 percent clay. The C horizon has color value of 6 to 8 (5 to 7 moist) and chroma of 2 or 3.

Platte series

The Platte series consists of deep, somewhat poorly drained, moderately rapidly permeable soils on flood plains that are occasionally flooded. These soils formed in loamy and sandy alluvium underlain by sand and gravel. Slope is 0 to 1 percent.

The Platte soils in Pawnee County are taxadjuncts to the Platte series because the sandy loam horizons below a depth of 10 inches are not thick enough for the soils to be considered Fluvaquents. This difference, however, does not alter the use or behavior of the soils.

Platte soils are similar to Waldeck soils and are near Lesho soils. Lesho soils have a fine-loamy over sandy control section. They are in old channels slightly above or at the same level as Platte soils. Waldeck soils have a coarse-loamy control section and are 20 to 40 inches deep over coarse material. Waldeck soils are on microridges and in old stream areas slightly above Platte and Lesho soils.

Typical pedon of Platte fine sandy loam, in an area of Platte soils, 650 feet east and 2,540 feet north of the southwest corner of sec. 27, T. 23 S., R. 18 W.

A1—0 to 8 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable; many fine roots; strong effervescence; moderately alkaline; clear smooth boundary.

C1—8 to 16 inches; pale brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) moist; common fine distinct strong brown (7.5YR 5/6) mottles; single grained; loose; few fine roots; violent effervescence; moderately alkaline; clear smooth boundary.

IIC2—16 to 60 inches; very pale brown (10YR 7/3) very coarse to fine sand and gravel, brown (10YR 5/3) moist; single grained; loose; slight effervescence; moderately alkaline.

The solum is 6 to 12 inches thick. The depth to coarse material ranges from 12 to 20 inches. Gray and brown mottles are at a depth of 6 to 15 inches. Reaction is mildly alkaline or moderately alkaline.

The A horizon has color value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is typically fine sandy loam, loam, or clay loam, but it is loamy fine sand in some areas. The C horizon has color value of 5 to 7 (4 to 6 moist) and chroma of 2 or 3. It is sandy loam or loamy fine sand. The IIC horizon is sand, coarse sand, and fine gravel.

Pratt series

The Pratt series consists of deep, well drained, rapidly permeable soils on uplands. These soils formed in sandy eolian sediments. Slope ranges from 1 to 15 percent.

Pratt soils are similar to Attica and Tivoli soils and are near Carwile and Naron soils. Attica soils have coarse-loamy argillic horizons, and Naron soils have fine-loamy argillic horizons. Attica and Naron soils occupy intermediate areas. Carwile soils have more clayey argillic horizons than Pratt soils and are in low areas. Tivoli soils lack argillic horizons and occupy the higher areas.

Typical pedon of Pratt loamy fine sand, undulating, 3,051 feet east and 330 feet south of the northwest corner of sec. 19, T. 23 S., R. 17 W.

A1—0 to 11 inches; grayish brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak medium granular structure; soft, very friable; many fine roots; medium acid; clear smooth boundary.

B2t—11 to 32 inches; brown (10YR 5/3) heavy loamy fine sand, dark brown (10YR 4/3) moist; moderate medium granular structure; slightly hard, very friable; few fine roots; few thin horizontal bands of clay-coated sand; slightly acid; gradual smooth boundary.

C—32 to 60 inches; brown (10YR 5/3) loamy fine sand, dark brown (10YR 4/3) moist; single grained; loose; few fine roots; slightly acid.

The thickness of the solum ranges from 25 to 40 inches. The A horizon has color value of 4 or 5 (3 or 4 moist) and chroma of 2 or 3. It is typically loamy fine sand, but it contains as much as 6 inches of fine sand in some areas. Reaction ranges from medium acid to neutral. The B2t horizon has color value of 5 or 6 (4 or 5 moist) and chroma of 2 to 4. It is heavy loamy fine sand or loamy fine sand. It averages between 10 and

15 percent clay and is about 3 to 5 percent more clay than the A horizon. Reaction ranges from medium acid to neutral. The C horizon has the same color range as the B2t horizon. It is loamy fine sand or fine sand and is slightly acid to neutral.

Roxbury series

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

Roxbury soils are similar to Bridgeport and Hord soils and are near New Cambria soils. Bridgeport soils have mollic epipedons less than 20 inches thick. Hord soils regularly decrease in content of organic matter with increasing depth. They lack free carbonates within a depth of 15 inches. In addition, Bridgeport and Hord soils are at slightly higher levels than Roxbury soils and are less frequently flooded. New Cambria soils have a fine textured control section and are in slight depressions.

Typical pedon of Roxbury silt loam, frequently flooded, 610 feet south and 246 feet east of the northwest corner of sec. 31, T. 20 S., R. 18 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; fine medium granular structure; slightly hard, friable; many fine roots; strong effervescence; mildly alkaline; gradual smooth boundary.

A12—6 to 14 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; fine medium granular structure; slightly hard, friable; many fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

B2—14 to 34 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, friable; threads of lime; strong effervescence; moderately alkaline; gradual smooth boundary.

C—34 to 60 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; massive; hard, friable; films and threads of lime; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 30 to 45 inches, and the depth to free carbonates is 0 to 15 inches. Reaction is mildly alkaline or moderately alkaline throughout.

The A horizon has color value 3 to 5 (2 or 3 moist) and chroma of 2. It is typically silt loam but is silty clay loam or loam in some areas. The B2 horizon is similar in color to the A horizon, but in some pedons it has chroma of 3. This horizon is silt loam or silty clay loam and averages between 18 and 34 percent clay. The C horizon has color value 5 to 7 (4 or 5 moist) and chroma of 2 or 3. It is silt loam, silty clay loam, or loam. Sandy or clayey material is below a depth of 40 inches in some small areas.

Tabler series

The Tabler series consists of deep, moderately well drained, very slowly permeable soils on uplands. These soils formed in calcareous loamy or clayey old alluvium. Slope is 0 to 1 percent.

Tabler soils are similar to Carwile, Lubbock, and Ness soils and are near Farnum soils. Carwile soils have distinctly mottled argillic horizons and are in slight depressions. Lubbock soils have a slightly less clayey B2t horizon than Tabler soils and have no wide cracks directly below the A horizon. They are at about the same level as Tabler soils. Ness soils lack argillic horizons and are in depressions. Farnum soils have a fine-loamy control section and are in higher areas.

Typical pedon of Tabler clay loam 2,640 feet east and 75 feet north of the southwest corner of sec. 29, T. 23 S., R. 17 W.

A1—0 to 8 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, friable; many fine roots; neutral; clear smooth boundary.

B21t—8 to 17 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; moderate fine blocky structure; very hard, very firm; few fine roots; moderately alkaline; gradual smooth boundary.

B22t—17 to 30 inches; gray (10YR 5/1) clay, very dark gray (10YR 3/1) moist; moderate medium blocky structure; very hard, very firm; few fine roots; moderately alkaline; gradual smooth boundary.

B3—30 to 46 inches; light gray (10YR 6/1) clay, gray (10YR 5/1) moist; weak medium subangular blocky structure; hard, firm; few fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

C—46 to 60 inches; light gray (10YR 7/1) clay loam, light brownish gray (10YR 6/2) moist; massive; hard, firm; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 40 to 55 inches. The depth to free carbonates ranges from 22 to 36 inches.

The A horizon has color value 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It is dominantly clay loam but is loam in some areas. Reaction ranges from slightly acid to mildly alkaline. The B2t horizon has value 4 to 6 (3 to 5 moist) and chroma of 1 or 2. It is dominantly clay or silty clay averaging between 45 and 55 percent clay. Reaction ranges from neutral to moderately alkaline. The C horizon is dominantly light gray, grayish brown, brown, or pale brown, calcareous loamy or clayey material.

Tivoli series

The Tivoli series consists of deep, excessively drained, rapidly permeable soils on uplands. These soils formed in sandy eolian sediments. Slope ranges from 5 to 20 percent.

Tivoli soils are similar to Pratt soils and are near Carwile and Pratt soils. Carwile soils have a fine textured subsoil and are in depressions. Pratt soils have argillic horizons, are rolling or undulating, and are in slightly lower areas.

Typical pedon of Tivoli fine sand, hilly, 2,475 feet east and 225 feet south of the northwest corner of sec. 35, T. 22 S., R. 17 W.

A1—0 to 6 inches; brown (10YR 5/3) fine sand, dark brown (10YR 4/3) moist; single grained; loose; common fine roots; slightly acid; gradual smooth boundary.

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

The A horizon has color value of 5 or 6 (4 or 5 moist) and chroma of 2 to 4. It is fine sand or loamy fine sand. Reaction ranges from slightly acid to mildly alkaline. The C horizon has color value of 5 to 7 (4 to 6 moist) and chroma of 2 to 6. Reaction ranges from slightly acid to mildly alkaline.

Uly series

The Uly series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in thick deposits of calcareous loess. Slope ranges from 1 to 6 percent.

Uly soils are similar to Holdrege and Wakeen soils and are near Harney soils. Harney and Holdrege soils have argillic horizons and are on the upper side slopes and in convex areas. Wakeen soils have chalky limestone and shale at a depth of 20 to 40 inches and occupy the lower side slopes.

Typical pedon of Uly silt loam, 1 to 3 percent slopes, 1,640 feet west and 200 feet south of the northeast corner of sec. 7, T. 22 S., R. 20 W.

A1—0 to 10 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable; many fine roots; mildly alkaline; gradual smooth boundary.

B2—10 to 18 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; hard, friable; many fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

C1—18 to 30 inches; pinkish gray (7.5YR 7/3) silt loam, brown (7.5YR 5/3) moist; weak medium granular structure; slightly hard, friable; few fine roots; many soft white accumulations of carbonates; violent effervescence; moderately alkaline; gradual smooth boundary.

C2—30 to 60 inches; pinkish gray (7.5YR 7/3) silt loam, brown (7.5YR 5/3) moist; massive; soft, very friable; many soft white accumulations of carbonates; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 12 to 30 inches. The thickness of the mollic epipedon and the depth to free carbonates range from 8 to 18 inches.

The A horizon has color value of 4 or 5 (2 or 3 moist) and chroma of 2. It is neutral or mildly alkaline. The B2 horizon has color value of 4 to 6 (3 or 4 moist) and chroma of 2 or 3. It is dominantly silt loam but is silty clay loam in some areas. Reaction is mildly alkaline to moderately alkaline. The C horizon has color value of 6 to 8 (5 or 6 moist) and chroma of 2 or 3.

Uly silt loam, 3 to 6 percent slopes, eroded, and the Uly soil in the Harney-Uly complex are taxadjuncts to the Uly series because they lack mollic epipedons and are shallower over free carbonates than is defined as the range for the series. These differences, however, do not alter the use or behavior of the soils.

Wakeen series

The Wakeen series consists of moderately deep, well drained, moderately permeable soils on uplands. These soils formed in silty material weathered from chalky limestone and shale. Slope ranges from 1 to 15 percent.

Wakeen soils are similar to Nibson and Uly soils and are near Harney and Holdrege soils. Nibson soils are underlain by bedrock at a depth of 10 to 20 inches and are on the steeper, lower side slopes. Uly soils have no bedrock within a depth of 40 inches and are on side slopes above Wakeen and Nibson soils. Harney and Holdrege soils have argillic horizons and are on the higher convex slopes.

Typical pedon of Wakeen silt loam, in an area of Wakeen-Nibson silt loams, 5 to 15 percent slopes, 2,460 feet east and 50 feet north of the southwest corner of sec. 30, T. 20 S., R. 19 W.

A1—0 to 10 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; many fine roots; strong effervescence; moderately alkaline; clear smooth boundary.

B2—10 to 20 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate fine subangular blocky structure; hard, friable; many fine roots; common fine fragments of limestone; violent effervescence; moderately alkaline; gradual smooth boundary.

B3—20 to 36 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 5/3) moist; weak fine granular structure; hard, friable; few fine roots; many soft white lumps of chalky limestone; violent effervescence; moderately alkaline; gradual wavy boundary.

Cr—36 to 60 inches; very pale brown (10YR 8/3) soft chalky silty shale and limestone; becomes more firm with increasing depth.

The thickness of the solum and the depth to chalky limestone and shale range from 20 to 40 inches. The thickness of the mollic epipedon ranges from 7 to 14 inches. Free carbonates and soft chalk fragments are throughout the solum, and reaction is mildly alkaline or moderately alkaline.

The A horizon has color value of 3 to 5 (2 or 3 moist) and chroma of 2. It is dominantly silt loam but is silty clay loam in some areas. The B2 horizon has color value of 5 to 7 (3 to 5 moist) and chroma of 2 or 3. It is dominantly silty clay loam but is silt loam in some areas. The C horizon has color value of 6 to 8 (5 to 7 moist) and chroma of 2 or 3.

Waldeck series

The Waldeck series consists of deep, somewhat poorly drained, moderately rapidly permeable soils on flood plains. Flooding is occasional and brief. These soils formed in loamy alluvium over sandy alluvium. Slope is 0 to 1 percent.

Waldeck soils are similar to Lesho and Platte soils and are near Platte and Zenda soils. Lesho soils have a fine-loamy over sandy control section. Platte soils have a sandy over coarse sandy and fine gravelly control section. Waldeck, Lesho, and Platte soils are in low areas of old channels along the Arkansas River. Zenda soils have a fine-loamy control section and are not limited in depth by sandy sediments within 40 inches of the surface. They occupy terraces slightly above the flood plain.

Typical pedon of Waldeck fine sandy loam 2,310 feet west and 270 feet south of the northeast corner of sec. 22, T. 23 S., R. 18 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable; many fine roots; neutral; gradual smooth boundary.

A12—6 to 12 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable; many fine roots; slight effervescence; mildly alkaline; gradual smooth boundary.

AC—12 to 20 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; few fine faint brown (7.5YR 5/3) mottles; weak medium granular structure; slightly hard, very friable; common fine roots; violent effervescence; moderately alkaline; gradual smooth boundary.

C1—20 to 40 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; common fine distinct brown (7.5YR 5/4) mottles; massive; few fine roots; violent effervescence; moderately alkaline; diffuse boundary.

C2—40 to 60 inches; very pale brown (10YR 7/3) fine sand, brown (10YR 5/3) moist; single grained; loose; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 18 to 30 inches. The thickness of the mollic epipedon ranges from 10 to 16 inches. The depth to free carbonates ranges from 0 to 12 inches. Reaction is dominantly mildly alkaline or moderately alkaline throughout, but the plow layer is neutral in many areas. Depth to mottles ranges from 12 to 30 inches.

The A horizon has color value 4 or 5 (2 or 3 moist) and chroma of 2 or 3. It is dominantly fine sandy loam but is loamy fine sand or loam in some areas. The AC horizon has color value 5 or 6 (4 or 5 moist) and chroma of 2 or 3. It is fine sandy loam averaging between 15 and 20 percent clay. The C horizon has the same color range as the AC horizon. It is dominantly fine sandy loam, sandy loam, or fine sand, but coarse sand and fine gravel or thin strata of clay loam are common below a depth of 40 inches.

Zenda series

The Zenda series consists of deep, somewhat poorly drained, moderately permeable soils on low terraces. Flooding is occasional and very brief. These soils formed in loamy alluvial sediments underlain by sandy material. Slope is 0 to 1 percent.

Zenda soils are similar to Hord and Lesho soils and are near Kaski and Waldeck soils. Hord soils have a fine-silty control section. Also, Hord and Kaski soils have mollic epipedons more than 20 inches thick. They are on the higher terraces. Lesho soils have sandy material at a depth of 20 to 40 inches. They are on flood plains. Waldeck soils have a coarse-loamy control section and are at the same level on the flood plains as Zenda soils.

Typical pedon of Zenda loam 1,485 feet north and 300 feet east of the southwest corner of sec. 12, T. 22 S., R. 17 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; fine medium granular structure; slightly hard, very friable; many fine roots; neutral; clear smooth boundary.

A12—6 to 12 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; fine medium granular structure; slightly hard, friable; many fine roots; neutral; clear smooth boundary.

AC—12 to 20 inches; mixed grayish brown (10YR 5/2) and dark grayish brown (10YR 4/2) loam, dark grayish brown (10YR 4/2) and very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, friable; many fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

C1—20 to 37 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; few fine faint yellowish brown (10YR 5/6) mottles; moderate medium granular structure; hard, friable; few fine roots; strong effervescence; moderately alkaline; diffuse boundary.

C2—37 to 60 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; common medium distinct reddish yellow (7.5YR 6/6) and light gray (N 6/0) mottles; moderate medium granular structure; hard, firm; many fine masses of lime; strong effervescence; moderately alkaline.

The thickness of the solum and the thickness of the mollic epipedon range from 10 to 20 inches. The depth to free carbonates ranges from 8 to 15 inches. The depth to sandy material ranges from 40 to 72 inches.

The A horizon has color value 3 to 5 (2 or 3 moist) and chroma of 2 or 3. It is dominantly loam but is silt loam or clay loam in some areas. Reaction is neutral to moderately alkaline. The AC horizon has the same color as the A horizon. It is dominantly loam but is clay loam in some areas. The C horizon has color value 5 to 7 (4 to 6 moist) and chroma of 2 to 4. It is dominantly clay loam or loam but is sandy loam, loamy sand, or fine sand in some areas.

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" (*6*).

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 18, 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 subgroups: the central (typic) concept of the great groups, 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 groups 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 describes the factors of soil formation, relates them to the formation of soils in the survey area, and explains the processes of soil formation.

Soil forms through the action of soil-forming processes on material deposited or altered by geologic forces. The characteristics of the soil are determined by (1) the physical and mineralogical composition of the parent material; (2) the climate under which the soil material formed and existed since accumulation; (3) the plant and animal life on and in the soil; (4) the relief, or lay of the land; and (5) the length of time the processes of soil formation have acted on the soil material.

Climate and plant and animal life, mainly plant life, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it into a natural body of soil having genetically related horizons. The soil layers thus formed are called the soil profile. The effects of climate and plants and animals on the formation of horizons in the soils are conditioned by relief. The parent material also affects the kind of soil profile that forms and in places may be the dominant factor. Finally, time is needed for changing the parent material into a soil profile. Usually, a long time is required for the formation of distinct horizons.

Parent material

Parent material is the weathered rocks or partly weathered material from which soils form. Rocks are weathered through the processes of freezing and thawing and abrasion and soil blowing, through the action of water and glaciers, and through chemical processes.

Unconsolidated deposits of silt, sand, and gravel cover most of Pawnee County. Quaternary material, much of which is sandy, covers the area south of the Arkansas River. Recent alluvium is the parent material for all soils formed on flood plains and stream terraces along the major streams in the county.

Climate

Climate influences both the physical and chemical weathering and the biological forces at work in the parent material. The downward movement of water is the major factor transforming the parent material into a soil that has distinct horizons. The amount of water that percolates through the soil depends on the temperature, the type and intensity of precipitation, and the humidity and on the nature of the soil material and the relief. Soil-forming processes are most active when the soil is warm and moist. In Pawnee County these processes are most active in spring and summer. Soil structure is modified by freezing and thawing and by wetting and drying. These processes tend to form aggregates in soils. Alternate wetting and drying are active in the subhumid climate of the county.

The average annual rainfall is about 22.49 inches in Pawnee County (*3*). Wind velocity, which is high, influences soil formation by sorting and moving soil material. The prevailing wind direction is from south to north.

Climate is important in causing differences among soils throughout a wide region, but it causes only negligible differences in the soils of Pawnee County.

Plants and animals

Plants and animals in and on the soil have an important effect on soil formation. Plant and animal remains furnish organic matter to the soil. Plants and animals, including bacteria and other microscopic animals, transform and decompose organic matter, mix the soil, use and release nutrients, and help to weather rocks. Many kinds of plants and animals grow and die in the soil and thus influence the physical, chemical, and biological characteristics of the soil. Plants and animals make the soil more permeable to water, promote leaching, and improve soil structure. Burrowing animals, insects, and earthworms mix and move large quantities of soil material and in many places bring fresh minerals into the surface horizons.

The soils of Pawnee County formed chiefly under prairie grasses. Grasses add a large amount of organic matter to the soil. Thus, over a period of time, the grasses help to darken the surface layer and subsoil, improve soil structure, and form a distinct soil profile.

Relief

Relief influences soil formation through its effect on drainage, runoff, erosion, and soil temperature. Through its effect on soil moisture and soil temperature, relief also affects the kinds of plants and animals that live on and in the soil. In the more sloping areas where runoff is rapid, the soil material is likely to be washed away before distinct horizons can form. In nearly level and depressional areas where erosion is slight, the soil receives extra water as runoff, is deep, and has distinct horizons.

Pawnee County has five main kinds of relief—flat, nearly level to sloping, undulating, rolling, and hilly. Most of the county north of the Arkansas River is nearly level to sloping. Small areas along the major streams and on upland ridges and divides are nearly level. In the valley of the Arkansas River and the nearby old meandering channels, the microrelief is characteristic of flood plains. The only distinctly hilly area that is less than 2 miles wide is near the Arkansas River. It extends southwest from Larned to the county line. A large area south of the Arkansas River is rolling. It averages about 4 to 5 miles wide and parallels the river. A flat area where drainage is sluggish and indefinite is in the central part of the southeastern third of the county, along Pickle Creek and Hubbard Creek. It averages about 3 to 4 miles wide and 15 miles long and extends from Ray to the county line. The nearly level and gently sloping area in the southeast corner makes up about one-ninth of the county.

Many soils have more than one kind of relief, but some have only one kind. For example, Tivoli fine sand is only on hilly dune land. Pratt loamy fine sand, on the other hand, is both undulating and rolling.

Time

Time is needed for soils to form from parent material. Some soils form rapidly, and others form slowly. The amount of time needed depends largely on the other factors of soil formation. As water moves downward through the soil, soluble matter and fine particles are leached from the surface layer and deposited in the subsoil. The amount of time needed for this leaching to occur depends chiefly on how long the soil material has been in place, the texture of the soil material, the amount of water that penetrates the soil and is able to move through the soil, and the extent to which chemical, physical, and biological activity assists in the process.

Some of the soils in the county, such as Tivoli soils, lack horizon development because the soil material is highly resistant to weathering. Others, such as Waldeck soils, formed in recent alluvium but have had little time to form distinct genetic horizons. Naron soils formed in loamy and sandy eolian deposits. They have been exposed to soil-forming processes for thousands of years and have distinct horizons. They are considered mature soils.

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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.

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

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	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.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

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 frequent 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.

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

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

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

Chalk. Very soft, white or light gray limestone.

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.

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 earthmoving 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.

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

Fast intake. 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.

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

Frost action. Freezing and thawing of soil moisture. Frost action can damage structures and plant roots.

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

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.

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

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

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

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

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

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

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

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

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

Limestone. Rock that dominantly consists of calcium carbonate. The many kinds of limestone are determined by the impurities, the varieties in texture, and the hardness.

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.

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

Poor outlets. Surface or subsurface drainage outlets difficult or expensive to install.

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.

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

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.

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* (0.005 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 characteristics 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 solum below plow depth.

Terrace (geologic). 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.

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.

Underlying material. Layers below the subsoil; roughly, the C horizon and below.

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

Unstable fill. Risk of caving or sloughing in banks of fill material.

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

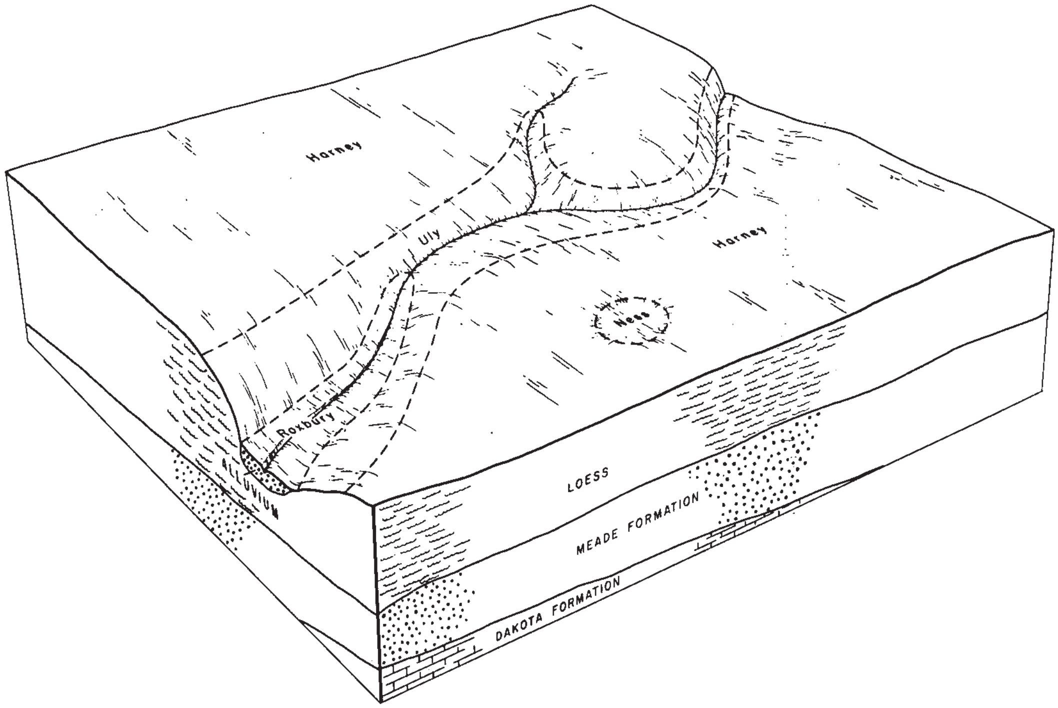

Figure 1.—Typical pattern of soils in the Harney-Uly map unit.

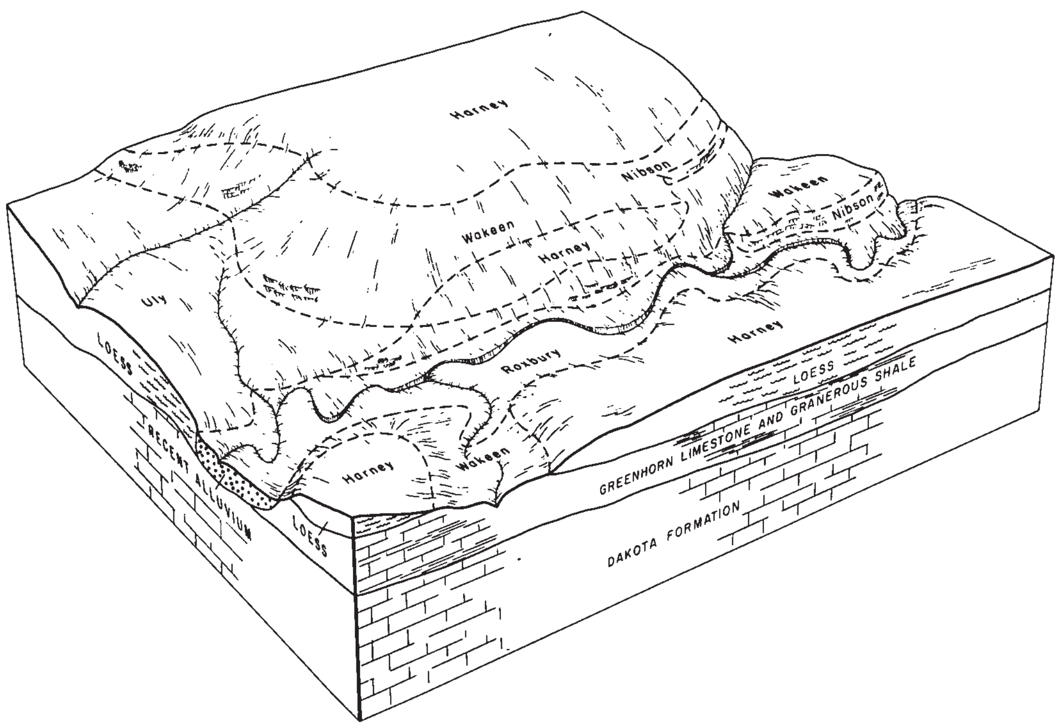

Figure 2.—Typical pattern of soils in the Harney-Wakeen map unit.

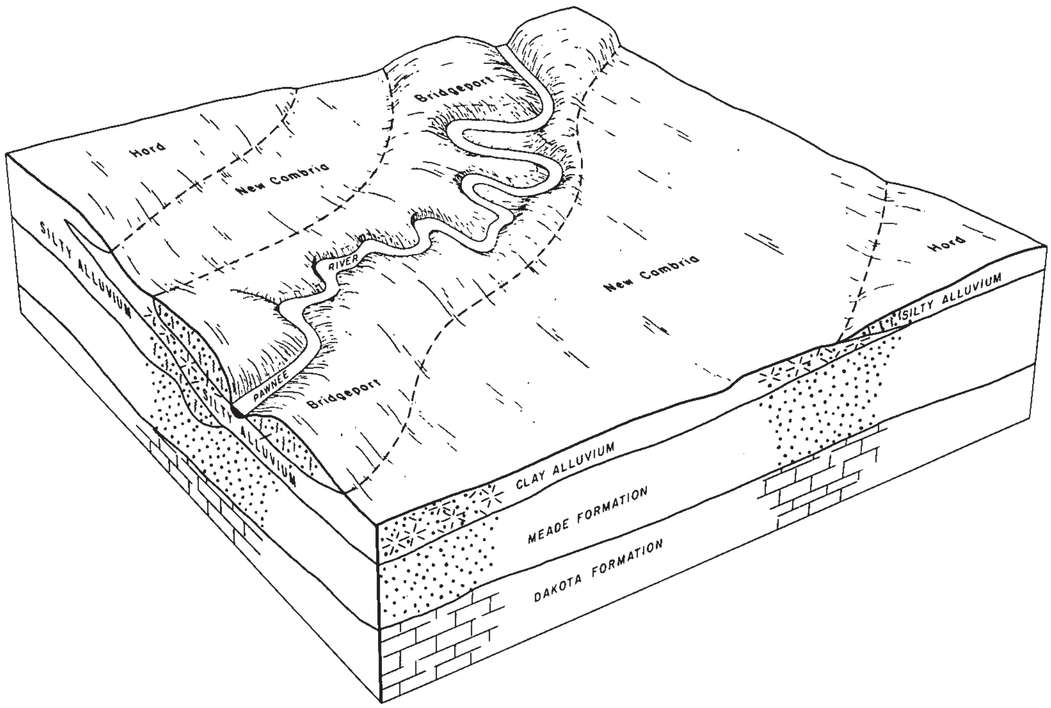

Figure 3.—Typical pattern of soils in the New Cambria-Bridgeport-Hord map unit.

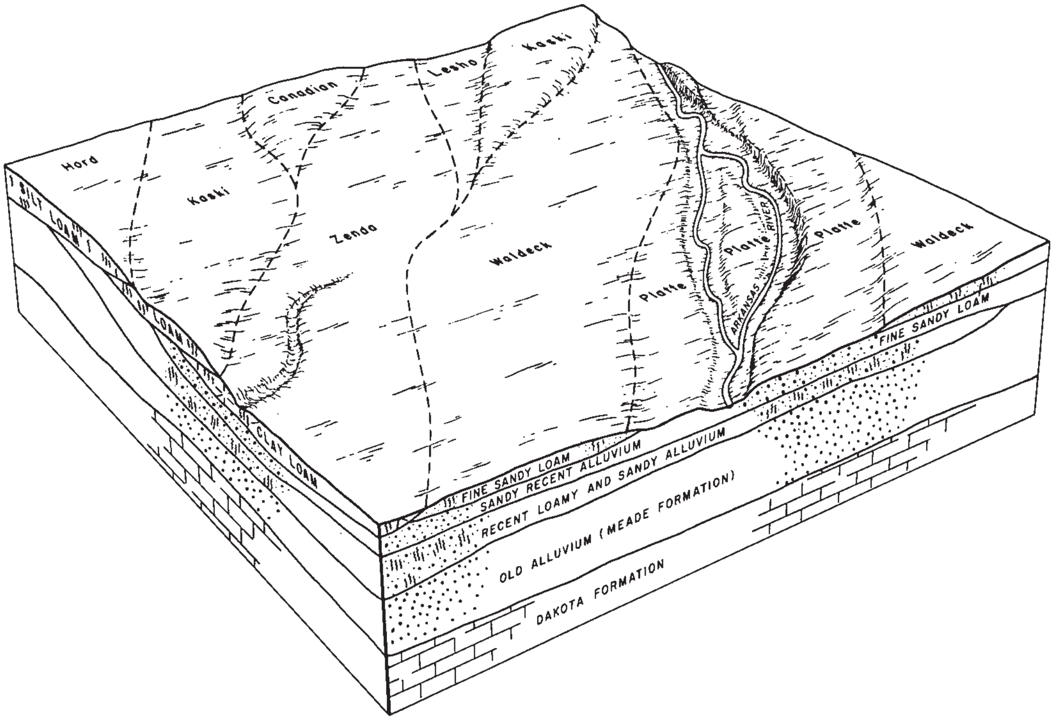

Figure 4.—Typical pattern of soils in the Waldeck-Kaski-Zenda map unit.

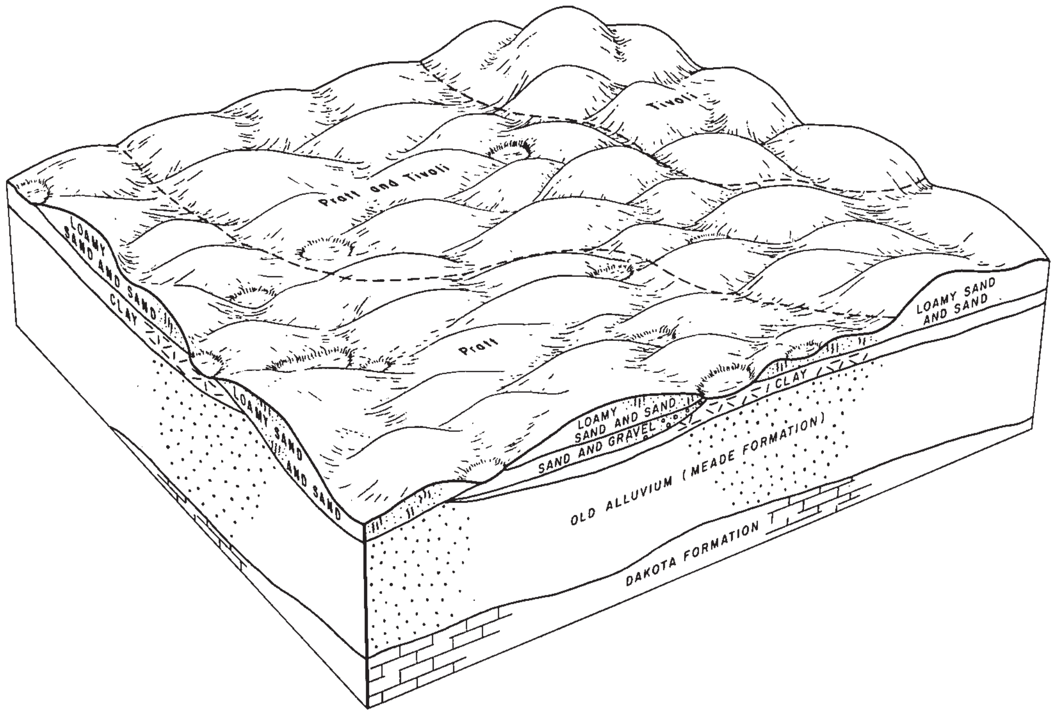

Figure 5.—Typical pattern of soils in the Pratt-Tivoli map unit.

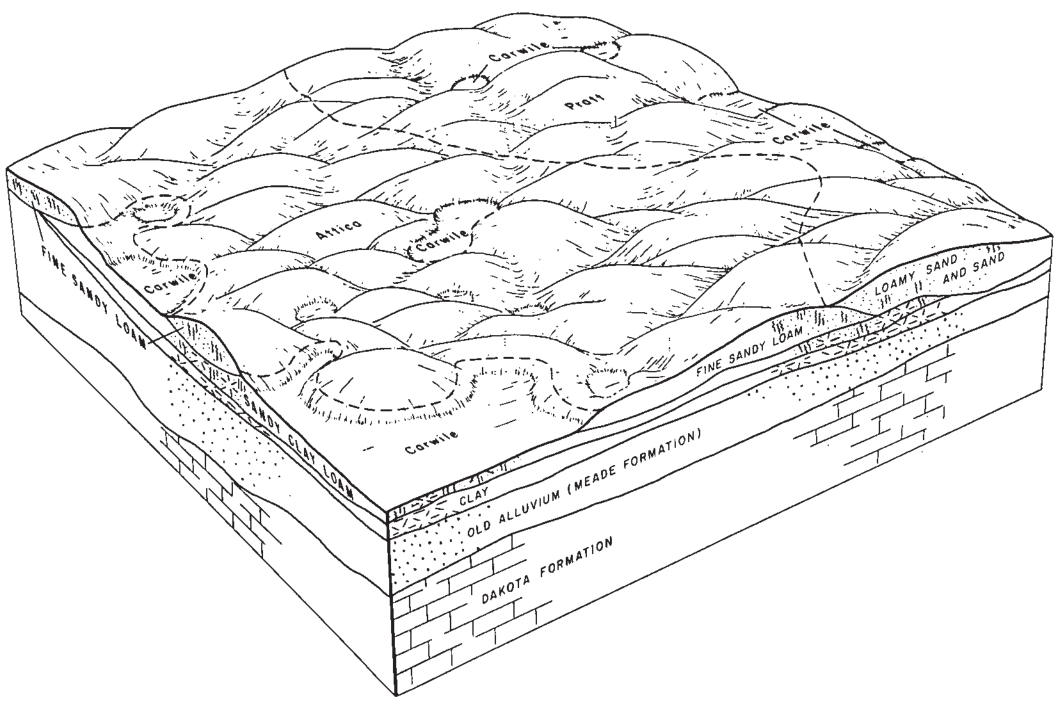

Figure 6.—Typical pattern of soils in the Attica-Pratt-Carwile map unit.

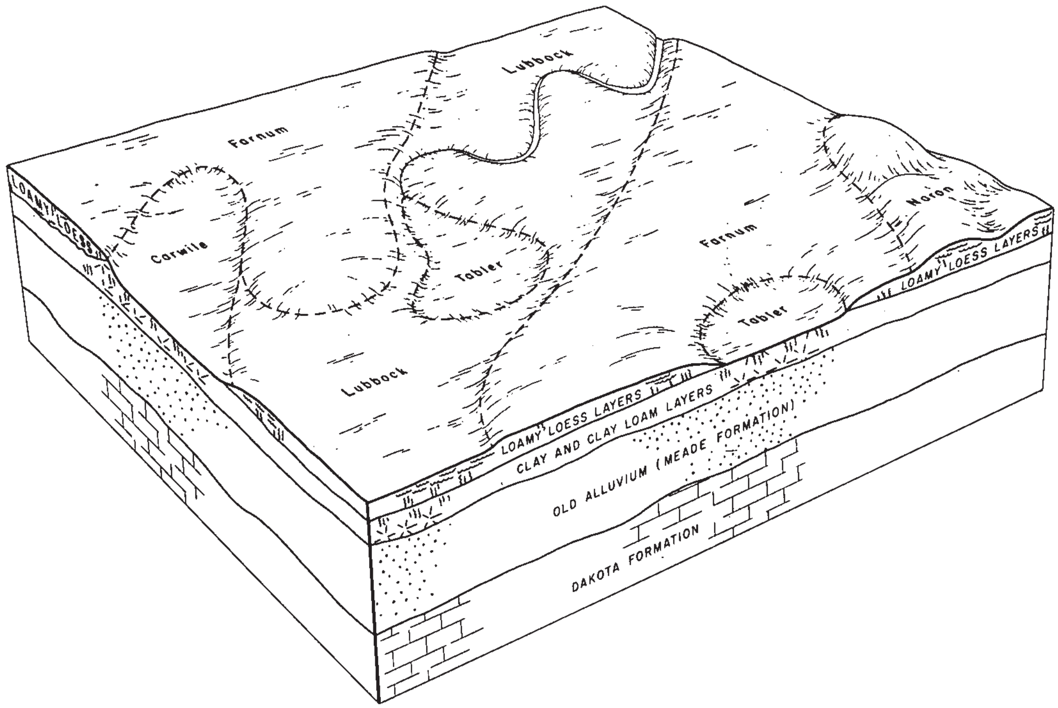

Figure 7.—Typical pattern of soils in the Farnum-Lubbock map unit.

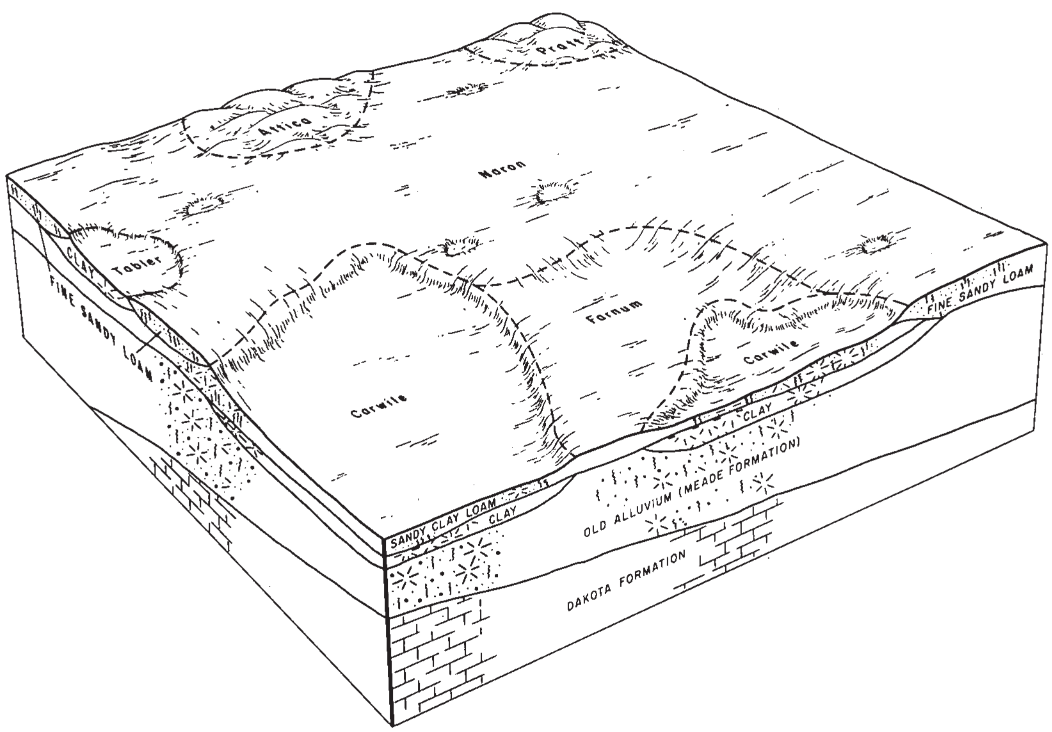

Figure 8.—Typical pattern of soils in the Naron-Carwile map unit.

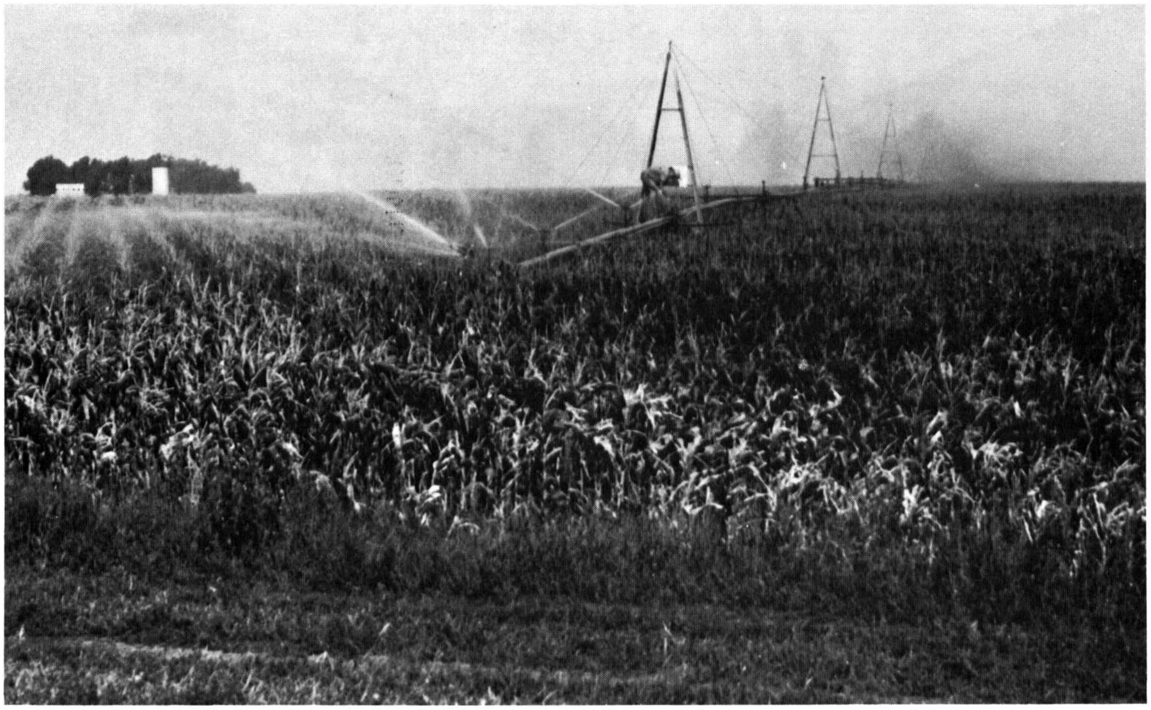

Figure 9.—Irrigating corn on Carwile fine sandy loam. Large quantities of irrigation water help in producing more than 100 bushels per acre.

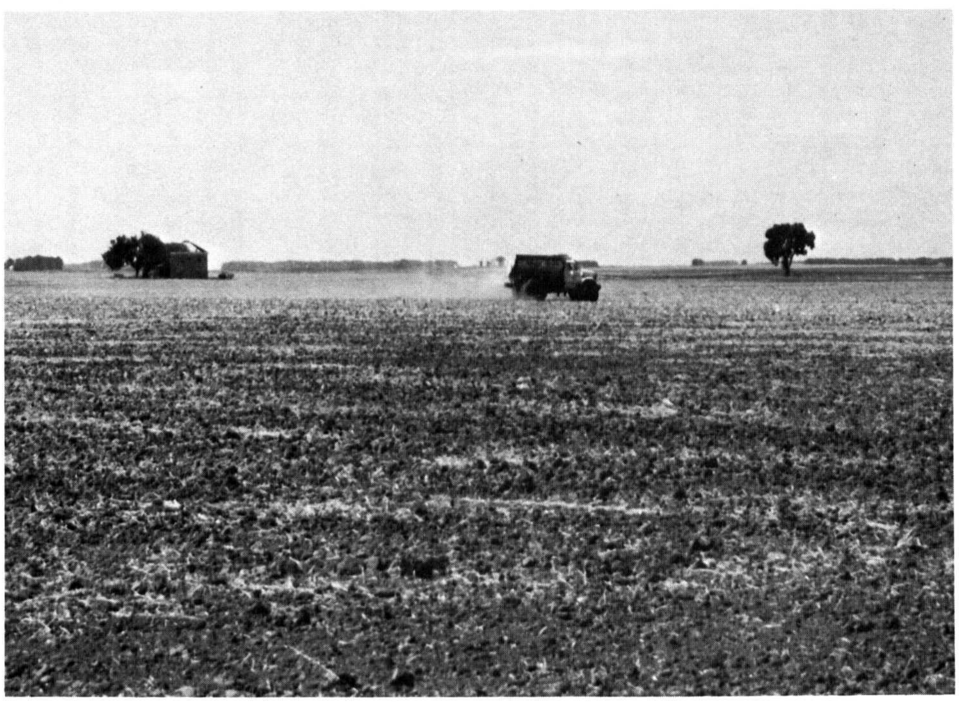

Figure 10.—Application of dry fertilizer prior to seeding wheat on Farnum loam, 0 to 1 percent slopes.

Figure 11.—Cattle grazing native grass on Tivoli fine sand, hilly.

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-----	43.3	19.3	31.3	72	-10	0.48	0.08	0.82	1	3.6
February----	48.4	23.6	36.0	78	- 3	0.73	0.20	1.04	2	4.8
March-------	56.0	29.5	42.8	87	1	1.27	0.32	2.20	3	5.0
April-------	69.5	42.1	55.8	93	21	1.97	0.81	3.09	3	0.9
May---------	78.1	52.5	65.3	100	31	3.03	1.62	4.43	6	0
June--------	87.7	62.4	75.1	105	45	3.95	1.69	5.85	6	0
July--------	92.9	67.2	80.1	107	53	3.59	1.46	4.54	6	0
August------	92.2	66.2	79.2	108	52	3.04	1.35	4.56	4	0
September---	83.3	56.9	70.1	100	37	2.42	0.61	3.88	4	0
October-----	72.7	45.7	59.2	95	25	1.75	0.42	2.58	3	0.4
November----	56.5	31.3	43.9	80	6	0.74	0.04	1.32	2	1.8
December----	45.3	22.3	33.8	71	- 4	0.64	0.10	1.05	2	4.7
Year------	68.8	43.3	56.1	108	-10	23.60	17.17	29.34	42	21.7

[1]Recorded in the period 1941-70 at Larned, 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 14	April 25	May 10
2 years in 10 later than--	April 9	April 20	May 5
5 years in 10 later than--	March 31	April 10	April 25
First freezing temperature in fall:			
1 year in 10 earlier than--	October 22	October 17	October 6
2 years in 10 earlier than--	October 26	October 22	October 10
5 years in 10 earlier than--	November 5	October 31	October 20

[1]Recorded in the period 1931-60 at Larned, 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	204	188	166
8 years in 10	210	194	173
5 years in 10	223	206	184
2 years in 10	235	217	196
1 year in 10	242	223	201

[1]Recorded in the period 1931-60 at Larned, Kansas.

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

Map symbol	Soil name	Acres	Percent
At	Attica sandy loam, 1 to 4 percent slopes	29,000	6.0
Br	Bridgeport silt loam	17,915	3.7
Ca	Canadian fine sandy loam	2,340	0.5
Cv	Canadian Variant sandy loam	1,350	0.3
Cw	Carwile fine sandy loam	13,600	2.8
Fa	Farnum loam, 0 to 1 percent slopes	12,200	2.5
Fr	Farnum loam, 1 to 3 percent slopes	1,210	0.3
Ha	Harney silt loam, 0 to 1 percent slopes	95,300	19.7
Hb	Harney silt loam, 1 to 3 percent slopes	86,000	17.8
Hc	Harney silty clay loam, 1 to 3 percent slopes, eroded	12,800	2.6
Hd	Harney-Uly complex, 3 to 6 percent slopes, eroded	29,700	6.1
Ho	Holdrege silt loam, 1 to 3 percent slopes	4,760	1.0
Hr	Hord silt loam	15,300	3.2
Ka	Kaski loam	6,970	1.4
Lh	Lesho clay loam	2,750	0.6
Lu	Lubbock silt loam	6,150	1.3
Na	Naron fine sandy loam	26,300	5.5
Ne	Ness clay	670	0.1
Nw	New Cambria silty clay loam	19,400	4.0
Pa	Platte soils	6,865	1.4
Ph	Pratt loamy fine sand, rolling	3,910	0.8
Po	Pratt loamy fine sand, undulating	15,300	3.2
Pt	Pratt-Tivoli loamy fine sands, rolling	8,200	1.7
Ro	Roxbury silt loam, frequently flooded	13,300	2.8
Ta	Tabler clay loam	4,730	1.0
Tv	Tivoli fine sand, hilly	2,980	0.6
Ub	Uly silt loam, 1 to 3 percent slopes	5,180	1.1
Uc	Uly silt loam, 3 to 6 percent slopes	11,860	2.5
Ue	Uly silt loam, 3 to 6 percent slopes, eroded	1,820	0.4
Wb	Wakeen silt loam, 1 to 3 percent slopes	4,090	0.8
Wc	Wakeen silt loam, 3 to 6 percent slopes	1,680	0.3
Wh	Wakeen-Nibson silt loams, 5 to 15 percent slopes	4,050	0.8
Wk	Waldeck fine sandy loam	8,670	1.8
Za	Zenda loam	6,850	1.4
	Total	483,200	100.0

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields in columns N are for nonirrigated soils; those in columns I are for irrigated soils. All yields were estimated for a high level of management in 1975. Absence of a yield figure indicates the crop is seldom grown or is not suited]

Soil name and map symbol	Wheat, winter		Grain sorghum		Sorghum silage		Alfalfa hay		Corn	
	N	I	N	I	N	I	N	I	N	I
	Bu	Bu	Bu	Bu	Ton	Ton	Ton	Ton	Bu	Bu
Attica:										
At	28	---	46	---	---	16	3.0	---	---	130
Bridgeport:										
Br	35	55	55	125	---	20	3.5	7.0	---	140
Canadian:										
Ca	30	45	45	110	---	16	3.5	6.0	---	130
Canadian Variant:										
Cv	25	---	30	---	---	12	---	---	---	---
Carwile:										
Cw	20	---	32	105	---	20	3.5	6.0	---	130
Farnum:										
Fa	31	---	50	120	---	22	3.5	7.0	---	135
Fr	28	---	48	110	---	20	3.0	6.5	---	130
Harney:										
Ha	32	---	49	120	---	20	2.5	6.5	---	125
Hb	30	---	49	110	---	18	2.5	5.5	---	115
Hc	26	---	40	---	---	---	---	---	---	---
[1]Hd	20	---	35	---	---	---	---	---	---	---
Holdrege:										
Ho	37	---	47	120	---	20	2.3	6.0	---	135
Hord:										
Hr	36	---	58	125	---	22	3.0	6.5	---	140
Kaski:										
Ka	36	---	58	125	---	20	3.0	6.5	---	135
Lesho:										
Lh	24	---	40	---	---	12	2.7	---	---	---
Lubbock:										
Lu	32	---	49	120	---	20	3.5	6.5	---	120
Naron:										
Na	32	---	54	115	---	24	3.0	6.5	---	135
Ness:										
Ne	---	---	---	---	---	---	---	---	---	---
New Cambria:										
Nw	28	---	48	100	---	---	3.0	6.0	---	115
Platte:										
[1]Pa	---	---	---	---	---	---	---	---	---	---
Pratt:										
Ph	20	---	39	85	90	22	---	5.5	---	110

See footnote at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Wheat, winter		Grain sorghum		Sorghum silage		Alfalfa hay		Corn	
	N	I	N	I	N	I	N	I	N	I
	Bu	Bu	Bu	Bu	Ton	Ton	Ton	Ton	Bu	Bu
Pratt:										
Po	24	---	42	95	---	23	2.0	5.5	---	120
[1]Pt	---	---	---	---	---	---	---	---	---	---
Roxbury:										
Ro	22	---	40	---	---	---	2.5	---	---	---
Tabler:										
Ta	28	---	40	85	---	18	2.5	5.0	---	100
Tivoli:										
Tv	---	---	---	---	---	---	---	---	---	---
Uly:										
Ub	28	---	40	105	---	20	2.4	5.0	---	125
Uc	25	---	35	90	---	---	1.9	4.5	---	105
Ue	22	---	33	---	---	---	---	---	---	---
Wakeen:										
Wb	22	---	36	---	---	---	---	---	---	---
Wc	17	---	30	---	---	---	---	---	---	---
[1]Wh	---	---	---	---	---	---	---	---	---	---
Waldeck:										
Wk	24	---	44	95	---	16	3.5	5.5	---	105
Zenda:										
Za	25	---	45	100	---	14	4.0	5.5	---	110

[1]This map unit is made up of two or more dominant kinds of soil. See map unit description for the composition and behavior of the whole map unit.

TABLE 6.--RANGE PRODUCTIVITY AND COMPOSITION

[Soils not listed are not in range sites; such soils can be used for grazing if grass cover is established]

Soil name and map symbol	Range site name	Potential production: Kind of year	Potential production: Dry weight	Common plant name	Composition
			Lb/acre		Pct
Attica:					
At	Sandy	Favorable	3,500	Sand bluestem	30
		Normal	3,000	Big bluestem	20
		Unfavorable	2,000	Indiangrass	10
				Switchgrass	10
				Sand lovegrass	5
				Serrateleaf eveningprimrose	5
				Lemon scurfpea	5
Bridgeport:					
Br	Loamy Terrace	Favorable	5,000	Big bluestem	30
		Normal	4,000	Western wheatgrass	15
		Unfavorable	3,000	Switchgrass	10
				Little bluestem	10
				Sideoats grama	8
				Indiangrass	5
				Maximilian sunflower	5
Canadian:					
Ca	Sandy Terrace	Favorable	7,000	Big bluestem	25
		Normal	5,500	Indiangrass	15
		Unfavorable	4,000	Switchgrass	15
				Little bluestem	10
				Eastern gamagrass	5
				Tall dropseed	5
				Compassplant	5
				Heath aster	5
				Sedge	5
Canadian Variant:					
Cv	Sandy Lowland	Favorable	5,000	Sand bluestem	35
		Normal	4,000	Indiangrass	15
		Unfavorable	2,500	Switchgrass	15
				Little bluestem	10
				Maximilian sunflower	10
				Sand dropseed	5
				Western wheatgrass	5
Carwile:					
Cw	Sandy	Favorable	5,000	Switchgrass	20
		Normal	3,800	Little bluestem	10
		Unfavorable	3,000	Indiangrass	15
				Sand bluestem	15
				Scribner panicum	5
				Canada wildrye	5
				Sideoats grama	5
Farnum:					
Fa, Fr	Loamy Upland	Favorable	6,000	Big bluestem	30
		Normal	5,000	Little bluestem	25
		Unfavorable	3,500	Indiangrass	10
				Switchgrass	10
				Sideoats grama	5
Harney:					
Ha, Hb, Hc	Loamy Upland	Favorable	4,000	Big bluestem	20
		Normal	2,500	Little bluestem	15
		Unfavorable	1,500	Blue grama	15
				Sideoats grama	10
				Buffalograss	10
				Western wheatgrass	10
				Western ragweed	5

See footnote at end of table.

TABLE 6.--RANGE PRODUCTIVITY AND COMPOSITION--Continued

Soil name and map symbol	Range site name	Potential production: Kind of year	Potential production: Dry weight	Common plant name	Composition
			Lb/acre		Pct
Harney:					
[1]Hd:					
Harney part	Loamy Upland	Favorable	4,000	Big bluestem	20
		Normal	2,500	Little bluestem	15
		Unfavorable	1,500	Blue grama	15
				Sideoats grama	10
				Buffalograss	10
				Western wheatgrass	10
				Western ragweed	5
Uly part	Loamy Upland	Favorable	3,800	Big bluestem	35
		Normal	2,400	Little bluestem	25
		Unfavorable	1,500	Western wheatgrass	12
				Blue grama	6
				Sedge	5
Holdrege:					
Ho	Loamy Upland	Favorable	4,000	Big bluestem	20
		Normal	2,650	Little bluestem	18
		Unfavorable	1,800	Sideoats grama	10
				Blue grama	10
				Western wheatgrass	10
				Indiangrass	5
				Switchgrass	5
				Buffalograss	5
				Sand dropseed	5
				Sedge	5
Hord:					
Hr	Loamy Terrace	Favorable	5,000	Big bluestem	30
		Normal	3,800	Little bluestem	10
		Unfavorable	2,500	Indiangrass	10
				Switchgrass	10
				Porcupinegrass	8
				Sideoats grama	5
				Tall dropseed	5
				Western wheatgrass	5
				Sedge	5
Kaski:					
Ka	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
				Maximilian sunflower	5
				Goldenrod	5
Lesho:					
Lh	Subirrigated	Favorable	7,500	Sand bluestem	15
		Normal	6,500	Indiangrass	15
		Unfavorable	6,000	Eastern gamagrass	15
				Switchgrass	10
				Prairie cordgrass	10
				Little bluestem	5
				Tall dropseed	5
				Western wheatgrass	5
				Sedge	5
				Maximilian sunflower	5

See footnote at end of table.

TABLE 6.--RANGE PRODUCTIVITY AND COMPOSITION--Continued

Soil name and map symbol	Range site name	Potential production: Kind of year	Potential production: Dry weight	Common plant name	Composition
			Lb/acre		Pct
Lubbock:					
Lu	Loamy Upland	Favorable	4,000	Blue grama	20
		Normal	2,500	Big bluestem	15
		Unfavorable	1,200	Sideoats grama	15
				Western wheatgrass	15
				Buffalograss	10
				Slimflower scurfpea	5
				Little bluestem	5
Naron:					
Na	Sandy	Favorable	4,000	Sand bluestem	35
		Normal	3,000	Big bluestem	20
		Unfavorable	2,000	Indiangrass	10
				Switchgrass	10
				Leadplant	5
				Sand lovegrass	5
New Cambria:					
Nw	Clay Terrace	Favorable	4,500	Big bluestem	30
		Normal	3,500	Little bluestem	15
		Unfavorable	2,000	Indiangrass	10
				Switchgrass	10
				Western wheatgrass	10
				Sideoats grama	5
				Tall dropseed	5
				Blue grama	5
Platte:					
[1]Pa	Subirrigated	Favorable	6,000	Big bluestem	30
		Normal	5,500	Switchgrass	15
		Unfavorable	4,000	Prairie cordgrass	10
				Indiangrass	5
				Little bluestem	5
				Kentucky bluegrass	5
Pratt:					
Ph, Po	Sands	Favorable	3,500	Sand bluestem	25
		Normal	3,000	Little bluestem	20
		Unfavorable	2,000	Indiangrass	10
				Sand lovegrass	10
				Switchgrass	5
				Blue grama	5
				Texas bluegrass	5
				Sand dropseed	5
[1]Pt:					
Pratt part	Sands	Favorable	3,500	Sand bluestem	25
		Normal	3,000	Little bluestem	20
		Unfavorable	2,000	Indiangrass	10
				Sand lovegrass	10
				Switchgrass	5
				Blue grama	5
				Texas bluegrass	5
				Sand dropseed	5
Tivoli part	Sands	Favorable	2,500	Little bluestem	25
		Normal	1,800	Sand bluestem	20
		Unfavorable	1,200	Big sandreed	10
				Texas bluegrass	10
				Sand lovegrass	5
				Scribner panicum	5
				Sand dropseed	5
				Lespedeza	5

See footnote at end of table.

TABLE 6.--RANGE PRODUCTIVITY AND COMPOSITION--Continued

Soil name and map symbol	Range site name	Potential production: Kind of year	Potential production: Dry weight	Common plant name	Composition
			Lb/acre		Pct
Roxbury:					
Ro	Loamy Lowland	Favorable	6,000	Big bluestem	40
		Normal	5,000	Indiangrass	10
		Unfavorable	4,000	Switchgrass	10
				Western wheatgrass	8
				Little bluestem	5
				Maximilian sunflower	5
Tabler:					
Ta	Clay Upland	Favorable	4,000	Little bluestem	25
		Normal	3,000	Big bluestem	20
		Unfavorable	2,000	Switchgrass	15
				Indiangrass	10
				Sideoats grama	5
				Blue grama	5
				Buffalograss	10
Tivoli:					
Tv	Choppy Sands	Favorable	2,500	Little bluestem	25
		Normal	1,800	Sand bluestem	20
		Unfavorable	1,200	Big sandreed	10
				Texas bluegrass	10
				Sand lovegrass	5
				Scribner panicum	5
				Sand dropseed	5
				Lespedeza	5
Uly:					
Ub, Uc, Ue	Loamy Upland	Favorable	3,200	Big bluestem	35
		Normal	2,400	Little bluestem	25
		Unfavorable	1,500	Western wheatgrass	12
				Blue grama	6
				Sedge	5
Wakeen:					
Wb, Wc	Limy Upland	Favorable	4,000	Big bluestem	35
		Normal	2,500	Little bluestem	20
		Unfavorable	1,000	Sideoats grama	15
				Switchgrass	5
				Western wheatgrass	5
[1]Wh:					
Wakeen part	Limy Upland	Favorable	4,000	Big bluestem	35
		Normal	2,500	Little bluestem	20
		Unfavorable	1,000	Sideoats grama	15
				Switchgrass	5
				Western wheatgrass	5
Nibson part	Limy Upland	Favorable	4,000	Big bluestem	30
		Normal	2,500	Little bluestem	20
		Unfavorable	1,000	Sideoats grama	20
				Indiangrass	5
				Blue grama	5
				Western wheatgrass	5
Waldeck:					
Wk	Subirrigated	Favorable	8,000	Big bluestem	20
		Normal	7,000	Indiangrass	15
		Unfavorable	6,500	Switchgrass	10
				Eastern gamagrass	10
				Prairie cordgrass	10
				Little bluestem	5
				Maximilian sunflower	5
				Alkali sacaton	5
				Meadow dropseed	5
				Western wheatgrass	5
				Sedge	5
				Wholeleaf rosinweed	5

See footnote at end of table.

TABLE 6.--RANGE PRODUCTIVITY AND COMPOSITION--Continued

Soil name and map symbol	Range site name	Potential production: Kind of year	Potential production: Dry weight	Common plant name	Composition
			Lb/acre		Pct
Zenda:					
Za	Subirrigated	Favorable	8,000	Big bluestem	20
		Normal	7,000	Indiangrass	15
		Unfavorable	6,500	Switchgrass	10
				Eastern gamagrass	10
				Prairie cordgrass	10
				Little bluestem	5
				Alkali sacaton	5
				Meadow dropseed	5
				Western wheatgrass	5
				Sedge	5
				Maximilian sunflower	5
				Wholeleaf rosinweed	5

[1]This map unit is made up of two or more dominant kinds of soil. See map unit description for the composition and behavior of the whole map unit.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[Absence of an entry means the species does not grow well on the soil]

Soil name and map symbol	Expected heights of specified trees at 20 years of age							
	Eastern cottonwood	Eastern redcedar	Hackberry	Honey-locust	Ponderosa pine	Russian-olive	Siberian elm	Osage-orange
	Ft	Ft	Ft	Ft	Ft	Ft	Ft	Ft
Attica: At	32	22	18	19	25	---	---	20
Bridgeport: Br	35	25	35	22	27	20	45	25
Canadian: Ca	50	30	22	22	22	---	50	22
Canadian Variant: Cv	---	22	---	---	22	---	20	16
Carwile: Cw	50	25	20	20	---	---	25	20
Farnum: Fa, Fr	35	25	25	24	20	17	37	19
Harney: Ha, Hb, Hc	34	24	22	24	24	18	33	18
[1]Hd: Harney part	34	24	22	24	24	18	33	18
Uly part	32	16	18	22	22	16	32	16
Holdrege: Ho	32	18	20	26	24	18	33	18
Hord: Hr	48	22	22	25	21	17	40	20
Kaski: Ka	50	28	30	30	21	22	45	22
Lesho: Lh	45	25	---	35	25	22	35	16
Lubbock: Lu	40	24	25	24	24	18	37	16
Naron: Na	48	24	27	35	25	---	44	22
Ness: Ne	---	17	---	---	---	---	---	---
New Cambria: Nw	28	25	30	---	---	20	45	16
Platte: [1]Pa	20	17	---	---	---	15	18	15
Pratt: Ph, Po	35	18	20	25	20	15	30	15
[1]Pt: Pratt part	35	18	20	25	20	15	30	15
Tivoli part	20	15	---	---	---	---	20	15
Roxbury: Ro	40	25	35	---	---	20	45	15

See footnote at end of table.

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

Soil name and map symbol	Expected heights of specified trees at 20 years of age							
	Eastern cottonwood	Eastern redcedar	Hackberry	Honey-locust	Ponderosa pine	Russian-olive	Siberian elm	Osage-orange
	Ft	Ft	Ft	Ft	Ft	Ft	Ft	Ft
Tabler:								
Ta------------------	40	20	22	20	---	---	35	24
Tivoli:								
Tv------------------	20	15	---	---	---	---	20	15
Uly:								
Ub, Uc, Ue----------	32	16	18	22	22	16	32	16
Wakeen:								
Wb, Wc--------------	28	16	---	22	---	16	28	---
[1]Wh:								
Wakeen part-------	28	16	---	22	---	16	28	---
Nibson part-------	---	14	12	---	---	12	---	14
Waldeck:								
Wk------------------	50	30	35	---	30	---	50	25
Zenda:								
Za------------------	50	30	30	---	---	---	50	20

[1]This map unit is made up of two or more dominant kinds of soil. See map unit description for the composition and behavior of the whole map unit.

TABLE 8.--BUILDING SITE DEVELOPMENT

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

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Attica: At	Slight	Slight	Slight	Slight	Slight.
Bridgeport: Br	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
Canadian: Ca	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods, low strength.
Canadian Variant: Cv	Severe: cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods.
Carwile: Cw	Severe: wetness, floods.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: wetness, floods, shrink-swell.	Severe: low strength, shrink-swell.
Farnum: Fa, Fr	Moderate: too clayey.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Severe: low strength.
Harney: Ha, Hb, Hc	Slight	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
[1]Hd: Harney part	Slight	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
Uly part	Slight	Moderate: low strength.	Moderate: low strength.	Moderate: slope, low strength.	Moderate: low strength, frost action.
Holdrege: Ho	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, frost action.
Hord: Hr	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: low strength, floods.
Kaski: Ka	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods.
Lesho: Lh	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Moderate: low strength, wetness, shrink-swell.

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
Lubbock:					
Lu	Slight	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
Naron:					
Na	Slight	Slight	Slight	Slight	Moderate: low strength.
Ness:					
Ne	Severe: floods, too clayey.	Severe: floods, shrink-swell.	Severe: floods, shrink-swell.	Severe: floods, shrink-swell.	Severe: wetness, floods, low strength.
New Cambria:					
Nw	Severe: too clayey.	Severe: floods, shrink-swell.	Severe: floods, shrink-swell.	Severe: floods, shrink-swell.	Severe: low strength, shrink-swell.
Platte:					
[1]Pa	Severe: floods, wetness, cutbanks cave.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.
Pratt:					
Ph	Severe: too sandy, cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
Po	Severe: too sandy, cutbanks cave.	Slight	Slight	Slight	Slight.
[1]Pt:					
Pratt part	Severe: too sandy, cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Tivoli part	Severe: cutbanks cave, too sandy.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Roxbury:					
Ro	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
Tabler:					
Ta	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.
Tivoli:					
Tv	Severe: cutbanks cave, too sandy.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Uly:					
Ub	Slight	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.
Uc, Ue	Slight	Moderate: low strength.	Moderate: low strength.	Moderate: slope, low strength.	Moderate: 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
Wakeen:					
Wb	Moderate: depth to rock.	Moderate: shrink-swell, low strength.	Moderate: depth to rock, shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: low strength.
Wc	Moderate: depth to rock.	Moderate: shrink-swell, low strength.	Moderate: depth to rock, shrink-swell, low strength.	Moderate: slope, shrink-swell, low strength.	Severe: low strength.
[1]Wh:					
Wakeen part	Moderate: slope, depth to rock.	Moderate: slope, shrink-swell, low strength.	Moderate: depth to rock, shrink-swell, low strength.	Severe: slope.	Severe: low strength.
Nibson part	Moderate: slope, depth to rock.	Moderate: slope, depth to rock.	Moderate: slope, depth to rock.	Severe: slope.	Moderate: slope, depth to rock.
Waldeck:					
Wk	Severe: floods, wetness.	Severe: floods.	Severe: floods, wetness.	Severe: floods.	Moderate: floods, wetness.
Zenda:					
Za	Severe: floods, wetness.	Severe: floods.	Severe: floods, wetness.	Severe: floods.	Severe: low strength, wetness.

[1]This map unit is made up of two or more dominant kinds of soil. See map unit description for the composition and behavior of the whole map unit.

TABLE 9.--SANITARY FACILITIES

["Depth to rock" and some of the other terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms used to rate soils]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Attica:					
At	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
Bridgeport:					
Br	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Good.
Canadian:					
Ca	Moderate: floods.	Severe: seepage, floods.	Severe: seepage.	Severe: seepage.	Good.
Canadian Variant:					
Cv	Moderate: floods.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: area reclaim.
Carwile:					
Cw	Severe: percs slowly, wetness, floods.	Severe: wetness, floods.	Severe: floods, too clayey.	Severe: wetness, floods.	Poor: thin layer.
Farnum:					
Fa	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey.
Fr	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Harney:					
Ha	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey.
Hb, Hc	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
[1]Hd:					
Harney part	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Uly part	Slight	Moderate: slope, seepage.	Slight	Slight	Good.
Holdrege:					
Ho	Slight	Moderate: slope, seepage.	Slight	Slight	Good.
Hord:					
Hr	Moderate: floods.	Moderate: seepage.	Moderate: floods.	Moderate: floods.	Good.
Kaski:					
Ka	Moderate: floods.	Moderate: floods, seepage.	Moderate: floods.	Moderate: floods.	Good.

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
Lesho:					
Lh	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Fair: thin layer, area reclaim.
Lubbock:					
Lu	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey.
Naron:					
Na	Slight	Moderate: seepage.	Moderate: seepage.	Moderate: seepage.	Good.
Ness:					
Ne	Severe: percs slowly, floods.	Severe: floods.	Severe: floods, too clayey.	Severe: wetness, floods.	Poor: wetness, too clayey.
New Cambria:					
Nw	Severe: percs slowly.	Slight	Severe: too clayey.	Moderate: floods.	Poor: too clayey.
Platte:					
[1]Pa	Severe: floods, wetness.	Severe: seepage, wetness.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Poor: wetness, area reclaim.
Pratt:					
Ph	Slight	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
Po	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
[1]Pt:					
Pratt part	Moderate: slope.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: too sandy, slope.
Tivoli part	Moderate: slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: thin layer, too sandy.
Roxbury:					
Ro	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Good.
Tabler:					
Ta	Severe: percs slowly, wetness.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: hard to pack, too clayey.
Tivoli:					
Tv	Moderate: slope.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy.
Uly:					
Ub, Uc, Ue	Slight	Moderate: slope, seepage.	Slight	Slight	Good.
Wakeen:					
Wb, Wc	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	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
Wakeen:					
[1]Wh:					
Wakeen part	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Moderate: slope.	Poor: area reclaim.
Nibson part	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Moderate: slope.	Poor: thin layer, area reclaim.
Waldeck:					
Wk	Severe: floods.	Severe: floods, seepage.	Severe: floods, seepage.	Severe: floods, seepage.	Good.
Zenda:					
Za	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Fair: too clayey.

[1]This map unit is made up of two or more dominant kinds of soil. See map unit description for the composition and behavior of the whole map unit.

TABLE 10.--CONSTRUCTION MATERIALS

["Shrink-swell" and some of the other terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," and "unsuited"]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Attica:				
At	Good	Poor: excess fines.	Unsuited	Good.
Bridgeport:				
Br	Fair: low strength, frost action.	Unsuited	Unsuited	Good.
Canadian:				
Ca	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Canadian Variant:				
Cv	Good	Fair: excess fines.	Fair: excess fines.	Good.
Carwile:				
Cw	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer.
Farnum:				
Fa, Fr	Poor: low strength.	Unsuited	Unsuited	Good.
Harney:				
Ha, Hb	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Fair: thin layer.
Hc	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Fair: too clayey.
[1]Hd:				
Harney part	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Fair: too clayey.
Uly part	Fair: low strength, frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: area reclaim.
Holdrege:				
Ho	Fair: shrink-swell, frost action.	Unsuited	Unsuited	Fair: thin layer.
Hord:				
Hr	Fair: low strength.	Unsuited	Unsuited	Good.
Kaski:				
Ka	Fair: low strength.	Unsuited	Unsuited	Good.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Lesho:				
Lh	Fair: low strength, wetness, shrink-swell.	Fair: excess fines.	Unsuited	Fair: area reclaim.
Lubbock:				
Lu	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Fair: thin layer.
Naron:				
Na	Fair: low strength.	Poor: excess fines.	Unsuited	Good.
Ness:				
Ne	Poor: wetness, low strength, shrink-swell.	Unsuited	Unsuited	Poor: too clayey.
New Cambria:				
Nw	Poor: low strength, shrink-swell.	Unsuited	Unsuited	Poor: too clayey.
Platte:				
[1]Pa	Poor: wetness, area reclaim.	Good	Good	Poor: wetness, area reclaim.
Pratt:				
Ph, Po	Good	Fair: excess fines.	Unsuited	Poor: too sandy.
[1]Pt:				
Pratt part	Good	Fair: excess fines.	Unsuited	Poor: too sandy.
Tivoli part	Good	Fair: excess fines.	Unsuited: excess fines.	Poor: too sandy.
Roxbury:				
Ro	Fair: low strength, shrink-swell.	Unsuited	Unsuited	Good.
Tabler:				
Ta	Poor: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: thin layer.
Tivoli:				
Tv	Good	Fair: excess fines.	Unsuited: excess fines.	Poor: too sandy.
Uly:				
Ub, Uc, Ue	Fair: low strength, frost action.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: area reclaim.
Wakeen:				
Wb, Wc	Poor: thin layer, low strength.	Unsuited	Unsuited	Poor: area reclaim.
[1]Wh:				
Wakeen part	Poor: thin layer, low strength.	Unsuited	Unsuited	Poor: area reclaim.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Wakeen:				
Nibson part	Poor: thin layer.	Unsuited	Unsuited	Poor: thin layer, area reclaim.
Waldeck:				
Wk	Fair: wetness.	Fair: excess fines.	Unsuited	Good.
Zenda:				
Za	Poor: low strength.	Unsuited	Unsuited	Good.

[1]This map unit is made up of two or more dominant kinds of soil. See map unit description for the composition and behavior of the whole map unit.

TABLE 11.--WATER MANAGEMENT

["Seepage" and some of the other terms that describe restrictive soil features are defined in the Glossary]

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Attica:						
At	Seepage	Seepage	Not needed	Fast intake, soil blowing.	Soil blowing, erodes easily.	Erodes easily.
Bridgeport:						
Br	Seepage	Low strength, piping.	Not needed	Floods	Not needed	Favorable.
Canadian:						
Ca	Seepage	Unstable fill	Not needed	Fast intake	Erodes easily	Erodes easily.
Canadian Variant:						
Cv	Seepage	Piping	Not needed	Fast intake, floods.	Not needed	Droughty.
Carwile:						
Cw	Favorable	Unstable fill, compressible.	Percs slowly, floods, poor outlets.	Slow intake, wetness.	Not needed	Percs slowly, wetness.
Farnum:						
Fa	Favorable	Low strength, shrink-swell.	Not needed	Slow intake	Favorable	Favorable.
Fr	Favorable	Low strength, shrink-swell.	Not needed	Slow intake, slope.	Favorable	Favorable.
Harney:						
Ha	Favorable	Shrink-swell, low strength.	Favorable	Slow intake	Percs slowly	Percs slowly.
Hb, Hc	Favorable	Shrink-swell, low strength.	Favorable	Slow intake, slope.	Percs slowly	Percs slowly.
[1]Hd:						
Harney part	Favorable	Shrink-swell, low strength.	Favorable	Slow intake, slope.	Percs slowly	Percs slowly.
Uly part	Seepage	Piping, low strength.	Not needed	Erodes easily, slope.	Erodes easily, piping.	Erodes easily.
Holdrege:						
Ho	Seepage	Piping, low strength.	Not needed	Erodes easily	Favorable	Erodes easily.
Hord:						
Hr	Seepage	Piping	Not needed	Favorable	Favorable	Favorable.
Kaski:						
Ka	Seepage	Low strength, piping.	Floods	Floods	Not needed	Favorable.
Lesho:						
Lh	Favorable	Low strength, shrink-swell.	Floods, wetness.	Floods	Not needed	Favorable.
Lubbock:						
Lu	Favorable	Shrink-swell, low strength.	Favorable	Slow intake	Percs slowly	Percs slowly.
Naron:						
Na	Seepage	Piping	Not needed	Fast intake, erodes easily.	Erodes easily, piping.	Erodes easily.

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
Ness:						
Ne	Favorable	Low strength, shrink-swell.	Floods, percs slowly, poor outlets.	Floods, slow intake.	Not needed	Floods, wetness.
New Cambria:						
Nw	Favorable	Shrink-swell, low strength.	Percs slowly	Floods, percs slowly.	Not needed	Not needed.
Platte:						
[1]Pa	Seepage	Seepage	Floods, wetness.	Seepage, floods.	Not needed	Not needed.
Pratt:						
Ph, Po	Seepage	Unstable fill, seepage, piping.	Not needed	Complex slope, soil blowing, fast intake.	Too sandy, complex slope, soil blowing.	Soil blowing, droughty.
[1]Pt:						
Pratt part	Seepage	Unstable fill, seepage, piping.	Not needed	Complex slope, soil blowing, fast intake.	Too sandy, complex slope, soil blowing.	Soil blowing, droughty.
Tivoli part	Seepage	Unstable fill, seepage, piping.	Not needed	Complex slope, erodes easily, droughty.	Complex slope, erodes easily, fast intake.	Erodes easily, droughty, seepage.
Roxbury:						
Ro	Seepage	Low strength, piping.	Floods	Floods	Floods	Favorable.
Tabler:						
Ta	Favorable	Unstable fill, compressible.	Percs slowly	Slow intake	Percs slowly	Percs slowly.
Tivoli:						
Tv	Seepage	Unstable fill, seepage, piping.	Not needed	Complex slope, erodes easily, droughty.	Complex slope, erodes easily, fast intake.	Erodes easily, droughty, seepage.
Uly:						
Ub, Uc, Ue	Seepage	Piping, low strength.	Not needed	Erodes easily, slope.	Erodes easily, piping.	Erodes easily.
Wakeen:						
Wb, Wc	Depth to rock	Thin layer, shrink-swell, low strength.	Not needed	Erodes easily, droughty.	Depth to rock, erodes easily.	Depth to rock, erodes easily.
[1]Wh:						
Wakeen part	Depth to rock	Thin layer, shrink-swell, low strength.	Not needed	Erodes easily, droughty.	Depth to rock, erodes easily.	Depth to rock, erodes easily.
Nibson part	Depth to rock	Thin layer	Not needed	Depth to rock, droughty.	Depth to rock	Depth to rock, rooting depth.
Waldeck:						
Wk	Seepage	Seepage	Floods, wetness.	Floods, wetness.	Not needed	Not needed.
Zenda:						
Za	Favorable	Low strength, shrink-swell, erodes easily.	Floods, wetness.	Floods, wetness.	Not needed	Not needed.

[1]This map unit is made up of two or more dominant kinds of soil. See map unit description for the composition and behavior of the whole map unit.

TABLE 12.--RECREATIONAL DEVELOPMENT

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

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Attica:				
At	Slight	Slight	Moderate: slope.	Slight.
Bridgeport:				
Br	Severe: floods.	Severe: floods.	Severe: floods.	Slight.
Canadian:				
Ca	Severe: floods.	Moderate: floods.	Moderate: floods.	Slight.
Canadian Variant:				
Cv	Severe: floods.	Moderate: floods.	Moderate: floods.	Slight.
Carwile:				
Cw	Severe: wetness, floods.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Farnum:				
Fa	Moderate: percs slowly.	Slight	Moderate: percs slowly.	Slight.
Fr	Moderate: percs slowly.	Slight	Moderate: percs slowly, slope.	Slight.
Harney:				
Ha	Moderate: percs slowly.	Slight	Moderate: percs slowly.	Slight.
Hb	Moderate: percs slowly.	Slight	Moderate: slope, percs slowly.	Slight.
Hc	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Moderate: slope, percs slowly.	Moderate: too clayey.
[1]Hd:				
Harney part	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Moderate: slope, percs slowly.	Moderate: too clayey.
Uly part	Slight	Slight	Moderate: slope.	Slight.
Holdrege:				
Ho	Slight	Slight	Moderate: slope.	Slight.
Hord:				
Hr	Slight	Slight	Slight	Slight.
Kaski:				
Ka	Severe: floods.	Moderate: floods.	Moderate: floods.	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
Lesho:				
Lh	Severe: floods, wetness.	Moderate: floods, wetness.	Moderate: floods, wetness, percs slowly.	Moderate: wetness.
Lubbock:				
Lu	Moderate: percs slowly.	Slight	Moderate: percs slowly.	Slight.
Naron:				
Na	Slight	Slight	Slight	Slight.
Ness:				
Ne	Severe: wetness, floods, percs slowly.	Severe: wetness, floods, too clayey.	Severe: wetness, floods, percs slowly.	Severe: wetness, floods, too clayey.
New Cambria:				
Nw	Moderate: too clayey, percs slowly.	Moderate: too clayey.	Moderate: too clayey, percs slowly.	Moderate: too clayey.
Platte:				
[1]Pa	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.
Pratt:				
Ph	Moderate: too sandy.	Moderate: too sandy.	Severe: slope.	Moderate: too sandy.
Po	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy, slope.	Moderate: too sandy.
[1]Pt:				
Pratt part	Moderate: too sandy, slope.	Moderate: too sandy, slope.	Severe: slope.	Moderate: too sandy.
Tivoli part	Severe: too sandy, dusty.	Severe: too sandy, dusty.	Severe: too sandy, dusty.	Severe: too sandy, dusty.
Roxbury:				
Ro	Severe: floods.	Moderate: floods.	Severe: floods.	Slight.
Tabler:				
Ta	Severe: percs slowly.	Moderate: too clayey.	Severe: percs slowly.	Moderate: too clayey.
Tivoli:				
Tv	Severe: too sandy, dusty.	Severe: too sandy, dusty.	Severe: too sandy, dusty.	Severe: too sandy, dusty.
Uly:				
Ub, Uc, Ue	Slight	Slight	Moderate: slope.	Slight.
Wakeen:				
Wb, Wc	Slight	Slight	Moderate: slope.	Slight.
[1]Wh:				
Wakeen part	Moderate: slope.	Moderate: slope.	Severe: slope.	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
Wakeen:				
Nibson part	Moderate: slope.	Moderate: slope.	Severe: depth to rock, slope.	Slight.
Waldeck:				
Wk	Severe: floods, wetness.	Moderate: floods, wetness.	Moderate: floods, wetness.	Moderate: wetness.
Zenda:				
Za	Severe: floods, wetness.	Moderate: floods, wetness.	Moderate: floods, wetness.	Moderate: wetness.

[1]This map unit is made up of two or more dominant kinds of soil. See map unit description for the composition and behavior of the whole map unit.

TABLE 13.--WILDLIFE HABITAT POTENTIALS

[See text for definitions of "good," "fair," "poor," and "very poor"]

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
Attica: At	Good	Good	Good	Fair	Fair	Poor	Very poor.	Good	Very poor.	Fair.
Bridgeport: Br	Good	Good	Good	Fair	Fair	Poor	Poor	Good	Poor	Fair.
Canadian: Ca	Good	Good	Fair	Fair	Fair	Poor	Very poor.	Good	Very poor.	Fair.
Canadian Variant: Cv	Fair	Fair	Fair	Poor	Fair	Very poor.	Very poor.	Fair	Very poor.	Fair.
Carwile: Cw	Fair	Good	Good	Good	Good	Good	Fair	Good	Fair	Good.
Farnum: Fa, Fr	Good	Good	Good	Fair	Fair	Fair	Poor	Good	Poor	Fair.
Harney: Ha	Good	Good	Fair	Poor	Poor	Poor	Good	Fair	Fair	Poor.
Hb, Hc	Good	Good	Fair	Poor	Poor	Poor	Fair	Fair	Poor	Poor.
[1]Hd: Harney part	Fair	Good	Fair	Poor	Poor	Poor	Poor	Fair	Poor	Poor.
Uly part	Fair	Good	Good	Fair	Fair	Very poor.	Very poor.	Fair	Very poor.	Good.
Holdrege: Ho	Good	Good	Good	Fair	Fair	Very poor.	Very poor.	Good	Very poor.	Good.
Hord: Hr	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Very poor.	Good.
Kaski: Ka	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Very poor.	Good.
Lesho: Lh	Fair	Fair	Fair	Poor	Fair	Fair	Fair	Fair	Fair	Fair.
Lubbock: Lu	Good	Good	Fair	Poor	Poor	Poor	Fair	Fair	Poor	Fair.
Naron: Na	Good	Good	Good	Fair	Fair	Poor	Very poor.	Good	Very poor.	Fair.
Ness: Ne	Poor	Poor	Poor	Poor	Poor	Poor	Fair	Poor	Poor	Poor.
New Cambria: Nw	Good	Good	Fair	Poor	Fair	Fair	Fair	Good	Fair	Fair.
Platte: [1]Pa	Fair	Good	Fair	Fair	Good	Fair	Good	Fair	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	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
Pratt:										
Ph, Po	Fair	Good	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Very poor.	Fair.
[1]Pt:										
Pratt part	Fair	Good	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Very poor.	Fair.
Tivoli part	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Very poor.	Poor.
Roxbury:										
Ro	Fair	Fair	Fair	Fair	Fair	Poor	Fair	Fair	Poor	Fair.
Tabler:										
Ta	Good	Good	Fair	Poor	Fair	Poor	Poor	Good	Poor	Fair.
Tivoli:										
Tv	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Very poor.	Poor.
Uly:										
Ub	Good	Good	Good	Fair	Fair	Very poor.	Very poor.	Good	Very poor.	Good.
Uc, Ue	Fair	Good	Good	Fair	Fair	Very poor.	Very poor.	Fair	Very poor.	Good.
Wakeen:										
Wb, Wc	Fair	Good	Fair	Poor	Poor	Very poor.	Very poor.	Fair	Very poor.	Fair.
[1]Wh:										
Wakeen part	Poor	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Fair	Very poor.	Fair.
Nibson part	Poor	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Fair	Very poor.	Poor.
Waldeck:										
Wk	Fair	Good	Good	Fair	Good	Fair	Fair	Good	Fair	Good.
Zenda:										
Za	Fair	Good	Good	Fair	Good	Fair	Fair	Good	Fair	Good.

[1]See map unit description for the composition and behavior of the map unit.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS

[The symbol < means less than; > means greater than. Absence of an entry means 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	
Attica:											
At------------------	0-12	Sandy loam-------	SM	A-2, A-4	0	100	95-100	70-100	20-50	<20	[1]NP-3
	12-25	Fine sandy loam, sandy loam.	SM, ML, SM-SC, CL-ML	A-2, A-4	0	100	95-100	75-100	30-55	<26	NP-6
	25-60	Fine sandy loam, loamy fine sand.	SM, SM-SC	A-2, A-4	0	100	95-100	70-100	20-50	<26	NP-6
Bridgeport:											
Br------------------	0-11	Silt loam--------	CL	A-4, A-6	0	100	100	95-100	75-100	25-40	8-20
	11-60	Silt loam, silty clay loam, loam.	CL	A-4, A-6	0	100	100	95-100	85-100	25-40	8-20
Canadian:											
Ca------------------	0-28	Fine sandy loam	SM, ML, SC, CL	A-4	0	100	98-100	94-100	36-85	<31	NP-10
	28-60	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
Canadian Variant:											
Cv------------------	0-24	Sandy loam-------	SM	A-2, A-4	0	95-100	95-100	60-100	30-50	<26	NP-6
	24-60	Gravelly coarse sand, sand, coarse sand.	SP-SM	A-2, A-1	0	70-90	50-75	30-50	5-15	---	NP
Carwile:											
Cw------------------	0-12	Fine sandy loam	ML, CL, CL-ML, SM	A-4	0	100	98-100	94-100	36-85	<30	NP-10
	12-30	Clay loam, sandy clay loam.	CL, SC	A-6, A-7	0	100	100	90-100	36-90	35-50	14-26
	30-40	Clay loam, clay, sandy clay.	CL, CH, SC	A-6, A-7	0	100	100	90-100	40-95	35-70	14-38
	40-60	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
Farnum:											
Fa, Fr--------------	0-11	Loam-------------	CL-ML, CL	A-4, A-6	0	100	100	95-100	65-85	<30	5-15
	11-60	Clay loam, sandy clay loam, loam.	SC, CL, CH	A-6, A-7-6	0	100	100	65-100	45-80	35-55	12-28
Harney:											
Ha, Hb--------------	0-12	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-20
	12-35	Silty clay, silty clay loam.	CL, CH	A-7	0	100	100	95-100	85-100	40-60	15-35
	35-60	Silty clay loam, silt loam.	CL	A-6	0	100	100	95-100	85-100	30-40	10-20
Hc------------------	0-7	Silty clay loam	CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-20
	7-40	Silty clay, silty clay loam.	CL, CH	A-7	0	100	100	95-100	85-100	40-60	15-35
	40-60	Silty clay loam, silt loam.	CL	A-6	0	100	100	95-100	85-100	30-40	10-20

See footnotes 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	
Harney:											
[2]Hd:											
Harney part-----	0-7	Silty clay loam	CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-20
	7-40	Silty clay, silty clay loam.	CL, CH	A-7	0	100	100	95-100	85-100	40-60	15-35
	40-60	Silty clay loam, silt loam.	CL	A-6	0	100	100	95-100	85-100	30-40	10-20
Uly part---------	0-7	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	100	90-100	25-40	2-15
	7-18	Silt loam--------	ML, CL	A-4, A-6	0	100	100	100	90-100	25-40	3-18
	18-60	Silt loam--------	ML, CL	A-4, A-6	0	100	100	100	90-100	25-40	2-15
Holdrege:											
Ho-----------------	0-10	Silt loam--------	ML, CL	A-4, A-6	0	100	100	95-100	90-100	24-40	2-18
	10-20	Silty clay loam	CL	A-7, A-6	0	100	100	98-100	95-100	30-50	15-35
	20-60	Silt loam, silty clay loam, loam.	CL, ML	A-6, A-4, A-7	0	100	100	95-100	95-100	25-45	2-20
Hord:											
Hr-----------------	0-12	Silt loam--------	CL	A-4, A-6	0	100	100	100	90-100	20-35	8-18
	12-42	Silt loam, silty clay loam, loam.	CL	A-6, A-4	0	100	100	100	90-100	25-40	8-23
	42-60	Silt loam, very fine sandy loam, silty clay loam.	CL, CL-ML	A-6, A-4	0	100	100	100	90-100	25-40	6-21
Kaski:											
Ka-----------------	0-18	Loam-------------	CL, CL-ML	A-4, A-6, A-7	0	100	100	85-100	60-85	20-45	5-25
	18-28	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
	28-60	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
Lesho:											
Lh-----------------	0-27	Clay loam--------	CL, ML	A-6, A-4, A-7-6	0	100	100	95-100	65-85	30-45	7-22
	27-60	Loamy fine sand, sand, coarse sand.	SM, SP-SM	A-2, A-3, A-4, A-1	0	100	100	30-85	5-45	---	NP
Lubbock:											
Lu-----------------	0-11	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	65-100	25-40	5-20
	11-36	Silty clay loam, silty clay, clay.	CL, CH	A-7	0	100	100	95-100	85-100	40-60	20-35
	36-60	Silty clay loam, silt loam, clay loam.	CL, ML	A-6, A-4	0	100	100	95-100	85-100	30-40	7-17
Naron:											
Na-----------------	0-11	Fine sandy loam	SM, SM-SC, ML, CL-ML	A-2, A-4	0	100	95-100	75-100	25-60	<26	1-7
	11-53	Fine sandy loam, sandy clay loam, loam.	SC, CL	A-4, A-6	0	100	95-100	80-100	36-60	26-40	8-18
	53-60	Fine sandy loam, loamy fine sand.	SM, SM-SC	A-2, A-4	0	100	95-100	75-100	20-50	<26	NP-7

See footnotes 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	
Ness:											
Ne	0-30	Clay	CH	A-7-6	0	100	100	95-100	90-100	50-70	30-45
	30-60	Silty clay loam, silty clay, silt loam.	CL, CH, ML, MH	A-6, A-7-6, A-4	0	100	100	95-100	90-100	30-55	5-30
New Cambria:											
Nw	0-14	Silty clay loam	CH, CL	A-7	0	100	100	95-100	90-100	41-60	28-45
	14-35	Silty clay, silty clay loam, clay.	CH, CL	A-7	0	100	100	95-100	85-100	41-60	28-45
	35-60	Silty clay, silty clay loam, clay.	CH, CL	A-7	0	100	100	95-100	85-100	41-60	28-45
Platte:											
[2]Pa	0-8	Fine sandy loam	CL-ML, ML, SM, SM-SC	A-4	0	100	95-100	70-85	40-55	20-35	3-10
	8-16	Very fine sandy loam, loam, loamy very fine sand.	ML, CL-ML	A-4	0	100	95-100	85-95	50-65	---	NP-5
	16-60	Gravelly coarse sand.	SP-SM, SM	A-1, A-3	0	70-90	50-75	30-50	5-15	---	NP
Pratt:											
Ph, Po	0-11	Loamy fine sand	SM	A-2	0	100	95-100	70-100	15-35	---	NP
	11-32	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
	32-60	Loamy fine sand, fine sand.	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-35	---	NP
[2]Pt:											
Pratt part	0-11	Loamy fine sand	SM	A-2	0	100	95-100	70-100	15-35	---	NP
	11-32	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
	32-60	Loamy fine sand, fine sand.	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-35	---	NP
Tivoli part	0-10	Loamy fine sand	SM, SP-SM	A-2, A-3	0	100	98-100	80-100	5-35	---	NP
	10-60	Fine sand, sand	SM, SP-SM	A-2, A-3	0	100	98-100	80-98	5-20	---	NP
Roxbury:											
Ro	0-14	Silt loam	ML, CL	A-4, A-6, A-7-6	0	100	100	96-100	65-98	30-45	7-20
	14-34	Silt loam, silty clay loam.	ML, CL	A-4, A-6, A-7-6	0	100	100	96-100	80-98	30-50	7-25
	34-60	Silt loam, silty clay loam, loam.	ML, CL	A-4, A-6, A-7-6	0	100	100	96-100	65-98	30-50	7-25
Tabler:											
Ta	0-8	Clay loam	CL, ML, CL-ML	A-4, A-6	0	100	100	96-100	80-98	20-40	3-18
	8-30	Silty clay, clay	CL, CH	A-7	0	100	100	96-100	90-99	41-65	18-35
	30-60	Silty clay, clay, silty clay loam.	CL, CH	A-7, A-6	0	96-100	96-100	92-100	80-99	33-60	13-33
Tivoli:											
Tv	0-6	Fine sand	SM, SP-SM	A-2, A-3	0	100	98-100	80-100	5-35	---	NP
	6-60	Fine sand, sand	SM, SP-SM	A-2, A-3	0	100	98-100	80-98	5-20	---	NP

See footnotes at end of table.

TABLE 14.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Uly:											
Ub, Uc, Ue	0-10	Silt loam	ML, CL, CL-ML	A-4, A-6	0	100	100	100	90-100	25-40	2-15
	10-18	Silt loam	ML, CL	A-4, A-6	0	100	100	100	90-100	25-40	3-18
	18-60	Silt loam	ML, CL	A-4, A-6	0	100	100	100	90-100	25-40	2-15
Wakeen:											
Wb, Wc	0-10	Silt loam	ML, CL	A-7, A-6	0	100	100	95-100	85-95	35-50	10-25
	10-36	Silty clay loam	CL, ML	A-6, A-7-6	0	100	100	95-100	85-95	35-50	10-25
	36	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
[2]Wh:											
Wakeen part	0-10	Silt loam	ML, CL	A-7, A-6	0	100	100	95-100	85-95	35-50	10-25
	10-36	Silty clay loam	CL, ML	A-6, A-7-6	0	100	100	95-100	85-95	35-50	10-25
	36	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Nibson part	0-8	Silt loam	CL	A-4, A-6	0-20	70-100	70-95	65-95	60-90	25-40	8-20
	8-19	Silty clay loam, silt loam.	CL	A-6, A-7	0-20	70-95	65-95	60-90	55-90	30-45	10-25
	19	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Waldeck:											
Wk	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
	12-40	Fine sandy loam, sandy loam.	SM, SM-SC	A-2, A-4	0	100	95-100	70-100	30-50	<25	NP-5
	40-60	Fine sand, sand	SM, SP	A-1, A-2, A-3	0	90-100	80-100	40-60	1-35	---	NP
Zenda:											
Za	0-12	Fine sandy loam	SM-SC, SC, CL, CL-ML	A-4, A-6	0	100	95-100	85-100	35-80	20-40	5-15
	12-60	Loam, clay loam	CL	A-6	0	100	95-100	85-100	55-80	25-40	10-25

[1]NP means nonplastic.

[2]This map unit is made up of two or more dominant kinds of soil. See map unit description for the composition and behavior of the whole map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[The symbol < means less than; > means greater then. The erosion tolerance factor (T) is for the entire profile. Absence of an entry means data were not available or were not estimated]

Soil name and map symbol	Depth	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete	Erosion factors: K	Erosion factors: T	Wind erodi- bility group
	In	In/hr	In/in	pH	Mmhos/cm						
Attica:											
At	0-12	2.0-6.0	0.16-0.18	5.6-7.3	<2	Low	Low	Low	0.24	5	3
	12-25	2.0-6.0	0.12-0.17	5.6-6.5	<2	Low	Low	Low	0.24		
	25-60	2.0-6.0	0.08-0.16	6.1-7.8	<2	Low	Low	Low	0.24		
Bridgeport:											
Br	0-11	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low	Low	Low	0.32	5	6
	11-60	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low	Low	Low	0.43		
Canadian:											
Ca	0-28	2.0-6.0	0.11-0.20	5.6-8.4	<2	Low	Low	Low	0.20	5	3
	28-60	2.0-20	0.07-0.20	6.1-8.4	<2	Low	Low	Low	0.20		
Canadian Variant:											
Cv	0-24	2.0-6.0	0.12-0.15	5.6-8.4	<2	Low	Low	Low	0.20	3	3
	24-60	>6.0	0.02-0.04	6.1-8.4	<2	Low	Low	Low	0.20		
Carwile:											
Cw	0-12	0.6-2.0	0.11-0.20	5.1-7.3	<2	Low	Moderate	Moderate	0.32	5	3
	12-30	0.2-2.0	0.12-0.20	5.1-7.3	<2	Moderate	High	Moderate	0.37		
	30-40	0.06-0.2	0.12-0.20	6.1-8.4	<2	High	High	Low	0.32		
	40-60	0.2-2.0	0.12-0.20	6.6-8.4	<2	High	High	Low	0.28		
Farnum:											
Fa, Fr	0-11	0.6-2.0	0.20-0.22	5.6-7.3	<2	Low	Low	Low	0.28	5	6
	11-60	0.2-0.6	0.14-0.21	6.1-8.4	<2	Moderate	Moderate	Low	0.28		
Harney:											
Ha, Hb, Hc	0-12	0.6-2.0	0.21-0.24	5.6-7.3	<2	Low	Moderate	Low	0.32	5-4	6
	12-35	0.2-0.6	0.12-0.19	6.6-8.4	<2	High	High	Low	0.43		
	35-60	0.6-2.0	0.18-0.22	7.9-8.4	<2	Low	Moderate	Low	0.43		
[1]Hd:											
Harney part	0-7	0.6-2.0	0.21-0.24	5.6-7.3	<2	Low	Moderate	Low	0.32	5-4	6
	7-40	0.2-0.6	0.12-0.19	6.6-8.4	<2	High	High	Low	0.43		
	40-60	0.6-2.0	0.18-0.22	7.9-8.4	<2	Low	Moderate	Low	0.43		
Uly part	0-7	0.6-2.0	0.22-0.24	6.1-7.3	<2	Moderate	Moderate	Low	0.32	5-4	6
	7-18	0.6-2.0	0.20-0.22	6.1-7.8	<2	Moderate	High	Low	0.43		
	18-60	0.6-2.0	0.20-0.22	7.4-8.4	<2	Low	High	Low	0.43		
Holdrege:											
Ho	0-10	0.6-2.0	0.22-0.24	5.6-6.5	<2	Moderate	Low	Low	0.32	5	6
	10-20	0.6-2.0	0.18-0.20	6.1-7.3	<2	Moderate	Low	Low	0.43		
	20-60	0.6-2.0	0.17-0.20	6.1-7.3	<2	Moderate	Low	Low	0.43		
Hord:											
Hr	0-12	0.6-2.0	0.22-0.24	6.1-7.3	<2	Low	Moderate	Low	0.32	5	6
	12-42	0.6-2.0	0.20-0.22	6.1-7.3	<2	Low	Moderate	Low	0.32		
	42-60	0.6-2.0	0.20-0.22	7.4-8.4	<2	Low	High	Low	0.43		
Kaski:											
Ka	0-18	0.6-2.0	0.18-0.22	5.6-7.3	<2	Low	Low	Low	---	---	6
	18-28	0.6-2.0	0.13-0.19	5.6-7.8	<2	Low	Low	Low	---		
	28-60	0.6-2.0	0.13-0.19	5.6-8.4	<2	Low	Low	Low	---		
Lesho:											
Lh	0-27	0.2-0.6	0.17-0.22	7.4-9.0	<2	Moderate	High	Low	---	---	4L
	27-60	>2.0	0.02-0.10	7.4-9.0	<2	Low	Low	Low	---		

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	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete	Erosion factors: K	Erosion factors: T	Wind erodibility group
	In	In/hr	In/in	pH	Mmhos/cm						
Lubbock:											
Lu	0-11	0.6-2.0	0.17-0.22	6.6-7.8	<2	Low	Moderate	Low	---	---	6
	11-36	0.2-0.6	0.11-0.19	6.6-8.4	<2	High	High	Low	---		
	36-60	0.6-2.0	0.15-0.20	7.9-8.4	<2	Low	Moderate	Low	---		
Naron:											
Na	0-11	0.6-6.0	0.14-0.20	5.6-7.3	<2	Low	Low	Low	0.20	5	3
	11-53	0.6-2.0	0.15-0.18	5.6-7.8	<2	Low	Low	Low	0.32		
	53-60	0.6-6.0	0.10-0.15	6.1-8.4	<2	Low	Low	Low	0.32		
Ness:											
Ne	0-30	<0.06	0.11-0.14	6.6-8.4	<2	Very high	High	Low	---	---	4
	30-60	0.06-2.0	0.10-0.20	7.4-8.4	<2	Moderate	Moderate	Low	---		
New Cambria:											
Nw	0-14	0.06-0.2	0.13-0.18	6.6-8.4	<2	High	High	Low	---	---	4
	14-35	0.06-0.2	0.13-0.18	7.9-8.4	<2	High	High	Low	---		
	35-60	0.06-0.6	0.12-0.16	7.9-8.4	<2	High	High	Low	---		
Platte:											
[1]Pa	0-8	2.0-6.0	0.16-0.18	6.6-8.4	<2	Low	High	Moderate	---	---	3
	8-16	2.0-6.0	0.17-0.19	6.6-8.4	<2	Low	High	Moderate	---		
	16-60	>20	0.02-0.04	6.6-8.4	<2	Low	High	Moderate	---		
Pratt:											
Ph, Po	0-11	6.0-20	0.10-0.13	5.6-7.3	<2	Low	Low	Moderate	0.17	5	2
	11-32	6.0-20	0.09-0.16	5.6-7.3	<2	Low	Low	Low	0.17		
	32-60	6.0-20	0.08-0.12	6.1-7.3	<2	Low	Low	Low	0.17		
[1]Pt:											
Pratt part	0-11	6.0-20	0.10-0.13	5.6-7.3	<2	Low	Low	Moderate	0.17	5	2
	11-32	6.0-20	0.09-0.16	5.6-7.3	<2	Low	Low	Low	0.17		
	32-60	6.0-20	0.08-0.12	6.1-7.3	<2	Low	Low	Low	0.17		
Tivoli part	0-10	6.0-20.0	0.05-0.11	6.1-7.8	<2	Low	Low	Low	0.17	5	1
	10-60	6.0-20.0	0.02-0.06	6.1-8.4	<2	Low	Low	Low	---		
Roxbury:											
Ro	0-14	0.6-2.0	0.22-0.24	7.4-8.4	<2	Moderate	Low	Low	0.32	5	4L
	14-34	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	Low	Low	0.43		
	34-60	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	Low	Low	0.43		
Tabler:											
Ta	0-8	0.2-0.6	0.15-0.24	5.6-8.4	<2	Low	Moderate	Low	0.43	5	---
	8-30	<0.06	0.12-0.18	6.1-8.4	<2	High	High	Low	0.37		
	30-60	<0.06	0.12-0.22	7.4-8.4	<2	High	High	Low	0.37		
Tivoli:											
Tv	0-6	6.0-20.0	0.05-0.11	6.1-7.8	<2	Low	Low	Low	0.17	5	1
	6-60	6.0-20.0	0.02-0.06	6.1-8.4	<2	Low	Low	Low	---		
Uly:											
Ub, Uc, Ue	0-10	0.6-2.0	0.22-0.24	6.1-7.3	<2	Moderate	Moderate	Low	0.32	5-4	6
	10-18	0.6-2.0	0.20-0.22	6.1-7.8	<2	Moderate	High	Low	0.43		
	18-60	0.6-2.0	0.20-0.22	7.4-8.4	<2	Low	High	Low	0.43		
Wakeen:											
Wb, Wc	0-10	0.6-2.0	0.21-0.24	7.4-8.4	<2	Moderate	Moderate	Low	0.32	4-3	4L
	10-36	0.6-2.0	0.18-0.20	7.4-9.0	<2	Moderate	Moderate	Low	0.43		
	36	---	---	---	---	---	---	---	---		
[1]Wh:											
Wakeen part	0-10	0.6-2.0	0.21-0.24	7.4-8.4	<2	Moderate	Moderate	Low	0.32	4-3	4L
	10-36	0.6-2.0	0.18-0.20	7.4-9.0	<2	Moderate	Moderate	Low	0.43		
	36	---	---	---	---	---	---	---	---		
Nibson part	0-8	0.6-2.0	0.20-0.24	7.4-9.0	<2	Low	Low	Low	0.37	2	4L
	8-19	0.6-2.0	0.18-0.22	7.4-9.0	<2	Moderate	Low	Low	0.37		
	19	---	---	---	---	---	---	---	---		

See footnote at end of table.

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

Soil name and map symbol	Depth	Permea-bility	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Risk of corrosion		Erosion factors		Wind erodi-bility group
							Uncoated steel	Concrete	K	T	
	In	In/hr	In/in	pH	Mmhos/cm						
Waldeck:											
Wk	0-12	2.0-6.0	0.14-0.18	7.4-8.4	<2	Low	Moderate	Low	0.20	4	3
	12-40	2.0-6.0	0.12-0.17	7.4-8.4	<2	Low	Moderate	Low	0.20		
	40-60	6.0-20	0.05-0.07	7.4-8.4	<2	Low	Moderate	Low	0.20		
Zenda:											
Za	0-12	0.6-2.0	0.16-0.18	6.6-8.4	<2	Moderate	High	Low	---	---	3
	12-60	0.6-2.0	0.15-0.19	7.4-8.4	<2	Moderate	High	Low	---		

[1]This map unit is made up of two or more dominant kinds of soil. See map unit description for the composition and behavior of the whole map unit.

TABLE 16.--SOIL AND WATER FEATURES

[Absence of an entry indicates the feature is not a concern. See text for descriptions of symbols and such terms as "rare," "brief," and "perched." The symbol < means less than; > means greater than]

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard-ness	
					Ft			In		
Attica:										
At	B	None	---	---	>6.0	---	---	>60	---	---
Bridgeport:										
Br	B	Occasional	Very brief	Apr-Sep	>6.0	---	---	>60	---	Moderate.
Canadian:										
Ca	B	Rare	---	---	>6.0	---	---	>60	---	---
Canadian Variant:										
Cv	B	Rare	---	---	>6.0	---	---	>60	---	---
Carwile:										
Cw	D	Occasional	Brief to very long.	Apr-Oct	0-2.0	Apparent	Oct-Apr	>60	---	---
Farnum:										
Fa, Fr	B	None	---	---	>6.0	---	---	>60	---	---
Harney:										
Ha, Hb, Hc	C	None	---	---	>6.0	---	---	>60	---	Low.
[1]Hd:										
Harney part	C	None	---	---	>6.0	---	---	>60	---	Low.
Uly part	B	None	---	---	>6.0	---	---	>60	---	Moderate.
Holdrege:										
Ho	B	None	---	---	>6.0	---	---	>60	---	Moderate.
Hord:										
Hr	B	Rare	---	---	>6.0	---	---	>60	---	Moderate.
Kaski:										
Ka	B	Rare	---	---	>6.0	---	---	>60	---	---
Lesho:										
Lh	C	Occasional	Very brief	Mar-Jul	2.0-6.0	Apparent	Jan-Dec	>60	---	---
Lubbock:										
Lu	C	None	---	---	>6.0	---	---	>60	---	Low.
Naron:										
Na	B	None	---	---	>6.0	---	---	>60	---	---
Ness:										
Ne	D	Frequent	Long	Mar-Dec	>6.0	---	---	>60	---	Moderate.
New Cambria:										
Nw	C	Rare	---	---	>6.0	---	---	>60	---	Low.
Platte:										
[1]Pa	B/D	Occasional	Brief	Apr-Oct	2.0-6.0	Apparent	Apr-Jun	>60	---	Moderate.
Pratt:										
Ph, Po	A	None	---	---	>6.0	---	---	>60	---	---
[1]Pt:										
Pratt part	A	None	---	---	>6.0	---	---	>60	---	---
Tivoli part	A	None	---	---	>6.0	---	---	>60	---	---
Roxbury:										
Ro	B	Common	Very brief	Apr-Sep	>6.0	---	---	>60	---	Low.

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		Potential frost action
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard-ness	
					Ft			In		
Tabler:										
Ta	D	None	---	---	2.5-3.5	Perched	Oct-Apr	>60	---	---
Tivoli:										
Tv	A	None	---	---	>6.0	---	---	>60	---	---
Uly:										
Ub, Uc, Ue	B	None	---	---	>6.0	---	---	>60	---	Moderate.
Wakeen:										
Wb, Wc	B	None	---	---	>6.0	---	---	20-40	Rippable	Low.
[1]Wh:										
Wakeen part	B	None	---	---	>6.0	---	---	20-40	Rippable	Low.
Nibson part	D	None	---	---	>6.0	---	---	10-20	Rippable	Moderate.
Waldeck:										
Wk	C	Occasional	Brief	Mar-Oct	2.0-6.0	Apparent	Oct-Apr	>60	---	---
Zenda:										
Za	C	Occasional	Very brief	Apr-Sep	2.0-6.0	Apparent	Oct-Apr	>60	---	---

[1]This map unit is made up of two or more dominant kinds of soil. See map unit description for the composition and behavior of the whole map unit.

TABLE 17.--ENGINEERING TEST DATA

[Tests performed by the Kansas Department of Transportation, in accordance with standard procedures of the American Association of State Highway and Transportation Officials (AASHTO) except as stated in footnotes 1 and 2]

Soil name and location	Parent material	Report number	Depth	Moisture density[1/]: Maximum dry density	Moisture density[1/]: Optimum moisture	Percentage less than 3 inches passing sieve--[2/]: No. 10	Percentage less than 3 inches passing sieve--[2/]: No. 40	Percentage less than 3 inches passing sieve--[2/]: No. 200	Percentage smaller than--[2/]: 0.05 mm	Percentage smaller than--[2/]: 0.02 mm	Percentage smaller than--[2/]: 0.005 mm	Percentage smaller than--[2/]: 0.002 mm	Liquid limit	Plasticity index	Classification[3/]: AASHTO	Classification[3/]: Unified
			In	Lb/cu ft	Pct								Pct			
Attica fine sandy loam:																
2,000 feet north and 1,150 feet east of the southwest corner of NW1/4SW1/4 sec. 14, T. 23 S., R. 17 W. (Modal).	Moderately sandy eolian sediments.	S71-Kans-73-1-1	0-12	123	10	100	85	33	28	18	10	8	19	3	A-2-4 (0)	SM
		73-1-2	12-25	119	12	100	94	37	32	22	15	11	22	6	A-4(0)	SM-SC
		73-1-3	36-60	122	10	100	78	20	16	11	7	6	18	2	A-2-4 (0)	SM
Carwile fine sandy loam:																
1,300 feet south and 300 feet west of the northeast corner of NE1/4NE1/4 sec. 21, T. 23 S., R. 17 W. (Modal).	Old alluvium.	S71-Kans-73-2-1	0-12	116	13	100	92	50	44	32	19	15	24	6	A-4(3)	SM-SC
		73-2-2	18-30	103	19	100	98	89	85	64	37	31	47	25	A-7-6 (15)	CL
		73-2-3	40-60	106	17	100	99	92	81	54	31	26	37	16	A-6(10)	CL
Naron fine sandy loam:																
2,300 feet north and 750 feet west of the southeast corner of NE1/4SE1/4 sec. 12, T. 23 S., R. 17 W. (Modal).	Moderately sandy eolian sediments.	S71-Kans-73-3-1	0-11	118	13	100	95	58	47	25	15	11	23	6	A-4(5)	CL-ML
		73-3-2	11-33	116	13	100	97	49	42	31	20	18	27	11	A-6(3)	SC
		73-3-3	53-65	120	13	100	93	39	33	23	15	11	21	4	A-4(1)	SM-SC
Roxbury silt loam, frequently flooded:																
675 feet east and 200 feet south of the northwest corner of NW1/4NW1/4 sec. 32, T. 20 S., R. 16 W. (Modal).	Recent alluvium.	S71-Kans-73-4-1	0-27	102	17	100	100	96	86	50	26	21	34	12	A-6(9)	CL-ML
		73-4-2	27-37	106	17	100	100	97	91	56	29	23	34	13	A-6(9)	CL
		73-4-3	37-60	107	17	100	100	97	92	56	25	20	33	11	A-6(8)	CL-ML

See footnotes at end of table.

TABLE 17.--ENGINEERING TEST DATA--Continued

Soil name and location	Parent material	Report number	Depth	Moisture density[1/]: Maximum dry density	Moisture density[1/]: Optimum moisture	Percentage less than 3 inches passing sieve--[2/]: No. 10	No. 40	No. 200	Percentage smaller than--[2/]: 0.05 mm	0.02 mm	0.005 mm	0.002 mm	Liquid limit	Plasticity index	Classification[3/]: AASHTO	Unified
			In	Lb/cu ft	Pct								Pct			
Waldeck fine sandy loam: 250 feet south and 100 feet west of the center of NE1/4 SW1/4 sec. 13, T. 23 S., R. 18 W. (Modal).	Recent alluvium.	S71-Kans-73-5-1	0-12	113	13	100	92	43	35	21	11	6	25	4	A-4(2)	SM-SC
		73-5-2	12-34	113	11	100	94	38	28	12	5	3	23	3	A-4(1)	SM
		73-5-3	34-60	111	13	89	44	1	0	0	0	0	---	[4/]NP	A-1-b (0)	SP

[1/]Based on AASHTO Designation T99-57, Method A(1), with the following variations: (1) all material is ovendried at 230° F and is crushed in a laboratory crusher, and (2) no time is allowed for dispersion of moisture after mixing with the soil material.

[2/]Mechanical analysis according to AASHTO Designation T88-57(1), with the following variations: (1) all material is ovendried at 230° F and crushed in a laboratory crusher; (2) the sample is not soaked prior to dispersion; (3) sodium silicate is used as the dispersing agent; and (4) dispersing time, in minutes, is established by dividing the plasticity index value by 2; the maximum time is 15 minutes, and the minimum time is 1 minute. Results from this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service. In the AASHTO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for naming textural classes of soils.

[3/]The Soil Conservation Service and the Bureau of Public Roads have agreed to consider that all soils having plasticity indexes within two points of the A-line are to be given a borderline classification. An example of a borderline classification is CL-ML.

[4/]Nonplastic.

TABLE 18.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates a taxadjunct to the series. See text for a description of those characteristics of this taxadjunct that are outside the range of the series]

Soil name	Family or higher taxonomic class
Attica	Coarse-loamy, mixed, thermic Udic Haplustalfs
Bridgeport	Fine-silty, mixed, mesic Fluventic Haplustolls
Canadian	Coarse-loamy, mixed, thermic Udic Haplustolls
Canadian Variant	Coarse-loamy, mixed, thermic Udic Haplustolls
Carwile	Fine, mixed, thermic Typic Argiaquolls
Farnum	Fine-loamy, mixed, thermic Pachic Argiustolls
Harney	Fine, montmorillonitic, mesic Typic Argiustolls
Holdrege	Fine-silty, mixed, mesic Typic Argiustolls
Hord	Fine-silty, mixed, mesic Cumulic Haplustolls
Kaski	Fine-loamy, mixed, thermic Cumulic Haplustolls
Lesho	Fine-loamy over sandy or sandy-skeletal, mixed, thermic Fluvaquentic Haplustolls
Lubbock	Fine, mixed, mesic Pachic Argiustolls
Naron	Fine-loamy, mixed, thermic Udic Argiustolls
Ness	Fine, montmorillonitic, mesic Udic Pellusterts
New Cambria	Fine, montmorillonitic, mesic Cumulic Haplustolls
Nibson	Loamy, carbonatic, mesic, shallow Entic Haplustolls
*Platte	Sandy, mixed, mesic Mollic Fluvaquents
Pratt	Sandy, mixed, thermic Psammentic Haplustalfs
Roxbury	Fine-silty, mixed, mesic Cumulic Haplustolls
Tabler	Fine, montmorillonitic, thermic Vertic Argiustolls
Tivoli	Mixed, thermic Typic Ustipsamments
Uly	Fine-silty, mixed, mesic Typic Haplustolls
Wakeen	Fine-silty, carbonatic, mesic Entic Haplustolls
Waldeck	Coarse-loamy, mixed, thermic Fluvaquentic Haplustolls
Zenda	Fine-loamy, mixed, thermic Fluvaquentic Haplustolls

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