United States
Department of
Agriculture

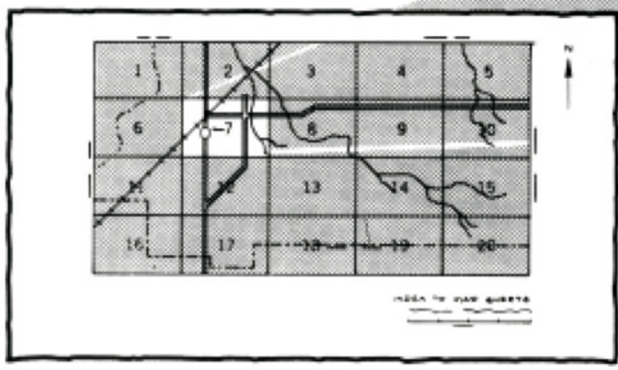
Soil
Conservation
Service

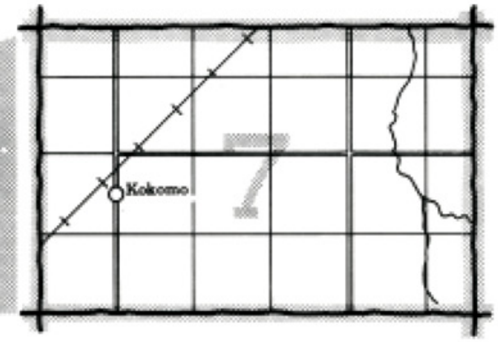
In cooperation with the
University of Nebraska
Conservation and
Survey Division

Soil Survey of Hayes County Nebraska

HOW TO USE

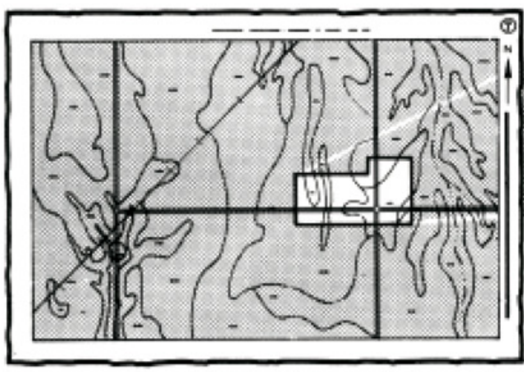
1. Locate your area of interest on the "Index to Map Sheets"

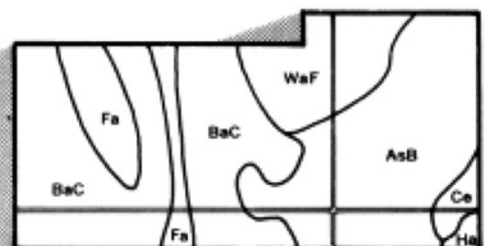




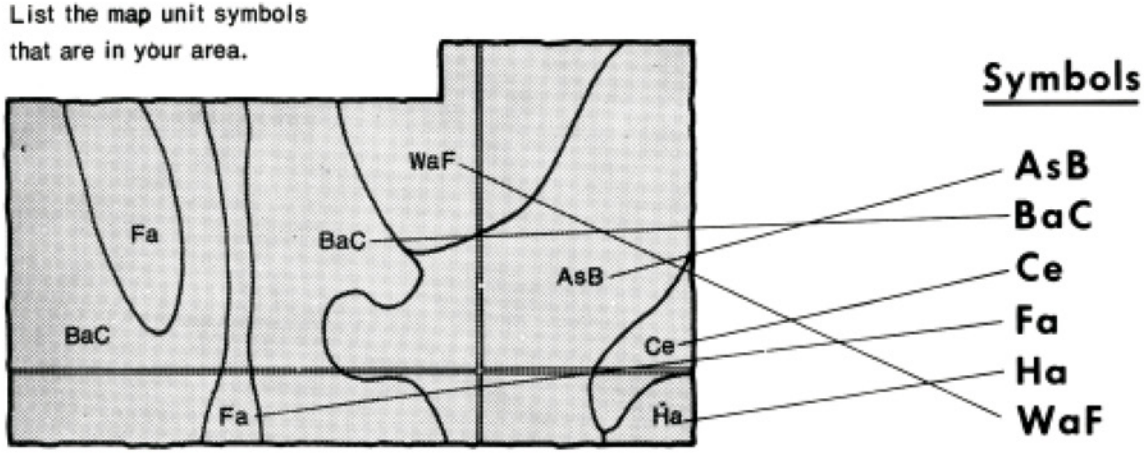
2. Note the number of the map sheet and turn to that sheet.

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



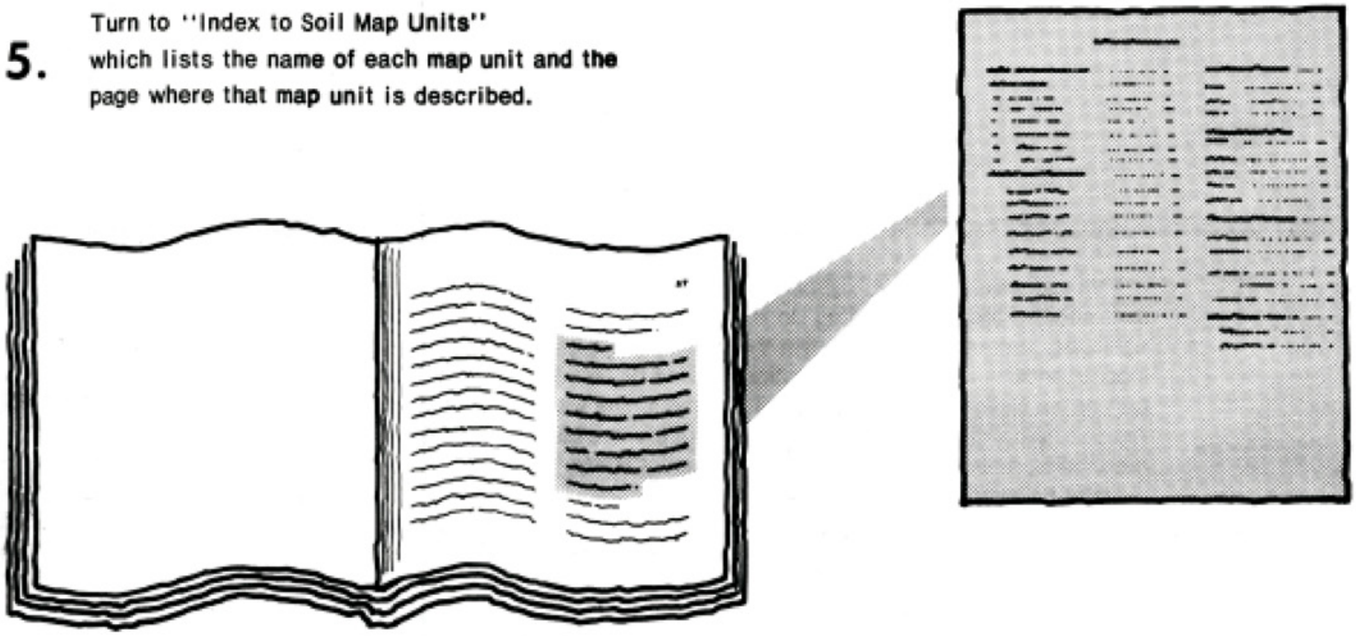


4. List the map unit symbols that are in your area.

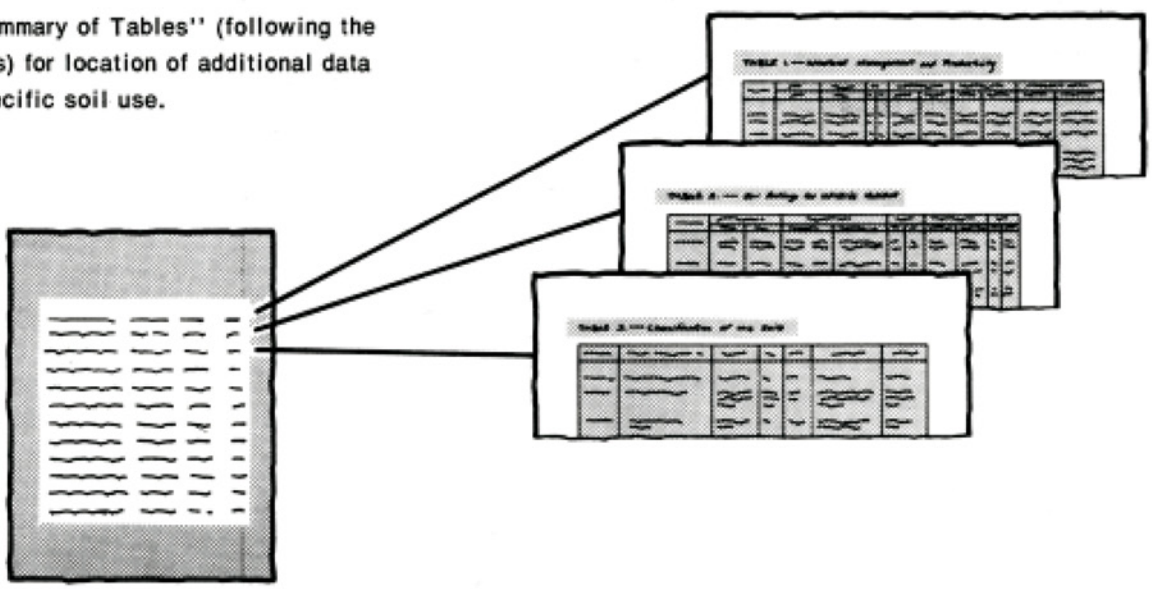


THIS SOIL SURVEY

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

Major fieldwork for this soil survey was performed in the period 1974-1980. Soil names and descriptions were approved in 1980. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1980. This survey was made cooperatively by the Soil Conservation Service and the University of Nebraska, Conservation and Survey Division. It is part of the technical assistance furnished to the Middle Republican Natural Resources District. The Middle Republican Natural Resources District provided financial assistance to purchase the high flight photography used in this survey.

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

Cover: The farmstead on the very gently sloping Kuma soil is protected by windbreaks. The steep and very steep Colby soils, background, are protected from erosion by terraces.

contents

soil series

Issued August 1982

index to map units

summary of tables

foreword

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

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

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

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

A. E. Sullivan
State Conservationist
Soil Conservation Service

soil survey of
Hayes County, Nebraska

By Steven A. Scheinost, Soil Conservation Service

Fieldwork by Steven A. Scheinost and Ronald R. Hoppes
Soil Conservation Service

United States Department of Agriculture
In Cooperation with
The University of Nebraska, Conservation and Survey Division

Hayes County is in southwest Nebraska (fig. 1). The county is rectangular in shape. It is 30 miles from east to west and 24 miles from north to south. The total area of the county is about 711 square miles, or 455,040 acres. The average elevation is 3,000 feet above sea level. Hayes Center is at an elevation of 3,058 feet. The general slope of Hayes County is southeastward.

The first soil survey of Hayes County was completed in 1934 (*4*). This newer survey provides additional information and larger scale maps that show the soils in greater detail.

The total population of Hayes County is about 1,400. Hayes Center, the county seat, is near the center of the county and is about 240 miles west of Lincoln. Hayes Center, with a population of about 250, is the largest town in the county. Other towns are Hamlet, in the southwestern part of the county, and Palisade, which is in the south-central part on the county line.

State Highway 25 is a good, paved highway extending north and south through the center of the county. U. S. 6 and a branch line of a railroad extend across the southwestern corner of the county and are in the Frenchman River Valley.

Farming and ranching are the main occupations in Hayes County, and most employment is related to agriculture. About 55 percent of the county is rangeland, and 40 percent is cropland. The remaining part is farmsteads or towns. Most farm enterprises combine cash grain crops and livestock production. Corn, small grains, alfalfa, and grain sorghum are grown extensively on the more productive soils. About 20 percent of the cropland is irrigated. Corn and alfalfa are the main irrigated crops. Crops are fed to cattle and hogs or sold for income.

Rangeland is a part of each farm throughout most of the county. The steeper canyons remain in native grass

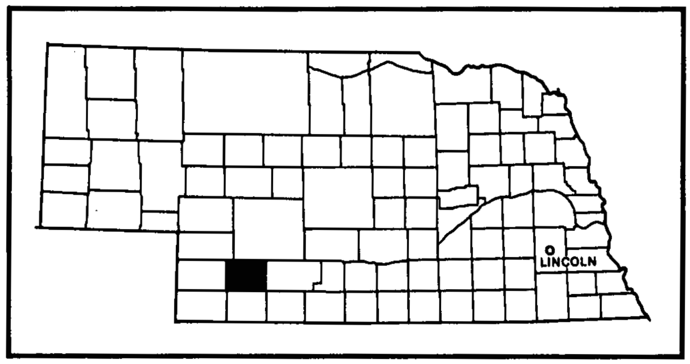


Figure 1.—Location of Hayes County in Nebraska.

and are separated by gently sloping divides that are used as cropland. Beef cattle herds are an important part of these units. The larger ranching enterprises are mainly in the sandhills in the northeastern part of the county.

Most of the soils in Hayes County are on uplands. There are three major upland physiographic divisions: The silty soils that formed in loess; the soils of the sandhill region that formed in eolian sands; and the loamy soils of the transitional region that formed in reworked eolian sands and loess. A fourth physiographic division, bottom lands, makes up a small part of the county. The bottom-land soils formed in alluvium along the Frenchman River and Stinking Water, Blackwood, and Red Willow Creeks. Water erosion and soil blowing are the principal hazards on upland soils. Lack of sufficient rainfall for crops is a concern during most growing seasons. Conservation of water by prevention of runoff and maintenance of fertility is a major concern of management.

general nature of the county

This section provides general information on Hayes County. It discusses the history and development; the physiography, relief and drainage; the geology; the climate; and the water supply.

history and development

The area that would become Hayes County was one of the last remaining in Nebraska which was natural habitat for buffalo. Many Indian battles were fought between various tribes, particularly the Pawnee and the Sioux, over the possession and use of this land. This hostility delayed settlement for many years (*4, 3*).

In 1867 General Custer established a military road through the central part of Hayes County. Also, in the 1860's and 1870's, the famous Texas cattle trail moved across the southwestern part of Hayes County and on toward Ogallala.

Hayes County was first part of a huge county called Shorter County. It included most of southwestern Nebraska. Later, it became part of Lincoln County. It was not until February 1877 that the legislature defined the present day boundaries of Hayes County. Hayes Center became the county seat on January 10, 1885.

In 1874 the Sitler, Keeler, and Paxton familes established the first homesteads where the Carrico post office would be established in 1880. In this year post offices were also established at Thornburg on Red Willow Creek and at Estelle on the Stinking Water Creek.

The population of Hayes County in 1880 was 119. By 1890 the population had increased rapidly to 3,953. In 1900 the population had decreased to 2,708, but it steadily increased again to 3,603 by 1930. Since then the population has declined steadily. A little over 1,400 people lived in Hayes County in 1980.

There is only one elementary and high school in Hayes County, which is located at Hayes Center. School districts in surrounding counties include areas of Hayes County in their districts. Adequate educational opportunities and facilities are available.

The railroad reached Palisade in 1891 and extended up the Frenchman River Valley to Imperial. It brought rapid settlement in the valleys. Soon the better land on the uplands was cropped. By 1934 total cropland reached approximately 196,000 acres. It decreased to about 177,000 acres in 1974 and has remained about the same. In 1978, 45,000 acres of wheat were harvested, 30,000 acres of corn, 18,000 acres of hay, 8,400 acres of alfalfa, and 3,500 acres of sorghum.

Irrigation development has significantly changed farm systems. In 1950 there were 2,050 acres under irrigation. In 1970 the total irrigated acres reached 15,700, and by 1978 some 35,000 acres were irrigated. Gravity irrigation is generally used on the silty soils, and sprinkler systems are generally used on the more sandy soils. All of the irrigation water is from wells.

Cropping systems and tillage practices gradually changed to cope with the soil blowing and water erosion caused by the droughts of the 1930's. Conservation tillage, contour farming, terraces, and windbreaks became common soil conservation practices.

The number of farms in Hayes County has steadily declined. In 1964 there were 390 farms, and by 1978 there were 325 farms.

Agri-businesses that supply fuel, fertilizers, and other supplies are available locally or in neighboring communities. Grain products are fed to livestock or sold through local elevators. Most livestock is sold at auction markets in adjacent counties.

physiography, relief, and drainage

Hayes County has four distinct physiographic regions that resulted from the erosive action of wind and water: Loess hills and plains, sandhills, sand-loess transitional areas, and colluvial-alluvial valleys.

The loess hills and plains are mostly in the southern half of the county. These areas are strongly dissected by moderately steep to very steep hills and canyons. The vertical height from the narrow flood plains along drainageways to the tableland is 50 to 100 feet or more. Drainage is generally well established. Some parts of the plains drain into small depressions, which then become intermittent ponds during years that have above average rainfall.

The sandhills consist mainly of stabilized rolling hills and dunes. Some areas have a choppy appearance. Little surface drainage occurs in the sandhills because precipitation is readily absorbed by the sandy soils. No lakes or marshy areas are in the sandhills of Hayes County.

Sand-loess transitional areas are between the sandhills and the loess hills and plains and are characterized by features of both types of landscape. Long ridges formed by the wind are common in the more sandy parts of the transitional areas. Where they are between drainageways, the ridges have depressions in which runoff accumulates in intermittent ponds. Some nearly level areas have poorly defined drainageways. For the most part, however, the transitional region is well drained, either internally or by drainageways.

The colluvial-alluvial valleys consist of stream terraces and bottom lands. The more extensive of these is along the Frenchman River and lower end of Red Willow Creek. Others are the narrow bottom lands along the Blackwood and Stinking Water Creeks and the upper end of Red Willow Creek. The terraces are nearly level to gently sloping and are well drained. The bottom lands are mostly well drained to somewhat poorly drained but in places are very poorly drained.

The general drainage of the county is southeastward. The main drainageways are the Frenchman River and Blackwood, Stinking Water, and Red Willow Creeks and their tributaries. All of these drain into the Republican River. The Frenchman River, Stinking Water Creek, and Red Willow Creek usually have water flowing year round. The Blackwood Creek is usually dry. Water flows only during storms or in years that have above average rainfall.

geology

In Hayes County soils formed in loess, eolian sand, alluvium, and Tertiary-Period materials of the Ogallala Formation.

The loess, eolian sand, and alluvium were deposited on a relatively uneven bedrock surface, which consists of caliche of the Ogallala Formation throughout most of the county, and a small area of Pierre Shale of the Cretaceous Period, in the south-central part of the county. In this small area, which is within the Frenchman Creek and Stinking Water Creek valleys, shale underlies the alluvium for a few miles upstream from the town of Palisade. Well records indicate, however, that most of the Pierre Shale is about 40 feet below ground level.

The Caliche bedrock is near the surface in northwestern Hayes County. It crops out on the northern valley side of Stinking Water Creek; on the valley sides of Red Willow Creek, in the southeastern part of the county; and on the valley sides of Frenchman Creek.

The loess is slightly clayey silt and varying amounts of very fine sand. It contains very little or no fine, medium, and coarse sand. The Keith, Colby, Ulysses, Duroc, Kuma, and Scott soils formed on loess-covered uplands. The very sandy Valent soils and the less sandy Sarben and Jayem soils formed in eolian sand materials. The Bridget soils, on foot slopes and stream terraces, and the McCook soils, on the bottom lands, are examples of soils that formed in silty alluvium washed down from loess-covered uplands. The Gibbon soils, on bottom lands, formed in silty alluvium that is somewhat poorly drained.

climate

In Hayes County winters are cold because incursions of cold, continental air bring fairly frequent spells of low temperature. Summers are hot but have occasional interruptions of cooler air from the north. Snowfall is fairly frequent in winter, but snow cover is usually not continuous. Rainfall is heaviest in late spring and early summer. Annual precipitation is normally adequate for wheat, sorghum, and range grasses.

Table 1 gives data on temperature and precipitation for the survey area, as recorded at Hayes Center, Nebraska, for the period 1951 to 1978. 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 28 degrees F, and the average daily minimum temperature is 15 degrees. The lowest temperature on record, which occurred at Hayes Center on January 1, 1969, is -20 degrees. In summer the average temperature is 73 degrees, and the average daily maximum temperature is 86 degrees. The highest recorded temperature, which occurred on July 12, 1954, is 114 degrees.

Growing degree days, shown in table 1, are equivalent to heat units. During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

Of the total annual precipitation, 16 inches, or 80 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 12 inches. The heaviest 1-day rainfall during the period of record was 5.28 inches at Hayes Center on July 20, 1973. Thunderstorms occur on about 50 days each year, and most occur in summer.

Average seasonal snowfall is 25 inches. The greatest depth of snow at any one time during the period of record was 16 inches. On the average, 18 days have at least 1 inch of snow on the ground, but the number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 50 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The percentage of possible sunshine is 75 percent in summer and 60 percent in winter. The prevailing wind is from the northwest.

Average windspeed is highest, 12 miles per hour, in spring.

Severe duststorms occur on occasion in spring when strong dry winds blow over unprotected soils. Tornadoes and severe thunderstorms, some with hail, occur occasionally. These storms are local and of short duration, and the pattern of damage is variable and spotty.

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

ground water

Water for domestic, livestock, and industrial uses is available from wells throughout the county. The water is of suitable quality, except for localized areas that are principally along Stinking Water Creek.

Water for irrigating farm crops can be obtained from wells throughout most of the county. The yield of water is low, however, and the water is of poor quality throughout most of the county. Records show yields from irrigation wells range from 150 to 2,700 gallons per minute. Most of the wells derive water from the saturated sand and gravel materials of the Ogallala Formation. A few wells derive water from the alluvium in the Frenchman Creek Valley. In a small area Pierre Shale underlies the Ogallala Formation, and it is of no value as a water source. Leakage from the Pierre Shale is presumed to be responsible for the poor quality of the water in some shallow domestic and livestock wells in the Stinking Water Creek Valley.

The water from livestock, domestic, and irrigation wells is rated 'hard' and 'very hard.' The hardness is often objectionable for some domestic and industrial uses, but it is not hazardous to the health of people or livestock. Softening improves the quality of the water used in the laundry and in industry. Ground water can be contaminated by drainage from feedlots, septic tanks, or other areas of waste disposal. If a domestic well is installed, samples of the water should be tested for contamination. Shallow wells tend to have more problems with contamination than deep wells.

how this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. 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; and the kinds of rock. They dug many holes to study 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 plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map units" and "Detailed soil map units."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management 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 can be used by farmers and rangeland managers, engineers, planners, developers and builders, home buyers, and others.

general soil map units

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

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

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

soil descriptions

1. Colby-Ulysses association

Deep, gently sloping to very steep, well drained to excessively drained, silty soils formed in loess; on uplands

This association consists of upland breaks and canyons (fig. 2). Slope ranges from 3 to 60 percent.

This association occupies about 170,000 acres, or 37 percent of the county. It is 81 percent Colby soils, 17 percent Ulysses soils, and 2 percent soils of minor extent.

Colby soils are on side slopes of the upland canyons and on breaks. These soils are strongly sloping to very steep and well drained to excessively drained. Typically, the surface layer of the Colby soil is grayish brown, friable, calcareous silt loam about 6 inches thick. The transitional layer is light brownish gray, friable, calcareous silt loam about 5 inches thick. The underlying material is light gray, calcareous silt loam to a depth of 60 inches or more.

Ulysses soils are in plane or concave areas of side slopes on uplands. These soils are gently sloping to moderately steep and are well drained. Typically, the surface layer of the Ulysses soil is dark grayish brown, friable silt loam about 10 inches thick. The subsoil, about 7 inches thick, is grayish brown, friable, calcareous silt loam. The underlying material is light brownish gray and light gray, calcareous silt loam to a depth of 60 inches or more.

Minor in this association are soils of the Canyon, Keith, and Kuma series and rock outcrops. Canyon soils are shallow to bedrock and are usually on the lower part of side slopes. Keith and Kuma soils have a dark surface layer, contain more clay in the subsoil, and are above the Colby and Ulysses soils on the less sloping divides. Rock outcrops usually are on the lower part of side slopes.

Farms and ranches in this association are diversified. The gently sloping and strongly sloping soils are used for cultivated crops. The moderately steep to very steep soils are used as rangeland.

Water erosion and drought are hazards. Continued overgrazing by livestock causes deterioration of the plant community and severe water erosion. As the more palatable plants decrease, shrubs, herbs, and woody plants invade.

Range management that includes proper grazing use, timely deferment of grazing, and a system that alternates grazing with rest each year maintains or improves the range condition.

2. Sarben-McCash-Jayem association

Deep, nearly level to steep, well drained, sandy and loamy soils formed in eolian and colluvial materials; on uplands

This association consists mainly of nearly level to rolling uplands (fig. 3). A few areas are hilly. Slope ranges from 0 to 20 percent.

This association occupies about 130,000 acres, or 29 percent of the county. It is 58 percent Sarben soils, 19 percent McCash soils, 17 percent Jayem soils, and 6 percent soils of minor extent.

Sarben soils are on side slopes and tops of ridges, knolls, and hills. They are gently sloping to steep and are well drained. Typically, the surface layer is dark grayish brown, very friable loamy very fine sand about 6 inches thick. The transitional layer is brown, very friable loamy very fine sand about 8 inches thick. The underlying material is pale brown, very friable loamy very fine sand to a depth of 60 inches or more.

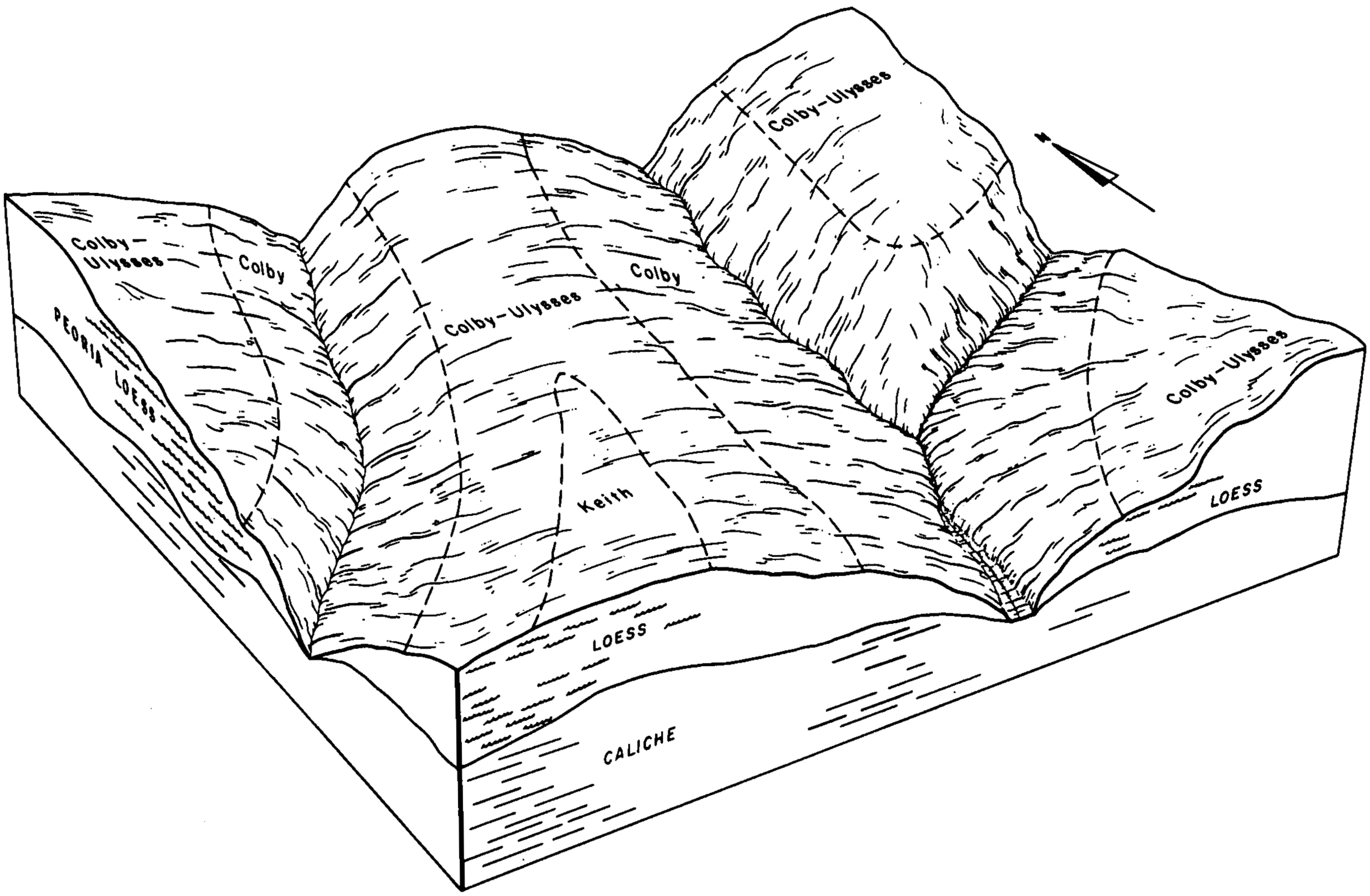


Figure 2.—The relationship of soils to topography and parent material in the Colby-Ulysses association

McCash soils are typically in long, narrow swales of uplands. They are well drained. Typically, the surface layer is brown, very friable very fine sandy loam about 8 inches thick. The subsurface layer is dark grayish brown, very friable very fine sandy loam about 7 inches thick. The subsoil is very friable very fine sandy loam about 21 inches thick. It is dark grayish brown in the upper part and brown in the lower part. The underlying material is brown loamy very fine sand to a depth of 60 inches or more.

Jayem soils are on nearly level to undulating uplands. They are well drained. Typically, the surface layer is brown, very friable loamy very fine sand about 6 inches thick. The subsurface layer is dark grayish brown, very friable very fine sandy loam about 4 inches thick. The subsoil is a loamy very fine sand about 20 inches thick. It is brown. The underlying material is light yellowish brown, loamy very fine sand to a depth of 60 inches or more.

Minor soils in this association are mainly of the Valent series. Valent soils are rolling and hilly and contain more sand throughout.

Farms in this association are diversified, and they are mainly combination cash grain-livestock enterprises. Winter wheat, corn, and alfalfa are the main crops. Over half of the association is under cultivation. The rest is in pasture or is rangeland. In the northwestern part of the county, this association has many sprinkler irrigation systems where deep, high producing wells have been drilled. The remainder of the association seems to lack a supply of good groundwater for irrigation. Livestock and domestic wells, however, can be developed throughout the association.

The major hazards are soil blowing and drought. Keeping an adequate amount of residue on the surface in cultivated areas is needed. Summer fallow is used to build moisture in the subsoil. Also, maintaining soil fertility is a concern in management.

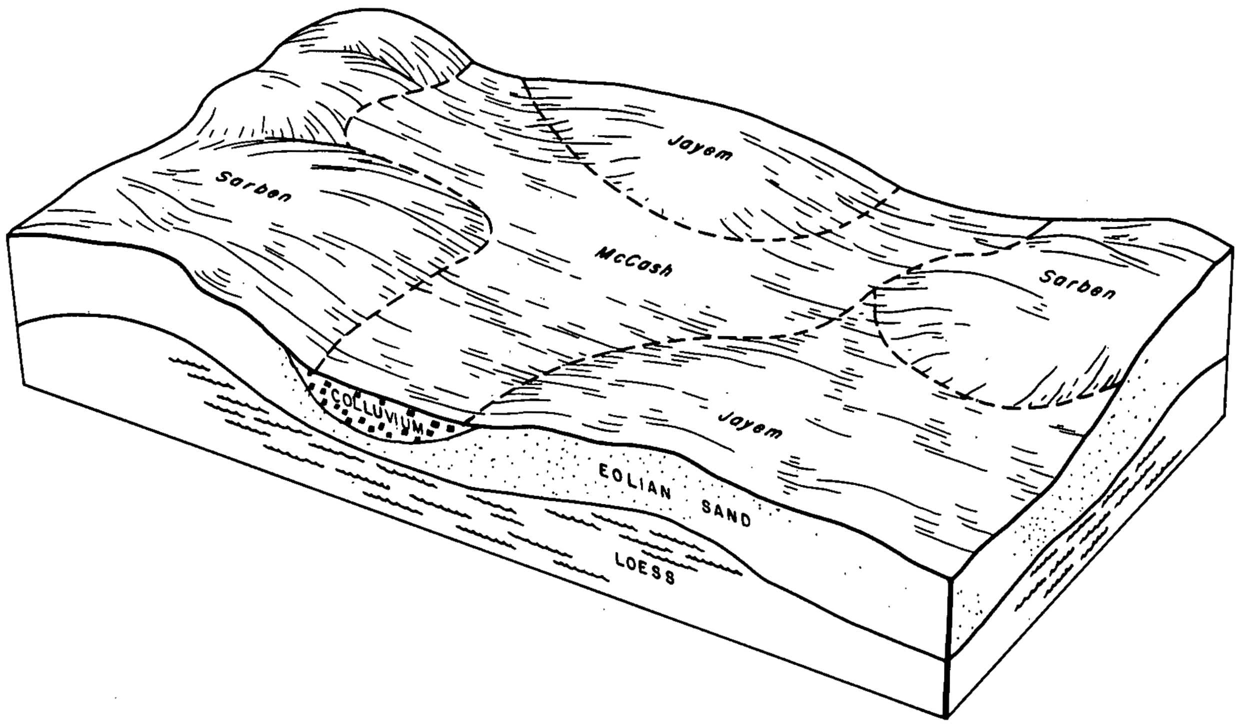


Figure 3.—The relationship of soils to topography and parent material in the Sarben-McCash-Jayem association.

3. Kuma-Keith association

Deep, nearly level to gently sloping, well drained, silty soils formed in loess; on uplands

This association consists mainly of long, smooth slopes of upland divides. Slope ranges from 0 to 6 percent.

This association occupies about 108,000 acres, or 24 percent of the county. It is 78 percent Kuma soils, 17 percent Keith soils, and 5 percent soils of minor extent.

The Kuma soils have a surface layer of dark grayish brown, friable silt loam about 7 inches thick. The subsoil is 47 inches thick. The upper part is dark gray, friable silt loam. The middle part is dark grayish brown, grayish brown, and dark gray silty clay loam. The lower part is light brownish gray, friable silt loam. The underlying material is pale brown, calcareous silt loam from a depth of 54 inches to 65 inches or more. Kuma soils have buried soil layers.

The Keith soils have a surface layer of grayish brown, very friable silt loam about 12 inches thick. The subsoil is about 17 inches thick. The upper part is brown and pale brown, friable silty clay loam. The lower part is very pale brown, very friable silt loam. The underlying material is light gray silt loam to a depth of 60 inches or more.

Minor soils in this association are in the Colby, Scott Variant, and Ulysses series. The strongly sloping and steep Colby soils do not have the dark colored surface layer. The Scott Variant is poorly drained and in depressional areas. Ulysses soils have gently sloping to steep slopes and contain less clay in the subsoil than the Kuma and Keith soils.

Farms in this association are diversified and are mainly combination cash grain-livestock enterprises. Winter wheat, corn, and alfalfa are the main crops. Most of the association is farmed. Over half is under dry cultivation. The method of irrigation is mostly by gravity systems. High producing wells are common.

These soils are susceptible to water erosion and soil blowing. Conservation tillage systems and terracing are needed to reduce water erosion. Leaving crop residue standing over winter reduces soil blowing. Summer fallow is used to help build up moisture in the subsoil on dry farmed fields.

4. Valent association

Deep, gently sloping to hilly, excessively drained, sandy soils formed in eolian sands; on uplands

This association consists mainly of hummocks, dunes, and choppy areas in the sandhills. Slope ranges from 3 to 60 percent.

This association occupies about 29,000 acres, or 6 percent of the county. It is 97 percent Valent soils and 3 percent soils of minor extent.

Typically, the surface layer is brown, loose fine sand about 7 inches thick. The underlying material is pale brown, loose fine sand to a depth of 60 inches or more.

Minor soils in this association are mainly of the Jayem and Sarben series. Jayem soils contain more clay in the subsoil than the Valent soil and are the nearly level or gently sloping. Sarben soils contain more clay throughout and are on the gently sloping to steep side slopes.

Ranches in this association are mainly cow-calf operations. Some small areas are cultivated and irrigated by center pivot irrigation systems.

The main hazards are soil blowing and drought. The main concerns of range management are: Maintaining or improving desirable kinds of grass by proper grazing or a system that alternates grazing with rest each year; establishing adequate and proper placement of water facilities and salt resources; and reseeding areas that have been cultivated in past years.

5. Bridget-McCook-Gibbon association

Deep, nearly level to gently sloping, well drained to somewhat poorly drained, silty soils formed in colluvium and alluvium; on foot slopes, stream terraces, fans, and bottom lands

This association consists mainly of long, narrow areas on foot slopes, stream terraces, and bottom lands (fig. 4). Slope ranges from 0 to 6 percent.

This association occupies about 18,000 acres, or about 4 percent of the county. It is about 48 percent Bridget soils, 31 percent McCook soils, 9 percent Gibbon soils, and 12 percent soils of minor extent.

Bridget soils are on foot slopes and high stream terraces. These soils are nearly level to gently sloping and well drained. Typically, the surface layer is dark grayish brown, friable silt loam about 13 inches thick. The transitional layer is light brownish gray, friable silt loam about 10 inches thick. The underlying material is pale brown silt loam to a depth of 60 inches or more.

McCook soils are in narrow areas along streams and rivers. They are on bottom lands and stream terraces.

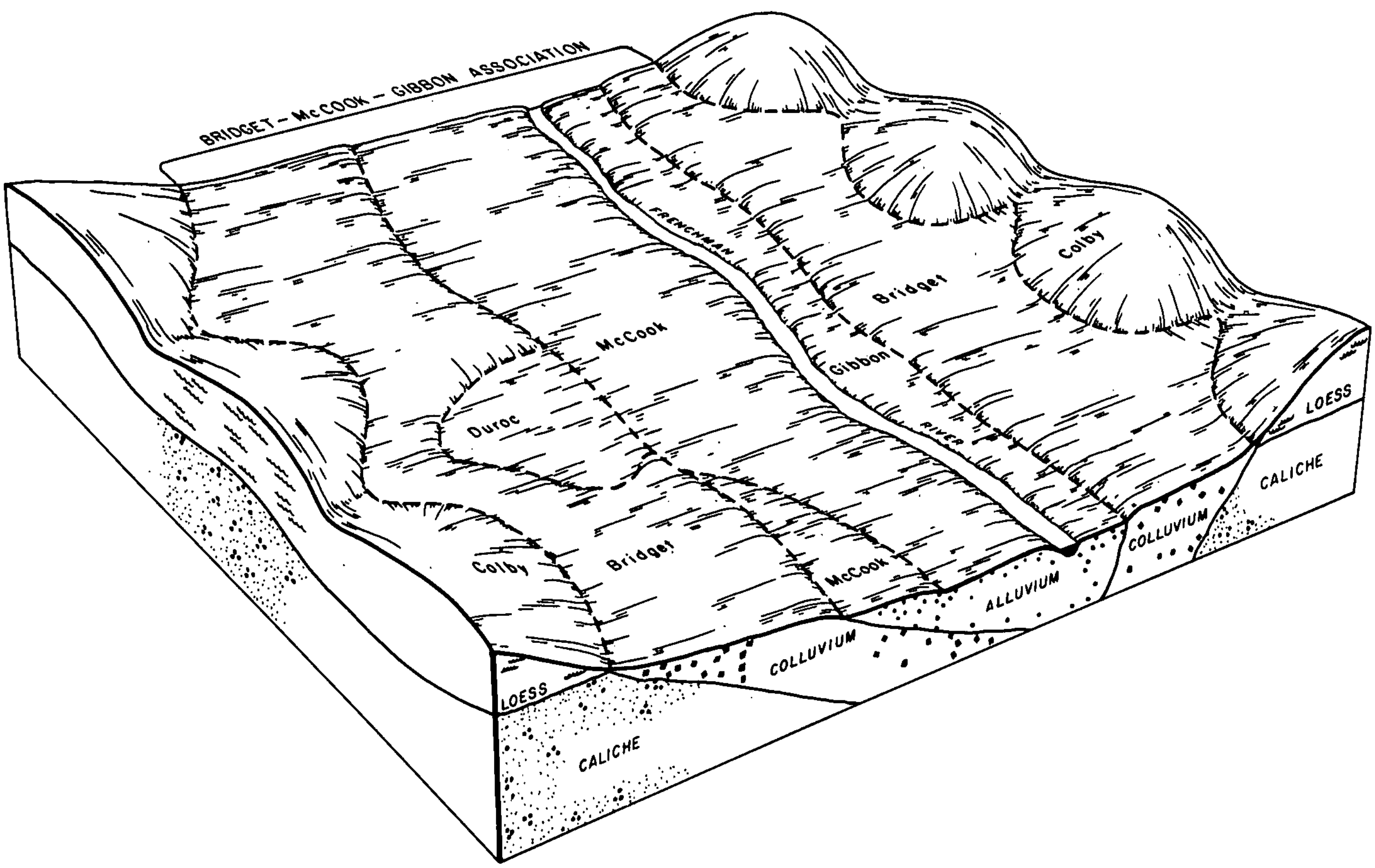


Figure 4.—The relationship of soils to topography and parent material in the Bridget-McCook-Gibbon association.

These soils are nearly level and well drained. Typically, the surface layer is grayish brown, friable silt loam about 12 inches thick. The transitional layer is a pale brown, friable silt loam about 12 inches thick. The underlying material is stratified to a depth of 60 inches or more. The upper part is very pale brown silt loam. The middle part is very pale brown very fine sandy loam. The lower part is pale brown sand and coarse sand.

Gibbon soils are on bottom lands along streams and rivers. They are nearly level and are somewhat poorly drained. They have a seasonal high water table that is 1.5 to 3.5 feet from the surface. Typically, the surface layer is grayish brown, calcareous silt loam about 7 inches thick. The transitional layer is grayish brown, calcareous silt loam about 4 inches thick. The underlying material is multi-colored, calcareous silt loam to a depth of 60 inches or more.

Minor soils in this association are in the Bankard, Duroc, and Gannett series and silty Fluvaquents. Bankard soils are on the bottom lands and are somewhat excessively drained and sandy throughout. Duroc soils contain more clay in the subsoil than the major soils and are in lower areas of the high stream terraces. Silty Fluvaquents are in the lowest areas of the bottom lands and are very poorly drained. They are usually covered by shallow water. Gannett soils are in depressions on bottom lands and are very poorly drained. The seasonal high water table ranges from 0.5 foot above the surface to 1.0 foot below the surface.

Farms in this association are diversified and are mainly combination cash grain-livestock enterprises. Corn, winter wheat, and alfalfa are the main crops. Some areas are in pasture, both dry farmed and irrigated. Over half of the Bridget soils are irrigated by a gravity system, and the remainder is dry farmed. Most of the bottom lands are used for alfalfa, hay, or pasture. Irrigation wells have been drilled throughout the association.

Water erosion and soil blowing are hazards on the Bridget soils. Rare to occasional flooding is a hazard on McCook and Gibbon soils. Maintaining soil fertility is a concern of managing cultivated areas.

detailed soil map units

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

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

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

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

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Keith silt loam, 0 to 1 percent, is one of several phases in the Keith series.

Some map units are made up of two or more major soils. These map units are called soil complexes.

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Colby-Ulysses silt loams, 9 to 30 percent slopes is an example.

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

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, sand and gravel, is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

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

Some soil boundaries and soil names may not fully match those of adjoining areas that were published at an earlier date. This is a result of changes and refinements in series concepts, different slope groupings, and application of the latest soil classification system.

soil descriptions

Ba—Bankard loamy sand, 0 to 2 percent slopes. This deep, nearly level, somewhat excessively drained soil is on bottom lands. This soil is occasionally flooded. Individual areas range from 5 to 50 acres in size.

Typically, the surface layer is light brownish gray, very friable, calcareous loamy sand about 6 inches thick. The underlying material is light brownish gray, loose, calcareous sand to a depth of 60 inches or more.

Included with this soil in mapping are small areas of the finer textured McCook and Gibbon soils. McCook soils and the Bankard soil are in the same position in the landscape. Gibbon soils are in slightly lower positions. Included soils make up from 5 to 15 percent of the unit.

Permeability in this Bankard soil is rapid, and runoff is slow or very slow. Available water capacity is low, and organic matter content is low. The intake rate for irrigation water is very high.

More than half of the acreage of this soil is farmed, and most of this is irrigated. Alfalfa is the principal crop. The rest of the acreage is in native or reseeded grass, which is used for pasture or is mowed for hay.

Under dryfarming, this soil is poorly suited to all crops. Drought and soil blowing are hazards, and low moisture supply and low fertility are limitations. Disking, chiseling, and stubble mulching that leave crop residue on the soil surface help prevent soil blowing. Incorporating crop residue and barnyard manure into the plow layer helps maintain and improve the organic matter content, fertility, and soil tilth.

Even if irrigated, this soil is poorly suited to all crops because of the low available water capacity and low fertility. Also, soil blowing can be a hazard. Disking or chiseling that leaves crop residue on the soil surface helps prevent soil blowing. Efficient management of the irrigation water is needed to prevent overwatering and loss of plant nutrients. This soil is best suited to sprinkler irrigation because water is taken into the soil at a very high rate.

This soil is suited to rangeland. This use is effective in controlling soil blowing and water erosion. Overgrazing by livestock or haying at the wrong time or with the wrong methods reduces the protective cover and causes deterioration of the native plants. Proper grazing use, timely deferment of grazing, timely haying, and a system that alternates grazing with rest each year help maintain or improve the range condition.

This soil is suited to trees and shrubs for windbreaks. Droughtiness and soil blowing are hazards. Lack of moisture can be overcome by irrigating during periods of low rainfall. Competition for moisture from weeds and grasses can be controlled by applying the appropriate herbicides, by hoeing, or by using a rotary weed cutter. Soil blowing can be overcome by maintaining strips of sod or a cover crop between the rows of trees.

This soil is not suited to sanitary facilities or building site development because of occasional flooding. A suitable alternate site should be selected. Constructing roads on well compacted fill material above flood level and providing adequate side ditches and culverts help protect roads from flood damage. The walls or sides of shallow excavations need to be shored to prevent sloughing or caving.

This soil is assigned to capability units IVe-5, dryland, and IVe-11, irrigated; the Sandy Lowland range site; and windbreak suitability group 5.

Bg—Bridget silt loam, 0 to 1 percent slopes. This deep, nearly level soil is well drained. It occurs on colluvial-alluvial stream terraces, foot slopes, and fans. Individual areas of this soil range from 5 to 80 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 18 inches thick. The transitional layer is a brown, friable silt loam about 7 inches thick. The underlying material is pale brown silt loam to a depth of 60 inches or more. In some areas the dark colored surface layer is more than 20 inches thick.

Included with this soil in mapping are small areas of Duroc and Keith soils. Duroc soils are finer textured and have dark colors to a depth of 20 inches or more. Keith soils are finer textured than the Bridget soil. Both of these soils and the Bridget soil are in the same positions on the landscape. Included soils make up less than 10 percent of the mapped area.

Permeability in the Bridget soil is moderate, and available water capacity is high. Runoff is slow. Organic matter content is moderate. The surface layer is friable and easily tilled through a wide range of moisture conditions.

Most of the acreage of this soil is in cultivated crops, but a few areas are in native grass, which is grazed or mowed for hay. Most of this soil is irrigated when water is available.

Under dryfarming, this soil is suited to wheat, alfalfa, and grasses. The lack of precipitation is the major limitation, although soil blowing is a slight hazard where the surface is not adequately protected by close-growing crops or crop residue. Stubble mulching, disking, chiseling, and summer fallow reduce the hazard of soil blowing and increase the moisture content in the subsoil. Incorporating crop residue into the plow layer improves the organic matter content and fertility.

If gravity and sprinkler irrigation systems are used, this soil is suited to corn, alfalfa, and grasses. Efficient management of the irrigation water is needed. Disking and chiseling reduce the hazard of soil blowing. Incorporating crop residue into the plow layer and applying fertilizer improve and maintain the fertility of the soil.

This soil is suited to rangeland. This use is very effective in controlling soil blowing. Overgrazing by livestock or haying at the wrong time or with the wrong methods reduces the protective cover and causes deterioration of the native plants. Proper grazing use, timely deferment of grazing or haying, and a system that alternates grazing with rest each year help maintain or improve the range condition.

This soil is suited to trees and shrubs in all types of windbreaks and shelterbelts. Competition for moisture from grasses and weeds is the principal hazard to the establishment of seedlings. This can be overcome by good site preparation and by timely cultivation between rows of trees. Some herbicides can also be used to help control weeds.

This soil is generally suited to septic tank absorption fields and dwellings. Sewage lagoons need to be lined or sealed to prevent seepage. Damage to roads and streets by frost action can be reduced by good surface drainage. Crowning the road by grading and constructing adequate side ditches help provide the needed surface drainage.

This soil is assigned to capability units IIc-1, dryland, and I-6, irrigated; Silty range site; and windbreak suitability group 3.

BgB—Bridget silt loam, 1 to 3 percent slopes. This deep, very gently sloping soil is well drained. It is on colluvial-alluvial stream terraces, foot slopes, and fans.

Individual areas of this soil range from 5 to 100 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 13 inches thick. The transitional layer is light brownish gray, friable silt loam about 10 inches thick. The underlying material is pale brown silt loam to a depth of 60 inches or more. In some areas the surface soil may be less than 7 inches thick or more than 20 inches thick.

Included with this soil in mapping are small areas of Duroc and Keith soils. Duroc soils are finer textured than this Bridget soil and are dark colored to a depth of more than 20 inches. Keith soils are also finer textured. Both these soils and the Bridget soil are in the same positions in the landscape. Included soils make up less than 10 percent of the unit.

Permeability of this Bridget soil is moderate, and available water capacity is high. Runoff is slow. Organic matter content is moderate. The surface layer is friable and easily tilled through a wide range of moisture conditions.

Most of the acreage of this soil is in cultivated crops, and the rest is in native grass, which is grazed or mowed for hay. Most of this soil is irrigated if water is available.

Under dryfarming, this soil is suited to wheat, alfalfa, and introduced grasses. Water erosion and soil blowing are hazards where the surface is not adequately protected by close-growing crops or crop residue. Incorporating crop residue into the plow layer and applying fertilizers help to improve the organic matter content and fertility. Practices, such as stubble mulching, chiseling, and disking and summer fallowing, help to reduce the hazard of soil blowing and increase the moisture content of the subsoil. Terraces help reduce water loss during heavy rains.

If gravity and sprinkler irrigation systems are used, this soil is suited to corn, alfalfa, and introduced grasses. Efficient management of the irrigation water is needed. Soil blowing and water erosion are hazards. Such practices as disking and chiseling reduce the hazard of soil blowing and water erosion. Incorporating crop residue into the plow layer and applying fertilizer help improve and maintain the fertility of the soil.

This soil is suited to rangeland. This use is very effective in controlling soil blowing and water erosion. Overgrazing by livestock or haying at the wrong time or with the wrong methods reduces the protective cover and causes deterioration of the native plants. Proper grazing use, timely deferment from grazing or haying, and a system that alternates grazing with rest each year helps maintain or improve the range condition.

This soil is suited to trees and shrubs in all types of windbreaks and shelterbelts. Competition for moisture from grasses and weeds is a principal hazard to the establishment of seedlings. This can be overcome by good site preparation and by timely cultivation between rows of trees. Some herbicides can also be used to help control weeds.

The soil is suited to building site development. It is generally suited to septic tank absorption fields. Sewage lagoons need to be lined or sealed to prevent seepage, and grading is required to modify the slope and shape the lagoon. Damage to roads and streets by frost action can be reduced by good surface drainage. Crowning the road by grading and constructing adequate side ditches help provide the needed surface drainage.

This soil is assigned to capability units IIe-1, dryland, and IIe-6, irrigated; Silty range site; and windbreak suitability group 3.

BgC—Bridget silt loam, 3 to 6 percent slopes. This deep, gently sloping soil is well drained. It is on colluvial-alluvial stream terraces, foot slopes, and fans. Individual areas of this soil range from 5 to 30 acres in size.

Typically, the surface layer is grayish brown, friable silt loam about 10 inches thick. The transitional layer is light brownish gray, friable silt loam about 10 inches thick. The underlying material is light brownish gray and pale brown, calcareous silt loam to a depth of 60 inches or more. In some areas the surface soil is less than 7 inches thick.

Included with this soil in mapping are small areas of Keith and Ulysses soils. Keith soils are finer textured than the Bridget soil. These soils are in the same position in the landscape. Ulysses soils are finer textured but are in the steeper sloping areas. Included soils make up less than 10 percent of the mapped area.

Permeability in the Bridget soil is moderate, and available water capacity is high. Runoff is medium. Organic matter content is moderate. The surface layer is friable and easily tilled through a wide range of moisture conditions.

Most of the acreage of this soil is in cultivated crops. The rest is in native grass, which is grazed or mowed for hay.

Under dryfarming, this soil is suited to wheat, alfalfa, and introduced grasses. Water erosion and soil blowing are hazards where the surface is not adequately protected by close-growing crops or crop residue. Incorporating crop residue into the plow layer and applying fertilizer improves the organic matter content and fertility. Conservation practices, such as stubble mulching, chiseling, disking, and summer fallow, reduce the hazard of soil blowing and increase the moisture content of the subsoil. Terraces reduce water loss after heavy rains.

If sprinkler irrigation is used, this soil is suited to corn, alfalfa, and tame grasses. Water erosion is a hazard on this soil. Terraces reduce water loss after heavy rains. Incorporating crop residue into the plow layer and applying fertilizer help improve and maintain the fertility of the soil. Efficient management of the irrigation water is needed.

This soil is suited to rangeland. This use is very effective in controlling soil blowing and water erosion. Overgrazing by livestock or haying at the wrong time or with the wrong methods reduces the protective cover and causes deterioration of the native plants. Overgrazing also can result in severe soil losses by water erosion. Proper grazing use, timely deferment of grazing or haying, and a system that alternates grazing with rest each year help maintain or improve the range condition.

This soil is suited to trees and shrubs in all types of windbreaks and shelterbelts. Competition for moisture from grasses and weeds is a principal hazard to the establishment of seedlings. This can be overcome by good site preparation and by timely cultivation between rows of trees. Some herbicides can also be used to help control weeds.

This soil is generally suited to septic tank absorption fields and dwellings. Sewage lagoons need to be lined or sealed to prevent seepage, and grading is required to modify the slope and shape the lagoon. Damage to roads and streets by frost action can be reduced by good surface drainage. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

This soil is assigned to capability units IIIe-1, dryland, and IIIe-6, irrigated; Silty range site; and windbreak suitability group 3.

CcG—Canyon-Otero-Rock outcrop complex, 15 to 60 percent slopes. This map unit consists of steep and very steep, excessively drained and somewhat excessively drained soils and rock outcrops. Areas of this map unit are on dissected uplands (fig. 5). Individual areas of this unit range from 5 to 200 acres in size. They are made up of 35 to 55 percent Canyon soils, 20 to 40 percent Otero soils, and 15 to 30 percent rock outcrops. The shallow Canyon soils are above and around the rock outcrops. The deep Otero soils are in colluvial positions below the Canyon soils and rock outcrop. These soils are so intricately mixed that it is not practical to separate them in mapping.

Typically, the surface soil of the Canyon series is grayish brown loam about 4 inches thick. The transitional layer is pale brown loam about 4 inches thick. The

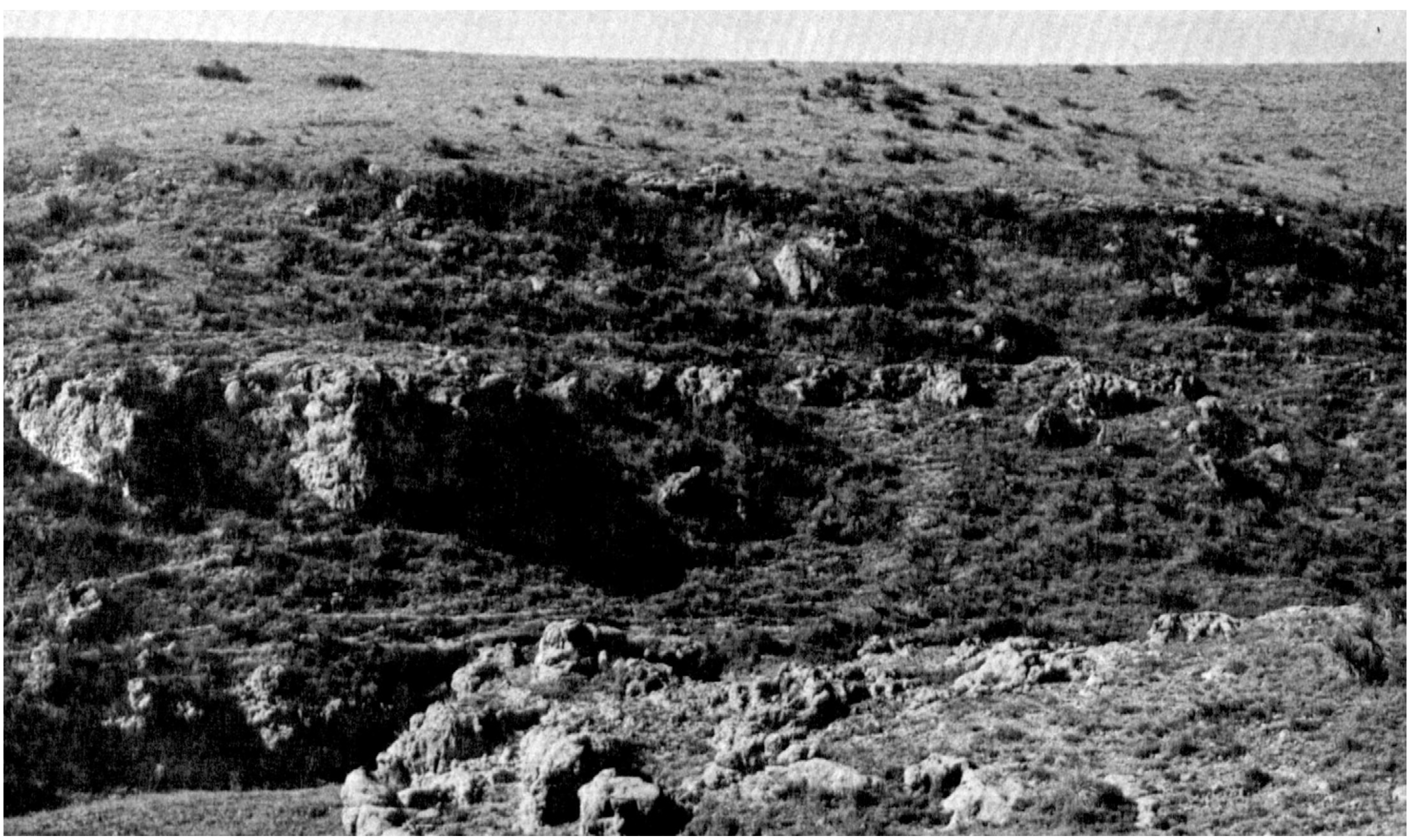


Figure 5.—Landscape of Canyon-Otero-Rock outcrop complex, 15 to 60 percent slopes. Canyon soils are above the rock outcrop, and Otero soils are usually in colluvial positions below the rock outcrop.

underlying material is a very pale brown loam about 12 inches thick. Weakly cemented caliche is at a depth of about 20 inches.

Typically, the surface soil of the Otero series is grayish brown loam about 5 inches thick. The underlying material extends to a depth of more than 60 inches. It is brown loam in the upper part and pale brown loam in the lower part. In some areas the depth to bedrock may be less than 60 inches. Also, in some areas, the surface soil may have dark colors to a depth of more than 7 inches.

Rock outcrops consist of exposed masses of bedrock and large boulders. Granitic pebbles are mixed in with the bedrock. Some areas have beds of exposed sand and gravel.

Included with this unit in mapping are small areas of Colby and Ulysses soils. Both Colby and Ulysses soils are deep and have more silt and clay than the Canyon and Otero soils. The Colby and Ulysses soils formed in loess. They are usually above the Canyon-Otero-Rock outcrop complex in the landscape.

Available water capacity is very low or low in the Canyon soil and high in the Otero soil. Permeability is moderately rapid in the Otero soil and moderate within the regolith of the Canyon soil. Organic matter content is low in both soils. Runoff is rapid or very rapid.

All of the acreage of this unit is in rangeland. It is unsuited to farming because of steep slopes and the presence of shallow soils and rock outcrops.

This unit is suited to rangeland. This use is effective in controlling water erosion. Overgrazing by livestock reduces the protective cover and causes deterioration of the native plants. It also can cause severe gully erosion. Proper grazing use, timely deferment of grazing, and a system that alternates grazing with rest each year help maintain or improve the range condition.

This unit is unsuited to windbreaks. Selected trees can be hand planted on the Otero soils for wildlife habitat.

This unit is generally unsuited to sanitary facilities and building site development. Extensive alternations of the slope or excavation of bedrock would be required. A suitable alternate site should be selected. Cuts and fills are generally needed to provide a suitable grade for roads and streets.

This unit is assigned to capability unit VIIs-4 and windbreak suitability group 10. The Canyon soil is assigned to the Shallow Limy range site and the Otero soil to the Limy Upland range site.

CdD—Colby silt loam, 6 to 9 percent slopes. This deep soil is well drained and strongly sloping. It is on convex breaks between the smooth upland divides and the steep canyons. Active erosion is evident in the thin surface layer and rilled surface. Individual areas are irregular in shape and range from 5 to 80 acres in size.

Typically, the surface layer is grayish brown, friable silt loam about 6 inches thick. The transitional layer is grayish brown, friable silt loam about 3 inches thick. The underlying material is very pale brown silt loam to a depth of 60 inches or more. Small areas of dark colluvial soils are at the base of some drainageways.

Included with this soil in mapping are the finer textured Keith soils, which are less sloping and above the Colby soil, and Ulysses soils, which are less sloping and adjacent to the Colby soil. Included soils make up less than 10 percent of the unit.

The Colby soil releases moisture readily to plants. Permeability is moderate, and available water capacity is high. Runoff is medium. Organic matter content is low. Nitrogen, phosphorous, and trace elements are often deficient in this soil.

Most of the acreage is dryfarmed. A few areas are used as rangeland.

Under dryfarming, this soil is poorly suited to growing wheat, grasses, and alfalfa for hay and pasture. Water erosion and soil blowing are hazards where the surface is not adequately protected by close-growing crops or crop residue. Terraces, stubble mulching, chiseling, disking, and contour farming can be used to reduce water erosion and soil blowing and to hold moisture in the soil. Such practices as summer fallow are used to build up moisture in the subsoil.

This soil is poorly suited to irrigation because of the severe hazard of erosion. Terraces, chiseling, contour farming, and very careful management practices in applying irrigation water can be used to reduce water erosion and to hold moisture on the fields.

This soil is suited to rangeland. This use is very effective in controlling soil blowing and water erosion. Overgrazing by livestock reduces the protective cover and causes deterioration of the native plants. It also can cause severe gully erosion. Proper grazing use, timely deferment of grazing, and a system that alternates grazing with rest each year help maintain or improve the range condition. Seeding to range may be needed on severely eroded cropland to stabilize the soils.

This soil is suited to trees and shrubs in windbreaks. Drought and competition from weeds and grasses are the principal hazards for the young seedlings. Irrigation can provide supplemental moisture during periods of insufficient rainfall. Cultivation between rows and the careful use of appropriate herbicides control weeds.

Land shaping and installation on the contour are generally necessary for the proper operation of a septic tank absorption field. If the soil is used for sewage lagoons, grading is required to modify the slope and to shape the lagoon. Buildings should be designed to fit the natural slope of the soil, or the soil can be graded to an acceptable level. Roads and streets need to be designed so that the surface pavement and base materials are thick enough to compensate for the low strength of the soil material. Coarser-grained base material can be substituted to ensure better performance.

This soil is assigned to capability unit IVe-9, dryland; Limy Upland range site; and windbreak suitability group 8.

CdG—Colby silt loam, 30 to 60 percent slopes. This soil is deep, excessively drained, and very steep. It is in deep canyons that dissect the upland divides (fig. 6). Soil erosion is evident in a succession of "catsteps," or short, vertical exposures of undeveloped loess. Larger vertical escarpments are near the base of the canyon sides. Individual areas range from 50 acres to several hundred acres in size.

Typically, the surface layer is grayish brown, friable, calcareous silt loam about 4 inches thick. The transitional layer is light brownish gray, calcareous silt loam about 2 inches thick. The underlying material is pale brown, calcareous silt loam to a depth of 60 inches or more. In some areas the underlying material may be exposed on the surface.

Included with this soil in mapping are areas of Bridget, Canyon, and Ulysses soils and rock outcrops. Bridget soils have less clay than the Colby soil. They are less sloping and on stream terraces below the Colby soil.

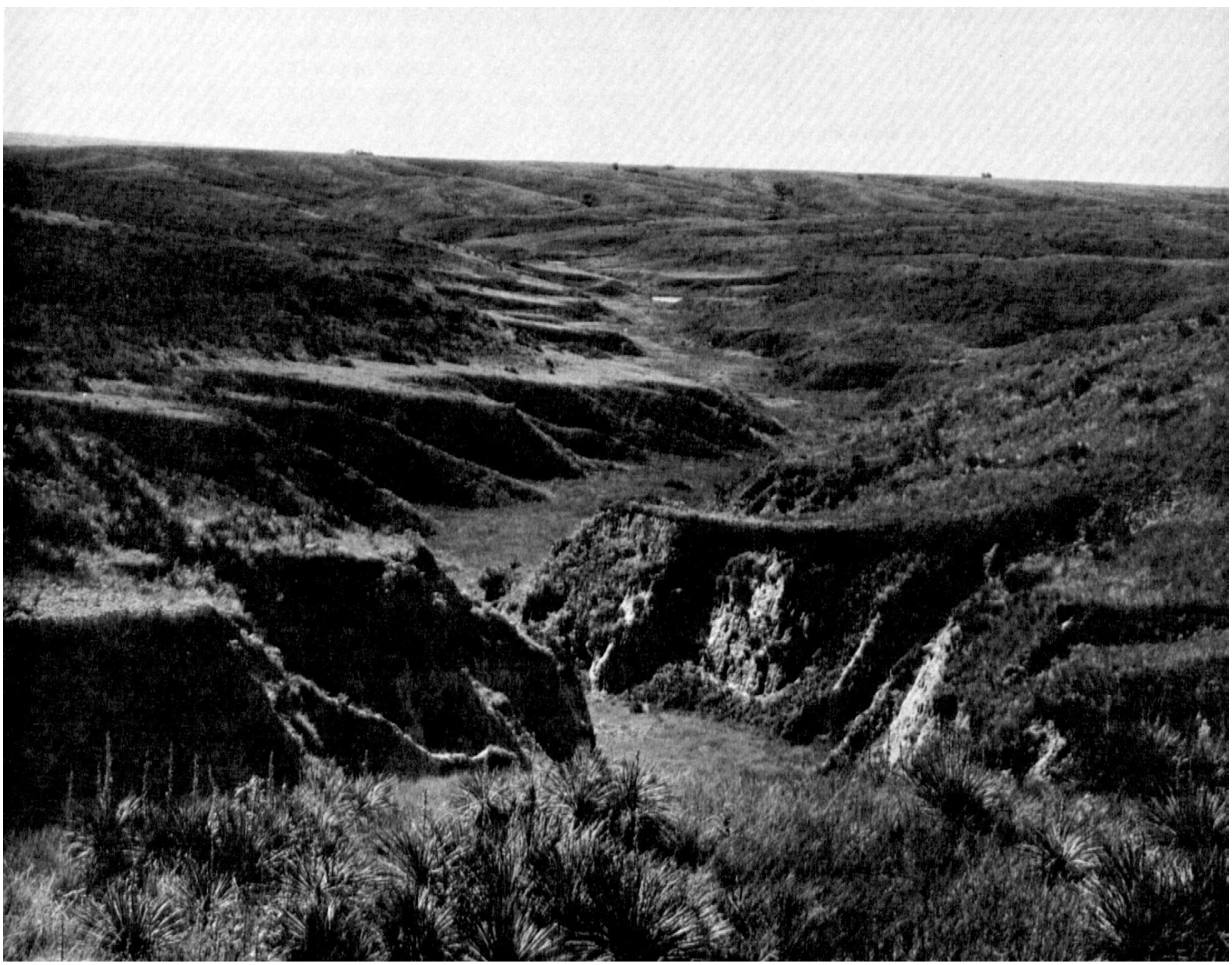


Figure 6.—Typical landscape of Colby silt loam, 30 to 60 percent slopes. The Colby soils have steep and very steep slopes. The included Ulysses soil is in less sloping areas.

Canyon soils are shallow and loamy. Both the Canyon soils and the rock outcrops occur at random. Ulysses soils have a better developed subsoil, have more than 7 inches of a darker surface layer, and are less sloping. Included soils make up from 5 to 20 percent of the unit.

Permeability in this Colby soil is moderate, and runoff is rapid. Available water capacity is high. Organic matter content is low.

All of the acreage of this soil is in rangeland. This soil is unsuited to farming because of the very steep slopes.

This soil is suited to rangeland. This use is very effective in controlling soil blowing and water erosion. Overgrazing by livestock reduces the protective cover and causes deterioration of the native plants. It also can cause severe gully erosion. Proper grazing use, timely deferment of grazing, and a system that alternates grazing with rest each year help maintain or improve the range condition.

This soil is unsuited to trees and shrubs in windbreaks. It is too steep for conventional planting equipment. Trees and shrubs for wildlife habitat could be hand planted in less sloping areas.

This soil is not suited to dwellings or sanitary facilities because of slope. Alternate sites should be selected. Roads and streets need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil material. Coarser grained base material can be substituted to ensure better performance. Cuts and fills are generally needed to provide a suitable grade for roads and streets.

This soil is assigned to capability unit VIIe-9, Thin Loess range site, and windbreak suitability group 10.

CeF—Colby-Ulysses silt loams, 9 to 30 percent slopes. This map unit consists of deep, moderately steep and steep soils on deeply dissected loess uplands. Individual areas of this unit range from 40 acres to several hundred acres in size. They are made up of 60 to 80 percent Colby soils and from 15 to 40 percent Ulysses soils. The Colby soils are on steep, convex slopes. The Ulysses soils are in less sloping areas on plane or concave slopes. The two soils are so intricately mixed or so small in size that it is not practical to separate them in mapping.

Typically, the surface layer of the Colby soil is grayish brown, friable calcareous silt loam about 6 inches thick. The transitional layer is light brownish gray, friable, calcareous silt loam about 5 inches thick. The underlying material is light gray, calcareous silt loam to a depth of 60 inches or more. In some areas the surface layer may be less than 3 inches thick. Also, the surface layer may not be calcareous.

Typically, the surface layer of the Ulysses soil is dark grayish brown, friable silt loam about 10 inches thick. The subsoil, about 7 inches thick, is grayish brown, friable, calcareous silt loam. The underlying material is light brownish gray and light gray, calcareous silt loam to a depth of 60 inches or more. In some areas the surface layer may be calcareous.

Included with these soils in mapping are areas of Bridget, Canyon, and Keith soils and rock outcrops. Bridget soils have less clay than the Colby and Ulysses soils. They are below the Colby-Ulysses soils on foot slopes and are on stream terraces. Canyon soils are shallow and loamy. These soils, along with the rock outcrops, occur anywhere in the unit. Keith soils have more clay and better subsoil development. They are less sloping and above the Colby-Ulysses soils. Included soils make up from 5 to 15 percent of the unit.

Permeability is moderate, and available water capacity is high in Colby and Ulysses soils. Runoff is medium to rapid. Organic matter is low in the Colby soil and moderate in the Ulysses soil.

All of the acreage of this map unit is in rangeland. This unit is unsuited to farming because of the steep slopes and the severe hazard of erosion. Seeding to range may be needed in severely eroded areas that have been cultivated in the past.

This unit is suited to rangeland. This use is very effective in controlling soil blowing and water erosion. Overgrazing by livestock reduces the protective cover and causes deterioration of the native plants. It also can cause severe gully erosion. Proper grazing use, timely deferment of grazing, and a system that alternates grazing with rest each year help maintain or improve the range condition.

This unit is unsuited to trees and shrubs in windbreaks. The soils are too steep for conventional planting equipment. Trees and shrubs could be hand planted in areas used for wildlife habitat.

The Colby soil generally is not suitable for building sites, sewage lagoons, and septic tank absorption fields because of the steep slope. A suitable alternate site should be selected for sewage disposal. Dwellings and buildings on the Ulysses soil should be designed to accommodate the natural slope of the land, or the soil can be graded to an acceptable level. The Ulysses soils that have slopes of less than 15 percent can be used for septic tank absorption fields. Land shaping and installation on the contour are generally necessary for the proper operation of the septic tank absorption field on the Ulysses soil. Roads and streets need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil material. Coarser-grained base material can be used to ensure better performance. Cuts and fills are generally needed to provide a suitable grade.

This unit is assigned to capability unit VIe-9 and windbreak suitability group 10. The Colby soil is assigned to Limy Upland range site and the Ulysses soil to the Silty range site.

Du—Duroc silt loam, 0 to 1 percent slopes. This deep, nearly level, well drained soil is in upland swales and on stream terraces. Individual areas of this unit are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 14 inches thick. The subsoil is about 36 inches thick. It is grayish brown, friable silt loam in the upper part and light brownish gray, calcareous silt loam in the lower part. The underlying material is pale brown, calcareous silt loam to a depth of 60 inches or more. In some areas the surface layer may be lighter in color.

Included with this soil in mapping are small areas of Bridget, Keith, and Kuma soils. Bridget soils have less clay than the Duroc soil has and do not have dark colors below 20 inches. They are in slightly higher positions in the landscape. Keith soils do not have dark colors below 20 inches and have a better developed subsoil than the Duroc soil has. Kuma soils have a buried surface soil. Both Keith and Kuma soils are in slightly higher positions in the landscape. Included soils make up from 5 to 15 percent of the unit.

This Duroc soil is easily tilled. Permeability is moderate, and available water capacity is high. Organic matter content is moderate. The intake rate for irrigation water is moderate. Runoff is slow.

Most of the acreage of this soil is cultivated, and most of the cultivated crops are irrigated when water is available. A few areas are used for rangeland.

Under dryfarming, this soil is suited to growing wheat, corn, alfalfa, grain sorghum, and grasses. The lack of precipitation is the major limitation, although soil blowing is a very slight hazard where the surface is not adequately protected by close-growing crops or by crop residue. Such practices as summer fallow and stubble mulching, chiseling, and disking are used to build up the subsoil moisture and reduce soil blowing.

This soil is suited to both gravity and sprinkler irrigation systems. Corn, alfalfa, and grasses are the principal irrigated crops grown. Incorporating crop residue and barnyard manure into the plow layer helps maintain and improve the organic matter content, fertility, and soil tilth and also increases infiltration of water.

This soil is suited to rangeland. This use is very effective in controlling soil blowing. Overgrazing by livestock or haying at the wrong time or with the wrong methods reduces the protective cover and causes deterioration of the native plants. Overgrazing also can result in severe losses of soil by water erosion. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Competition for moisture from weeds and grasses is the principal hazard and limitation to the young seedlings. This can be controlled by cultivation between rows and the use of appropriate herbicides in the rows.

This soil is generally suited to dwellings and roads. The moderate permeability of this soil is a limitation for septic tank absorption fields, but this can generally be overcome by increasing the size of the absorption field. Sewage lagoons need to be lined or sealed to prevent seepage.

This soil is assigned to capability units IIc-1, dryland, and I-6, irrigated; Silty range site and windbreak suitability group 1.

DuB—Duroc silt loam, 1 to 3 percent slopes. This deep, very gently sloping, well drained soil is in upland swales and on stream terraces. Individual areas of this unit are irregular in shape and range from 5 to 100 acres in size.

Typically, the surface layer is grayish brown, friable silt loam about 13 inches thick. The subsoil is about 29 inches thick. The upper part is grayish brown, friable silt loam. The lower part is brown, calcareous silt loam. The underlying material is light brownish gray, calcareous silt loam to a depth of 60 inches or more. In some areas the surface layer may be lighter in color. In some areas the subsoil contains less clay.

Included with this soil in mapping are small areas of Bridget, Keith, and Kuma soils. Bridget soils have less clay than the Duroc soil has, and they do not have dark colors below 20 inches. They are in a slightly higher position in the landscape. Keith soils also do not have dark colors below 20 inches. They have a better developed subsoil than the Duroc soil has. Kuma soils have a buried surface soil. Both Keith and Kuma soils are in slightly higher positions in the landscape. Included soils make up from 5 to 15 percent of the unit.

This Duroc soil is easily tilled. Permeability is moderate, and available water capacity is high. Organic matter content is moderate. The intake rate for irrigation water is moderate. Runoff is slow.

Most of the acreage of this soil is cultivated, and most of the cultivated crops are irrigated when water is available. A few areas are used for rangeland.

Under dryfarming, this soil is suited to growing wheat, corn, alfalfa, grain sorghum, and grasses. Water erosion and soil blowing are hazards where the surface is not adequately protected by growing crops or crop residue. Some practices, such as summer fallow and stubble mulching, disking, and chiseling are used to build up subsoil moisture and reduce soil blowing.

This soil is suited to both gravity and sprinkler irrigation systems. Corn, alfalfa, and grasses are the principal irrigated crops. Incorporating crop residue and barnyard manure into the plow layer helps maintain and improve the organic matter content, fertility, and soil tilth and also increases infiltration of water.

This soil is suited to rangeland. This use is very effective in controlling erosion. Overgrazing by livestock or haying at the wrong time or with the wrong methods reduces the protective cover and causes deterioration of the native plants. Overgrazing also can result in severe losses of soil by water erosion. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition.

This soil is suited to trees and shrubs in windbreaks. Competition for moisture from weeds and grasses is the principal hazard and limitation to the young seedlings. This can be controlled by cultivation between rows and by the use of appropriate herbicides in the rows.

This soil is generally suited to dwellings and roads. The moderate permeability of this soil is a limitation for septic tank absorption fields, but this can generally be overcome by increasing the size of the absorption field. Sewage lagoons need to be lined or sealed to prevent seepage, and grading is required to modify the slope and shape the lagoon.

This soil is assigned to capability units IIe-1, dryland, and IIe-6, irrigated; Silty range site; and windbreak suitability group 3.

Fu—Fluvaquents, silty. These soils are deep, level, and very poorly drained. They are in low areas on bottom lands. These soils are usually covered with 3 to 12 inches of water. Individual areas are usually long and narrow. Areas range from 5 to 80 acres in size.

Typically, the surface layer is decaying organic matter about 12 inches thick. The underlying material is dark gray and very dark gray silt loam to a depth of 48 inches. The texture, color, and thickness of these soils vary from one area to another.

Included with these soils in mapping are small areas of Gannett and Gibbon soils. Gannett soils are in slightly higher positions than the Fluvaquents and do not have shallow water covering the surface. The water table ranges from slightly above the surface to a depth of 1.0 foot. Gibbon soils are somewhat poorly drained and have a water table at a depth of 1.5 to 3.5 feet. Included soils make up less than 10 percent of the unit.

Permeability in the Fluvaquents is moderate, and runoff is ponded. Available water capacity is high, and organic matter content is very high. The seasonal high water table is near or above the surface.

All of the acreage of this soil is in cattails, rushes, and other aquatic vegetation. These areas make good habitat for aquatic wildlife and water fowl.

This soil is unsuited to farming, rangeland, windbreaks, and building site development. Alternate sites should be selected.

These soils are assigned to capability unit VIIIw-7 and windbreak suitability group 10.

Ga—Gannett silt loam, 0 to 2 percent slopes. This deep, nearly level, very poorly drained soil is in low areas of bottom lands. This soil is occasionally flooded and also is ponded. Individual areas range from 3 to 80 acres in size.

Typically, the surface layer is grayish brown, friable, calcareous silt loam about 4 inches thick. The transitional layer is gray, calcareous silt loam about 16 inches thick. The underlying material is gray, calcareous very fine sandy loam to a depth of 60 inches or more. In some areas the dark upper layers are more than 20 inches thick.

Included with this soil in mapping are small areas of the very poorly drained, silty Fluvaquents. The Fluvaquents are usually covered with shallow water. Also included are Gibbon and McCook soils. The Gibbon soils are somewhat poorly drained and have a water table from 1.5 to 3.5 feet from the surface. The well drained McCook soils are in higher positions in the landscape. Included soils make up less than 10 percent of the unit.

Permeability in the Gannett soil is moderate. Runoff is very slow or is ponded. Available water capacity is high. Organic matter content is moderate. The seasonal high water table is near or above the surface.

Most of the acreage is in native grasses that are mowed for hay. Some small areas are used for pasture during dry periods of the year.

This soil is not suited to farming because it is too wet.

This soil is suited to rangeland and native hay. Haying at the wrong time or with the wrong methods reduces the protective cover and causes deterioration of the native plants.

This soil is generally unsuited to trees and shrubs in windbreaks.

This soil is unsuited for sanitary disposal systems, roads, or building site development because of the high water table, ponding, and occasional flooding. An alternate site should be selected.

This soil is assigned to capability unit Vw-7, Wetland range site, and windbreak suitability group 10.

Gc—Gibbon silt loam, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is on bottom lands. The soil is occasionally flooded. Individual areas of this unit are commonly long and narrow and range from 5 acres to several hundred acres in size.

Typically, the surface layer is grayish brown, calcareous silt loam about 7 inches thick. The transitional layer is grayish brown, calcareous silt loam about 4 inches thick. The underlying material is multicolored, calcareous silt loam to a depth of 60 inches or more. In some areas the dark upper layers are more than 20 inches thick.

Included with this soil in mapping are small areas of silty Fluvaquents and Gannett and McCook soils. Very poorly drained, silty Fluvaquents and Gannett soils are in depressional areas that are commonly ponded. The well drained McCook soils are in slightly higher positions in the landscape. Included soils make up less than 10 percent of the unit.

This Gibbon soil is easily tilled. Permeability is moderate, and available water capacity is high. The intake of water is moderate, and runoff is slow. A seasonal high water table is at a depth of 1.5 to 3.5 feet from the surface. Organic matter content is moderate.

More than half of the acreage is farmed. Alfalfa is the predominant crop. The rest is in native or reseeded grass, which is mowed for hay, or it is in pasture.

Under dryfarming and irrigation, this soil is suited to alfalfa, corn, and grasses. Occasional flooding is a hazard on this soil. Dams, dikes, or diversions can be used to protect the fields from occasional flooding. Incorporating crop residue and barnyard manure into the plow layer helps maintain and improve the organic matter content, fertility, and soil tilth and also increases infiltration of water.

This soil is suited to rangeland for either grazing or hay. This use is effective in controlling soil blowing. Overgrazing by livestock or haying at the wrong time or with the wrong methods reduces the protective cover and causes deterioration of the native plants. In addition, when the soil is wet, overgrazing can cause surface compaction and small mounds, making continued grazing or harvesting of hay difficult. Proper grazing use and timely deferment of grazing or haying, along with restricted use during very wet periods, help keep the native plants in good condition.

This soil is suited to trees and shrubs in windbreaks. Establishment of seedlings can be a problem during years that have above average rainfall. Tilling the soil and planting the seedlings after the soil has begun to dry help reduce this problem. Also, only those species that can tolerate occasional wetness should be planted.

This soil is not suited to sanitary facilities or building site development because of occasional flooding and the high water table. An alternate site should be selected. Constructing roads on suitable, well compacted fill material above flood level and providing adequate side ditches and culverts help protect roads from flood damage and wetness from the seasonal high water table.

This soil is assigned to capability units IIw-4, dryland, and IIw-6, irrigated; Subirrigated range site; and windbreak suitability group 2S.

JaB—Jayem loamy very fine sand, 0 to 3 percent slopes. This deep, nearly level and very gently sloping, well-drained soil is on uplands. Individual areas of this unit range from 5 to 100 acres in size.

Typically, the surface layer is brown, very friable loamy very fine sand about 6 inches thick. The subsurface layer is dark grayish brown, very friable very fine sandy loam about 4 inches thick. The subsoil is brown loamy very fine sand about 20 inches thick. The underlying material is light yellowish brown, loamy very fine sand to a depth of 60 inches or more. In a few areas the surface layer is lighter in color.

Included with this soil in mapping are small areas of McCash soils. The McCash soils have dark colors that extend to a depth of more than 20 inches. They contain less fine sand than the Jayem soil. They are in depressional areas. This included soil makes up less than 10 percent of the mapped area.

Available water capacity in the Jayem soil is moderate, and permeability is moderately rapid. Organic matter content is moderately low. The intake rate for irrigation water is moderately high. The soil is easily tilled through a wide range of moisture conditions. Runoff is slow.

More than half of the acreage of this soil is in cultivated crops. The rest is in native or reseeded grasses, which are grazed or mowed for hay.

Under dryfarming, this soil is suited to wheat, grasses, and legumes. Soil blowing is a hazard where the surface is not adequately protected by close-growing crops or crop residue. Such practices as summer fallow, stubble mulching, disking, and chiseling are used to build up and to conserve moisture and to reduce the hazards of soil blowing. Fertilizers are used to build up the fertility of the soil.

If irrigated, this soil is suited to a sprinkler system. Corn is the main irrigated crop. Some alfalfa and introduced grasses are also irrigated. Soil blowing is the most serious hazard. Such practices as disking and chiseling are used to build up and to conserve moisture and to reduce the hazard of soil blowing. Efficient management of irrigation water is needed to prevent over irrigation and loss of plant nutrients. Incorporating crop residue into the plow layer and the application of fertilizers help improve and maintain the fertility of the soil.

This soil is suited to rangeland. This use is very effective in controlling soil blowing. Overgrazing by livestock or haying at the wrong time or with the wrong methods reduces the protective cover and causes deterioration of the native plants. Overgrazing also can lead to severe losses by soil blowing, which can create small blowouts. Proper grazing use, timely deferment of grazing or haying, and a system that alternates grazing with rest each year help maintain or improve the range condition. Seeding to range may be needed to stabilize severely eroded cropland.

This soil is suited to growing trees and shrubs in all types of windbreaks. Competition for moisture from grasses and weeds is the principal hazard to the establishment of seedlings. Soil blowing is also a hazard. Planting a cover crop between rows helps to control soil blowing. Good site preparation and the use of selected herbicides around the young trees to kill weeds help to conserve moisture for the trees.

This soil is generally suited to dwellings and septic tank absorption fields. Sewage lagoons need to be lined or sealed to prevent seepage. The walls or sides of shallow excavations need to be shored to prevent sloughing or caving.

This soil is assigned to capability units IIIe-5, dryland, and IIIe-10, irrigated; Sandy range site; and windbreak suitability group 5.

JaC—Jayem loamy very fine sand, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is on uplands. Individual areas of this unit are irregular in shape and range from 5 to 50 acres in size.

Typically, the surface layer is grayish brown, very friable loamy very fine sand about 7 inches thick. The subsoil is loamy very fine sand about 18 inches thick. It is brown in the upper part and pale brown in the lower part. The underlying material is light brownish gray, loamy very fine sand to a depth of 60 inches or more. In a few areas the surface layer may be lighter in color.

Included with this soil in mapping are small areas of McCash soils. McCash soils have dark colors that extend to a depth of more than 20 inches. They contain less fine sand than the Jayem soil. They are in depressional areas. This included soil makes up less than 10 percent of the unit.

The Jayem soil is easily tilled. Available water capacity is moderate, and permeability is moderately rapid. Organic matter content is moderately low. The intake rate of water is high. Runoff is slow.

Most of the acreage of this soil is in native or reseeded grass, which is grazed or mowed for hay. The remaining areas are in cultivation.

This soil is suited to rangeland. This use is very effective in controlling soil blowing and water erosion. Overgrazing by livestock or haying at the wrong time or with the wrong methods reduces the protective cover and causes deterioration of the native plants. Overgrazing can lead to severe losses by soil blowing, which can create small blowouts. Proper grazing use, timely deferment of grazing or haying, and a system that alternates grazing with rest each year help maintain or improve the range condition. Seeding to range may be needed to stabilize severely eroded cropland.

Under dryfarming, this soil is poorly suited to corn, wheat, grasses, and legumes. Soil blowing is the main hazard. Such practices as summer fallow and stubble mulching and disking are used to build up and to conserve moisture and to reduce the hazards of soil blowing. Fertilizers are used to build up the fertility of the soil.

If irrigated, this soil is suited to a sprinkler system. Corn is the main irrigated crop. Some alfalfa and introduced grasses are also irrigated. Soil blowing is the most serious hazard. Such practices as disking and chiseling are used to conserve moisture and to reduce the hazard of soil blowing. Efficient management of irrigation water is needed to prevent over irrigation and loss of plant nutrients. Incorporating crop residue into the plow layer and the application of fertilizers help improve and maintain the fertility of the soil.

This soil is suited to growing trees and shrubs in all types of windbreaks. Soil blowing and competition from grasses and weeds are principal hazards to the establishment of seedlings. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the rows of trees. Trees can be planted on the contour in combination with terraces to help prevent erosion. Selected herbicides can help kill weeds in the rows of trees.

This soil is generally suited to use for dwellings and septic tank absorption fields. Sewage lagoons need to be lined or sealed to prevent seepage. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving.

This soil is assigned to capability units IVe-5, dryland, and IVe-10, irrigated; Sandy range site; and windbreak suitability group 5.

Ke—Keith silt loam, 0 to 1 percent slopes. This deep, nearly level, well drained soil is on uplands. Individual areas of this unit are irregular in shape and range from 5 to 300 acres in size.

Typically, the surface layer is grayish brown, friable silt loam about 10 inches thick. The subsoil is about 26 inches thick. It is grayish brown silty clay loam in the upper part, light brownish gray silty clay loam in the middle part, and very pale brown, calcareous light silty clay loam in the lower part. The underlying material is very pale brown, calcareous silt loam to a depth of 60 inches or more. In some areas the dark color of the surface soil extends to a depth of more than 20 inches.

Included with this soil in mapping are small areas of the very poorly drained Scott Variant, which is in small depressional areas, and the more sloping Ulysses soils. The Ulysses soils have less clay in the subsoil than the Keith soil has. Included soils make up less than 10 percent of the unit.

This Keith soil has moderate permeability, and high available water capacity. The intake rate of irrigation water is moderately low. Organic matter content is moderate. Runoff is slow.

Most all of the acreage of this soil is in cultivated crops. A few areas are used as rangeland.

Under dryfarming, this soil is suited to growing winter wheat and grasses and legumes for hay and pasture. The lack of precipitation is the major limitation, although soil blowing is a very slight hazard where the surface is not adequately protected by close-growing crops or by crop residue. Such practices as stubble mulching, disking, and chiseling that leave crop residue on the surface help prevent soil blowing as well as conserve moisture.

If irrigated, this soil is suited to corn, alfalfa, and grain sorghum. Soil blowing is the most serious hazard. Such practices as disking and chiseling that leave crop residue on the surface help prevent soil blowing. Efficient management of the irrigation water is needed. A sprinkler or gravity system of irrigation can be used on this soil.

This soil is suited to rangeland. This use is very effective in controlling soil blowing. Overgrazing by livestock or haying at the wrong time or with the wrong methods reduces the protective cover and causes deterioration of the native plants. Overgrazing also can result in severe soil losses by soil blowing. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system helps maintain or improve the range condition.

This soil is suited to growing trees and shrubs in all types of windbreaks and shelterbelts. Competition for moisture from grasses and weeds are principal hazards to the establishment of seedlings. This can be overcome by good preparation and cultivation between rows with conventional equipment. Selected herbicides can also be used to help control weeds between rows.

This soil is generally suited to septic tank absorption fields. Sewage lagoons need to be lined or sealed to prevent seepage. Foundations for buildings need to be strengthened and backfilled with coarse materials to prevent damage by the shrinking and swelling of the soil. Roads and streets need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil material. Coarser grained base material can be used to ensure better performance.

This soil is assigned to capability units IIc-1, dryland, and I-4, irrigated; Silty range site; and windbreak suitability group 3.

KeB—Keith silt loam, 1 to 3 percent slopes. This deep, very gently sloping, well drained soil is mostly on uplands. A few small areas are on stream terraces. Individual areas of this unit are irregular in shape from 5 acres to more than 1,000 acres in size.

Typically, the surface layer is grayish brown, very friable silt loam about 12 inches thick. The subsoil is about 17 inches thick. The upper part is brown and pale brown, friable silty clay loam. The lower part is very pale brown, very friable silt loam. The underlying material is light gray silt loam to a depth of 60 inches or more. In a few areas the surface soil is lighter in color. In other areas the dark colors of the upper layers extend to a depth of more than 20 inches.

Included with this soil in mapping are small areas of the more sloping Ulysses soils. The Ulysses soils have less clay in the subsoil than the Keith soil has. This included soil makes up less than 10 percent of the unit.

The Keith soil has moderate permeability and high available water capacity. The intake rate for irrigation water is moderately low. Organic matter content is moderate. Runoff is slow to medium.

Most all of the acreage of this map unit is in cultivated crops. Some areas are irrigated when water is available. A few areas are used as rangeland.

Under dryfarming, this soil is suited to growing winter wheat, corn, and grasses and legumes for hay and pasture. Water erosion and soil blowing are hazards where the surface is not adequately protected. Such practices as stubble mulching, disking, and chiseling that leave crop residue on the surface help prevent soil blowing and water erosion as well as conserve moisture. Channel terraces are being used to reduce water loss during heavy rains and to hold more moisture in the soil for crops. Leaving fields in summer fallow builds up moisture for winter wheat. Incorporating crop residue into the plow layer helps to maintain and to improve the organic matter content, fertility, and soil tilth and also to increase infiltration of water.

If irrigated, this soil is suited to growing corn, alfalfa, and grain sorghum. Soil blowing and water erosion are the principal hazards. Such practices as disking and chiseling that leave crop residue on the surface help prevent soil blowing and water erosion. Terraces are being used to reduce loss of water and soil during heavy rains. Sprinkler irrigation systems can be used on this soil. Gravity systems are also suited where the soil has been leveled or a suitable grade is established to prevent water erosion.

This soil is suited to rangeland. Overgrazing by livestock or haying at the wrong time or with the wrong methods reduces the protective cover and causes deterioration of the plants. Overgrazing reduces the effectiveness of the protective cover in controlling soil blowing and water erosion. Proper use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition and keep the soil in good condition.

This soil is suited to growing trees and shrubs in all types of windbreaks. Competition for moisture from grass and weeds is the principal hazard to the establishment of seedlings. This can be overcome by good site preparation and by timely cultivation between rows of trees. Some herbicides can also be used in helping to control weeds.

This soil is generally suited to septic tank absorption fields. Sewage lagoons need to be lined or sealed to prevent seepage, and grading is required to modify the slope and shape the lagoon. Foundations for buildings need to be strengthened and backfilled with coarse materials to prevent damage by the shrinking and swelling of the soil. Roads and streets need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil material. Coarser grained base material can be used to ensure better performance.

This soil is assigned to capability units IIe-1, dryland, and IIe-4, irrigated; Silty range site; and windbreak suitability group 3.

KeC—Keith silt loam, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is mostly on uplands. A few small areas are on stream terraces. Individual areas of this unit are irregular in shape and range from 3 acres to approximately 150 acres in size.

Typically, the surface layer is grayish brown, very friable silt loam about 6 inches thick. The subsoil is about 22 inches thick. The upper part is dark grayish brown and brown, friable silty clay loam. The lower part is pale brown, friable silt loam. The underlying material is pale brown silt loam to a depth of 60 inches or more. In a few small areas the surface soil may be lighter in color and may contain more clay. In some concave areas the surface layer is more than 20 inches thick.

Included with this soil in mapping are small areas of the more sloping Ulysses silt loam. The Ulysses soils have less clay in the subsoil than the Keith soil has. This included soil makes up less than 10 percent of the unit.

Organic matter content in the Keith soil is moderate. This soil has moderate permeability and high available water capacity. The intake rate for irrigation water is moderately low. Runoff is medium.

Most of the acreage of this map unit is in cultivated crops. A few areas are used as rangeland.

Under dryfarming, this soil is suited to winter wheat, grasses, and legumes for hay and pasture. Water erosion and soil blowing are hazards where the surface is not adequately protected by close-growing crops or crop residue. Such practices as stubble mulching, disking, and chiseling that leave crop residue on the surface help control soil blowing and water erosion as well as conserve moisture. Terraces are being used to reduce water and soil loss during heavy rains and hold more moisture in the soil for crops.

If irrigated by a sprinkler system, this soil is suited to corn, alfalfa, and grain sorghum. Water erosion is a serious hazard. Such practices as disking and chiseling that leave crop residue on the surface help reduce water erosion. Terraces are being used to reduce water and soil loss during heavy rains.

This soil is suited to rangeland. This use is very effective in controlling soil blowing and water erosion. Overgrazing by livestock or haying at the wrong time or with the wrong methods reduces the protective cover and causes deterioration of the native plants. Overgrazing also can result in severe soil losses by water erosion. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system helps maintain or improve the range condition.

This soil is suited to growing trees and shrubs in all types of windbreaks. Competition for moisture from grasses and weeds is the principal hazard to the establishment of seedlings. This can be overcome by good site preparation and by timely cultivation between rows of trees. Some herbicides can also be used to help control weeds.

This soil is generally suited to septic tank absorption fields. Sewage lagoons need to be lined or sealed to prevent seepage, and grading is required to modify the slope and the shape of the lagoon. Foundations for buildings need to be strengthened and backfilled with coarse materials to prevent damage by the shrinking and swelling of the soil. Roads and streets need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil material. Coarser grained base material can be used to ensure better performance.

This soil is assigned to capability units IIIe-1, dryland, and IIIe-4, irrigated; Silty range site; and windbreak suitability group 3.

Ku—Kuma silt loam, 0 to 1 percent slopes. This deep, nearly level, well drained soil is on uplands. Individual areas of this unit are irregular in shape and range from 5 to 500 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 8 inches thick. The subsoil is about 14 inches thick. It is grayish brown, firm silty clay loam. A buried surface soil is at a depth of 22 inches. It is dark grayish brown, friable silt loam about 7 inches thick. The buried subsoil is about 23 inches thick. The upper part is grayish brown and light brownish gray, firm light silty clay loam. The lower part is light brownish gray, friable silt loam. The underlying material is grayish brown silt loam to a depth of 60 inches or more. In some pedons there is no buried surface layer, and the dark color of the surface layer extends to a depth of less than 20 inches.

Included with this soil in mapping are small areas of the very poorly drained Scott Variant, which occurs in small depressional areas, and the more sloping Ulysses soils. The Ulysses soils have less clay in the subsoil than the Kuma soil has. Included soils make up less than 10 percent of the unit.

This Kuma soil has moderate to moderately slow permeability and high available water capacity. The intake rate for irrigation water is moderately low. Organic matter content is moderate. Runoff is slow.

Most all of the acreage of this soil is in cultivated crops. Some areas are irrigated when water is available. A few areas are used as rangeland.

Under dryfarming, this soil is suited to growing winter wheat, corn, and grasses and legumes for hay and pasture. The lack of precipitation is the major limitation, although soil blowing is a very slight hazard where the surface is not adequately protected. Such practices as stubble mulching, disking, and chiseling that leave crop residue on the surface help prevent soil blowing as well as conserve moisture. Summer fallow is used to build up moisture for winter wheat. Incorporating crop residue into the plow layer helps maintain and improve the organic matter content, fertility, and soil tilth and also increases infiltration of water.

If irrigated, this soil is suited to growing corn, alfalfa, and grain sorghum. Soil blowing is the principal hazard. Such practices as disking and chiseling that leave crop residue on the surface help prevent soil blowing. Sprinkler irrigation systems can be used on this soil. Gravity systems are suited where the soil has been leveled or a suitable grade is established to prevent water erosion.

This soil is suited to rangeland. This use is very effective in controlling soil blowing. Overgrazing by livestock or haying at the wrong time or with the wrong methods reduces the protective cover and causes deterioration of the native plants. Proper stocking rates, deferred grazing, and a planned grazing system help maintain or improve the range condition and keep the soil in good condition.

This soil is suited to growing trees and shrubs in all windbreaks. Competition for moisture from grasses and weeds is the principal hazard to the establishment of seedlings. This can be overcome by good site preparation and timely cultivation between rows of trees. Herbicides can also be used to help control weeds between rows.

This soil is generally suited to dwellings. The moderate or moderately slow permeability of this soil is a limitation for septic tank absorption fields, but this can generally be overcome by increasing the size of the absorption field. Sewage lagoons need to be lined or sealed to prevent seepage. Roads and streets need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil material. Coarser grained base material can be used to ensure better performance.

This soil is assigned to capability units IIc-1, dryland, and I-4, irrigated; Silty range site; and windbreak suitability group 3.

KuB—Kuma silt loam, 1 to 3 percent slopes. This deep, very gently sloping, well drained soil is on uplands (fig. 7). Individual areas of this unit range from 5 acres to more than 1,000 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsoil is 47 inches thick. The upper part is dark gray, friable silt loam. The middle part is dark grayish brown, grayish brown, and dark gray silty clay loam. The lower part is light brownish gray, very friable silt loam. The underlying material extends from a depth of 54 inches to a depth of 60 inches or more. It is pale brown, calcareous silt loam. In some areas the dark surface layer is less than 20 inches thick, and the buried surface layer is absent.

Included with this soil in mapping are small areas of the poorly drained Scott Variant, which is in depressional areas, and the more sloping Ulysses soils. Ulysses soils lack a buried soil. Included soils make up less than 10 percent of the unit.

This Kuma soil has moderate to moderately slow permeability and high available water capacity. The intake rate for irrigation water is moderately low. Organic matter content is moderate. Runoff is medium.

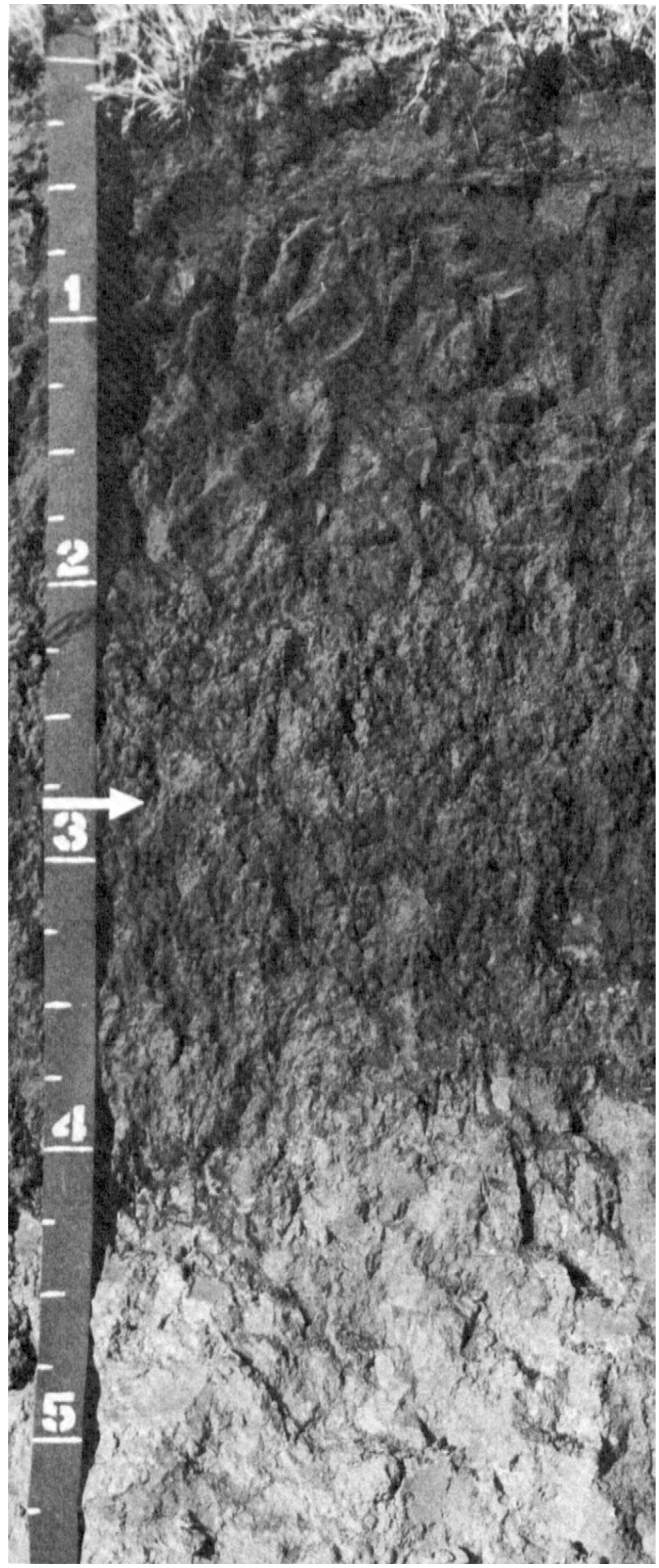


Figure 7.—Profile of Kuma silt loam, 1 to 3 percent slopes.

Most all of this soil is in cultivated crops. Some areas are irrigated. A few areas are used as rangeland.

Under dryfarming, this soil is suited to growing winter wheat, corn, and grasses and legumes for hay and pasture. Water erosion and soil blowing are hazards where the surface is not adequately protected. Such practices as stubble mulching, disking, and chiseling that leave crop residue on the surface help prevent soil blowing and water erosion as well as conserve moisture. Flat channel terraces are being used to reduce water and soil loss during heavy rains and to hold more moisture in the soil for crops. Summer fallow is used to build up moisture for winter wheat. Incorporating crop residue and green manure crops into the plow layer helps maintain and improve the organic matter content, fertility, and soil tilth and also increases infiltration of water.

If irrigated, this soil is suited to growing corn, alfalfa, and grain sorghum. Soil blowing and water erosion are the principal hazards. Such practices as disking and chiseling that leave crop residue on the surface help prevent soil blowing and water erosion. Terraces are being used to reduce water and soil loss during heavy rains. Sprinkler irrigation systems can be used on this soil. Gravity systems are also suited where the soil has been leveled or a suitable grade is established to prevent water erosion.

This soil is suited to rangeland. This use is very effective in controlling soil blowing and water erosion. Overgrazing by livestock or haying at the wrong time or with the wrong methods reduces the protective cover and causes deterioration of the native plants. Overgrazing also exposes the soil, which leads to soil blowing and water erosion. Proper stocking rates, deferred grazing, and a planned grazing system help maintain or improve the range condition and keep the soil in good condition.

This soil is suited to growing trees and shrubs in all types of windbreaks. Competition for moisture from grasses and weeds is the principal hazard to the establishment of seedlings. This can be overcome by good site preparation and timely cultivation between rows of trees. Some herbicides can also be used to help control weeds.

This soil is generally suited to dwellings. The moderate or moderately slow permeability of this soil is a limitation for septic tank absorption fields, but this can generally be overcome by increasing the size of the absorption fields. Sewage lagoons need to be lined or sealed to prevent seepage, and grading is required to modify the slope and the shape of the lagoon. Roads and streets need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil material. Coarser grained base material can be used to ensure better performance.

This soil is assigned to capability units IIe-1, dryland, and IIe-4, irrigated; Silty range site; and windbreak suitability group 3.

KuC—Kuma silt loam, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is on uplands. Individual areas of this unit are irregular in shape and range from 5 to 150 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 6 inches thick. The subsoil is 30 inches thick. It is dark brown, very dark grayish brown, and dark grayish brown silty clay loam in the upper part and grayish brown silty clay loam in the lower part. The underlying material is pale brown, calcareous silt loam to a depth of 60 inches or more. In some areas the darker colors of the surface layer may be less than 20 inches, and the buried soil layer is absent.

Included with this soil in mapping are small areas of Ulysses silt loam, which has less clay in the subsoil than the Kuma soil and is lighter colored. Ulysses soils are in the more sloping areas. Included soils make up less than 10 percent of the unit.

Organic matter content in the Kuma soil is moderate. The soil has moderate permeability to moderately slow permeability and high available water capacity. The intake rate for irrigation water is moderately low. Runoff is medium.

Most of the acreage of this map unit is in cultivated crops. A few areas are used as rangeland.

Under dryfarming, this soil is suited to growing winter wheat, corn, and grasses and legumes for hay and pasture. Water erosion and soil blowing are hazards where the surface is not adequately protected. Such practices as stubble mulching, disking, and chiseling that leave crop residue on the surface help prevent soil blowing and water erosion as well as conserve moisture. Terraces are being used to reduce water and soil loss during heavy rains and to hold more moisture in the soil for crops. Fields are left in summer fallow to build up moisture for winter wheat. Incorporating crop residue into the plow layer helps maintain and improve the organic matter content, fertility, and soil tilth and also increases infiltration of water.

If irrigated by a sprinkler system, this soil is suited to growing corn, alfalfa, and grain sorghum. Soil blowing and water erosion are the principal hazards. This soil is unsuited to gravity irrigation because of the slope, which would cause severe erosion. Such practices as disking and chiseling that leave crop residue on the surface help prevent soil blowing and water erosion. Terraces are being used to reduce water and soil loss during heavy rains.

This soil is suited to rangeland. This use is very effective in controlling soil blowing and water erosion. Overgrazing by livestock or haying at the wrong time or with the wrong methods reduces the protective cover and causes deterioration of the native plants.

Overgrazing also can result in severe soil losses by water erosion. Proper grazing use, timely deferment of grazing or haying, and a planned grazing system help maintain or improve the range condition.

This soil is suited to growing trees and shrubs in all types of windbreaks. Competition for moisture from grasses and weeds is the principal hazard to the establishment of seedlings. This can be overcome by cultivating between the rows with conventional equipment. Careful use of appropriate herbicides in the row can also help control undesirable weeds and grasses. Irrigation can provide supplemental moisture during periods of low rainfall.

This soil is generally suited to dwellings. The moderate or moderately slow permeability of this soil is a limitation for septic tank absorption fields, but this can generally be overcome by increasing the size of the absorption fields. Sewage lagoons need to be lined or sealed to prevent seepage, and grading is required to modify the slope and the shape of the lagoon. Roads and streets need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil material. Coarser grained base material can be used to ensure better performance.

This soil is assigned to capability units IIIe-1, dryland, and IIIe-4, irrigated; Silty range site; and windbreak suitability group 3.

Ma—McCash very fine sandy loam, 0 to 1 percent slopes. This deep, nearly level, well drained soil is in swales and colluvial positions on uplands. Individual areas of this unit are commonly long and narrow and range from 5 to 150 acres in size.

Typically, the surface layer is brown, very friable very fine sandy loam about 8 inches thick. The subsurface layer is dark grayish brown, very friable very fine sandy loam about 7 inches thick. The subsoil is very friable, very fine sandy loam about 21 inches thick. It is dark grayish brown in the upper part and brown in the lower part. The underlying material is brown loamy very fine sand to a depth of 60 inches or more. In some areas the dark color of the surface layer extends to a depth of less than 20 inches. Also, in places the subsoil contains more clay than the McCash soil.

Included with this soil in mapping are small areas of Jayem and Sarben soils. Jayem and Sarben soils have more fine sand in the profile than the McCash soil, and the darker colors do not extend below 20 inches. These soils are in higher positions in the landscape. Included soils make up less than 10 percent of the unit.

Permeability in the McCash soil is moderate. Available water capacity is high. Organic matter content is moderately low. The intake rate for irrigation water is moderate. Runoff is slow. The soil is easily tilled through a wide range of moisture conditions.

Most of the acreage of this soil is cultivated, and the rest is in native or reseeded grasses that are grazed or mowed for hay. Some areas are irrigated.

Under dryfarming, this soil is suited to corn, wheat, and grasses and legumes. The lack of precipitation is the major limitation, although soil blowing is a slight hazard where the surface is not adequately protected by growing crops or crop residue. Such practices as summer fallow, stubble mulching, disking, and chiseling that leave crop residue on the surface are used to build up and to conserve moisture and to reduce soil blowing.

If irrigated by a sprinkler system, this soil is suited to corn, alfalfa, and introduced grasses. Corn is the main irrigated crop. Gravity irrigation systems may not be as feasible because the surrounding, undulating soils take in water at a moderately high rate. Soil blowing is the most serious hazard. Such practices as disking and chiseling that leave crop residue on the surface help prevent soil blowing. Incorporating crop residue into the plow layer and the application of fertilizers help improve and maintain the fertility of the soil. Efficient management of the irrigation water is needed to prevent over-irrigation and loss of plant nutrients.

This soil is suited to rangeland. This use is very effective in controlling soil blowing and water erosion. Overgrazing by livestock or haying at the wrong time or with the wrong methods reduces the protective cover and causes deterioration of the native plants. Proper grazing use, timely deferment of grazing or haying, and a system that alternates grazing with rest each year help maintain or improve the range condition.

This soil is suited to growing trees and shrubs in all types of windbreaks. Competition for moisture from grasses and weeds is the principal hazard to the establishment of seedlings. Cultivating between rows and the use of selected herbicides to kill weeds around young trees help conserve moisture.

This soil is generally suited to septic tank absorption fields and dwellings. Sewage lagoons need to be lined or sealed to prevent seepage. The walls or sides of shallow excavations need to be shored to prevent sloughing or caving. Damage to roads and streets by frost action can be reduced by providing good surface drainage. Crowning the road by grading and constructing adequate side ditches help provide the needed surface drainage.

This soil is assigned to capability units IIc-1, dryland, and I-6, irrigated; Silty range site; and windbreak suitability group 1.

MaB—McCash very fine sandy loam, 1 to 3 percent slopes. This deep, very gently sloping, well drained soil is on uplands. Individual areas of this soil range from 5 to 50 acres in size.

Typically, the surface layer is dark grayish brown, very friable very fine sandy loam about 12 inches thick. The subsoil is very friable very fine sandy loam about 17 inches thick. It is dark grayish brown and brown. The underlying material is pale brown very fine sandy loam to a depth of 60 inches or more. In a few small areas the texture of the underlying material may be silt loam. Also, in a few areas the color of the surface soil extends to a depth of more than 20 inches.

Included with this soil in mapping are small areas of Jayem, Keith, and Kuma soils. Jayem soils are coarser textured than the McCash soil is. Keith and Kuma soils have more clay in the subsoil. These soils are in slightly higher positions in the landscape. Included soils make up less than 10 percent of the mapped area.

Permeability in the McCash soil is moderate, and available water capacity is high. Runoff is slow. Organic matter content is moderately low. The intake rate for irrigation water is moderate. The surface layer is very friable and easily tilled through a wide range of moisture conditions.

Most of the acreage of this soil is in cultivated crops. The rest is in native or reseeded grasses, which are grazed or mowed for hay.

Under dryfarming, this soil is suited to corn, wheat, and grasses and legumes. Soil blowing is the principal hazard on this soil. Such practices as summer fallow and stubble mulching, disking, and chiseling that leave crop residue on the surface are used to build up and to conserve moisture and to reduce the hazard of soil blowing. Terraces are used to reduce the runoff from heavy rains.

If irrigated, this soil is suited to corn, alfalfa, and introduced grasses. Soil blowing is the most serious hazard. Such practices as disking and chiseling that leave crop residue on the surface help reduce soil blowing. A sprinkler system of irrigation can be used on this soil. Gravity systems are also suited where the soil has been leveled or has been suitably graded to prevent water erosion. Incorporating crop residue into the plow layer and the application of fertilizers help improve and maintain the fertility of the soil.

This soil is suited to rangeland. This use is very effective in controlling soil blowing and water erosion. Overgrazing by livestock or haying at the wrong time or with the wrong methods reduces the protective cover and causes deterioration of the native plants. Overgrazing also can result in severe soil losses by water erosion. Proper grazing use, timely deferment of grazing or haying, and a system that alternates grazing with rest each year helps maintain or improve the range condition.

This soil is suited to growing trees and shrubs in all types of windbreaks and shelterbelts. Competition for moisture from grasses and weeds are principal hazards to the establishment of seedlings. Good site preparation, cultivation between rows, or the use of selected herbicides around young trees helps to conserve moisture for the trees.

This soil is generally suited to septic tank absorption fields and dwellings. Sewage lagoons need to be lined or sealed to prevent seepage, and grading is required to modify the slope and shape the lagoon. The walls or sides of shallow excavations need to be shored to prevent sloughing or caving. Damage to roads and streets by frost action can be reduced by providing good surface drainage. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

This soil is assigned to capability units IIe-1, dryland, and IIe-6, irrigated; Silty range site; and windbreak suitability group 3.

Mc—McCook silt loam, 0 to 2 percent slopes. This deep, nearly level, well drained soil is on bottom lands. Flooding is rare. Individual areas of this unit are commonly long and narrow and range from 5 acres to several hundred acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 13 inches thick. The transitional layer is pale brown, friable silt loam about 7 inches thick. The underlying material is stratified pale brown, light brownish gray, and dark grayish brown silt loam and very fine sandy loam to a depth of 60 inches or more. In some areas the color of the surface soil extends to a depth of more than 20 inches.

Included with this soil in mapping are small areas of Bridget and Duroc soils. Bridget soils do not have any stratified layers in the profile. Duroc soils have more clay in the profile than the McCook soil has, and the dark colors extend below a depth of 20 inches. Both Bridget and Duroc soils are in higher positions in the landscape. Included soils make up less than 10 percent of the unit.

Permeability in the McCook soil is moderate. Available water capacity is high. The intake rate for irrigation water is moderate. Runoff is slow. Organic matter content is moderate. The soil is easily tilled through a wide range of moisture conditions.

Most of the acreage of this soil is in cultivated crops, and the rest is in native or reseeded grasses, which are grazed or mowed for hay. Most of the cropland is irrigated.

Under dryfarming, this soil is suited to corn, wheat, and grasses and legumes. The lack of precipitation is a major limitation, although soil blowing is a slight hazard where the surface is not adequately protected by growing crops or crop residue. Such practices as summer fallow and stubble mulching, disking, and chiseling are used to build up and to conserve moisture and to prevent soil blowing. Incorporating crop residue into the plow layer and the use of fertilizers help to maintain good fertility in the soil.

If irrigated, this soil is suited to alfalfa, wheat, and introduced grasses. Corn is the main irrigated crop. Soil blowing is the most serious hazard where the surface is not adequately protected by close-growing crops or crop residue. Such practices as disking and chiseling that leave crop residue on the surface help reduce soil blowing. Both gravity and sprinkler systems can be used. Efficient management of the irrigation water is needed to prevent overirrigation and loss of plant nutrients. Incorporating crop residue into the plow layer and the application of fertilizers help improve and maintain the fertility of the soil.

This soil is suited to rangeland. This use is very effective in controlling soil blowing. Overgrazing by livestock or haying at the wrong time or with the wrong methods reduces the protective cover and causes deterioration of the native plants. Proper grazing use, timely deferment from grazing or haying, and a system that alternates grazing with rest each year help maintain or improve the range condition.

This soil is suited to growing trees and shrubs in all types of windbreaks. Competition for moisture from grasses and weeds is the principal hazard to the establishment of seedlings. Cultivating between rows and the use of selected herbicides to kill weeds around young trees help conserve moisture.

The hazard of rare flooding needs to be considered if this soil is to be used for sanitary facilities and building sites. Dwellings and buildings can be constructed on elevated, well compacted fill material as protection against flooding. Dikes are needed to protect sewage lagoons from flooding. Constructing roads on suitable, well compacted fill material above flood level and providing adequate side ditches and culverts help protect roads from flood damage. Damage to roads by frost action can be reduced by providing good surface drainage. Crowning the roads by grading and constructing adequate side ditches help to provide the needed surface drainage.

This soil is assigned to capability units IIc-1, dryland, and I-6, irrigated; Silty Lowland range site; and windbreak suitability group 1.

Md—McCook silt loam, occasionally flooded, 0 to 2 percent slopes. This deep, nearly level, moderately well drained soil is on bottom lands. This soil is occasionally flooded. Individual areas of this unit are commonly long and narrow and range from 5 acres to several hundred acres in size.

Typically, the surface layer is grayish brown, friable silt loam about 12 inches thick. The transitional layer is pale brown, friable silt loam about 12 inches thick. The underlying material is stratified to a depth of 60 inches or more. The upper part is very pale brown silt loam, the middle part is very pale brown very fine sandy loam, and the lower part is pale brown sand and coarse sand. In some areas the color of the surface soil extends to a depth of more than 20 inches.

Included with this soil in mapping are small areas of Bankard, Gannett, and Gibbon soils. Bankard soils have more sand and gravel in the profile than the McCook soil has. They are in the same positions in the landscape. Gannett soils have more clay than the McCook soil has and are in lower positions in the landscape. They have a water table within 24 inches from the surface. Gibbon soils have a water table from 2 to 5 feet from the surface. They are in similar positions in the landscape. Included soils make up less than 10 percent of the unit.

Permeability in this McCook soil is moderate, and available water capacity is high. The intake rate for irrigation water is moderate. Runoff is slow. Organic matter content is moderate. The soil is easily tilled through a wide range of moisture conditions.

Most of the acreage of this soil is in cultivated crops. The rest is in native or reseeded grasses, which are grazed or mowed for hay.

Under dryfarming, this soil is suited to corn, wheat, and grasses and legumes. Occasional flooding is a hazard. Also, soil blowing is a hazard where the surface is not adequately protected by close-growing crops or crop residue. Dams, dikes, or diversions can be used to help protect the fields from occasional flooding. Such practices as disking and chiseling are used to build up and conserve moisture in the soil and to prevent soil blowing. Incorporating crop residue into the plow layer and using commercial fertilizers help maintain fertility in the soil.

If irrigated, this soil is suited to corn, alfalfa, wheat, and introduced grasses. Corn is the main irrigated crop. Soil blowing is the most serious hazard and can be controlled with disking and chiseling that leave crop residue on the surface. Efficient management of irrigation water is needed to prevent overirrigation and loss of plant nutrients. Incorporating crop residue into the plow layer and applying fertilizers help improve and maintain the fertility of the soil.

This soil is suited to rangeland. This use is very effective in controlling soil blowing. Overgrazing by livestock or haying at the wrong time or with the wrong methods reduces the protective cover and causes deterioration of the native plants. Proper grazing use, timely deferment of grazing or haying, and a system that alternates grazing with rest each year help to maintain or improve the range condition.

This soil is suited to growing trees and shrubs in all types of windbreaks. Competition for moisture from grasses and weeds is the principal hazard to the establishment of seedlings. Cultivating between rows and the use of selected herbicides to kill weeds around young trees help conserve moisture.

This soil is not suited to sanitary facilities and building sites because of occasional flooding. A suitable alternate site should be considered. Constructing roads on suitable, well compacted fill material above flood level and providing adequate side ditches and culverts help protect roads from flood damage.

This soil is assigned to capability units IIw-3, dryland, and IIw-6, irrigated; Silty Lowland range site; and windbreak suitability group 1.

MfB—McCook silt loam, channeled, 0 to 3 percent slopes. This deep, well drained soil is on flood plains. The soil is dissected by channels that meander back and forth across the flood plain. The channels are 30 to 80 feet wide and 5 to 20 feet deep. This soil is subject to occasional flooding. Slopes are mainly less than 3 percent but are as much as 6 percent on some narrow benches, on streambanks, and in some deep gullies. Individual areas are long and narrow and range from 5 to 100 acres.

Typically, the surface layer is grayish brown, friable silt loam about 6 inches thick. The upper part of the underlying material is pale brown silt loam to a depth of 40 inches and is stratified with thin lenses of dark colored material. The middle part is very pale brown loamy very fine sand about 5 inches thick. The lower part is very pale brown very fine sandy loam to a depth of 60 inches or more.

Included with this soil in mapping are small areas of Gannett and Gibbon soils. Gannett soils have more clay than the McCook soil. They have a water table within 18 inches of the surface. They are in lower, depressional areas. Gibbon soils have a water table from 1.5 to 3.5 feet of the surface. Gibbon and McCook soils are in the same position in the landscape. Included soils make up 3 to 10 percent of the unit.

Permeability in this McCook soil is moderate, and available water capacity is high. Runoff is slow. Organic matter content is moderate. The seasonal high water table is usually below a depth of 6 feet.

Most of the acreage of this soil is in rangeland. Some large areas are covered by trees and shrubs. Occasional overflow, streambank cutting, and channel changes make this soil unsuitable for cultivation.

This soil is suited to rangeland. This use is effective in controlling soil blowing and water erosion. Overgrazing by livestock and deposition of silt reduce the protective cover and cause deterioration of the native plants. Proper grazing use and a system that alternates grazing with rest each year help maintain or improve range condition.

The areas that are covered with trees and shrubs provide good cover and habitat for many kinds of wildlife.

This soil is generally unsuited to windbreak plantings of any kind because of streambank cutting and changing channels. Some areas can be used for wildlife or forestation plantings if trees and shrubs are hand planted.

This soil is unsuited to dwellings, septic tanks, or sewage lagoons because of occasional flooding. Alternate sites at higher elevations should be selected. Constructing roads on suitable, well compacted fill material above flood level and providing adequate side ditches and culverts help protect roads from flood damage.

This soil is assigned to capability unit VIw-7, Silty Overflow range site, and windbreak suitability group 10.

Pt—Pits, sand and gravel. This map unit consists mostly of excavated pits which are filled with water and from which sand and gravel are removed. In most of the areas, gravel is being pumped from water-filled pits, and the areas are subject to constant changes in shape and size. Piles and ridges of waste sand and gravel border the pits. Areas range from 5 to 40 acres in size.

Included with this unit in mapping are old pits that are no longer being used and an area of silty material deposited on the surface by a dredger used to clean out irrigation canals.

Abandoned pits are not suitable for cultivation and have little value for range unless vegetation is reestablished. Some of these areas can be developed for recreation, especially fishing, and some provide limited cover for wildlife. Planting native grass and trees on these areas helps control soil blowing. Species selected must be suited to sandy, droughty conditions and low fertility.

Most of the gravel pits are privately owned and operated. Sand and gravel extracted from these pits are used mostly for roads and building material.

This map unit is assigned to capability unit VIIIs-1 and windbreak suitability group 10.

SaB—Sarben loamy very fine sand, 0 to 3 percent slopes. This deep, nearly level to very gently sloping, well drained soil is on uplands. Individual areas of this unit range from 5 acres to about 100 acres in size.

Typically, the surface layer is pale brown, very friable loamy very fine sand about 4 inches thick. The transitional layer is pale brown loamy very fine sand about 8 inches thick. The underlying material is light brownish gray and pale brown loamy very fine sand to a depth of 60 inches or more. In some areas the dark surface layer is more than 7 inches thick.

Included with this soil in mapping are small areas of McCash soils. McCash soils have darker colors that extend to a depth of more than 20 inches and contain less fine sand than the Sarben soil. They are in swales. The included soil makes up less than 10 percent of the unit.

Available water capacity in this Sarben soil is moderate, and permeability is moderately rapid. Organic matter content is low in the Sarben soil. The intake rate of water is high. This soil is easily tilled. Surface runoff is slow.

Most of the acreage of this soil is in cultivated crops. The rest is in native or reseeded grasses, which are grazed or mowed for hay.

Under dryfarming, this soil is suited to corn, winter wheat, and grasses and legumes. Soil blowing is a severe hazard, and low fertility is a limitation. Such practices as summer fallow and stubble mulching, disking, and chiseling are used to build up and to conserve moisture and to reduce the hazards of soil blowing. Incorporating crop residue into the plow layer helps maintain and improve the organic matter content, fertility, and soil tilth. Fertilizers are used to build up the fertility of the soil.

If irrigated by a sprinkler system, this soil is suited to corn, alfalfa, and introduced grasses. Soil blowing is a severe hazard that can be reduced by leaving a crop residue on the soil surface. Incorporating crop residue into the plow layer helps maintain and improve the organic matter content, fertility, and soil tilth.

This soil is suited to gravity irrigation if the slope is from 0 to 1.5 percent and maximum length of the run is from 300 to 500 feet. The high intake rate of water is a limitation to the length of runs. Soil blowing is a severe hazard in the spring time. It can be overcome by leaving a crop residue on the surface. Incorporating crop residue and green manure crops into the plow layer helps maintain and improve the organic matter content, fertility, and soil tilth.

This soil is suited to rangeland. This use is very effective in controlling water erosion and soil blowing. Overgrazing by livestock or haying at the wrong time or with the wrong methods reduces the protective cover and causes deterioration of the native plants. Overgrazing can also cause severe losses by soil blowing and create small blowouts. Proper grazing use, timely deferment of grazing or haying, and a system that alternates grazing with rest each year help maintain or improve the range condition.

This soil is suited to growing trees and shrubs in all types of windbreaks. Soil blowing and competition from grasses and weeds are principal hazards to the establishment of seedlings. Soil blowing can be controlled by maintaining strips of sod or by a cover crop between the rows of trees. Selected herbicides can help kill weeds in tree rows.

This soil is generally suited to use as septic tank absorption fields and dwellings. Sewage lagoons need to be lined or sealed to prevent seepage. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving.

This soil is assigned to capability units IIIe-5, dryland, and IIIe-10, irrigated; Sandy range site; and windbreak suitability group 5.

SaC—Sarben loamy very fine sand, 3 to 6 percent slopes. This deep, gently sloping, well drained soil is on uplands. Individual areas of this unit range from 5 acres to several hundred acres in size.

Typically, the surface layer is brown, friable loamy very fine sand about 7 inches thick. The transitional layer is brown loamy very fine sand about 6 inches thick. The underlying material is light yellowish brown loamy very fine sand to a depth of 60 inches or more. In some areas the thickness of the transitional layer may be less or the thickness of the dark surface layer is more than 7 inches.

Included with this soil in mapping are small areas of McCash soils. McCash soils have darker colors that extend to a depth of more than 20 inches and contain less fine sand than the Sarben soil. They are in swales. The included soil makes up less than 10 percent of the unit.

Available water capacity in the Sarben soil is moderate. Permeability is moderately rapid. Organic matter content is low. The intake rate of irrigation water is high. This soil is easily tilled. Surface runoff is slow.

Most of the acreage of this soil is in cultivated crops. The rest is in native or reseeded grasses, which are grazed or mowed for hay.

Under dryfarming, this soil is poorly suited to corn, winter wheat, and grasses and legumes. Soil blowing is a severe hazard, and low fertility is a limitation. Such practices as summer fallow and stubble mulching and disking are used to build up and conserve moisture in the soil and to reduce the hazards of soil blowing. Incorporating crop residue into the plow layer helps maintain and improve the organic matter content, fertility, and soil tilth. Fertilizers are used to build up the fertility of the soil.

If irrigated by a sprinkler system, this soil is suited to corn, alfalfa, and introduced grasses. Soil blowing is a severe hazard that can be reduced by leaving crop residue on the surface. Incorporating crop residue into the plow layer helps maintain and improve the organic matter content, fertility, and soil tilth. This soil is unsuited to gravity irrigation because of the high intake rate of water and the undulating topography of the landscape.

This soil is suited to rangeland. This use is very effective in controlling soil blowing and water erosion. Overgrazing by livestock or haying at the wrong time or with the wrong methods reduces the protective cover and causes deterioration of the native plants. Overgrazing also can lead to severe losses by soil blowing, which can create small blowouts. Proper grazing use, timely deferment of grazing or haying, and a system that alternates grazing with rest each year help maintain or improve the range condition. Seeding to range may be needed to stabilize severely eroded cropland.

This soil is suited to growing trees and shrubs in all types of windbreaks. Soil blowing and competition from grasses and weeds are principal hazards to the establishment of seedlings. Soil blowing can be controlled by maintaining strips of sod or a cover crop between the rows of trees. Trees can be planted on the contour in combination with terraces to help prevent erosion. Selected herbicides can help kill weeds in the rows.

This soil is generally suited to septic tank absorption fields and dwellings. Sewage lagoons need to be lined or sealed to prevent seepage. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving.

This soil is assigned to capability units IVe-5, dryland, and IVe-10, irrigated; Sandy range site; and windbreak suitability group 5.

SaD—Sarben loamy very fine sand, 6 to 9 percent slopes. This deep, strongly sloping, well drained soil is on rolling uplands (fig. 8). Individual areas of this unit are irregular in shape and range from 3 to 100 acres in size.

Typically, the surface layer is dark grayish brown, very friable loamy very fine sand about 6 inches thick. The transitional layer is brown, very friable loamy very fine sand about 8 inches thick. The underlying material is pale brown, very friable loamy very fine sand to a depth of 60 inches or more. In cultivated areas the surface soil may be thinner or absent where erosion has removed the topsoil. In areas the dark color of the surface soil extends to a depth of more than 7 inches.

Included with this soil in mapping are the coarser textured Valent soils, which are more sloping and along the edge of the sandhills. Also included are small areas of the darker and more silty McCash soils in swales. Included soils make up less than 10 percent of the unit.

This Sarben soil has moderately rapid permeability and moderate available water capacity. The intake rate of irrigation water is high. Organic matter content is low. Runoff is medium.

Most of the acreage of this map unit is in rangeland. The rest is in cultivated crops and is usually irrigated.

Under dryland farming, this soil is poorly suited to wheat, grasses, and legumes. Soil blowing and water erosion are hazards. Such practices as summer fallow and stubble mulching are used to build up and conserve moisture in the soil and to reduce the hazards of soil blowing and wind erosion.

This soil is poorly suited to sprinkler irrigation because of the severe hazards of soil blowing and water erosion. Low fertility is also a problem. Such practices as stubble mulching and disking that leave as much residue as possible on the soil help reduce the hazards of soil blowing and water erosion. These practices also help maintain and improve the organic matter content and fertility of the soil. Fertilizers are also applied to increase the fertility of the soil.

This soil is suited to rangeland. This use is very effective in controlling soil blowing and water erosion. Overgrazing by livestock or haying at the wrong time or with the wrong methods reduces the protective cover and causes deterioration of the native plants. Also, overgrazing leads to severe losses by soil blowing, which creates small blowouts. Proper grazing use, timely deferment of grazing or haying, and a system that alternates grazing with rest each year helps maintain or improve the range condition. Seeding to range may be needed to stabilize severely eroded cropland.

This soil is suited to growing trees in windbreaks. Sod should be maintained between rows of trees to reduce

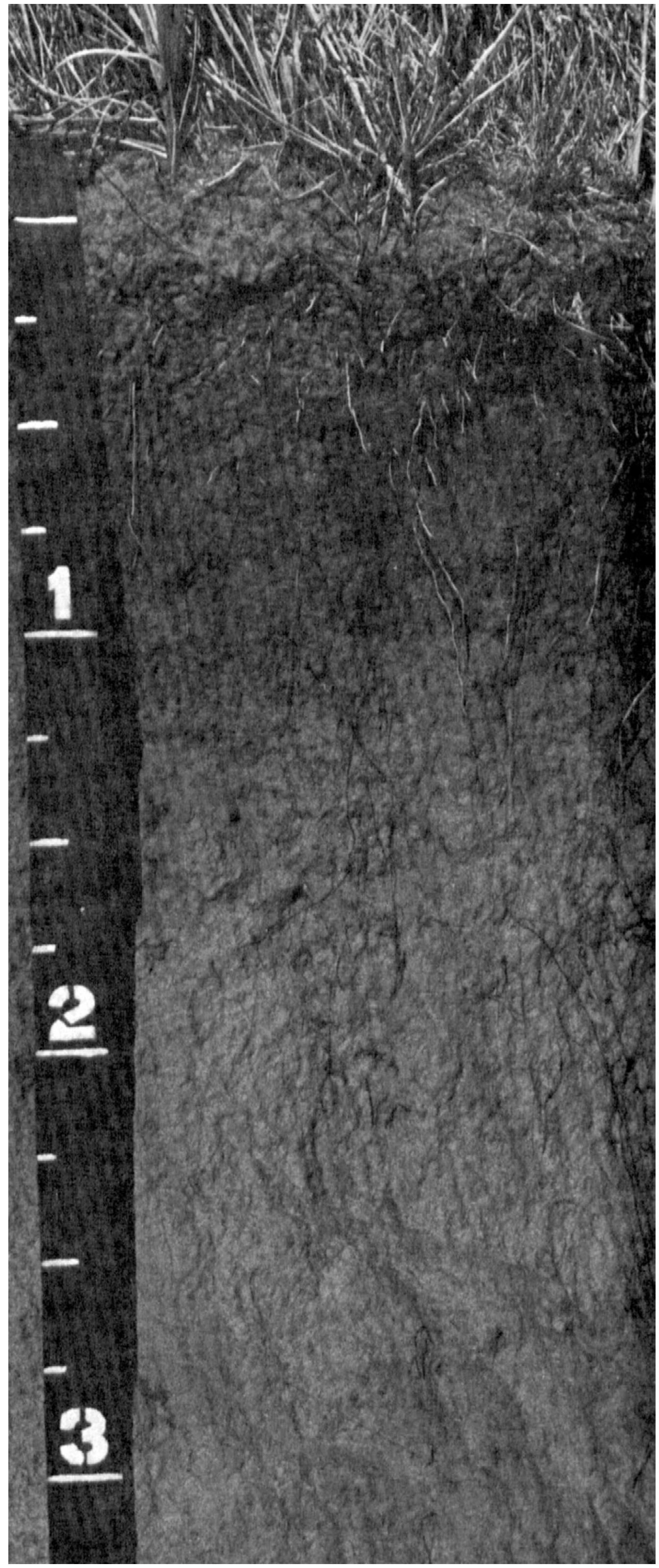


Figure 8.—Profile of Sarben loamy very fine sand.

the hazard of soil blowing. Areas near the trees can be hoed by hand. Irrigation can provide supplemental water during times of insufficient moisture.

Land shaping and installing the septic tank absorption fields on the contour are generally necessary for proper operation. Sewage lagoons need to be lined or sealed to prevent seepage, and grading is required to modify the slope and shape the lagoon. Buildings need to be properly designed to accommodate the slope, or the soil can be graded to an acceptable gradient. The walls or sides of shallow excavations can be temporarily shored to prevent sloughing or caving.

This soil is assigned to capability units IVe-5, dryland, and IVe-10, irrigated; Sandy range site; and windbreak suitability group 7.

SaE—Sarben loamy very fine sand, 9 to 20 percent slopes. This deep, strongly sloping to steep, well drained soil is on uplands. Individual areas of this unit are irregular in shape and range from 3 to 300 acres in size.

Typically, the surface layer is grayish brown, very friable loamy very fine sand about 6 inches thick. The transitional layer is pale brown, very friable loamy very fine sand about 6 inches thick. The underlying material is very pale brown, loose loamy very fine sand to a depth of 60 inches or more. The surface soil may be thinner in places. In some areas the dark color of the surface layer extends to a depth of more than 10 inches.

Included with this soil in mapping are the coarser textured Valent soils, which are more sloping and along the edge of the sandhills. This included soil makes up less than 10 percent of the unit.

The Sarben soil has moderately rapid permeability and moderate available water capacity. Organic matter content is low. Runoff is medium.

Most of the acreage of this map unit is in rangeland. This soil is suited to rangeland. This use is very effective in controlling soil blowing and water erosion. Overgrazing by livestock or haying at the wrong time or with the wrong methods reduces the protective cover and causes deterioration of the native plants. Overgrazing can lead to severe losses by soil blowing, which creates small blowouts. Proper grazing use, timely deferment of haying or grazing, and a system that alternates grazing with rest each year help maintain or improve the range condition. Seeding to range may be needed to stabilize severely eroded cropland.

This soil is generally unsuited to cropland because it is too steep and because the natural fertility and organic matter content are low.

This soil is suited to growing trees in windbreaks. Sod should be maintained between rows of trees to reduce the hazard of soil blowing. Areas near the trees can be hoed by hand. Irrigation can provide supplemental water during times of insufficient moisture.

On slopes of less than 15 percent, land shaping and installation on the contour are generally necessary for the proper operation of a septic tank absorption field. For sewage lagoons, extensive grading is required to modify the slopes. The lagoons need to be lined or sealed to prevent seepage. This soil generally is not suitable for sanitary facilities where the slope exceeds 15 percent. A suitable alternate site is needed. Dwellings should be designed to accommodate the natural slope of the land, or the soil can be graded to an acceptable gradient. The walls or sides of shallow excavations need to be shored to prevent sloughing or caving. Cuts and fills are generally needed to provide a suitable grade for roads.

This soil is assigned to capability unit VIe-5, dryland; Sandy range site; and windbreak suitability group 7.

SaG—Sarben loamy very fine sand, 20 to 60 percent slopes. This deep, steep to very steep, well drained soil is on uplands. Individual areas of this unit are irregular in shape and range from 5 to 300 acres in size.

Typically, the surface layer is grayish brown, very friable loamy very fine sand about 4 inches thick. The transitional layer is light brownish gray loamy very fine sand about 4 inches thick. The underlying material is very pale brown loamy very fine sand to a depth of 60 inches or more. In some areas the transitional layer may not be present.

Included with this soil in mapping are small areas of the coarser textured Valent soils. The Valent and Sarben soils are in the same positions in the landscape. Also included are small areas of the finer textured Colby soils, which are below the Sarben soils in the landscape. Included soils make up less than 10 percent of the unit.

This soil has moderately rapid permeability and moderate available water capacity. Organic matter content is low. Runoff is rapid.

All of the acreage of this unit is in rangeland. The soil is suited to rangeland. This use is very effective in controlling soil blowing and water erosion. Overgrazing by livestock reduces the protective cover and causes deterioration of the native plants. It can also lead to severe losses by soil blowing, which creates small blowouts. Proper grazing use, timely deferment of haying or grazing, and a system that alternates grazing with rest each year help maintain or improve the range condition.

This soil is unsuitable for cultivation of the steep slopes because of the severe hazard of erosion.

This soil is very poorly suited to growing trees in any type of windbreak because it is too steep.

This soil is generally unsuitable for dwellings and sanitary facilities because of the steep and very steep slopes. A suitable alternate site is needed. The walls or sides of shallow excavations need to be shored to prevent sloughing or caving. Cuts and fills are generally needed to provide a suitable grade for roads.

This soil is assigned to capability unit VIIe-5, dryland; Sandy range site; and windbreak suitability group 10.

Sc—Scott Variant silty clay loam, 0 to 1 percent slopes. This deep, nearly level, poorly drained soil is in depressions of the loess uplands. There is no runoff, and water ponds for days or weeks. Individual areas range from 5 to 50 acres in size.

Typically, the surface layer is dark gray silty clay loam about 5 inches thick. The subsoil is about 55 inches thick. It is dark gray heavy silty clay loam in the upper part and gray silty clay loam in the lower part. In some areas the subsoil may be silty clay. Also, some pedons may have a subsurface layer of gray or light gray silt loam.

Included with this soil in mapping are small areas of Keith and Kuma soils. These soils have less clay in the subsoil and are better drained than the Scott Variant. They are in higher positions in the landscape. Included soils make up less than 5 percent of the unit.

Permeability in the Scott Variant is slow, and available water capacity is high. Organic matter content is moderate. The clayey subsoil absorbs water slowly and releases it slowly to plants. It becomes very hard when dry. The soil is ponded during some parts of the year and is dry during others. It is difficult to work because it is either too wet or too dry and hard. Maintaining good tilth is difficult. The seasonal high water table is near or above the surface.

Over half of the acreage of this soil is farmed, and the rest is in grass. Some years when the annual rainfall is below normal a crop can be grown. In years when there is normal to above average rainfall this soil is under water.

This soil is poorly suited to dryfarming. It is somewhat suited to winter wheat, forage sorghum, and introduced grasses, which do not require tillage in early spring. Constructing terraces around the depressions helps to reduce the risk of flooding from run-in water. Pits, or dug-outs, in the lowest part of the depression help to concentrate run-in water in a small area and help to dry out the soil. Incorporating crop residue into the plow layer and avoiding tilling when the soil is wet help maintain good tilth. This soil is not suited to irrigation.

This soil is not suited to rangeland, trees, or shrubs.

This soil is generally not suited to sanitary facilities and building site development because of ponding and slow permeability. Alternate sites should be selected. Constructing roads on suitable, well compacted fill material above the ponding level and providing adequate side ditches and culverts help protect roads from damage by ponding and wetness from the seasonal water table. Damage to roads by frost action can be reduced by providing good surface drainage and by the use of gravel in the subgrade as a moisture barrier. Crowning the road by grading and constructing adequate side ditches help to provide the needed surface drainage.

This soil is assigned to capability unit IVw-2, dryland, and windbreak suitability group 10.

UsC—Ulysses silt loam, 3 to 6 percent slopes. This deep, gently sloping soil is well drained. It is on narrow ridgetops and the lower part of side slopes of the loess uplands. Individual areas of this unit are irregular in shape and range from 5 to 50 acres in size.

Typically, the surface layer is grayish brown, friable silt loam about 7 inches thick. The subsoil is brown, heavy, friable silt loam about 6 inches thick. The underlying material is very pale brown, calcareous silt loam to a depth of 60 inches or more. In some areas the color of the surface layer extends to a depth of less than 7 inches.

Included with this soil in mapping are small areas of Colby soils, which have a surface soil less than 6 inches thick. The Colby soils are typically steeper. Also included are Keith and Kuma soils, which have a more developed subsoil than the Ulysses soil. These three soils are in the same position in the landscape. Kuma soils have dark colors extending below 20 inches. Included soils make up less than 10 percent of the unit.

Organic matter content in the Ulysses soil is moderate. The soil has a high available water capacity and moderate permeability. Runoff is medium. The intake rate for irrigation water is moderate.

Most of the acreage of this unit is in native or introduced grasses. Some small areas are used for dryfarming.

Under dryfarming, this soil is suited to growing wheat and grasses and legumes for hay and pasture. Soil blowing and water erosion are hazards where the surface is not adequately protected by close-growing crops or crop residue. Terraces reduce soil loss by water erosion and hold more moisture in the soil for crops. Such practices as summer fallow and stubble mulching, disking, and chiseling are used to build up the moisture in the subsoil and reduce soil blowing.

If irrigated by a sprinkler system, this soil is suited to growing corn, alfalfa, and grain sorghum. Efficient management of the irrigation water is needed. Water erosion is a hazard and can be controlled by terraces and contour farming. Soil blowing is a hazard and can be controlled by close-growing crops or crop residue on the surface. This soil is unsuited to gravity irrigation systems.

This soil is suited to rangeland. This use is very effective in controlling soil blowing and water erosion. Overgrazing by livestock or haying at the wrong time or with the wrong methods reduces the protective cover and causes deterioration of the native plants. Overgrazing also can result in severe soil losses by water erosion. Proper grazing use, timely deferment of grazing or haying, and a system that alternates grazing with rest each year help maintain or improve the range condition.

This soil is suited to growing trees and shrubs in windbreaks. Competition for moisture from grasses and weeds are principal hazards to the establishment of seedlings. This can be overcome by good site preparation and timely cultivation between rows of trees. Selected herbicides can also be used in helping to control weeds. Irrigation can provide supplemental moisture during periods of insufficient rainfall.

This soil is generally suited to septic tank absorption fields. Sewage lagoons need to be lined or sealed to prevent seepage, and grading is required to modify the slope and shape the lagoon. Foundations for buildings need to be strengthened and backfilled with coarse material to prevent damage by the shrinking and swelling of the soil. Roads and streets need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil material. Coarser grained base material can be used to ensure better performance.

This soil is assigned to capability units IIIe-1, dryland, and IIIe-6, irrigated; Silty range site; and windbreak suitability group 8.

UsD—Ulysses silt loam, 6 to 9 percent slopes. This deep, strongly sloping, well drained soil is on uplands. Individual areas of this unit are irregular in shape and range from 5 to 80 acres in size.

Typically, the surface layer is grayish brown, friable silt loam about 7 inches thick. The subsoil is friable silt loam about 6 inches thick. The underlying material is pale brown and very pale brown, calcareous silt loam to a depth of 60 inches or more. In some areas the surface layer is less than 7 inches thick.

Included with this soil in mapping are small areas of Colby soils, which have less than 7 inches of surface soil and are typically steeper. Also included are Keith and Kuma soils, which have a more developed subsoil than the Ulysses soil. These soils are typically less sloping. Included soils make up less than 10 percent of the unit.

Organic matter content in the Ulysses soil is moderate. The soil has high available water capacity and moderate permeability. Runoff is medium.

Most of the acreage of this unit is in native or introduced grasses. Very few acres of this soil are dryfarmed.

This soil is poorly suited to dryfarming. Wheat is the dominant crop. Water erosion, which removes the topsoil, is a severe hazard. Terraces help reduce this hazard. Leaving this soil in native grasses or reseeding to native grasses helps reduce erosion.

This soil is poorly suited to growing corn, alfalfa, and grain sorghum even if sprinkler irrigated because water erosion is a severe hazard. Terraces and farming on the contour help reduce the loss of soil. Efficient management of the irrigation water is needed. This soil is unsuited to gravity irrigation systems.

This soil is suited to rangeland. This use is very effective in controlling soil blowing and water erosion. Overgrazing by livestock or haying at the wrong time or with the wrong methods reduces the protective cover and causes deterioration of the native plants. Overgrazing also can result in severe soil losses by water erosion. Proper grazing use, timely deferment of grazing or haying, and a system that alternates grazing with rest each year help maintain or improve the range condition. Seeding to range may be needed to stabilize severely eroded cropland.

This soil is suited to trees and shrubs in windbreaks. Slope and competition from grasses and weeds are principal hazards to the establishment of seedlings. Trees can be planted on the contour to allow normal cultivation between the rows, and the soil can be terraced to store moisture. Selected herbicides can be used to help control weeds.

Land shaping and installation on the contour are generally necessary for the proper function of a septic tank absorption field. For sewage lagoons, grading is required to modify the slope and shape the lagoon. Foundations for dwellings and buildings need to be strengthened and backfilled with coarse materials to prevent damage by the shrinking and swelling of the soil. Dwellings and buildings need to be properly designed to accommodate the slope, or the soil can be graded to an acceptable gradient. Roads and streets need to be designed so that the surface pavement and base material are thick enough to compensate for the low strength of the soil material. Coarser grained base material can be used to ensure better performance.

This soil is assigned to capability units IVe-1, dryland, and IVe-6, irrigated; Silty range site; and windbreak suitability group 8.

VaD—Valent fine sand, 3 to 9 percent slopes. This deep, gently sloping to strongly sloping, excessively drained soil is on sandhills. Individual areas of this unit are irregular in shape and range from 3 to 500 acres in size.

Typically, the surface layer is grayish brown, loose fine sand about 4 inches thick. The transitional layer is light brownish gray, loose fine sand about 3 inches thick. The underlying material is pale brown fine sand to a depth of 60 inches or more. Blowouts may occur in places where all of the surface layer has been removed by soil blowing.

Included with this soil in mapping are small areas of the finer textured Jayem and Sarben soils, which are less sloping and are around the edge of the Valent soils. Also included in this unit are small outcrops of bedrock. Included soils make up less than 10 percent of the unit, and rock outcrops make up less than 3 percent of the unit.

Permeability in this Valent soil is rapid, and available water capacity is low. Organic matter content is low. The intake rate for irrigation water is very high. Runoff is slow.

Most of the acreage of this map unit is in rangeland. Some small areas are under center pivot irrigation. Corn is the principal irrigated crop.

This soil is suited to rangeland. This use is very effective in controlling soil blowing and water erosion. Overgrazing by livestock or haying at the wrong time or with the wrong methods reduces the protective cover and causes deterioration of the native plants. Also, overgrazing leads to severe losses by soil blowing, which creates small blowouts. Proper grazing use, timely deferment of haying or grazing, and a system that alternates grazing with rest each year help maintain or improve the range condition.

Under dryfarming, this soil is generally unsuitable for cultivation. Even if irrigated by a sprinkler system, it is poorly suited to cropland. Soil blowing is a hazard. By leaving all of the crop residue that is possible on the field and by using such practices as stubble mulching, the chance of the soil being exposed to the wind is reduced. Since the soil has such a high permeability rate, much of the fertilizer applied directly to the soil leaches down into the soil and out of reach of the plant roots. Therefore, by applying the fertilizer through a sprinkler irrigation system, the fertilizer is more readily available to the plants.

This soil is suited to windbreaks. Drought resistant trees, such as eastern red cedar and ponderosa pine, should be used. Careful site preparation is needed to remove weeds and grasses but leave enough residue to prevent soil blowing. Selected herbicides can be used within the rows of trees to control weeds.

This soil readily absorbs the effluent from septic tank absorption fields, but it does not adequately filter the effluent. The poor filtering capacity may result in pollution of the underground water table. Sewage lagoons need to be lined or sealed to prevent seepage. This soil is generally suited to dwellings. The walls or sides of shallow excavations need to be shored to prevent sloughing or caving.

This soil is assigned to capability units VIe-5, dryland, and IVe-12, irrigated; Sands range site; and windbreak suitability group 7.

VaF—Valent fine sand, rolling. This deep, strongly sloping to steep, excessively drained soil is on uplands. Slope ranges from 9 to 17 percent. Individual areas of this unit are irregular in shape and range from 3 to 1,000 acres in size.

Typically, the surface layer is brown, loose fine sand about 7 inches thick. The underlying material is pale brown, loose fine sand to a depth of 60 inches or more. In blowouts, all of the surface layer has been removed by wind erosion.

Included with this soil in mapping are small areas of the finer textured Jayem and Sarben soils, which are less sloping and at the edge of the Valent soils. Included soils make up less than 20 percent of the unit.

Permeability in this Valent soil is rapid, and available water capacity is low. Organic matter content is low. Runoff is slow.

Most of the acreage of this map unit is in rangeland. This soil is suited to rangeland. This use is very effective in controlling soil blowing (fig. 9). Overgrazing by livestock reduces the protective cover and causes deterioration of the native plants. Overgrazing leads to severe losses by soil blowing, which creates small blowouts. Proper grazing use, timely deferment of grazing, and a system that alternates grazing with rest each year help maintain or improve the range condition. Seeding to range may be needed to stabilize active blowouts.

This soil is unsuited to cropland because the main hazard is soil blowing. Slope prevents a center pivot irrigation system from working properly. A large amount of land alteration is needed to reduce the slope of the soil.

This soil is suited to windbreaks and shelterbelts. Soil blowing and drought are severe hazards on this soil. Leaving a strip of sod between rows and leaving other residue on the soil help reduce the hazard of soil blowing. Drought resistant trees, such as eastern red cedar, should be used. Selected herbicides can be used to control weeds within the row of trees.

This soil readily absorbs the effluent from septic tank absorption fields, but it does not adequately filter the effluent. The poor filtering capacity may result in pollution of the underground water table. Sewage lagoons need to be lined or sealed to prevent seepage, and grading is required to modify the slope and shape the lagoon. The walls or sides of shallow excavations need to be shored to prevent sloughing or caving. Dwellings and buildings need to be properly designed to accommodate the slope, or the soil can be graded to an acceptable gradient. Cuts and fills are generally needed to provide a suitable grade for roads.

This soil is assigned to capability unit VIe-5, dryland; Sands range site; and windbreak suitability group 7.

VaG—Valent fine sand, rolly and hilly. This deep, steep to very steep, excessively drained soil is on uplands. Slope ranges from 14 to 60 percent. Individual areas of this unit are irregular in shape and range from 3 to 300 acres in size.

Typically, the surface layer is grayish brown, loose fine sand about 3 inches thick. The underlying material is pale brown fine sand to a depth of 60 inches or more. Blowouts are common in this unit.

Included with this soil in mapping are small areas of the finer textured Sarben soils, which are less sloping

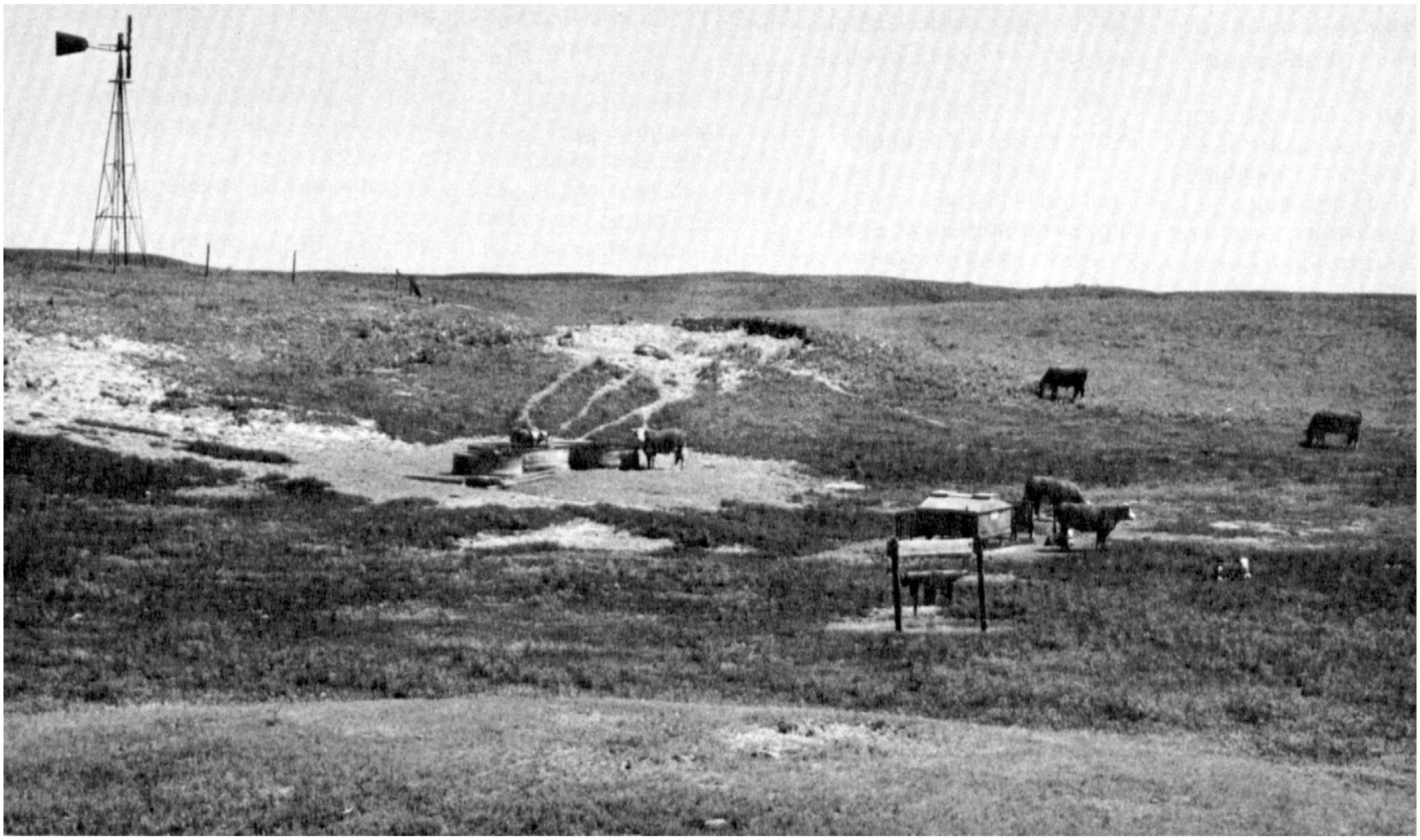


Figure 9.—Most of the acreage of Valent fine sand, rolling, is used as rangeland. This protects the soil from blowing.

and at the edge of the Valent soils. This included soil makes up less than 10 percent of the unit.

Permeability in the Valent soil is rapid, and available water capacity is low. Organic matter content is low. Runoff is slow.

All of the acreage of this map unit is in rangeland. This soil is suited to rangeland. This use is the most effective way to control soil blowing and water erosion. Overgrazing by livestock reduces the protective cover and causes deterioration of the native plants. Overgrazing leads to losses by soil blowing, which creates blowouts. Proper grazing use, timely deferment of grazing, and a system that alternates grazing with rest each year help maintain or improve the range condition. Seeding to range may be needed to stabilize active blowouts.

This soil is very poorly suited to cropland and windbreaks. Major land alterations would be needed to reduce the slope of the soil.

This soil is generally unsuitable for sanitary facilities because of the steep and very steep slopes. A suitable alternate site is needed. The walls or sides of shallow excavations need to be shored to prevent sloughing or caving. Cuts and fills are generally needed to provide a suitable grade for roads. Dwellings and buildings need to be properly designed to accommodate the slope, or the soil can be extensively graded to an acceptable gradient.

This soil is assigned to capability unit VIIe-5, dryland, and windbreak suitability group 10. Valent, rolling, is assigned to the Sands range site and Valent, hilly, to the Choppy Sands range site.

use and management of the soils

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

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

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

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

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

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

crops and pasture

By William E. Reinch, conservation agronomist, Soil Conservation Service.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils are identified; 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 listed for each soil.

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

According to the Nebraska Agriculture Census, 40 percent of the agricultural land in Hayes County is planted to crops. The largest acreage is in wheat and corn, followed by alfalfa and sorghum. About 20 percent of the cropland is irrigated.

The potential of soils in Hayes County for increased production of food is good.

managing dryfarmed cropland

Good management practices on dryfarmed cropland are those that reduce runoff and the risk of erosion, conserve moisture, and improve tilth. Most of the soils in Hayes County are suitable for crop production. In many places, however, the hazard of erosion is severe and needs to be reduced by suitable conservation practices.

Conservation tillage systems that keep crop residue on the surface, terraces, and contour farming help reduce water erosion. Keeping crop residue on the surface or growing a protective plant cover reduces sealing and crusting of the soil during and after heavy rains. In winter stubble catches drifting snow that can provide additional moisture. Crop residue is also a stable bank of plant nutrients that cannot be lost by leaching or volatilization.

Soil blowing is a hazard in Hayes County, especially during periods of below average rainfall. Many of the management practices that control water erosion are also effective in controlling soil blowing. Examples of these practices are crop residue use, conservation tillage, and stripcropping. The overall hazard of erosion can be reduced if areas of the more productive soils are used for row crops and the steeper, more erodible soils are used for close-grown crops, such as small grains and alfalfa, or for hay and pasture. Proper land use alone reduces the potential for erosion.

In Hayes County, rainfall is the limiting factor for crop production, and wind and water are active as erosive forces. A cropping system needs to be planned which fits the soils in each field and which provides maximum vegetative and plant residue cover to minimize soil blowing and water erosion.

The sequence of crops grown on a field, in combination with the practices needed for the management and conservation of the soil, is known as a conservation cropping system. On dryfarmed soils, the cropping system should preserve tilth and fertility; maintain a plant cover that protects the soil from erosion; conserve moisture; and control weeds, insects, and diseases. Effective cropping systems vary according to the soils on which they are used. For example, a conservation cropping system on Jayem loamy very fine sand, 3 to 6 percent slopes, should include a conservation tillage system that maintains 2,000 pounds per acre of flat, small grain residue on the surface to protect the soil from soil blowing and water erosion. On Kuma silt loam, 0 to 1 percent slopes, however, 1,200 pounds of flat, small grain residue per acre protects the soil from blowing and water erosion.

When the farmer plants crops, soils need to be worked to prepare a seedbed, to control weeds, and to provide a favorable place for plants to grow. Excessive tillage, however, breaks down the granular structure in the surface layer that is needed for good soil tilth. Steps in the cultivation process should be limited to those that are essential. Various methods of conservation tillage are used in Hayes County. The conservation tillage systems of eco-fallow, till-plant, disc or chisel, and plant and stubble mulch are well suited to all crops grown. Grasses can be established by drilling into a cover of stubble without further seedbed preparation.

All soils that are used for cultivated crops or for pasture should be tested to determine their need for additional nutrients. When managing dryland soils, the kind and amount of fertilizer to be applied should be based on results of soil tests and on the content of moisture in the soil at time of application. Where the subsoil is dry and precipitation is the limiting factor in crop production, the amount of fertilizer applied should be slightly lower than the amount needed when the soil is moist. Dryfarmed soil requires smaller amounts of fertilizer because there is generally a lower plant population. For nonlegume crops, nitrogen fertilizer is beneficial on all soils. Phosphorus and zinc are needed on the more eroded soils or on terraces or diversions after construction.

The best management practices to protect and to reduce soil erosion on Bridget and Keith soils of subclass IIc and IIe are crop residue use, addition of nutrients in fertilizers or barnyard manure, and good agronomic practices. On Kuma, Ulysses, and other soils of subclass IIIe, the best practices are: Let the crop residue stand on the soil over winter, contour farming or stripcropping, and a conservation tillage system that leaves 3,000 pounds per acre of corn residue or 1,500 pounds per acre of small grains residue on the soil surface after the crop is planted. On Ulysses and other soils of subclass IVe, management practices include leaving the stand of crop residue on the soil over winter, contour farming or stripcropping, and a conservation tillage system that leaves 4,000 pounds per acre of corn or sorghum residue or 2,000 pounds per acre of small grain residue on the soil surface after planting the crops. The conversion of cropland to pasture or hayland and maintaining a permanent cover may be an economic alternative for subclass IV soils (fig. 10).

Soils in Hayes County, such as Gannett and the Scott Variant, are subject to ponding. Where the water table cannot be lowered sufficiently for good crop growth, crops can be planted that are tolerant to wet conditions.

Use of herbicides is a practical way to control weeds, however, care should be taken to apply the correct kind and the proper amount to correspond with soil conditions. The colloidal clay and humus fraction of the soil is responsible for the greatest part of the chemical activity of the soil. Therefore, crop damage from herbicides can occur on sandy sites that are low in colloidal clay and in soils where the organic matter content is moderately low to low. Application rates of herbicides need to be correspondingly lowered on these soils.

managing irrigated cropland

About 20 percent of all cropland in Hayes County is irrigated. Corn is grown on 85 percent of the irrigated cropland, and a smaller acreage is in alfalfa hay.

The irrigation water is derived from wells and irrigation canals.

Either furrow or sprinkler systems are suited to row crops. Alfalfa can be irrigated by borders, contour ditches, corrugations, or sprinklers.

The cropping system on soils well suited to irrigation consists mostly of row crops. A cropping sequence that includes different row crops, small grain, and alfalfa or grass helps control the cycles of disease and insects that are commonly present if the same crop is grown year after year. Gently sloping soils, such as Keith silt loam, 3 to 6 percent slopes, are subject to water erosion if they are furrow irrigated down the slope. If furrow irrigated, these soils can be bench leveled on the contour or irrigated with contour furrows in combination with parallel terraces.

Land leveling increases the efficiency of irrigation because water can be more evenly distributed. The efficiency of a furrow system of irrigation can be improved by the addition of a tailwater recovery system. Sprinkler irrigation is most satisfactory on coarser textured soils, provided an adequate amount of water is available. Terraces and contour farming, in addition to conservation tillage systems that keep crop residue on the surface, help control water erosion on soils irrigated with a sprinkler system.

Figure 10.—Cropland has been reseeded to grasses to control soil blowing in the Sarben-McCash-Jayem association.

On soils, such as Valent fine sand, 3 to 9 percent slopes, and Ulysses silt loam, 6 to 9 percent slopes, where sprinkler irrigation systems are used, the same conservation practices that control water erosion on nonirrigated cropland should be applied. These practices include terraces, contour farming, and conservation tillage practices that leave a protective cover of crop residue on the soil after the row crop is planted. These practices are important in conserving the supply of surface water and in protecting soil from erosion.

If sprinkler irrigation methods are used, water should be applied by sprinklers at a rate that the soil can absorb without runoff. Sprinklers can be used on the more sloping soils as well as the nearly level ones. Some soils, such as Valent fine sand, 3 to 9 percent slopes, are suited to sprinkler irrigation when conservation practices are applied that control erosion. Because the water can be carefully controlled, sprinklers have special use in conservation, such as establishing new pasture on moderately steep slopes. In summer, however, much water is lost through evaporation. Wind drift can cause uneven applications of water under some sprinkler irrigation systems.

Sprinkler systems are of two general kinds: Those that operate in sets, which means they are set at a certain location and operate there until a specified amount of water is applied, and the moving sprinkler, which moves across or around a field as water is applied.

Soils in the Jayem, Sarben, and Valent series are low in organic matter, have low fertility levels, and poor water holding capacities. This complicates management. Because of these problems, applied nitrogen can quickly percolate down below the crop's rooting system and be lost. To overcome the poor water holding capacity and fertility level of these soils, fertilizers can be applied with the irrigation water at frequent intervals, but applying excess water should be avoided.

The serious and continuing threat of soil blowing can become catastrophic as more of the Valent fine sand, rolling and hilly, is brought into crop production. Soil blowing damage results from the sorting action of the erosion process that removes the finer soil particles from the coarser soil fractions. Assistance in planning conservation measures for effective soil blowing control is available through the local office of the Soil Conservation Service.

Soil holds only a limited amount of water. Irrigation water, therefore, is applied at regular intervals to keep the soil moist at all times. The interval varies according to the crop, the soil, and the time of year. The water should be applied only as fast as the soil can absorb it. Crop residue on the soil surface can increase intake rates and can slow evaporation rates under sprinkler irrigation systems.

Irrigated silt loam and loam soils in Hayes County hold about 2 inches of available water per foot of soil depth. A soil that is 4 feet deep and planted to a crop that sends its roots to that depth can hold about 8 inches of water for that crop.

Maximum efficiency for furrow irrigation is obtained if the irrigation process is started when about one-half of the stored water has been used by the plants. Thus, if a soil holds 8 inches of water, irrigation should be started when about 4 inches have been removed by the crop. Irrigation sets or systems should be planned to replace the amount that is used by the crop.

A tailwater recovery pit can be installed at the end of a furrow-irrigated field to trap runoff of excess irrigation tailwater. This water can then be pumped to the upper ends of the field and used again. This practice increases the efficiency of the irrigation system and helps conserve the supply of underground water.

All of the soil series in Nebraska are placed in irrigation design groups. These design groups are described in the Nebraska Irrigation Guide, which is part of the technical specifications for conservation in Nebraska. Arabic numbers of the irrigation capability unit indicate the irrigation design group to which the soils belong.

managing pasture and hayland

Hayland or pasture should be managed for maximum production. Once the pasture is established, the grasses need to be kept productive. A rotation grazing system that meets the needs of the plants and promotes uniform grazing is important if high returns are expected. Many forages are a good source of minerals, vitamins, and other nutrients. A well managed pasture can thus provide a balanced ration throughout the growing season. Irrigated pastures require a high level of management if they are to produce maximum returns.

A mixture of grasses and legumes can be grown on many kinds of soils, and with proper management they will return a fair profit. They are compatible with grain crops in a crop rotation and have beneficial soil building effects. This is because grasses and legumes improve tilth, add organic matter, and reduce erosion. They are an ideal crop for use in a conservation cropping system.

Grasses and legumes used for pasture and hay, both dryland and irrigated, require additional plant nutrients to obtain maximum production. The kinds and amount of fertilizer needed should be determined by a soil test.

If managed at a high level, irrigated pastures in Hayes County can produce 750 to 900 pounds of beef per acre. Irrigated pastures are an economic alternative in choosing a resource management system for irrigated cropland.

yields per acre

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

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

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

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

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

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

land capability classification

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

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. These levels are defined in the following paragraphs.

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

Class I soils have slight limitations that restrict their use.

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

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

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

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

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

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

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

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

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

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-1 or IIe-6.

The acreage of irrigated and nonirrigated soils in each capability class and subclass is shown in table 6. The capability classification of each map unit is given in the section "Detailed soil map units."

prime farmland

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

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to producing food, feed, forage, fiber, and oilseed crops. It has the soil quality, growing season, and moisture supply needed to economically produce a sustained high yield of crops when it is treated and managed using acceptable farming methods. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland may now be in crops, pasture, woodland, or other land, but not urban and built-up land or water areas. It must either be used for producing food or fiber or be available for these uses.

Prime farmland usually has an adequate and dependable supply of moisture from precipitation or irrigation. It also has favorable temperature and growing season, acceptable acidity or alkalinity. It has few or no rocks and is permeable to water and air. Prime farmland is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. For more detailed information on the criteria for prime farmland consult the local staff of the Soil Conservation Service.

When irrigated, about 156,000 acres, or nearly 34 percent, of Hayes County meets the soil requirements for prime farmland.

A recent trend in land use in some parts of the county has been the loss of some prime farmlands to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and difficult to cultivate and are usually less productive.

Soil map units that make up prime farmland in Hayes County are listed in this section. This list does not constitute a recommendation for a particular land use. Each listed map unit is shown in Table 7. For total extent of the acreage of each map unit see Table 4. The location is shown on the detailed soil maps in the back of this publication. The soil qualities that affect use and management are described in the section "Detailed soil map units."

Soils that have limitations—a high water table, flooding, or inadequate rainfall—may qualify for prime farmland if these limitations are overcome by such measures as drainage, flood control, or irrigation. The measures used to overcome the limitations, if any, are shown in parentheses after the map unit name. Onsite evaluation is necessary to see if these limitations have been overcome by corrective measures. In Hayes County only the soils that are irrigated meet the requirements for prime farmland.

rangeland

Prepared by Peter N. Jensen, range conservationist, Soil Conservation Service.

Rangeland amounts to approximately 57 percent of the total agricultural land in Hayes County. It is scattered throughout the county, but the greatest concentration is in the broken, loess hills and the sandhills. In addition, the high water tablelands along the Stinking Water and Willow Creeks are used primarily for native hay production. Rangeland is the principal use of the Colby-Ulysses and Valent soil associations.

Most of the rangeland is in the Silty, Limy Upland, Thin Loess, Shallow Limy, Sands, and Choppy Sands range sites. The remainder of the sites are Wet Land, Subirrigated, Silty Overflow, Sandy Lowland, Silty Lowland, and Sandy. The average size of ranches or livestock farms in Hayes County is about 1,280 acres.

Raising livestock is the largest agricultural industry in the county. Most livestock enterprises are cow and calf operations that sell calves in the fall as feeders.

The rangeland is generally grazed during late spring to early fall. The livestock spend the remainder of the year grazing corn or grain sorghum (milo) aftermath in the fall and early winter. They are fed hay (native and/or alfalfa), silage, or both for the remainder of the winter. In addition, the native forage is commonly supplemented with protein.

Approximately one-half of the rangeland has been depleted or is producing less than one-half its potential in kinds and amounts of native plants. This is largely because of overstocking and poor livestock distribution. The productivity of the range can be increased by proper range management and such improvement practices as proper grazing use, deferment or rest, planned grazing systems, range seeding, and weed control.

soils used as native hayland

Some of the soils that have a high water table are used as meadows of native hay. The meadows are in the Wet Land and Subirrigated range sites. The dominant vegetation in meadows is big bluestem, little bluestem, Indiangrass, switchgrass, prairie cordgrass, and various members of the sedge family. Mowing has reduced the large population of native wildflowers.

Production of native meadows can be maintained or improved by proper haying management. The optimum time to mow to maintain strong plant vigor, quality, and quantity is prior to the emergence of grass seedheads. Mowing height is important in maintaining the stand of grass and high forage production. Meadows should not be mowed closer than 3 inches to maintain strong plant vigor.

Meadows should not be grazed when the soil is wet or when the water table is within 6 inches of the surface. This prevents the formation of small bogs or mounds and the difficulty in mowing during later years. Meadows can be grazed after frost for the aftermath or regrowth.

At the end of each map unit description, the soil or soils in that unit are placed in an appropriate range site according to the kind or amount of vegetation that is grown on the soil when the site is in excellent or climax condition. The interpretations for each range site in the county are in the technical guide in the local office of the Soil Conservation Service. Ranchers or livestock producers who want technical help with range management or improvement programs can obtain help from the local office of the Soil Conservation Service.

soils used as rangeland

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

Table 8 shows, for each soil, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as or are suited to rangeland are listed. Explanation of the column headings in table 8 follows.

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

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

Dry weight is the total annual yield per acre reduced to a common percent of air-dry moisture.

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

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only. It does not have a specific meaning that pertains to the present plant community in a given use.

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

native woodland

By Keith A. Ticknor, forester, Soil Conservation Service.

Native woody vegetation is along the streams in the Bridget-McCook-Gibbon soil association and in the canyons of the Colby-Ulysses soil association. American plum, sumac species, common chokecherry, and indiancurrant coralberry (buckbrush) are found in the canyons. The major streams are wooded with eastern cottonwood, black willow, boxelder, green ash, common hackberry, American elm, Siberian elm, black walnut, American plum, skunkbush sumac, and common chokecherry.

Several of the species found along the streams, such as black walnut, eastern cottonwood, and green ash, have value for wood products, but they are not in large enough concentrations to be of commercial value. Bridget and McCook soils have good potential for wood products, but most of these areas are presently being used as cropland, and they are unlikely to be converted to other uses. On these soils, fields too small to farm or other odd areas are good sites for trees for future wood production.

windbreaks and environmental plantings

Prepared by Keith A. Ticknor, forester, Soil Conservation Service.

Most of the ranch buildings and farmsteads in Hayes County have windbreaks and other trees around them that have been planted over a period of time. Also, many livestock-protection windbreaks have been planted around winter pastures or calving areas. Siberian elm and eastern redcedar are the most common trees found around most farmsteads. In addition, Rocky Mountain juniper, green ash, common hackberry, Russian mulberry, honeylocust, Russian-olive, ponderosa pine, lilac, black locust, boxelder, and eastern cottonwood are frequently planted.

In order for windbreaks to fulfill their intended purpose, the species of trees or shrubs selected must be those adapted to the soil. Matching the proper trees to the soil type is the first step towards ensuring survival. This also helps to ensure that a maximum rate of growth is obtained in the windbreak. Permeability, available water capacity, and fertility are soil characteristics that greatly affect the rate of growth for trees and shrubs in windbreaks.

Lack of moisture limits the survival of trees in Hayes County. Therefore, proper site preparation prior to planting and controlling weeds or other competition after planting are the major concerns when establishing and managing a windbreak. Supplemental watering with a drip irrigation system may be used to overcome moisture deficiencies.

Many older windbreaks are now deteriorating because of crowded growing conditions or because short-lived trees, such as Siberian elm, have reached or passed maturity. Culling is needed to restore the effectiveness of the windbreaks.

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

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

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

Table 9 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 9 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. The windbreak suitability unit is given at the end of each soil description of the detailed map units. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

recreation

Prepared by Robert O. Koerner, biologist, Soil Conservation Service.

Hayes County offers many recreational opportunities. The main designated recreation area, northeast of Hayes Center on Red Willow Creek, is the Hayes Center State Special Use Area (fig. 11). This area, administered by the Nebraska Game and Parks Commission, consists of 119 acres. The area has a 40-acre lake and a 20-acre picnic area. Minimum toilet facilities are provided. Recreational activities include fishing, camping, picnicking, and hiking. The public can use the recreational facilities to hunt small game and waterfowl during the regularly designated hunting seasons.

The majority of the county is under private ownership. Hunting for deer, prairie grouse, pheasant, quail, and mourning dove is possible during the regular hunting seasons with landowner permission.

The Frenchman River, Red Willow Creek, and farm ponds throughout the county are stocked with largemouth bass, bluegill, and catfish for fishing.

Technical assistance is available for designing installations to improve the habitat for wildlife, as well as facilities for recreation within Hayes County. The Soil Conservation Service has a field office in Hayes Center and can provide this assistance, or they can direct applicants to an appropriate federal or state agency that can provide the needed assistance.

The soils of the survey area are rated in table 10 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 10, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 10 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 13 and interpretations for dwellings without basements and for local roads and streets in table 12.

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

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

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

Paths and trails for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty

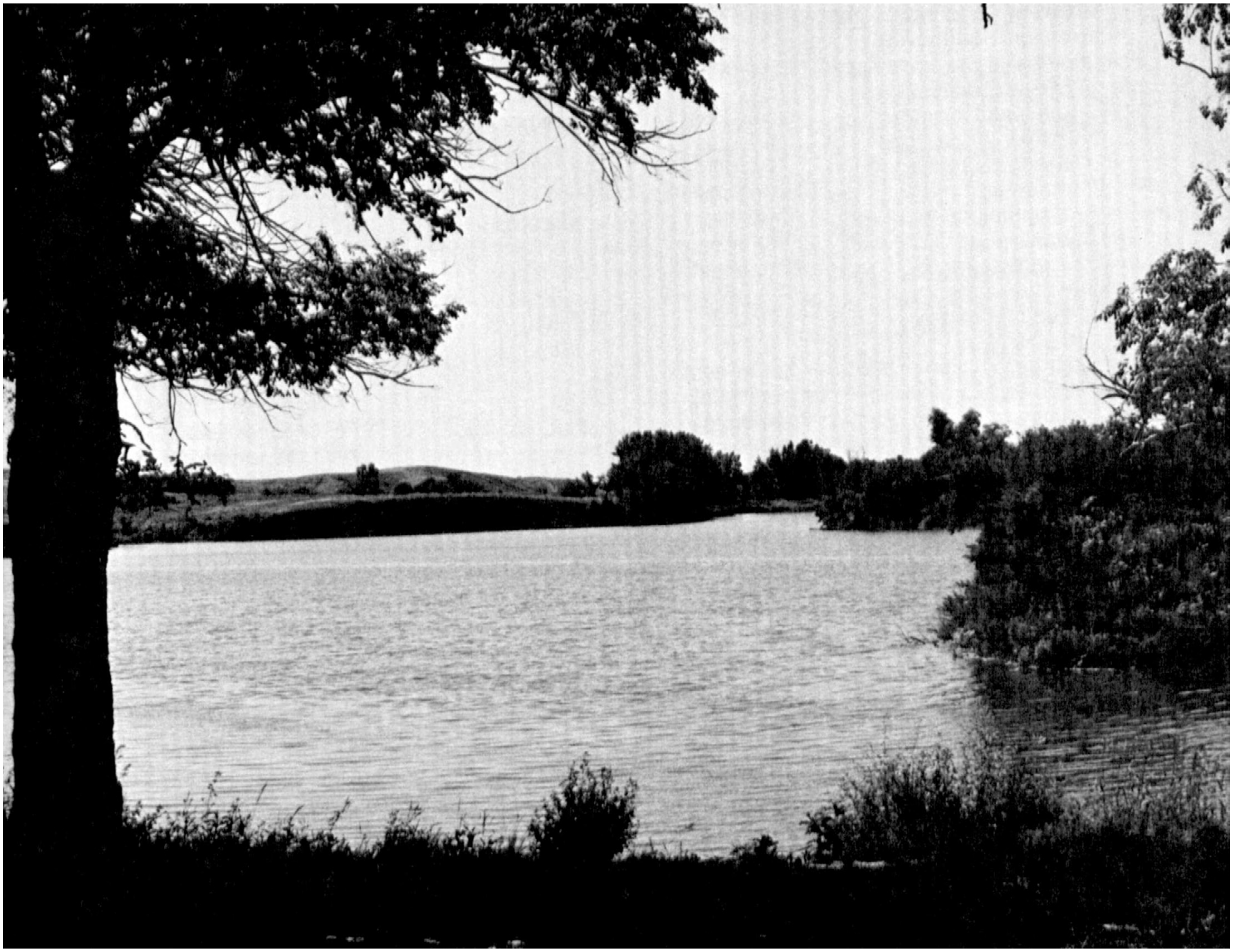


Figure 11.—Hayes Center Special Use Area provides recreational facilities for campers, hunters, and fishermen as well as habitat for upland and aquatic wildlife.

when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

wildlife habitat

Prepared by Robert O. Koerner, biologist, Soil Conservation Service.

The five soil associations in Hayes County are discussed in relation to wildlife habitat in the following paragraphs.

The Sarben-Jayem-McCash association provides habitat for such wildlife species as pheasants and bobwhite quail as well as prairie grouse. Approximately 65 percent of the acreage is cropland, and the remainder is rangeland and pasture. Some windbreaks are planted around farmsteads and ranch buildings.

Scattered clumps of sumac, plum, and chokecherry are found along fence lines and in the drainageways. Wet areas, or potholes, provide habitat for waterfowl and shore birds during all or part of the year, depending upon rain or surface runoff.

The Colby-Ulysses association is gently sloping to very steep. This association offers rangeland wildlife habitat. Mule deer and white-tailed deer are the major kinds of wildlife. Rough terrain also makes it ideal for the hawks, owls, and eagles. Some prairie grouse, ring-necked pheasant, and bobwhite quail are also found. Fur and game mammals, such as raccoon, skunk, badger, and coyote, and small mammals, such as ground squirrels, prairie dogs, and pocket gophers, are also in this association.

The Kuma-Keith association is relatively flat to gently sloping. These croplands provide food, such as winter wheat, grain sorghum, and corn. Early in the morning and late in the afternoon, deer, both white-tailed and mule deer, feed in these fields. Along the roads plum and chokecherry thickets provide escape cover for bobwhite quail and pheasants. Shelterbelts are planted around farmsteads and ranch buildings. Common wood species are red cedar, pine, Chinese elm, green ash, hackberry, and Russian-olive.

The Valent association is gently sloping to hilly. This association offers rangeland wildlife habitat of native grasses. Big and little bluestem and prairie sandreed are common plant species. Prairie grouse and deer, both white-tailed and mule deer, are the main wildlife species.

The Bridget-McCook-Gibbon association offers the greatest diversity for a variety of wildlife species. Marshy areas along Red Willow Creek provide habitat for waterfowl, shore birds, muskrats, mink, and weasel. The Frenchman Creek is a wide stream and provides habitat for deer, squirrels, opossum, and porcupine. Many songbirds are also found along the streams. Food is provided by the bittersweet and grape vines and the buckbrush, western snowberry, sumac, and rose bushes. Wildlife species use these streams as travel lanes and for drinking water. Riparian habitat is found adjacent to the streams and offers cover. Food is found in the adjacent cropland fields, and nesting cover is provided in the adjoining range and pasture.

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

In table 11, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

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

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

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

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

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

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are bur oak, green ash, honeylocust, apple, hawthorn, dogwood, eastern cottonwood, hackberry, Chinese elm, mulberry, and black walnut.

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

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are American plum, cotoneaster, sumac, western snowberry, honeysuckle, and buckbrush.

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

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

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

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

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

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

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include deer, prairie grouse, coyote, badger, meadowlark, and prairie dog.

engineering

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

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

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

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

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

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

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

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

building site development

Table 12 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

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

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

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

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

sanitary facilities

Table 13 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 13 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

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

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

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

Table 13 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, up to 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

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

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

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

The ratings in table 13 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

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

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

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

construction materials

Table 14 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

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

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

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

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

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 14, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

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

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

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

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

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

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

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

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

water management

Table 15 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

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

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

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

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

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

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

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

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

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

soil properties

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

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 19.

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

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

engineering index properties

Table 16 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

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

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

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

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

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

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 19.

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

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

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

physical and chemical properties

Table 17 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

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

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

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

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

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

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

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

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

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

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

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

The higher the value the more susceptible the soil is to sheet and rill erosion by water.

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

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

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

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

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

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

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

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

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

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

8. Stony or gravelly soils and other soils not subject to wind erosion.

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

In table 17, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

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

soil and water features

Table 18 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

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

The four hydrologic soil groups are:

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

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

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

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

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes are not considered flooding.

Table 18 gives the frequency and duration of flooding and the time of year when flooding is most likely.

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

November-May, for example, means that flooding can occur during the period November through May.

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

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

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 18 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. A water table that is seasonally high for less than 1 month is not indicated in table 18.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

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

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

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

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

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

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

engineering index test data

Table 19 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are typical of the series and are described in the section "Soil series and their morphology." The soil samples were tested by the Nebraska Department of Roads.

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

The tests and methods are: AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); Particle density, Method T100-757 (AASHTO). The group index number that is part of the AASHTO Classification is computed by using a system that has been modified by the Nebraska Department of Roads.

classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*6*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 20, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

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

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

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

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

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

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

soil series and their morphology

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

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (*5*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*6*). Unless otherwise stated, colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

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

Bankard series

The Bankard series consists of deep, somewhat excessively drained, rapidly permeable soils. These soils formed in sandy alluvium on botton lands. Slope ranges from 0 to 2 percent.

Bankard soils are adjacent to McCook and Gibbon soils. Both McCook and Gibbon soils contain more clay and silt than the Bankard soils and have a mollic epipedon. Gibbon soils have a water table at a depth of 1.5 to 3.5 feet. McCook and Bankard soils are in the same positions in the landscape. Gibbon soils are in slightly lower positions.

Typical pedon of Bankard loamy sand, 0 to 2 percent slopes, 300 feet east and 700 feet south of the northwest corner of sec. 17, T. 5 N., R. 35 W.

Ap—0 to 6 inches; light brownish gray (10YR 6/2) loamy sand, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; slight effervescence; moderately alkaline; abrupt smooth boundary.

C—6 to 60 inches; light brownish gray (10YR 6/2) sand, brown (10YR 4/3) moist; single grained, loose; many fine and medium gravel and caliche fragments; strong effervescence; moderately alkaline.

The A horizon has color value of 5 or 6 (3 through 5 moist) and chroma of 2 through 4. It is typically loamy sand or sand. It is mildly or moderately alkaline. The C horizon has color value of 5 through 7 (3 through 5 moist) and chroma of 2 through 4. It is typically sand or loamy sand and is from 5 to 12 percent gravel and caliche fragments. It is moderately or strongly alkaline.

Bridget series

The Bridget series consists of deep, well drained, moderately permeable soils on stream terraces and colluvial-alluvial foot slopes and fans. These soils formed in silty, calcareous, colluvial-alluvial sediments. Slope ranges from 0 to 6 percent.

Bridget soils are similar to McCash and are commonly adjacent to Colby, Duroc, McCook, and Ulysses soils. McCash soils have a mollic epipedon more than 20 inches thick. The steep sloping Colby soils lack a mollic epipedon. They are on uplands. Duroc soils have a mollic epipedon more than 20 inches thick and contain more clay than the Bridget soils do. Duroc and Bridget soils are in the same position on the landscape. McCook soils have stratified layers throughout the pedon and are below the Bridget soils on botton lands. Ulysses soils have more clay in the pedon and are on the uplands.

Typical pedon of Bridget silt loam, 1 to 3 percent slopes, 450 feet south and 1,000 feet west of the northeast corner of section 7, T. 5 N., R. 34 W.

Ap2—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; neutral; abrupt smooth boundary.

A12—7 to 13 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium and fine subangular blocky structure; slightly hard, friable; mildly alkaline; clear smooth boundary.

AC—13 to 23 inches; light brownish gray (10YR 6/3) silt loam, dark grayish brown (10YR 4/2) moist; weak medium prismatic structure; slightly hard, friable; few soft white accumulations of carbonates; strong effervescence; moderately alkaline; clear smooth boundary.

C—23 to 60 inches; pale brown (10YR 6/3) silt loam, grayish brown (10YR 5/2) moist; massive; soft, very friable; few small soft white accumulations of carbonates; strong effervescence; moderately alkaline.

The solum ranges from 10 to 30 inches in thickness.

The A horizon has color value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. It is typically silt loam and, less commonly, loam or very fine sandy loam. Reaction is neutral or mildly alkaline. The AC horizon has color value of 5 through 7 (4 or 5 moist) and chroma of 2 or 3. It is typically silt loam, and, less commonly, loam or very fine sandy loam, which has an average of 10 to 18 percent clay. The C horizon has color value of 6 through 8 (4 through 6 moist) and chroma of 2 through 4. It is typically silt loam or very fine sandy loam. It is less commonly loam.

Canyon series

The Canyon series consists of shallow, excessively drained soils on uplands. These soils are moderately permeable above the bedrock. They formed in residuum weathered from weakly cemented caliche. Slope ranges from 15 to 60 percent.

Canyon soils are commonly adjacent to Colby, Otero, and Ulysses soils. Colby soils are deep and formed in loess. They usually are above the Canyon soils in the landscape. Otero soils are deep and are colluvial. They are below the Canyon soils. Ulysses soils are deep and have more silt and clay than the Canyon soils have. They are usually in higher positions in the landscape.

Typical pedon of Canyon loam from an area of Canyon-Otero-Rock outcrop complex, 15 to 60 percent slopes, 2,600 feet east and 2,000 feet south of the northwest corner of section 12, T. 5 N., R. 31 W.

A1—0 to 4 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, friable; violent effervescence; moderately alkaline; clear smooth boundary.

AC—4 to 8 inches; pale brown (10YR 6/3) loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure; soft, friable; violent effervescence; moderately alkaline; clear smooth boundary.

C—8 to 20 inches; very pale brown (10YR 7/3) loam, yellowish brown (10YR 5/4) moist; massive; hard, firm; common medium caliche fragments; violent effervescence; moderately alkaline; clear smooth boundary.
Cr—20 to 60 inches; light yellowish brown and white, weakly cemented caliche; violent effervescence.

The thickness of solum ranges from 6 to 12 inches, and the depth to semiconsolidated bedrock ranges from 6 to 20 inches. Reaction is mildly or moderately alkaline. Rock fragments are common in all horizons. Some pedons have a few granitic pebbles on the surface and mixed throughout the soil.

The A horizon has color value of 4 through 7 (3 through 6 moist) and chroma of 2 or 3. It is typically loam and, less commonly, fine sandy loam or gravelly loam. The AC horizon may be absent in some pedons. The AC and C horizons have color value of 6 through 8 (4 through 7 moist) and chroma of 2 through 4. They are typically loam or gravelly loam.

Colby series

The Colby series consists of deep, well drained to excessively drained, moderately permeable soils on uplands. These soils formed in silty, calcareous loess. Slope ranges from 6 to 60 percent.

Colby soils are commonly adjacent to Bridget, Canyon, Keith, Kuma, and Ulysses soils. Bridget soils have less clay than the Colby soils and have a mollic epipedon 7 to 20 inches thick. They are below the Colby soils on stream terraces. Canyon soils are shallow to bedrock and are loamy. They generally are below the Colby soils. Keith and Kuma soils both have more clay than the Colby soils. Keith soils have a mollic epipedon 7 to 20 inches thick, and Kuma soils have a mollic epipedon more than 20 inches thick. Keith and Kuma soils are more nearly level and are above the Colby soils on the landscape. Ulysses soils have a mollic epipedon 7 to 20 inches thick. Ulysses soils are less sloping and have plane to concave slopes.

Typical pedon of Colby silt loam in an area of Colby-Ulysses silt loams, 9 to 30 percent slopes, 2,300 feet west and 1,400 feet south of the northeast corner of section 10, T. 7 N., R. 32 W.

A1—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; slight effervescence; moderately alkaline; clear smooth boundary.
AC—6 to 11 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, friable; violent effervescence; moderately alkaline; clear smooth boundary.
C—11 to 60 inches; light gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable; few soft carbonate accumulations; violent effervescence; moderately alkaline.

The solum ranges from 3 to 12 inches in thickness. Typically, these soils have carbonates at the surface, but some pedons do not have carbonates in the upper 6 inches.

The A horizon has color value of 5 through 7 (3 through 5 moist) and chroma of 2 or 3. It is typically silt loam and less commonly loam or silty clay loam. The AC and C horizons have color value of 5 through 7 (4 through 6 moist) and chroma of 2 through 4. They are typically silt loam and less commonly loam. Reaction is mildly or moderately alkaline.

Duroc series

The Duroc series consists of deep, well drained, moderately permeable soils in upland swales and on stream terraces. These soils formed in silty, local colluvium and alluvium. Slope ranges from 0 to 3 percent.

Duroc soils are similar to McCash soils and are commonly adjacent to Bridget, Colby, Keith, Kuma, McCash, and Ulysses soils. McCash soils have less clay than the Duroc soils. The McCash and Duroc soils are in the same positions on the landscape. Bridget soils have less clay and do not have a mollic epipedon below 20 inches. They are in slightly higher positions in the landscape. Colby soils lack a mollic epipedon. Keith and Ulysses soils do not have a mollic epipedon that extends below a depth of 20 inches. They are in higher positions in the landscape. Kuma soils have a buried soil layer.

Typical pedon of Duroc silt loam, 0 to 1 percent slopes, 300 feet west and 1,600 feet north of the southeast corner of section 23, T. 7 N., R. 32 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, friable; neutral; abrupt smooth boundary.
A12—7 to 14 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine subangular blocky structure; slightly hard, friable; mildly alkaline; clear smooth boundary.
B2—14 to 30 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable; mildly alkaline; gradual smooth boundary.

B3ca—30 to 50 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; slightly hard, friable; calcium carbonates occur as concretions and in thin seams and streaks; strong effervescence; moderately alkaline; gradual smooth boundary.

C—50 to 60 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; massive; slightly hard, friable; few fine soft masses of calcium carbonates; strong effervescence; moderately alkaline.

The mollic epipedon is from 20 to 50 inches thick. Calcareous material ranges in depth from 10 to 36 inches.

The A horizon has color value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. It is typically silt loam and less commonly loam or very fine sandy loam. The B horizon has color value of 5 through 7 (3 through 5 moist) and chroma of 2 through 4. It is typically silt loam and, less commonly, loam or light silty clay loam that has an average of 18 to 30 percent clay. The C horizon has color value of 5 through 7 (4 through 6 moist) and chroma of 2 through 4. Reaction is moderately or strongly alkaline.

Gannett series

The Gannett series consists of deep, very poorly drained, moderately permeable soils on bottom lands. These soils formed in silty and loamy, calcareous alluvium. Slope ranges from 0 to 2 percent.

The Gannett soil in this survey area is higher in silt content than the defined range for the Gannett series. This difference does not alter the usefulness or behavior of the soil.

Gannett soils are adjacent to Fluvaquents and Gibbon and McCook soils. Fluvaquents are very poorly drained and in depressional areas. They are usually covered with shallow water. Gibbon soils are somewhat poorly drained and have a water table from 1.5 to 3.5 feet below the surface. McCook soils are well drained. Both soils are in slightly higher positions in the landscape.

Typical pedon of Gannett silt loam, 0 to 2 percent slopes, 1,300 feet east and 1,000 feet north of the southwest corner of section 16, T. 8 N., R. 32 W.

A1—0 to 4 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; hard, friable; violent effervescence; moderately alkaline; abrupt smooth boundary.

AC—4 to 20 inches; gray (10YR 5/1) silt loam, black (10YR 2/1) moist; common fine faint (10YR 4/4) mottles; weak fine subangular blocky structure; hard, friable; violent effervescence; moderately alkaline; abrupt smooth boundary.

C1—20 to 32 inches; gray (5Y 6/1) very fine sandy loam, dark gray (5Y 4/1) moist; common fine distinct (2.5Y 6/4) mottles; massive; slightly hard, friable; slight effervescence; mildly alkaline; gradual wavy boundary.

C2—32 to 60 inches; gray (5Y 5/1) very fine sandy loam, very dark gray (5Y 3/1) moist; massive; slightly hard, friable; strong effervescence; moderately alkaline.

The solum ranges from 7 to 24 inches in thickness, and the mollic epipedon ranges from 7 to 20 inches in thickness. Reaction is mildly alkaline or moderately alkaline.

The A horizon has hue of 10YR or 2.5Y, color value of 3 through 5 (2 or 3 moist), and chroma of 1 or 2. It is typically silt loam, but the range includes very fine sandy loam or silty clay loam. The C horizon has hue of 10YR through 5Y, color value of 5 through 7 (2 through 5 moist), and chroma of 1 or 2. Texture is silt loam or very fine sandy loam.

Gibbon series

The Gibbon series consists of deep, somewhat poorly drained, moderately permeable soils on bottom lands. These soils formed in silty, calcareous alluvium. Slope ranges from 0 to 2 percent.

The Gibbon soil in this survey area contains less clay and is slightly browner in color in the upper part of the subsoil than is defined as the range for the Gibbon series. This difference does not alter the usefulness or behavior of the soil.

Gibbon soils are commonly adjacent to Fluvaquents and Gannett and McCook soils. Fluvaquents and Gannett soils are very poorly drained and in depressional areas. Fluvaquents usually have shallow water over the surface. Gannett soils have a seasonal high water table that ranges from 0.5 foot above the surface to 1.0 foot below the surface. McCook soils are well drained, and the water table is below a depth of 5 feet. They are in slightly higher positions in the landscape.

Typical pedon of Gibbon silt loam, 0 to 2 percent slopes, 2,000 feet east and 2,220 feet north of the southwest corner of section 24, T. 7 N., R. 31 W.

Ap—0 to 7 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; slight effervescence; mildly alkaline; abrupt smooth boundary.

AC—7 to 11 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure; slightly hard, friable; few soft white accumulations of carbonates; strong effervescence; moderately alkaline; clear smooth boundary.

C1—11 to 18 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; common fine faint (10YR 4/4) mottles; massive; slightly hard, friable; thin stratification of darker material; few soft white accumulations of carbonates; strong effervescence; moderately alkaline; clear smooth boundary.

C2—18 to 25 inches; light brownish gray (10YR 6/2) silt loam, very dark grayish brown (10YR 3/2) moist; massive; slightly hard, friable; few small soft white accumulations of carbonates; strong effervescence; moderately alkaline; clear smooth boundary.

C3—25 to 46 inches; light gray (2.5Y 7/2) silt loam, grayish brown (2.5Y 5/2) moist; common fine faint (10YR 4/4) mottles; massive; slightly hard, friable; few small soft white accumulations of carbonates; strong effervescence; moderately alkaline; abrupt smooth boundary.

C4—46 to 60 inches; gray (5Y 6/1) silt loam, olive gray (5Y 5/2) moist; common fine distinct (10YR 4/4) mottles; massive; slightly hard, friable; few small soft accumulations of carbonates; strong effervescence; moderately alkaline.

The solum ranges from 7 to 30 inches in thickness, and the mollic epipedon ranges from 7 to 20 inches in thickness.

The A horizon has color value of 3 through 5 (2 or 3 moist) and chroma of 1 or 2. It is typically silt loam and, less commonly, loam or very fine sandy loam. The C horizon has hue of 5Y through 10YR, color value of 5 through 7 (3 through 5 moist), and chroma of 1 or 2. It is typically silt loam or loam and, less commonly, very fine sandy loam that has an average clay content of less than 18 percent. Reaction is mildly or moderately alkaline.

Jayem series

The Jayem series consists of deep, well drained, moderately rapidly permeable soils on uplands. These soils formed in sandy textured eolian material. Slope ranges from 0 to 9 percent.

Jayem soils are similar to Sarben soils and are adjacent to Keith, Kuma, McCash, Sarben, and Valent soils in the landscape. Sarben soils do no have a mollic epipedon and are usually more sloping. Sarben and Jayem soils are in the same positions in the landscape. Keith and Kuma soils contain more clay in the subsoil than the Jayem soils. McCash soils have a mollic epipedon that is thicker than 20 inches. They are in depressional areas. Valent soils contain more sand and are more sloping than Jayem soils.

Typical pedon of Jayem loamy very fine sand, 0 to 3 percent slopes, 1,750 feet north and 90 feet west of the southeast corner of section 24, T. 8 N., R. 35 W.

Ap—0 to 6 inches; brown (10YR 5/3) loamy very fine sand, dark grayish brown (10YR 3/3) moist; weak fine granular structure; soft, very friable; neutral; abrupt smooth boundary.

A12—6 to 10 inches; dark grayish brown (10YR 4/2) very fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium and fine subangular blocky structure; soft, very friable; neutral; clear smooth boundary.

B2—10 to 30 inches; brown (10YR 5/3) loamy very fine sand, dark brown (10YR 4/3) moist; weak coarse prismatic structure parting to weak medium subangular blocky; soft, very friable; neutral; gradual wavy boundary.

C—30 to 60 inches; light yellowish brown (10YR 6/4) loamy very fine sand, brown (10YR 5/3) moist; massive; soft, very friable; neutral.

The mollic epipedon ranges from 7 to 20 inches thick.

The A horizon has color value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. It is dominantly loamy, very fine sand and, less commonly, very fine sandy loam or fine sandy loam. The B2 horizon has value of 5 or 6 (3 through 5 moist) and chroma of 2 through 4. It is commonly loamy very fine sand or very fine sandy loam. It has color value of 5 or 6 (4 or 5 moist) and chroma of 2 through 4. It is neutral or mildly alkaline.

Keith series

The Keith series consists of deep, well drained, moderately permeable soils. These soils are mostly on uplands, but a few small areas are on stream terraces. They formed in silty, calcareous loess. Slope ranges from 0 to 6 percent.

Keith soils are similar to Kuma soils and are commonly adjacent to Colby, Duroc, Kuma, and Ulysses soils and the Scott Variant. Kuma soils have a mollic epipedon thicker than 20 inches. The strongly sloping to steep Colby soils lack a mollic epipedon and are typically below Keith soils. Duroc soils contain less clay in the subsoil than Keith soils, and the Scott Variant contains more clay in the subsoil. The Scott Variant is in shallow depressions. Ulysses soils contain less clay in the subsoil. They are typically below Keith soils and are steeper.

Typical pedon of Keith silt loam, 1 to 3 percent slopes, 150 feet north and 340 feet west of the southeast corner of section 5, T. 6 N., R. 32 W.

Ap—0 to 8 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; slightly acid; abrupt smooth boundary.

A12—8 to 12 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak fine granular; soft, very friable; slightly acid; clear smooth boundary.

B21t—12 to 18 inches; brown (10YR 5/3) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable; neutral; clear, smooth boundary.

B22t—18 to 25 inches; pale brown (10YR 6/3) silty clay loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable; neutral; clear, smooth boundary.

B3—25 to 29 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; weak coarse prismatic structure parting to weak medium subangular blocky; soft, very friable; mildly alkaline; clear smooth boundary.

C1ca—29 to 39 inches; light gray (10YR 7/2) silt loam, pale brown (10YR 6/3) moist; massive; soft, very friable; few white mycelia of calcium carbonate; strong effervescence; moderately alkaline; clear smooth boundary.

C2—39 to 60 inches; light gray (10YR 7/2) silt loam, light brownish gray (10YR 6/2) moist; massive; soft, very friable; strong effervescence; moderately alkaline.

The solum ranges from 16 to 36 inches in thickness. The mollic epipedon ranges from 8 to 20 inches in thickness. Carbonates are at a depth of 14 to 33 inches.

The A horizon has a color value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is typically silt loam and, less commonly, fine sandy loam, loam, or very fine sandy loam. The B2t horizon has color value of 4 through 6 (2 through 5 moist) and chroma of 2 or 3. The darker colors are in the upper part. The B2t horizon is silt loam, silty clay loam, or loam that has a range of 25 to 33 percent. Where the B2t horizon is loam, content of very fine sand is high. The C1ca and C2 horizons have hue of 10YR or 2.5Y, color value of 6 to 8 (5 or 6 moist), and chroma of 2 or 3. The C horizon is silt loam or loam. It is mildly or moderately alkaline.

Kuma series

The Kuma series consists of deep, well drained, moderately permeable or moderately slowly permeable soils on uplands. These soils formed in loess over a buried soil that also formed in loess. Slope ranges from 0 to 6 percent.

Kuma soils are similar to the Keith soils and are commonly adjacent to Colby, Duroc, Keith, and Ulysses soils and Scott Variant. Keith soils have a mollic epipedon less than 20 inches thick. Both the Duroc and Keith soils and the Kuma soils are in similar positions in the landscape. Colby soils lack a mollic epipedon and are steeper. Duroc soils contain less clay in the subsoil than the Kuma soils. Scott soils contain more clay in the subsoil and are in shallow depressions. Ulysses soils have a mollic epipedon less than 20 inches thick and contain less clay in the subsoil. They usually are above the Kuma soils.

Typical pedon of Kuma silt loam, 1 to 3 percent slopes, 100 feet west and 1,700 feet north of the southeast corner of section 20, T. 5 N., R. 32 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; neutral; abrupt smooth boundary.

B1—7 to 16 inches; dark gray (10Y 4/1) silt loam, very dark gray (10YR 3/1) moist; weak fine subangular blocky structure; slightly hard, friable; neutral; clear smooth boundary.

B21t—16 to 22 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm; neutral; clear smooth boundary.

B22t—22 to 31 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; hard, firm; mildly alkaline; clear smooth boundary.

B23tb—31 to 44 inches; dark gray (10YR 4/1) silty clay loam, very dark brown (10YR 2/2) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard; friable; mildly alkaline; clear smooth boundary.

B3cab—44 to 54 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; soft, very friable; many mycelia-like calcium carbonates concentrated in the structural cracks and on faces of peds; strong effervescence; moderately alkaline; gradual wavy boundary.

C—54 to 65 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; massive; soft, very friable; strong effervescence; moderately alkaline.

The solum ranges from 30 to 60 inches or more in thickness. The mollic epipedon is from 20 to 50 inches thick.

The A horizon has color value of 4 or 5 (2 or 3 moist) and chroma of 1 through 3. It is typically silt loam and, less commonly, loam. The B2t horizon has color value of 4 or 5 (2 or 3 moist) and chroma of 1 to 3. It is typically silty clay loam or loam. The B2tb and B2tcab horizons have color value of 4 through 7 (2 through 6 moist) and chroma of 1 through 4. They are typically silty clay loam or loam. The C horizon has color value of 6 or 7 (5 or 6 moist) and chroma of 2 through 4. It is typically silt loam and, less commonly, light silty clay loam or loam. It is moderately or strongly alkaline.

McCash series

The McCash series consists of deep, well drained, moderately permeable soils in upland swales. These soils formed in loamy and sandy colluvial material. Slope ranges from 0 to 3 percent.

McCash soils are similar to Bridget and Duroc soils and are commonly adjacent to Duroc, Jayem, Kuma, and Sarben soils in the landscape. Bridget soils have a mollic epipedon less than 20 inches thick. Duroc and Kuma soils contain more clay throughout than the McCash soils. Duroc and McCash soils are in similar positions in the landscape. Jayem soils contain less silt in the subsoil than the McCash soils and have a mollic epipedon less than 20 inches thick. Sarben soils contain less silt in the subsoil and lack a mollic epipedon. Kuma, Jayem, and Sarben soils are in higher positions in the landscape.

Typical pedon of McCash very fine sandy loam, 0 to 1 percent slopes, 50 feet south and 475 feet east of the northwest corner of section 35, T. 7 N., R. 31 W.

Ap—0 to 8 inches; brown (10YR 5/3) very fine sandy loam, dark brown (10YR 3/3) moist; weak fine granular structure; slightly hard, very friable; neutral; abrupt smooth boundary.

A12—8 to 15 inches; dark grayish brown (10YR 4/2) very fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; slightly hard, very friable; mildly alkaline; clear smooth boundary.

B21—15 to 24 inches; dark grayish brown (10YR 4/2) very fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, very friable; mildly alkaline; clear smooth boundary.

B22—24 to 36 inches; brown (10YR 5/3) very fine sandy loam, dark brown (10YR 3/3) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, very friable; mildly alkaline; gradual wavy boundary.

C—36 to 60 inches; brown (10YR 5/3) loamy very fine sand, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable; mildly alkaline.

The solum ranges from 24 to 54 inches in thickness, and the mollic epipedon ranges between 20 and 54 inches in thickness.

The A horizon has color value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. It is typically very fine sandy loam and, less commonly, loamy very fine sand or silt loam. Reaction ranges from slightly acid to mildly alkaline. The B2 horizon has color value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. It is typically very fine sandy loam and, less commonly, loamy very fine sand or silt loam. Clay content averages from 8 to 18 percent. Reaction ranges from slightly acid to mildly alkaline. The C horizon has color value of 5 through 7 (4 or 5 moist) and chroma of 2 or 3. It is typically loamy very fine sand and, less commonly, very fine sandy loam or fine sandy loam. Reaction is neutral or mildly alkaline. In the map unit MaB, the mollic epipedon is less than 20 inches thick, but this difference does not alter the usefulness or behavior of the soil.

McCook series

The McCook series consists of deep, well drained or moderately well drained, moderately permeable soils on bottom lands. These soils formed in stratified, calcareous, silty alluvium. Slope ranges from 0 to 3 percent.

McCook soils are commonly adjacent to Bridget, Bankard, Duroc, Gannett, and Gibbon soils. Bridget soils are not stratified and are in higher positions on terraces. Bankard soils are sandy throughout. Bankard and McCook soils are in the same positions in the landscape. Duroc soils have more clay, have darker colors below a depth of 20 inches, and are in higher positions on terraces. Gannett soils are very poorly drained and have a water table that ranges from 0.5 foot above the surface to 1.0 foot below the surface. Gannett soils are in lower positions in the landscape. Gibbon soils are somewhat poorly drained and have a water table from 1.5 to 3.5 feet below the surface. The Gibbon and McCook soils are in the same positions in the landscape.

Typical pedon of McCook silt loam, occasionally flooded, 0 to 2 percent slopes, 20 feet north and 1,050 feet east of the southwest corner of section 19, T. 5 N., R. 34 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; slight effervescence; mildly alkaline; abrupt smooth boundary.

A12—6 to 12 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium and fine subangular blocky structure; slightly hard, friable; slight effervescence; mildly alkaline; clear smooth boundary.

AC—12 to 24 inches; pale brown (10YR 6/3) silt loam, dark grayish brown (10YR 4/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable; strong effervescence; moderately alkaline; clear smooth boundary.

C1—24 to 36 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; weak fine subangular blocky structure; slightly hard, friable; fine stratification; strong effervescence; moderately alkaline; clear smooth boundary.

C2—36 to 53 inches; very pale brown (10YR 7/3) very fine sandy loam, brown (10YR 5/3) moist; massive, but bedding planes are evident; slightly hard, friable; fine stratification; strong effervescence; moderately alkaline; abrupt smooth boundary.

IIC3—53 to 60 inches; pale brown (10YR 6/3) sand and coarse sand, brown (10YR 5/3) moist; common fine faint mottles; massive; loose; slight effervescence; mildly alkaline.

The solum ranges from 16 to 33 inches in thickness, and the mollic epipedon ranges from 7 to 20 inches in thickness.

The A horizon has color value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is typically silt loam and, less commonly, loam or very fine sandy loam. The AC and C horizons have color value of 5 through 7 (4 through 6) moist and chroma of 2 or 3. Strata in these horizons have chroma of 1. These horizons are silt loam or very fine sandy loam. A buried A horizon, or thin strata of slightly coarser to finer textured material, is under the AC horizon in some pedons.

In the map unit MfB, the surface layer lacks a mollic epipedon and is stratified in the upper part, but these differences do not alter the usefulness or behavior of the soil.

Otero series

The Otero series consists of deep, somewhat excessively drained, moderately rapidly permeable soils. These soils formed on colluvial fans below escarpments of sedimentary rock. Slope ranges from 15 to 30 percent.

Otero soils are commonly adjacent to Bridget and Canyon soils. Bridget soils contain more silt throughout than the Otero soils. They are less sloping and below the Otero soils. Canyon soils are shallow to bedrock and are in higher positions in the landscape.

Typical pedon of Otero loam from an area of Canyon-Otero-Rock outcrop complex, 15 to 60 percent slopes, 2,200 feet west and 650 feet south of the northeast corner of section 6, T. 5 N., R. 34 W.

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

C1—5 to 48 inches; brown (10YR 5/3) loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable; common small caliche limy chips and fragments; sandstone fragments; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—48 to 60 inches; pale brown (10YR 6/3) loam; massive; slightly hard, friable; many small and large caliche chips and fragments; violent effervescence; moderately alkaline.

The solum ranges from 4 to 12 inches in thickness. Some pedons have a transitional horizon.

The A horizon has color value of 5 through 7 (3 through 6 moist) and chroma of 2 through 4. It is typically loam and, less commonly, sandy loam. Reaction is mildly alkaline or moderately alkaline. The C horizon has color value of 5 through 7 (4 through 6 moist). It is typically loam or gravelly loam. Reaction is moderately or strongly alkaline.

Sarben series

The Sarben series consists of deep, well drained, moderately rapidly permeable soils on uplands. These soils formed in sandy eolian materials. Slope ranges from 0 to 60 percent.

Sarben soils are similar to Jayem soils and are commonly adjacent to Jayem, Keith, Kuma, McCash, and Valent soils. Jayem soils have a mollic epipedon and are in less sloping areas. Keith and Kuma soils have a mollic epipedon and contain more clay throughout than the Sarben soils. Both soils are less sloping. McCash soils have a mollic epipedon thicker than 20 inches and are in depressional areas. Valent soils contain more sand than the Sarben soils and are higher in the landscape.

Typical pedon of Sarben loamy very fine sand, 6 to 9 percent slopes, 1,000 feet south and 2,250 feet east of the northwest corner of section 34, T. 7 N., R. 31 W.

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

AC—6 to 14 inches; brown (10YR 5/3) loamy very fine sand, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; soft, very friable; slightly acid; clear smooth boundary.

C1—14 to 24 inches; pale brown (10YR 6/3) loamy very fine sand, grayish brown (10YR 5/2) moist; massive; soft, very friable; neutral.

C2—24 to 60 inches; very pale brown (10YR 7/3) loamy very fine sand, pale brown (10YR 6/3) moist; massive; soft, very friable; neutral.

The solum ranges from 8 to 22 inches in thickness. Carbonates are typically below a depth of 40 inches but range in depth from 24 inches to more than 60 inches.

The A horizon has color value of 4 through 6 (3 or 4 moist) and chroma of 2 or 3. It is commonly loamy very fine sand and, less commonly, fine sandy loam or loamy fine sand. Reaction is slightly acid or neutral. The C horizon has color value of 5 through 8 (4 to 6 moist) and chroma of 2 or 3. It is commonly loamy fine sand or loamy very fine sand and, less commonly, fine sandy loam or very fine sandy loam.

Scott Variant

The Scott Variant consists of deep, poorly drained, slowly permeable soils in upland depressions. This soil formed in silty loess that has been modified by water. Slope ranges from 0 to 1 percent.

The Scott Variant is adjacent to Keith and Kuma soils. Both have less clay in the subsoil than the Scott Variant, are well drained, and are in higher positions in the landscape.

Typical pedon of Scott Variant silty clay loam, 0 to 1 percent slopes, 1,290 feet east and 2,060 feet south of the northwest corner of section 32, T. 5 N., R. 34 W.

Ap—0 to 5 inches; dark gray (10YR 4/1) silty clay loam, black (10YR 2/1) moist; moderate fine granular structure; very hard, firm; slightly acid; abrupt smooth boundary.

B21t—5 to 18 inches; dark gray (10YR 4/1) silty clay loam, black (10YR 2/1) moist; strong medium subangular blocky structure; extremely hard, very firm; shiny faces on most ped surfaces; neutral; clear smooth boundary.

B22t—18 to 30 inches; dark gray (10YR 4/1) silty clay loam, black (10YR 2/1) moist; strong coarse prismatic structure parting to moderate medium subangular blocky; extremely hard, very firm; shiny faces on most peds; neutral; clear smooth boundary.

B23t—30 to 46 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; strong coarse prismatic structure parting to moderate medium subangular blocky; extremely hard, very firm; shiny faces on most ped surfaces; neutral; clear smooth boundary.

B3t—46 to 60 inches; gray (10YR 5/1) silty clay loam, very dark gray (10YR 3/1) moist; moderate medium subangular blocky structure; very hard, very firm; slight effervescence; mildly alkaline.

The solum ranges from 27 to 56 inches in thickness. Carbonates are at a depth of 35 to 60 inches.

The A horizon has color value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is typically silty clay loam or silt loam. The B2t horizon has hue of 10YR or 2.5Y, color value of 3 through 5 (2 or 3 moist), and chroma of 1 or 2. It is typically silty clay loam or clay loam that has an average of 27 to 35 percent clay. The C horizon has a hue of 10YR or 2.5Y, color value of 5 through 7 (4 through 6 moist), and chroma of 2 through 4.

Ulysses series

The Ulysses series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in silty, calcareous loess. Slope ranges from 3 to 15 percent.

Ulysses soils are commonly adjacent to Colby, Keith, and Kuma soils. Colby soils do not have a mollic epipedon and are typically steeper. Both Keith and Kuma soils have more clay in the subsoil than the Ulysses soils, and Kuma soils have a mollic epipedon thicker than 20 inches. Both Keith and Kuma soils are typically less sloping.

Typical pedon of Ulysses silt loam from an area of Colby-Ulysses silt loams, 9 to 30 percent slopes, 50 feet south and 1,320 feet west of the northeast corner, section 16, T. 5 N., R. 31 W.

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

B2—10 to 17 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, friable; slight effervescence; mildly alkaline; clear smooth boundary.

C1ca—17 to 24 inches; light brownish gray (10YR 6/2) silt loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; slightly hard, friable; common soft white accumulations of carbonates; strong effervescence; moderately alkaline; clear smooth boundary.

C2—24 to 60 inches; very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) moist; massive; slightly hard, very friable; few soft white accumulations of carbonates; violent effervescence; moderately alkaline.

The solum ranges from 11 to 24 inches in thickness. The mollic epipedon ranges from 7 to 20 inches in thickness. Carbonates are at a depth of 7 to 15 inches. Reaction ranges from neutral to moderately alkaline throughout the pedon.

The A horizon has color value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. It is dominantly silt loam and, less commonly, very fine sandy loam or loam. The B2 horizon has color value of 4 through 6 (3 or 4 moist) and chroma of 2 or 3. It is typically silt loam or light silty clay loam that averages from 21 to 32 percent clay. The C horizon has color value of 5 through 7 (4 through 6 moist) and chroma of 2 through 4.

Valent series

The Valent series consists of deep, excessively drained, rapidly permeable soils in sandhills. These soils formed in noncalcareous, eolian sands. Slope ranges from 3 to 60 percent.

Valent soils are commonly adjacent to Jayem and Sarben soils. Jayem soils have a mollic epipedon and are less sloping. Sarben soils have more silt and clay throughout the profile than the Valent soils. The Sarben and Valent soils are in similar positions in the landscape.

Typical pedon of Valent fine sand, rolling, 400 feet south and 200 feet west from center of section 15, T. 8 N., R. 32 W.

A1—0 to 7 inches; brown (10YR 4/3) fine sand, dark grayish brown (10YR 4/2) moist; weak fine granular structure parting to single grain; loose; neutral; gradual wavy boundary.

C—7 to 60 inches; pale brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; single grain; loose; neutral.

The solum ranges from 3 to 10 inches in thickness.

The A horizon has a color value of 5 or 6 (3 through 5 moist). It is fine sand or loamy fine sand. The C horizon is fine sand or sand. It is neutral or mildly alkaline.

formation of the soils

The characteristics of a soil in any given place are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief or lay of the land and (5) the length of time the forces of soil formation have acted on the soil material.

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

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

parent material

The soils in Hayes County formed in several kinds of material, such as loess, eolian sand, colluvium, and alluvium. There are also outcrops of rocks from the Ogallala Formation. The soils that formed in material weathered from bedrock are the Canyon soils.

Loess, or wind-deposited silt, is the parent material of soils throughout a large part of the county. Peoria Loess is a friable, massive, light gray or pale brown silt loam. It is calcareous and contains a few lime concretions. In Hayes County it ranges from a few feet to more than 80 feet in thickness. Keith, Colby, and Ulysses soils formed in this material.

Eolian sand is pale brown and very pale brown soil material deposited by wind. This material ranges from less than 5 feet thick to many feet in thickness. Soils formed in eolian sand are mostly coarse textured and excessively drained. In some places, however, they consist of well drained sand that contains silt and clay. Valent soils formed in coarse eolian sand in the sandhills. They are mostly gently sloping to rolling and hilly. They are immature soils that have a thin surface layer and lack well developed horizons. Jayem, Sarben, and McCash soils formed in sandy to loamy eolian material in transitional areas between the eolian sand and loess. McCash soils are in lower swales.

Colluvium is soil material that accumulated as a result of combined forces of gravity and water. This material is on foot slopes at the base of loess hills that border the larger drainageways. It is pale brown, calcareous silt loam. The Bridget and Duroc soils formed in colluvium.

Alluvium is a heterogeneous mixture of silt, sand, and clay deposited by water. It is on flood plains and at the bottom of canyons. McCook, Gibbon, and Gannett soils formed in alluvium. McCook soils are well drained or moderately well drained. Gibbon soils are somewhat poorly drained, and Gannett soils are very poorly drained.

climate

Climate influences formation of soils both directly and indirectly. It weathers and reworks the parent material by rainfall, temperature, and wind. It affects the soils indirectly by the amount and kind of vegetation and animal life sustained.

In Hayes County the average annual precipitation is about 19 inches. Sufficient moisture has moved through the soil to leach free lime from the surface layer to the subsoil and, in some soils, to the upper part of the underlying material. In a few soils moisture has moved clay particles from the suface layer downward into the subsoil. This is especially evident in depressions where ponding has increased the water movement into and through the soil and has formed a claypan type of subsoil. Where slopes are steep, erosion has reduced the thickness of the surface layer. On low-lying bottom land, excessive runoff of rainfall or snowmelt results in flooding and deposition of sediment, which influences the soil characteristics.

Temperature influences soil formation. Hot weather in summer and abundant soil moisture speeds chemical weathering. Alternate freezing and thawing and wetting and drying aid in the development of granular structure in the surface layer.

Northwest winds have influenced the distribution of eolian sand and loess. In winter snow accumulates on the southeast-facing slopes, which adds moisture to the soil and increases vegetative growth. This, in turn, causes both deeper leaching and an added amount of organic matter. Soil blowing results in a thinned surface layer. Movement of soil material by wind is most active on the sandier soils.

plants and animal life

Plants and animals on and in the soil actively influence in the soil forming process.

Prairie grasses provide the organic matter that has accumulated in the soils. This organic matter has darkened the color of the surface layer and parts of the subsoil. The largest amount of organic matter is generally near the surface and generally declines gradually as depth increases. Keith soils, for example, have a fairly large amount of organic matter in the surface layer. They have dark colors to a depth of 10 to 20 inches. Below this the colors become lighter as the amount of organic matter decreases.

In contrast to the Keith soils, the Scott Variant formed in depressions. The additional moisture produces more tall grasses and, consequently, more organic matter. As a result, soils in moist sites have organicly enriched layers that are thicker and darker colored than those on uplands where moisture moves off the soil more rapidly.

Kuma soils have a buried layer 2 to 4 feet below the surface in which there is increased organic matter.

Animals and insects mix the darkened, organic-rich layers and the mineral-rich material from below. Rodent burrows filled with soil material of a contrasting color are evidence of animal activity in the soil. Worms and burrowing insects mix the soil material, improve granulation, and increase the availability of plant nutrients.

Micro-organisms are an important factor in soil development. They aid the decomposition of organic matter into nutrients that can be used by plants. Some bacteria perform specific processes, such as using nitrogen gas from the atmosphere or transforming ammonium nitrogen into nitrate nitrogen.

Man's activities are a major influence in soil formation. Through his management of soils for increased production and the introduction of drainage, irrigation, summer fallow, and soil conservation practices, the soil-water erosion relationship that existed for several thousand years has changed. Removing the grass cover has exposed the fertile surface layer to erosion. Drainage increases chemical activity and weathering in poorly drained soils. Irrigation and summer fallow increase the moisture supply in the soil, which results in increased chemical weathering and greater water movement through the soil. Man's activities have an immediate effect upon both rate and direction of soil forming processes.

relief

Relief, or lay of the land, is an important factor in the formation of soils in Hayes County.

Steepness, shape, length, and direction of slope affect runoff, erosion, and the amount of moisture available for soil development. For example, moderately steep and steep Colby soils have a thin surface layer, which is the result of the combined effects of excessive runoff, erosion, insufficient moisture to produce the large amounts of vegetation needed to increase organic matter, and insufficient moisture for subsoil development.

In nearly level to gently sloping Keith and Kuma soils, water infiltrates into the soil instead of running off. These soils have a surface layer that is moderately thick to thick. The increased soil moisture has stimulated development of the subsoil by leaching carbonates and clay particles from the surface layer into a lower horizon.

The shape of the slope is often important in soil formation. The upper part of the steeply sloping Colby and Ulysses silt loams, 9 to 30 percent slopes, is commonly convex. Water is shed rapidly, and only a limited amount enters the soil. Soils that have a thin surface layer and lack subsoil development, as in the Colby series, formed in these areas. Where the slope is plane or concave, a thicker surface layer and subsoil formed.

The influence of shape of slope is also evident in nearly level areas in Hayes County. Upland depressions receive additional moisture that runs off from higher lying surrounding areas. This additional moisture has contributed to the development of a thick claypan subsoil. The Scott Variant, for example, formed in depressions.

On bottom land, the water table is closest to the surface where the relative elevation is lowest. When the soil is saturated, many physical and chemical reactions are altered. Downward movement of water is restricted. Anaerobic reaction becomes dominant because the lack of oxygen inhibits growth of bacteria. These soils tend to be colder than soils that are aerobic. In Gannett soils the ground water is at or near the surface.

Bottom land, because of the relatively low-lying position, commonly receives additional sediment from flooding. This usually prevents normal soil formation. Each period of flooding and deposition provides new soil parent material and starts another cycle of soil development.

time

Time, in soil formation, begins once a land surface is reasonably stabilized. Several thousand years are required for the formation of a mature soil, but younger soils have formed in a few tens to hundreds of years.

Mature soils commonly have a darkened surface layer, a clay enriched subsoil, and a horizon where calcium carbonate has accumulated. Such soils as Keith, Kuma, and Scott Variant are mature soils in Hayes County. They are approaching an equilibrium with their environment. An example of a less mature soil is the Bridget soil. It is on high stream terraces that have been stabilized for a shorter period of time than soils on uplands.

Some soils in Hayes County are kept perpetually young by deposition of soil material, by erosion, or by lack of sufficient moisture for soil development to progress very rapidly. Soils on bottom land that are frequently subject to flooding and deposition of soil material have little time for uninterrupted soil formation. They are considered young soils. Some Colby soils have steep slopes where runoff is rapid. Rapid runoff limits the amount of moisture necessary for soil formation to take place and erodes the surface nearly as fast as soil forms. Colby soils, however, formed in material that is the same age as the material in which the mature Keith soils formed.

references

(1) American Association of State Highway [and Transportation] Officials. 1970. Standard specifications for highway materials and methods of sampling and testing. Ed. 10, 2 vol., illus.

(2) American Society for Testing and Materials. 1974. Method for classification of soil for engineering purposes. ASTM Stand. D 2487–69. *In* 1974 Annual Book of ASTM Standards, Part 19, 464 pp., illus.

(3) Hayes County Bicentennial Committee. 1977. Hayes County bicentennial book. 60 pp., illus.

(4) United States Department of Agriculture. 1938. Soil survey of Hayes County, Nebraska. Bur. of Chemistry and Soils in cooperation with the Univ. of Nebr., State Soil Survey, Dep. of Conserv. and Survey Div. 41 pp., illus.

(5) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus. [Supplements replacing pp., 173–188 issued May 1962]

(6) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436, 754 pp., illus.

glossary

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

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

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

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

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

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

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

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

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 flooding.

Breaks. The broken land at the border of an upland that is dissected by ravines.

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.

Canyon. A steep-walled chasm, gorge, or ravine; a channel cut by running water in the surface of the earth, the sides of which are composed of cliffs rising from its bed.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catsteps. Very small, irregular terraces on steep hillsides, especially in pasture, formed by the trampling of cattle or the slippage of saturated soil.

Chiseling. Tillage with an implement having one or more soil-penetrating points that loosen the subsoil and bring clods to the surface. A form of emergency tillage to control soil blowing.

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

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

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

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.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15.2 to 38.1 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

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

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

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

Compressible (in tables). 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. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

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

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

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

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

Deferred grazing. Postponing grazing or arresting grazing for a prescribed period.

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

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

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

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

Eco-fallow. A system to control weeds and conserve moisture with a minimum disturbance to the soil and crop residue.

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

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

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

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

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

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

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.

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

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

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

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

Foot slope. The inclined surface at the base of a hill.

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

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

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

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

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

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

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

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have 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 in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

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

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

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

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

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

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

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

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

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

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

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

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

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

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

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

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

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

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

Percolation. The downward movement of water through the soil.

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

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

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

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

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

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

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

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

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

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

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

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

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

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

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

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

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

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

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

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

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

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

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

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

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.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

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 (in tables). The slow movement of water into the soil.

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

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

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

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

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

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

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

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

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

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

Surface layer. All of the A horizon except the A2 horizon.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

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

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

Till-plant. Seedbed preparation and planting of row crops are completed in the same operation. The seedbed is prepared by scalping the area of the old row crop and by pushing the soil and residue aside, which leaves a protective cover of crop residue on and mixed into the surface layer between the rows.

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

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

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

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

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

tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[From incomplete data recorded in the period 1951-78 at Hayes Center, Nebraska]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days[1]	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	Units	In	In	In		In
January----	37.4	12.3	24.9	67	-14	0	.29	.04	.48	1	3.8
February---	42.9	17.4	30.2	74	-7	11	.51	.07	.85	2	6.6
March------	49.2	23.3	36.3	84	-2	31	1.01	.27	1.59	3	6.7
April------	62.2	35.1	48.7	88	16	79	1.86	.81	2.75	5	1.3
May--------	71.9	46.2	59.1	94	29	297	3.22	1.81	4.45	6	.1
June-------	82.3	55.7	69.0	105	40	570	3.49	1.46	5.19	6	.0
July-------	89.0	61.7	75.4	106	50	787	3.22	1.52	4.67	6	.0
August-----	87.7	59.6	73.6	104	47	732	1.96	1.00	2.78	5	.0
September--	77.8	49.5	63.7	101	33	420	1.78	.40	2.85	4	.0
October----	67.4	37.9	52.6	90	20	156	1.01	.26	1.60	3	.3
November---	50.8	24.6	37.7	77	2	0	.58	.12	.93	2	2.3
December---	41.1	16.6	29.0	68	-9	0	.37	.09	.58	2	4.2
Yearly:											
Average--	63.3	36.7	50.0	---	---	---	---	---	---	---	---
Extreme--	---	---	---	106	-15	---	---	---	---	---	---
Total----	---	---	---	---	---	3,083	19.30	15.31	23.03	45	25.3

[1] A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[From data recorded in the period 1951-78 at Hayes Center, Nebraska]

Probability	Temperature: 24° F or lower	Temperature: 28° F or lower	Temperature: 32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 29	May 5	May 12
2 years in 10 later than--	April 23	April 30	May 8
5 years in 10 later than--	April 11	April 21	April 29
First freezing temperature in fall:			
1 year in 10 earlier than--	October 16	October 9	September 24
2 years in 10 earlier than--	October 21	October 13	September 29
5 years in 10 earlier than--	October 31	October 22	October 9

TABLE 3.--GROWING SEASON

[From data recorded in the period 1951-78 at Hayes Center, Nebraska]

Probability	Daily minimum temperature during growing season: Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	181	164	144
8 years in 10	188	170	150
5 years in 10	202	183	162
2 years in 10	215	196	174
1 year in 10	222	202	180

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

Map symbol	Soil name	Acres	Percent
Ba	Bankard loamy sand, 0 to 2 percent slopes	110	*
Bg	Bridget silt loam, 0 to 1 percent slopes	2,430	0.5
BgB	Bridget silt loam, 1 to 3 percent slopes	5,140	1.1
BgC	Bridget silt loam, 3 to 6 percent slopes	1,060	0.2
CcG	Canyon-Otero-Rock outcrop complex, 15 to 60 percent slopes	1,430	0.3
CdD	Colby silt loam, 6 to 9 percent slopes	2,140	0.5
CdG	Colby silt loam, 30 to 60 percent slopes	71,332	15.7
CeF	Colby-Ulysses silt loams, 9 to 30 percent slopes	91,410	20.1
Du	Duroc silt loam, 0 to 1 percent slopes	1,110	0.2
DuB	Duroc silt loam, 1 to 3 percent slopes	1,030	0.2
Fu	Fluvaquents, silty	620	0.1
Ga	Gannett silt loam, 0 to 2 percent slopes	360	0.1
Gc	Gibbon silt loam, 0 to 2 percent slopes	1,670	0.4
JaB	Jayem loamy very fine sand, 0 to 3 percent slopes	17,730	3.9
JaC	Jayem loamy very fine sand, 3 to 6 percent slopes	6,430	1.4
Ke	Keith silt loam, 0 to 1 percent slopes	1,480	0.3
KeB	Keith silt loam, 1 to 3 percent slopes	14,090	3.1
KeC	Keith silt loam, 3 to 6 percent slopes	3,280	0.7
Ku	Kuma silt loam, 0 to 1 percent slopes	20,840	4.6
KuB	Kuma silt loam, 1 to 3 percent slopes	61,250	13.5
KuC	Kuma silt loam, 3 to 6 percent slopes	1,920	0.4
Ma	McCash very fine sandy loam, 0 to 1 percent slopes	24,770	5.5
MaB	McCash very fine sandy loam, 1 to 3 percent slopes	11,600	2.6
Mc	McCook silt loam, 0 to 2 percent slopes	440	0.1
Md	McCook silt loam, occasionally flooded, 0 to 2 percent slopes	4,150	0.9
MfB	McCook silt loam, channeled, 0 to 3 percent slopes	1,100	0.2
Pt	Pits, sand and gravel	90	*
SaB	Sarben loamy very fine sand, 0 to 3 percent slopes	2,420	0.5
SaC	Sarben loamy very fine sand, 3 to 6 percent slopes	46,540	10.3
SaD	Sarben loamy very fine sand, 6 to 9 percent slopes	19,130	4.2
SaE	Sarben loamy very fine sand, 9 to 20 percent slopes	4,700	1.0
SaG	Sarben loamy very fine sand, 20 to 60 percent slopes	2,390	0.5
Sc	Scott Variant silty clay loam, 0 to 1 percent slopes	910	0.2
UsC	Ulysses silt loam, 3 to 6 percent slopes	1,030	0.2
UsD	Ulysses silt loam, 6 to 9 percent slopes	690	0.2
VaD	Valent fine sand, 3 to 9 percent slopes	9,510	2.1
VaF	Valent fine sand, rolling	16,060	3.6
VaG	Valent fine sand, rolling and hilly	2,520	0.6
	Water areas >40 acres in size	128	*
	Total	455,040	100.0

* Less than 0.1 percent.

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

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

Soil name and map symbol	Corn		Winter wheat	Grain sorghum		Alfalfa hay	
	N	I	N	N	I	N	I
	Bu	Bu	Bu	Bu	Bu	Ton	Ton
Ba----------------------- Bankard	---	---	20	25	50	---	2.5
Bg----------------------- Bridget	35	135	40	30	100	---	5.5
BgB---------------------- Bridget	35	130	38	28	90	---	5.3
BgC---------------------- Bridget	30	115	34	25	80	---	4.8
CcG---------------------- Canyon-Otero-Rock outcrop	---	---	---	---	---	---	---
CdD---------------------- Colby	---	100	22	---	80	---	3.5
CdG---------------------- Colby	---	---	---	---	---	---	---
CeF---------------------- Colby-Ulysses	---	---	---	---	---	---	---
Du----------------------- Duroc	35	125	36	30	100	---	5.5
DuB---------------------- Duroc	35	120	34	28	95	---	5.3
Fu. Fluvaquents							
Ga----------------------- Gannett	---	---	---	---	---	---	---
Gc----------------------- Gibbon	60	125	30	60	110	4.0	5.5
JaB---------------------- Jayem	25	120	25	35	90	1.3	4.5
JaC---------------------- Jayem	20	100	22	30	80	1.0	3.8
Ke----------------------- Keith	40	140	45	40	115	1.7	5.5
KeB---------------------- Keith	38	135	40	38	105	1.5	5.3
KeC---------------------- Keith	36	120	35	34	95	1.3	4.8
Ku----------------------- Kuma	40	145	45	40	115	---	5.5
KuB---------------------- Kuma	38	140	40	38	105	---	5.3
KuC---------------------- Kuma	36	125	35	34	95	---	5.0
Ma----------------------- McCash	50	130	40	45	130	2.5	4.8

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

Soil name and map symbol	Corn		Winter wheat	Grain sorghum		Alfalfa hay	
	N	I	N	N	I	N	I
	Bu	Bu	Bu	Bu	Bu	Ton	Ton
MaB----------------------- McCash	30	115	38	38	110	1.8	4.5
Mc----------------------- McCook	45	135	35	55	120	2.8	6.0
Md----------------------- McCook	45	130	35	40	115	2.8	6.0
MfB----------------------- McCook	---	---	---	---	---	---	---
Pt*. Pits							
SaB----------------------- Sarben	23	105	25	32	85	1.5	4.0
SaC----------------------- Sarben	20	100	25	30	80	1.4	3.5
SaD----------------------- Sarben	---	100	22	---	75	1.2	3.2
SaE----------------------- Sarben	---	---	---	---	---	---	---
SaG----------------------- Sarben	---	---	---	---	---	---	---
Sc----------------------- Scott Variant	20	---	20	20	---	---	---
UsC----------------------- Ulysses	28	115	24	31	90	---	4.5
UsD----------------------- Ulysses	25	100	22	25	85	---	---
VaD----------------------- Valent	---	85	---	---	70	---	3.0
VaF----------------------- Valent	---	---	---	---	---	---	---
VaG----------------------- Valent	---	---	---	---	---	---	---

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

TABLE 6.--CAPABILITY CLASSES AND SUBCLASSES

[All soils are assigned to nonirrigated capability subclasses (N). Only potentially irrigable soils are assigned to irrigated subclasses (I). Miscellaneous areas are excluded. Absence of an entry indicates no acreage]

Class	Total acreage	Major management concerns (Subclass)			
		Erosion (e)	Wetness (w)	Soil problem (s)	Climate (c)
		Acres	Acres	Acres	Acres
I (N)	---	---	---	---	---
(I)	51,070	---	---	---	---
II (N)	150,000	93,110	5,820	---	51,070
(I)	98,930	93,110	5,820	---	---
III (N)	27,440	27,440	---	---	---
(I)	27,440	27,440	---	---	---
IV (N)	56,820	55,910	910	---	---
(I)	81,720	81,720	---	---	---
V (N)	360	---	360	---	---
VI (N)	141,910	140,810	1,100	---	---
VII (N)	77,672	76,242	---	1,430	---
VIII(N)	710	---	620	90	---

TABLE 7.--PRIME FARMLAND

[Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name]

Map symbol	Soil name
Bg	Bridget silt loam, 0 to 1 percent slopes (where irrigated)
BgB	Bridget silt loam, 1 to 3 percent slopes (where irrigated)
BgC	Bridget silt loam, 3 to 6 percent slopes (where irrigated)
Du	Duroc silt loam, 0 to 1 percent slopes (where irrigated)
DuB	Duroc silt loam, 1 to 3 percent slopes (where irrigated)
*Gc	Gibbon silt loam, 0 to 2 percent slopes (where irrigated and drained)
Ke	Keith silt loam, 0 to 1 percent slopes (where irrigated)
KeB	Keith silt loam, 1 to 3 percent slopes (where irrigated)
KeC	Keith silt loam, 3 to 6 percent slopes (where irrigated)
Ku	Kuma silt loam, 0 to 1 percent slopes (where irrigated)
KuB	Kuma silt loam, 1 to 3 percent slopes (where irrigated)
KuC	Kuma silt loam, 3 to 6 percent slopes (where irrigated)
Ma	McCash very fine sandy loam, 0 to 1 percent slopes (where irrigated)
MaB	McCash very fine sandy loam, 1 to 3 percent slopes (where irrigated)
Mc	McCook silt loam, 0 to 2 percent slopes (where irrigated)
Md	McCook silt loam, occasionally flooded, 0 to 2 percent slopes (where irrigated)
UsC	Ulysses silt loam, 3 to 6 percent slopes (where irrigated)

* These soils generally have been adequately drained either by the application of drainage measures or through incidental drainage that results from farming operations, roadbuilding, and other kinds of land development.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

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

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Ba: Bankard	Sandy Lowland	Favorable	2,500	Prairie sandreed	30
		Normal	1,750	Needleandthread	15
		Unfavorable	750	Sand bluestem	15
				Blue grama	10
				Western wheatgrass	5
				Sand dropseed	5
				Switchgrass	5
				Sedge	5
Bg, BgB, BgC: Bridget	Silty	Favorable	3,300	Western wheatgrass	15
		Normal	2,300	Blue grama	15
		Unfavorable	1,500	Needleandthread	10
				Threadleaf sedge	10
				Little bluestem	10
				Buffalograss	5
				Big bluestem	5
				Sideoats grama	5
				Plains muhly	5
CcG*:					
Canyon	Shallow Limy	Favorable	1,500	Little bluestem	20
		Normal	1,300	Threadleaf sedge	15
		Unfavorable	700	Sideoats grama	15
				Big bluestem	10
				Blue grama	5
				Hairy grama	5
				Plains muhly	5
Otero	Limy Upland	Favorable	2,250	Blue grama	25
		Normal	1,750	Prairie sandreed	25
		Unfavorable	1,000	Needleandthread	20
				Sand dropseed	5
				Western wheatgrass	5
				Threadleaf sedge	5
				Sand bluestem	5
Rock outcrop.					
CdD: Colby	Limy Upland	Favorable	2,400	Little bluestem	30
		Normal	1,800	Sideoats grama	15
		Unfavorable	1,000	Blue grama	10
				Western wheatgrass	10
				Tall dropseed	5
				Small soapweed	5
CdG: Colby	Thin Loess	Favorable	2,400	Little bluestem	30
		Normal	1,800	Sideoats grama	15
		Unfavorable	1,000	Blue grama	10
				Western wheatgrass	10
				Tall dropseed	5
				Small soapweed	5
CeF*:					
Colby	Limy Upland	Favorable	2,400	Little bluestem	30
		Normal	1,800	Sideoats grama	15
		Unfavorable	1,000	Blue grama	10
				Western wheatgrass	10
				Tall dropseed	5
				Small soapweed	5

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Compo- sition
			Lb/acre		Pct
CeF*:					
Ulysses	Silty	Favorable	2,400	Blue grama	25
		Normal	1,800	Western wheatgrass	15
		Unfavorable	1,000	Sideoats grama	10
				Little bluestem	10
				Buffalograss	10
				Big bluestem	10
				Small soapweed	5
Du: Duroc	Silty	Favorable	3,000	Big bluestem	20
		Normal	2,000	Western wheatgrass	20
		Unfavorable	1,500	Green needlegrass	10
				Switchgrass	10
				Little bluestem	5
				Needleandthread	5
				Prairie sandreed	5
				Silver sagebrush	5
				Slender wheatgrass	5
				Threadleaf sedge	5
DuB: Duroc	Silty	Favorable	1,900	Western wheatgrass	35
		Normal	1,400	Needleandthread	15
		Unfavorable	700	Blue grama	10
				Big sagebrush	5
				Green needlegrass	5
				Little bluestem	5
				Prairie junegrass	5
				Sandberg bluegrass	5
				Threadleaf sedge	5
Ga: Gannett	Wet Land	Favorable	5,500	Prairie cordgrass	40
		Normal	5,000	Reedgrass	20
		Unfavorable	4,500	Sedge	15
				Slender wheatgrass	10
				Plains bluegrass	5
Gc: Gibbon	Subirrigated	Favorable	5,000	Big bluestem	25
		Normal	4,500	Little bluestem	15
		Unfavorable	3,700	Indiangrass	15
				Switchgrass	10
				Prairie cordgrass	10
				Sedge	10
				Kentucky bluegrass	5
JaB, JaC: Jayem	Sandy	Favorable	2,500	Prairie sandreed	20
		Normal	2,000	Needleandthread	15
		Unfavorable	1,500	Little bluestem	15
				Blue grama	10
				Sand bluestem	10
				Sand dropseed	5
				Western wheatgrass	5
Ke, KeB, KeC: Keith	Silty	Favorable	3,200	Western wheatgrass	20
		Normal	2,300	Blue grama	20
		Unfavorable	1,500	Needleandthread	10
				Buffalograss	10
				Little bluestem	10
				Sedge	5
				Big bluestem	5
				Sideoats grama	5
Ku, KuB, KuC: Kuma	Silty	Favorable	2,500	Blue grama	60
		Normal	1,500	Buffalograss	10
		Unfavorable	1,000	Western wheatgrass	10
				Needlegrass	5

See footnote at end of table.

TABLE 8.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
Ma, MaB: McCash	Silty	Favorable	3,000	Western wheatgrass	20
		Normal	2,500	Blue grama	15
		Unfavorable	1,700	Little bluestem	10
				Buffalograss	10
				Big bluestem	5
				Sand dropseed	5
				Needleandthread	5
				Sideoats grama	5
				Sedge	5
Mc, Md: McCook	Silty Lowland	Favorable	3,800	Big bluestem	25
		Normal	3,300	Little bluestem	15
		Unfavorable	2,200	Switchgrass	10
				Indiangrass	10
				Western wheatgrass	10
				Canada wildrye	5
				Sedge	5
				Blue grama	5
				Sideoats grama	5
MfB: McCook	Silty Overflow	Favorable	3,300	Big bluestem	25
		Normal	2,800	Western wheatgrass	25
		Unfavorable	2,000	Little bluestem	10
				Sideoats grama	10
				Switchgrass	5
				Sedge	5
				Blue grama	5
SaB, SaC, SaD, SaE, SaG: Sarben	Sandy	Favorable	2,500	Prairie sandreed	20
		Normal	2,000	Needleandthread	20
		Unfavorable	1,500	Little bluestem	15
				Blue grama	10
				Sand bluestem	10
				Western wheatgrass	5
				Sand dropseed	5
UsC, UsD: Ulysses	Silty	Favorable	2,400	Blue grama	25
		Normal	1,800	Western wheatgrass	15
		Unfavorable	1,000	Sideoats grama	10
				Little bluestem	10
				Buffalograss	10
				Big bluestem	10
				Small soapweed	5
VaD, VaF: Valent	Sands	Favorable	2,500	Prairie sandreed	20
		Normal	2,000	Sand bluestem	20
		Unfavorable	1,200	Little bluestem	20
				Needleandthread	15
				Blue grama	10
				Sand dropseed	5
				Switchgrass	5
VaG: Valent, rolling	Sands	Favorable	2,500	Prairie sandreed	20
		Normal	2,000	Sand bluestem	20
		Unfavorable	1,200	Little bluestem	20
				Needlegrass	15
				Blue grama	10
				Sand dropseed	5
				Switchgrass	5
Valent, hilly	Choppy sands	Favorable	2,000	Sand bluestem	20
		Normal	1,800	Little bluestem	15
		Unfavorable	1,000	Prairie sandreed	15
				Needleandthread	10
				Switchgrass	5
				Sand lovegrass	5
				Blue grama	5

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

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Only the soils suited to windbreaks and environmental plantings are listed. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
Ba: Bankard	American plum, skunkbush sumac.	Siberian peashrub, Russian-olive.	Eastern redcedar, honeylocust, green ash, ponderosa pine, common hackberry.	Siberian elm	---
Bg, BgB, BgC: Bridget	Lilac, American plum.	Rocky Mountain juniper, common chokecherry, Manchurian crabapple, Siberian peashrub.	Common hackberry, ponderosa pine, Russian-olive, green ash, honeylocust.	Siberian elm	---
CdD: Colby	Siberian peashrub, fragrant sumac, silver buffaloberry, Tatarian honeysuckle.	Eastern redcedar, Russian-olive, ponderosa pine, Rocky Mountain juniper, green ash, black locust.	Siberian elm, honeylocust.	---	---
Du: Duroc	Lilac, American plum.	Tatarian honeysuckle.	Eastern redcedar, ponderosa pine, blue spruce, common hackberry, green ash, Russian-olive.	Honeylocust, Siberian elm.	Eastern cottonwood.
DuB: Duroc	Lilac, American plum.	Rocky Mountain juniper, Manchurian crabapple, Siberian peashrub, common chokecherry.	Ponderosa pine, honeylocust, common hackberry, green ash, Russian-olive.	Siberian elm	---
Gc: Gibbon	Redosier dogwood, lilac, Siberian peashrub.	Common chokecherry, American plum.	Eastern redcedar, common hackberry, ponderosa pine.	Green ash, honeylocust, golden willow.	Eastern cottonwood.
JaB, JaC: Jayem	American plum, Tatarian honeysuckle, lilac.	Rocky Mountain juniper, Manchurian crabapple, Siberian peashrub, Russian-olive, common chokecherry.	Green ash, ponderosa pine, honeylocust.	Siberian elm	---
Ke, KeB, KeC: Keith	Lilac, American plum.	Rocky Mountain juniper, Manchurian crabapple, common chokecherry, Siberian peashrub.	Common hackberry, ponderosa pine, green ash, honeylocust, Russian-olive.	Siberian elm	---

See footnote at end of table.

TABLE 9.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
Ku, KuB, KuC------ Kuma	Fragrant sumac, lilac, Amur honeysuckle.	Russian-olive, common chokecherry.	Eastern redcedar, green ash, ponderosa pine, honeylocust, bur oak.	Siberian elm------	---
Ma---------------- McCash	Lilac, American plum, Amur honeysuckle.	---	Russian-olive, common hackberry, green ash, honeylocust, ponderosa pine, eastern redcedar, Rocky Mountain juniper.	Siberian elm------	Eastern cottonwood.
MaB--------------- McCash	Fragrant sumac, lilac, Amur honeysuckle.	Russian-olive, common choke-cherry.	Eastern redcedar, common hackberry, green ash, ponderosa pine, honeylocust, bur oak.	Siberian elm------	---
Mc---------------- McCook	American plum, lilac.	Tatarian honeysuckle.	Eastern redcedar, ponderosa pine, common hackberry, green ash, Russian-olive, Rocky Mountain juniper.	Honeylocust, Siberian elm.	Eastern cottonwood.
Md---------------- McCook	American plum, lilac.	Tatarian honeysuckle.	Eastern redcedar, ponderosa pine, Russian-olive, common hackberry, green ash, Rocky Mountain juniper.	Honeylocust, Siberian elm.	Eastern cottonwood.
SaB, SaC---------- Sarben	Amur honeysuckle, American plum, common chokecherry, lilac.	Russian mulberry, Rocky Mountain juniper.	Eastern redcedar, ponderosa pine, common hackberry, green ash, honeylocust.	Siberian elm------	---
SaD, SaE---------- Sarben	---	Eastern redcedar, Rocky Mountain juniper.	Ponderosa pine----	---	---
UsC, UsD---------- Ulysses	Fragrant sumac, Siberian peashrub, silver buffaloberry, Tatarian honeysuckle.	Eastern redcedar, ponderosa pine, Russian-olive, green ash, Rocky Mountain juniper, black locust.	Honeylocust, Siberian elm.	---	---
VaD, VaF---------- Valent	---	Eastern redcedar, Rocky Mountain juniper.	Ponderosa pine----	---	---

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

TABLE 10.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
Ba: Bankard	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: droughty, flooding.
Bg: Bridget	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Slight.
BgB, BgC: Bridget	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.	Slight.
CcG*:					
Canyon	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope, thin layer.
Otero	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
Rock outcrop.					
CdD: Colby	Moderate: dusty.	Moderate: dusty.	Severe: slope.	Severe: erodes easily.	Slight.
CdG: Colby	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.	Severe: slope.
CeF*:					
Colby	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
Ulysses	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.	Moderate: slope.
Du: Duroc	Slight	Slight	Slight	Severe: erodes easily.	Slight.
DuB: Duroc	Slight	Slight	Moderate: slope.	Severe: erodes easily.	Slight.
Fu. Fluvaquents					
Ga: Gannett	Severe: ponding, flooding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Gc: Gibbon	Severe: flooding.	Moderate: wetness.	Moderate: wetness, flooding.	Moderate: wetness.	Moderate: wetness, flooding.
JaB: Jayem	Slight	Slight	Moderate: small stones.	Slight	Slight.
JaC: Jayem	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.
Ke: Keith	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Slight.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
KeB, KeC: Keith	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.	Slight.
Ku: Kuma	Slight	Slight	Slight	Slight	Slight.
KuB, KuC: Kuma	Slight	Slight	Moderate: slope.	Slight	Slight.
Ma: McCash	Slight	Slight	Slight	Slight	Slight.
MaB: McCash	Slight	Slight	Moderate: slope.	Slight	Slight.
Mc: McCook	Severe: flooding.	Slight	Slight	Slight	Slight.
Md: McCook	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
MfB: McCook	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
Pt*. Pits					
SaB: Sarben	Slight	Slight	Slight	Slight	Slight.
SaC: Sarben	Slight	Slight	Moderate: slope.	Slight	Slight.
SaD: Sarben	Slight	Slight	Severe: slope.	Slight	Slight.
SaE: Sarben	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
SaG: Sarben	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Sc: Scott Variant	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding, erodes easily.	Severe: ponding.
UsC: Ulysses	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.	Slight.
UsD: Ulysses	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Moderate: dusty.	Moderate: slope.
VaD: Valent	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Moderate: droughty.
VaF: Valent	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.	Moderate: droughty, slope.
VaG: Valent	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.	Severe: slope.

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

TABLE 11.--WILDLIFE HABITAT POTENTIALS

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

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Ba: Bankard	Fair	Good	Good	Fair	Good	Fair	Very poor.	Very poor.	Good	Good	Very poor.	Fair.
Bg, BgB: Bridget	Good	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
BgC: Bridget	Fair	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
CcG*:												
Canyon	Poor	Poor	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.	Poor.
Otero	Poor	Fair	Good	Good	Good	Fair	Poor	Very poor.	Fair	Good	Very poor.	Fair.
Rock outcrop.												
CdD, CdG: Colby	Poor	Fair	Fair	Fair	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.	Poor.
CeF*:												
Colby	Poor	Fair	Fair	Fair	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.	Poor.
Ulysses	Poor	Fair	Fair	Good	Good	Poor	Very poor.	Very poor.	Fair	Good	Very poor.	Fair.
Du: Duroc	Good	Fair	Fair	Good	Good	Fair	Very poor.	Very poor.	Good	Good	Very poor.	Fair.
DuB: Duroc	Fair	Fair	Fair	Good	Good	Fair	Very poor.	Very poor.	Fair	Good	Very poor.	Fair.
Fu. Fluvaquents												
Ga: Gannett	Very poor.	Poor	Fair	Poor	Poor	Fair	Good	Good	Poor	Poor	Good	Fair.
Gc: Gibbon	Good	Good	Good	Good	Fair	Good	Fair	Good	Good	Good	Fair	Good.
JaB, JaC: Jayem	Fair	Good	Good	Good	Good	Fair	Very poor.	Very poor.	Good	Good	Very poor.	Good.
Ke, KeB: Keith	Good	Good	Good	Fair	Fair	Good	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
KeC: Keith	Fair	Good	Good	Fair	Fair	Good	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
Ku, KuB, KuC: Kuma	Good	Good	Fair	Good	Good	Fair	Poor	Very poor.	Good	Good	Very poor.	Poor.
Ma, MaB: McCash	Good	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.	Good.
Mc, Md: McCook	Good	Good	Good	Good	Fair	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
MfB: McCook	Poor	Poor	Fair	Good	Fair	Good	Very poor.	Very poor.	Poor	Fair	Very poor.	Good.

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
Pt*. Pits												
SaB, SaC, SaD------ Sarben	Fair	Good	Good	Fair	Fair	Good	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
SaE, SaG----------- Sarben	Poor	Fair	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
Sc----------------- Scott Variant	Poor	Poor	Poor	Very poor.	Very poor.	Very poor.	Good	Good	Poor	Very poor.	Good	Poor.
UsC---------------- Ulysses	Fair	Good	Fair	Good	Good	Fair	Poor	Poor	Fair	Good	Poor	Fair.
UsD---------------- Ulysses	Poor	Fair	Fair	Good	Good	Fair	Very poor.	Very poor.	Fair	Good	Very poor.	Fair.
VaD, VaF----------- Valent	Poor	Fair	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.	Fair.
VaG---------------- Valent	Very poor.	Very poor.	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.	Fair.

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

TABLE 12.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Ba----------------- Bankard	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: droughty, flooding.
Bg, BgB----------- Bridget	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: frost action.	Slight.
BgC--------------- Bridget	Slight---------	Slight---------	Slight---------	Moderate: slope.	Moderate: frost action.	Slight.
CcG*:						
Canyon-----------	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, thin layer.
Otero------------	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Rock outcrop.						
CdD--------------- Colby	Slight---------	Slight---------	Slight---------	Moderate: slope.	Severe: low strength.	Slight.
CdG--------------- Colby	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
CeF*:						
Colby------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
Ulysses----------	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope.	Severe: slope.	Severe: low strength.	Moderate: slope.
Du, DuB----------- Duroc	Slight---------	Slight---------	Slight---------	Slight---------	Slight---------	Slight.
Fu. Fluvaquents						
Ga---------------- Gannett	Severe: cutbanks cave, ponding.	Severe: ponding, flooding.	Severe: ponding, flooding.	Severe: ponding, flooding.	Severe: ponding, frost action, flooding.	Severe: ponding.
Gc---------------- Gibbon	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding, frost action.	Moderate: wetness, flooding.
JaB--------------- Jayem	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Slight.
JaC--------------- Jayem	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Slight.
Ke, KeB----------- Keith	Slight---------	Moderate: shrink-swell.	Slight---------	Moderate: shrink-swell.	Severe: low strength.	Slight.
KeC--------------- Keith	Slight---------	Moderate: shrink-swell.	Slight---------	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
Ku, KuB----------- Kuma	Slight---------	Slight---------	Slight---------	Slight---------	Severe: low strength.	Slight.

See footnote at end of table.

TABLE 12.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
KuC: Kuma	Slight	Slight	Slight	Moderate: slope.	Severe: low strength.	Slight.
Ma, MaB: McCash	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.	Slight.
Mc: McCook	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding, frost action.	Slight.
Md: McCook	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
MfB: McCook	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Pt*. Pits						
SaB: Sarben	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Slight.
SaC, SaD: Sarben	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Slight.
SaE: Sarben	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.
SaG: Sarben	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Sc: Scott Variant	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, frost action.	Severe: ponding.
UsC: Ulysses	Slight	Moderate: shrink-swell.	Slight	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
UsD: Ulysses	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope.	Severe: slope.	Severe: low strength.	Moderate: slope.
VaD: Valent	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
VaF: Valent	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
VaG: Valent	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

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

TABLE 13.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ba: Bankard	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, too sandy.	Severe: flooding.	Poor: seepage, too sandy.
Bg: Bridget	Slight	Moderate: seepage.	Slight	---	Good.
BgB, BgC: Bridget	Slight	Moderate: seepage, slope.	Slight	---	Good.
CcG*:					
Canyon	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, small stones, slope.
Otero	Severe: slope.	Severe: seepage, slope.	Severe: slope.	Severe: slope.	Poor: slope.
Rock outcrop.					
CdD: Colby	Slight	Severe: slope.	Slight	Slight	Good.
CdG: Colby	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
CeF*:					
Colby	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Ulysses	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Du: Duroc	Moderate: percs slowly.	Moderate: seepage.	Slight	Slight	Good.
DuB: Duroc	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
Fu. Fluvaquents					
Ga: Gannett	Severe: ponding, poor filter, flooding.	Severe: seepage, ponding, flooding.	Severe: seepage, ponding, too sandy.	Severe: seepage, ponding, flooding.	Poor: seepage, too sandy, ponding.
Gc: Gibbon	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Fair: wetness.
JaB, JaC: Jayem	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
Ke: Keith	Slight	Moderate: seepage.	Slight	Slight	Good.

See footnote at end of table.

TABLE 13.--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
KeB, KeC Keith	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
Ku Kuma	Moderate: percs slowly.	Moderate: seepage.	Slight	Slight	Good.
KuB, KuC Kuma	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
Ma McCash	Slight	Moderate: seepage.	Moderate: too sandy.	Slight	Good.
MaB McCash	Slight	Moderate: seepage, slope.	Moderate: too sandy.	Slight	Good.
Mc McCook	Moderate: flooding, percs slowly.	Severe: flooding.	Moderate: flooding.	Moderate: flooding.	Good.
Md, MfB McCook	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
Pt*. Pits					
SaB, SaC Sarben	Slight	Severe: seepage.	Moderate: too sandy.	Slight	Good.
SaD Sarben	Slight	Severe: seepage, slope.	Moderate: too sandy.	Slight	Good.
SaE Sarben	Moderate: slope.	Severe: seepage, slope.	Moderate: slope, too sandy.	Moderate: slope.	Fair: slope.
SaG Sarben	Severe: slope.	Severe: seepage, slope.	Severe: slope.	Severe: slope.	Poor: slope.
Sc Scott Variant	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
UsC Ulysses	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
UsD Ulysses	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
VaD Valent	Severe: poor filter.	Severe: seepage.	Severe: too sandy.	Slight	Poor: too sandy.
VaF Valent	Severe: poor filter.	Severe: seepage, slope.	Severe: too sandy.	Moderate: slope.	Poor: too sandy.
VaG Valent	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: slope, too sandy.	Severe: slope.	Poor: too sandy, slope.

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

TABLE 14.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ba-------------------- Bankard	Good	Probable	Improbable: too sandy.	Fair: too sandy, small stones.
Bg, BgB, BgC---------- Bridget	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
CcG*:				
Canyon	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
Otero	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Rock outcrop.				
CdD------------------- Colby	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
CdG------------------- Colby	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
CeF*:				
Colby	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Ulysses	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Du, DuB--------------- Duroc	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Fu. Fluvaquents				
Ga-------------------- Gannett	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
Gc-------------------- Gibbon	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
JaB, JaC-------------- Jayem	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy, small stones.
Ke, KeB, KeC---------- Keith	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Ku, KuB, KuC---------- Kuma	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Ma, MaB--------------- McCash	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Mc, Md, MfB----------- McCook	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Pt*. Pits				

See footnote at end of table.

TABLE 14.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
SaB, SaC, SaD: Sarben	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
SaE: Sarben	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy, slope.
SaG: Sarben	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Sc: Scott Variant	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
UsC: Ulysses	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
UsD: Ulysses	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
VaD, VaF: Valent	Good	Probable	Improbable: too sandy.	Poor: too sandy.
VaG: Valent	Poor: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope.

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

TABLE 15.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Ba: Bankard	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
Bg, BgB: Bridget	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
BgC: Bridget	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
CcG*:						
Canyon	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock	Slope, depth to rock.
Otero	Severe: seepage, slope.	Severe: piping.	Deep to water	Soil blowing, rooting depth	Slope, erodes easily soil blowing.	Slope, erodes easily, rooting depth.
Rock outcrop.						
CdD: Colby	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, erodes easily	Erodes easily	Erodes easily.
CdG: Colby	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily	Slope, erodes easily	Slope, erodes easily.
CeF*:						
Colby	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily	Slope, erodes easily	Slope, erodes easily.
Ulysses	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily	Slope, erodes easily.
Du, DuB: Duroc	Moderate: seepage.	Severe: piping.	Deep to water	Erodes easily	Erodes easily	Erodes easily.
Fu. Fluvaquents						
Ga: Gannett	Severe: seepage.	Severe: seepage, piping, ponding.	Ponding, frost action, cutbanks cave	Ponding, droughty, flooding.	Ponding, too sandy.	Wetness, droughty.
Gc: Gibbon	Severe: seepage.	Severe: piping, wetness.	Flooding, frost action.	Wetness, flooding.	Wetness	Favorable.
JaB: Jayem	Severe: seepage.	Severe: piping.	Deep to water	Fast intake, soil blowing.	Soil blowing	Favorable.
JaC: Jayem	Severe: seepage.	Severe: piping.	Deep to water	Fast intake, soil blowing, slope.	Soil blowing	Favorable.
Ke, KeB: Keith	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
KeC: Keith	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.

See footnote at end of table.

TABLE 15.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
Ku, KuB----------- Kuma	Moderate: seepage.	Severe: piping.	Deep to water	Favorable-----	Erodes easily	Erodes easily.
KuC--------------- Kuma	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope---------	Erodes easily	Erodes easily.
Ma, MaB----------- McCash	Moderate: seepage.	Severe: piping.	Deep to water	Soil blowing	Erodes easily, soil blowing.	Erodes easily.
Mc---------------- McCook	Moderate: seepage.	Severe: piping.	Deep to water	Favorable-----	Erodes easily	Erodes easily.
Md, MfB----------- McCook	Moderate: seepage.	Severe: piping.	Deep to water	Flooding------	Erodes easily	Erodes easily.
Pt*. Pits						
SaB--------------- Sarben	Severe: seepage.	Severe: piping.	Deep to water	Fast intake, soil blowing.	Soil blowing	Favorable.
SaC, SaD---------- Sarben	Severe: seepage.	Severe: piping.	Deep to water	Fast intake, soil blowing, slope.	Soil blowing	Favorable.
SaE, SaG---------- Sarben	Severe: seepage, slope.	Severe: piping.	Deep to water	Fast intake, soil blowing, slope.	Slope, soil blowing.	Slope.
Sc---------------- Scott Variant	Slight----------	Severe: ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly, erodes easily	Erodes easily, ponding, percs slowly.	Wetness, erodes easily percs slowly.
UsC--------------- Ulysses	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope---------	Erodes easily	Erodes easily.
UsD--------------- Ulysses	Severe: slope.	Severe: piping.	Deep to water	Slope---------	Slope, erodes easily	Slope, erodes easily
VaD--------------- Valent	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
VaF, VaG---------- Valent	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.

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

TABLE 16.--ENGINEERING INDEX PROPERTIES

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

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Ba------------ Bankard	0-6	Loamy sand-------	SM	A-2	0	95-100	90-100	50-90	15-35	---	NP*
	6-60	Stratified loamy sand to sand.	SM, SP-SM	A-2	0	95-100	75-100	60-80	10-25	---	NP
Bg, BgB, BgC----- Bridget	0-13	Silt loam--------	ML, CL-ML, CL	A-4	0	95-100	95-100	85-100	80-100	20-35	2-10
	13-23	Very fine sandy loam, silt loam.	ML, CL-ML, CL	A-4	0	95-100	95-100	85-100	80-100	20-35	2-10
	23-60	Very fine sandy loam, loam, silt loam.	ML, CL-ML, CL	A-4	0	95-100	95-100	85-100	80-100	20-35	2-10
CcG**:											
Canyon----------	0-8	Loam-------------	ML, CL, CL-ML	A-4	0-5	90-95	75-95	50-95	50-75	15-30	2-10
	8-20	Very fine sandy loam, loam, gravelly loam.	ML, SM, SC, GM	A-4	0-5	60-95	50-95	45-95	35-75	<20	NP-10
	20-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Otero-----------	0-5	Loam-------------	ML	A-4	0	100	95-100	85-95	60-80	20-30	NP-5
	5-60	Very fine sandy loam, loamy very fine sand, loam.	ML, SM	A-4	0	100	95-100	85-95	40-60	---	NP
Rock outcrop.											
CdD, CdG--------- Colby	0-6	Silt loam--------	CL, ML, CL-ML	A-4, A-6	0	100	100	90-100	85-100	25-40	3-15
	6-60	Silt loam, loam	CL, ML	A-4, A-6	0	100	100	90-100	85-100	25-40	3-15
CeF**:											
Colby-----------	0-6	Silt loam--------	CL, ML, CL-ML	A-4, A-6	0	100	100	90-100	85-100	25-40	3-15
	6-60	Silt loam, loam	CL, ML	A-4, A-6	0	100	100	90-100	85-100	25-40	3-15
Ulysses---------	0-10	Silt loam--------	CL, ML	A-4, A-6	0	100	100	90-100	85-100	25-40	3-15
	10-24	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	85-100	25-43	11-20
	24-60	Silt loam, loam	CL, ML	A-4, A-6	0	100	100	90-100	85-100	25-40	3-15
Du, DuB---------- Duroc	0-14	Silt loam--------	ML, CL-ML	A-4	0	100	90-100	85-95	75-85	25-35	5-10
	14-30	Loam, silt loam	ML, CL-ML	A-4	0	100	90-100	85-95	65-85	25-35	5-10
	30-60	Loam, silt loam	ML, CL-ML	A-4	0	100	90-100	85-95	65-85	25-35	5-10
Fu. Fluvaquents											
Ga-------------- Gannett	0-4	Silt loam--------	ML, CL-ML, CL	A-4	0	100	100	85-100	70-90	20-30	2-10
	4-32	Silt loam, very fine sandy loam.	ML, CL, CL-ML	A-4	0	100	100	85-100	55-100	20-30	2-10
	32-60	Very fine sandy loam.	ML, CL	A-4	0	100	100	90-100	50-80	20-30	2-10
Gc-------------- Gibbon	0-7	Silt loam--------	ML, CL, CL-ML	A-4	0	100	100	85-100	70-90	20-30	2-10
	7-18	Silt loam--------	CL, ML, CL-ML	A-4	0	100	100	85-100	70-90	20-30	2-10
	18-60	Very fine sandy loam, silt loam.	CL, ML, CL-ML	A-4	0	100	100	95-100	80-90	20-30	NP-10

See footnotes at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--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	
JaB, JaC--------- Jayem	0-10	Loamy very fine sand, very fine sandy loam.	SM	A-4, A-2	0	85-100	75-100	55-95	25-50	20-25	NP-5
	10-60	Fine sandy loam, very fine sandy loam, loamy very fine sand.	ML, SM	A-4, A-2	0	85-100	75-100	70-95	25-60	20-25	NP-5
Ke, KeB, KeC----- Keith	0-12	Silt loam--------	ML, CL, CL-ML	A-4	0	100	100	85-100	85-100	20-35	2-10
	12-29	Silt loam, silty clay loam, loam.	CL	A-6, A-7	0	100	100	95-100	85-100	30-45	10-25
	29-60	Silt loam, loam, very fine sandy loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	85-100	20-35	2-12
Ku, KuB, KuC----- Kuma	0-7	Silt loam--------	CL, CL-ML, ML	A-4, A-6	0	100	95-100	90-100	70-95	25-40	NP-15
	7-44	Silty clay loam, silt loam, loam.	CL	A-6	0	100	95-100	90-100	85-95	30-40	10-20
	44-60	Silt loam, loam, very fine sandy loam.	CL, CL-ML	A-4, A-6	0	95-100	95-100	90-100	85-95	25-40	5-15
Ma, MaB---------- McCash	0-15	Very fine sandy loam.	ML	A-4	0	100	100	90-100	50-80	20-30	NP-7
	15-36	Very fine sandy loam, loamy very fine sand, silt loam.	ML, SM	A-4	0	100	100	90-100	45-80	20-30	NP-7
	36-60	Loamy very fine sand, very fine sandy loam, fine sandy loam.	ML, SM	A-4	0	100	100	90-100	40-65	20-30	NP-7
Mc--------------- McCook	0-12	Silt loam--------	ML, CL, CL-ML	A-4	0	100	100	95-100	60-100	20-35	2-10
	12-60	Very fine sandy loam, silt loam, loam.	ML, CL, CL-ML	A-4	0	100	100	95-100	55-100	<20	NP-10
Md, MfB---------- McCook	0-12	Silt loam--------	ML, CL, CL-ML	A-4	0	100	100	95-100	60-100	20-35	2-10
	12-53	Very fine sandy loam, silt loam, loam.	ML, CL, CL-ML	A-4	0	100	100	95-100	80-100	<20	NP-10
	53-60	Sand, coarse sand	SP-SM	A-2	0	100	100	50-70	5-15	--	NP
Pt**. Pits											
SaB, SaC, SaD, SaE, SaG-------- Sarben	0-6	Loamy very fine sand.	SM, ML	A-4	0	100	100	90-100	40-60	<25	NP
	6-14	Loamy very fine sand, fine sandy loam, very fine sandy loam.	SM, ML	A-4	0	100	100	90-100	40-65	<20	NP
	14-60	Very fine sandy loam, loamy very fine sand, fine sandy loam.	SM, ML	A-4	0	100	100	90-100	40-65	<20	NP
Sc--------------- Scott Variant	0-5	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-45	18-24
	5-46	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-50	20-32
	46-60	Silty clay loam	CL	A-6, A-7	0	100	100	100	95-100	35-45	18-25
UsC, UsD--------- Ulysses	0-7	Silt loam--------	CL, ML	A-4, A-6	0	100	100	90-100	85-100	25-40	3-15
	7-13	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	85-100	25-43	11-20
	13-60	Silt loam, loam	CL, ML	A-4, A-6	0	100	100	90-100	85-100	25-40	3-15

See footnotes at end of table.

TABLE 16.--ENGINEERING INDEX PROPERTIES--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	
VaD, VaF, VaG---- Valent	0-7	Fine sand--------	SM, SP-SM	A-2	0	100	100	80-95	10-30	---	NP
	7-60	Fine sand, loamy fine sand, loamy sand.	SM	A-2	0	100	95-100	75-90	10-30	---	NP

* NP means nonplastic.

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

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

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

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cm^3	In/hr	In/in	pH	Mmhos/cm					Pct
Ba----------------- Bankard	0-6	2-10	1.80-1.95	6.0-20	0.10-0.15	6.6-8.4	<2	Low--------	0.17	5	2	0.5-1
	6-60	0-10	1.85-2.00	6.0-20	0.07-0.15	6.6-8.4	<2	Low--------	0.17			
Bg, BgB, BgC------ Bridget	0-13	10-18	1.20-1.40	0.6-2.0	0.20-0.24	6.6-8.4	<2	Low--------	0.32	5	5	1-3
	13-23	13-18	1.20-1.40	0.6-2.0	0.17-0.19	7.4-8.4	<2	Low--------	0.43			
	23-60	13-18	1.20-1.45	0.6-2.0	0.17-0.19	7.4-8.4	<2	Low--------	0.43			
CcG*:												
Canyon------------	0-8	12-20	1.20-1.30	0.6-2.0	0.20-0.22	7.4-8.4	<2	Low--------	0.32	2	4L	.5-1
	8-20	12-25	1.30-1.50	0.6-2.0	0.13-0.18	7.4-8.4	<2	Low--------	0.43			
	20-60	---	---	---	---	---	---	-----------	----			
Otero-------------	0-5	5-18	1.40-1.60	2.0-6.0	0.18-0.22	7.4-8.4	<2	Low--------	0.37	5	4L	.5-1
	5-60	5-10	1.45-1.75	2.0-6.0	0.12-0.19	7.4-8.4	<2	Low--------	0.32			
Rock outcrop.												
CdD, CdG---------- Colby	0-6	15-30	1.20-1.30	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low--------	0.43	5	4L	.5-2
	6-60	18-27	1.25-1.40	0.6-2.0	0.17-0.22	7.4-8.4	<2	Low--------	0.43			
CeF*:												
Colby-------------	0-6	15-30	1.20-1.30	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low--------	0.43	5	4L	.5-2
	6-60	18-27	1.25-1.40	0.6-2.0	0.17-0.22	7.4-8.4	<2	Low--------	0.43			
Ulysses-----------	0-10	10-27	1.15-1.25	0.6-2.0	0.20-0.24	6.6-7.8	<2	Low--------	0.32	5	6	1-3
	10-24	21-32	1.20-1.35	0.6-2.0	0.18-0.22	7.4-8.4	<2	Moderate	0.43			
	24-60	18-27	1.25-1.35	0.6-2.0	0.18-0.22	7.9-8.4	<2	Low--------	0.43			
Du, DuB----------- Duroc	0-14	15-25	1.30-1.50	0.6-2.0	0.16-0.18	6.6-8.4	<2	Low--------	0.43	5	6	1-4
	14-30	18-30	1.25-1.40	0.6-2.0	0.15-0.17	6.6-7.8	<2	Low--------	0.43			
	30-60	18-27	1.25-1.40	0.6-2.0	0.15-0.17	7.9-9.0	<2	Low--------	0.43			
Fu. Fluvaquents												
Ga----------------- Gannett	0-4	15-18	1.20-1.40	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low--------	0.32	5	4L	2-4
	4-32	10-18	1.20-1.50	0.6-2.0	0.13-0.22	7.4-8.4	<2	Low--------	0.43			
	32-60	12-18	1.20-1.50	0.6-2.0	0.12-0.17	7.4-8.4	<2	Low--------	0.43			
Gc----------------- Gibbon	0-7	10-18	1.20-1.40	0.6-2.0	0.20-0.24	7.9-8.4	<2	Low--------	0.32	5	4L	2-4
	7-18	10-18	1.30-1.45	0.6-2.0	0.18-0.22	7.9-8.4	<2	Low--------	0.43			
	18-60	10-18	1.30-1.45	0.6-2.0	0.16-0.20	7.9-8.4	<2	Low--------	0.43			
JaB, JaC---------- Jayem	0-10	5-15	1.30-1.50	2.0-6.0	0.13-0.15	6.6-7.8	<2	Low--------	0.28	5	2	1-3
	10-60	5-18	1.20-1.40	2.0-6.0	0.13-0.15	6.6-7.8	<2	Low--------	0.28			
Ke, KeB, KeC------ Keith	0-12	15-25	1.20-1.30	0.6-2.0	0.20-0.24	6.1-7.3	<2	Low--------	0.32	5	6	1-3
	12-29	20-35	1.10-1.20	0.6-2.0	0.18-0.22	6.6-8.4	<2	Moderate	0.32			
	29-60	10-20	1.30-1.40	0.6-2.0	0.20-0.22	7.4-8.4	<2	Low--------	0.43			
Ku, KuB, KuC------ Kuma	0-7	15-27	1.20-1.30	0.6-2.0	0.18-0.21	6.6-7.8	<2	Low--------	0.32	5	6	2-4
	7-44	18-35	1.10-1.20	0.2-2.0	0.18-0.21	6.6-8.4	<2	Low--------	0.37			
	44-60	15-27	1.30-1.40	0.6-2.0	0.16-0.18	7.4-8.4	<2	Low--------	0.32			
Ma, MaB----------- McCash	0-15	8-18	1.20-1.40	0.6-2.0	0.20-0.24	6.1-7.8	<2	Low--------	0.32	5	3	1-2
	15-36	8-18	1.20-1.40	0.6-2.0	0.13-0.22	6.1-7.8	<2	Low--------	0.43			
	36-60	5-12	1.20-1.50	0.6-2.0	0.12-0.19	6.6-7.8	<2	Low--------	0.24			
Mc, Md, MfB------- McCook	0-12	15-20	1.20-1.40	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low--------	0.32	5	4L	2-4
	12-53	10-18	1.30-1.45	0.6-2.0	0.17-0.20	7.4-8.4	<2	Low--------	0.43			
	53-60	2-10	1.85-2.00	6.0-20	0.07-0.15	7.4-8.4	<2	Low--------	0.15			
Pt*. Pits												

See footnote at end of table.

TABLE 17.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors		Wind erodi- bility group	Organic matter
									K	T		
	In	Pct	G/cm3	In/hr	In/in	pH	Mmhos/cm					Pct
SaB, SaC, SaD, SaE, SaG--------- Sarben	0-6	10-18	1.30-1.50	2.0-6.0	0.16-0.18	6.1-7.3	<2	Low--------	0.24	5	2	0.5-2
	6-14	10-18	1.20-1.40	2.0-6.0	0.16-0.18	6.6-7.3	<2	Low--------	0.24			
	14-60	10-18	1.20-1.40	2.0-6.0	0.15-0.17	6.6-8.4	<2	Low--------	0.24			
Sc---------------- Scott Variant	0-5	27-31	1.10-1.25	0.2-0.6	0.21-0.23	6.1-7.3	<2	High-------	0.37	3	7	2-4
	5-46	32-35	1.10-1.20	0.06-0.2	0.18-0.20	6.6-7.8	<2	High-------	0.37			
	46-60	27-30	1.10-1.25	0.2-0.6	0.18-0.20	7.4-7.8	<2	High-------	0.37			
UsC, UsD---------- Ulysses	0-7	10-27	1.15-1.25	0.6-2.0	0.20-0.24	6.6-7.8	<2	Low--------	0.32	5	6	1-3
	7-13	21-32	1.20-1.35	0.6-2.0	0.18-0.22	7.4-8.4	<2	Moderate	0.43			
	13-60	18-27	1.25-1.35	0.6-2.0	0.18-0.22	7.9-8.4	<2	Low--------	0.43			
VaD, VaF, VaG----- Valent	0-7	3-10	1.50-1.60	6.0-20	0.07-0.12	6.6-7.8	<2	Low--------	0.10	5	1	.5-1
	7-60	2-8	1.50-1.60	6.0-20	0.05-0.10	6.6-7.8	<2	Low--------	0.10			

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

TABLE 18--SOIL AND WATER FEATURES

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

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
Ba-----------------Bankard	A	Occasional	Very brief	Mar-Aug	>6.0	---	---	>60	---	Low-------	Moderate	Low.
Bg, BgB, BgC-------Bridget	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	High------	Low.
CcG*:												
Canyon------------	D	None---------	---	---	>6.0	---	---	6-20	Soft	Low-------	High------	Low.
Otero-------------	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	High------	Low.
Rock outcrop.												
CdD, CdG-----------Colby	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	Low-------	Low.
CeF*:												
Colby-------------	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	Low-------	Low.
Ulysses-----------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
Du, DuB------------Duroc	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	High------	Low.
Fu. Fluvaquents												
Ga**---------------Gannett	D	Occasional	Very brief	Mar-Jul	+.5-1.0	Apparent	Nov-May	>60	---	High------	High------	Low.
Gc-----------------Gibbon	B	Occasional	Very brief	Mar-Jul	1.5-3.5	Apparent	Nov-Jun	>60	---	High------	High------	Low.
JaB, JaC-----------Jayem	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	High------	Low.
Ke, KeB, KeC-------Keith	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
Ku, KuB, KuC-------Kuma	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	High------	Low.
Ma, MaB------------McCash	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low-------	Low.
Mc-----------------McCook	B	Rare---------	---	---	>6.0	---	---	>60	---	Moderate	Low-------	Low.
Md-----------------McCook	B	Occasional	Very brief	Apr-Jul	>6.0	---	---	>60	---	Moderate	Low-------	Low.

See footnotes at end of table.

TABLE 18.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
MfB--------------- McCook	B	Occasional	Very brief	Apr-Jul	>6.0	---	---	>60	---	Moderate	Low-------	Low.
Pt*. Pits												
SaB, SaC, SaD, SaE, SaG---------- Sarben	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	High------	Low.
Sc**--------------- Scott Variant	D	None---------	---	---	+1-1.0	Perched	Mar-Jun	>60	---	High------	High------	High.
UsC, UsD----------- Ulysses	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
VaD, VaF, VaG------ Valent	A	None---------	---	---	>6.0	---	---	>60	---	Low-------	Low-------	Low.

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

** A plus sign under "Depth to high water table" indicates that the water table is above the surface of the soil.

TABLE 19.--ENGINEERING INDEX TEST DATA

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution							Liquid limit	Plasticity index	Particle density
			Percentage passing sieve				Percentage smaller than--					
	AASHTO	Unified	No. 4	No. 10	No. 40	No. 200	.02 mm	.005 mm	.002 mm			
										Pct		G/cc
Bridget silt loam: (S78NE-085-009)												
Ap-------0 to 6	A-4(08)	ML			100	89	73	13	9	29	5	2.63
A12------6 to 10	A-4(08)	ML			100	93	81	14	9	30	6	2.63
AC------10 to 18	A-4(08)	ML			100	93	79	16	10	31	7	2.65
C1------18 to 26	A-4(08)	ML			100	92	67	16	12	30	7	2.65
C2------26 to 60	A-4(08)	ML			100	95	82	16	10	28	5	2.67
Colby silt loam: (S77NE-085-003)												
A1-------0 to 6	A-4(08)	ML			100	88	61	18	13	32	8	2.65
AC-------6 to 11	A-4(08)	CL			100	91	75	20	15	33	10	2.63
C-------11 to 60	A-4(08)	ML			100	92	76	17	12	29	6	2.66
Jayem loamy very fine sand: (S79NE-085-002)												
Ap------0 to 6	A2-4(00)	SM			100	28	12	6	6	20	NP*	2.62
A12-----6 to 10	A-4(02)	SM			100	45	28	14	11	23	3	2.64
B2-----10 to 30	A-4(02)	SM			100	44	26	14	11	23	3	2.64
C------30 to 60	A-4(01)	SM			100	40	20	12	9	22	NP	2.65
Kuma silt loam: (S77NE-085-004)												
Ap-------0 to 7	A-4(08)	ML			100	95	83	20	16	28	5	2.60
A12------7 to 16	A-6(09)	CL			100	96	87	25	21	36	13	2.62
B21t----16 to 22	A-6(10)	CL			100	96	88	27	23	35	14	2.64
B22t----22 to 31	A-6(11)	CL			100	96	87	32	28	38	17	2.63
B23t3---31 to 44	A-6(10)	CL			100	95	86	33	29	38	16	2.63
B3CA----44 to 54	A-6(09)	CL			100	93	82	31	23	35	13	2.65
C-------54 to 65	A-4(08)	ML			100	95	83	13	9	29	6	2.68
McCash very fine sandy loam: (S77NE-085-002)												
Ap------0 to 8	A-4(04)	ML			100	57	36	16	14	23	3	2.64
A12-----8 to 15	A-4(04)	ML			100	54	32	17	14	24	4	2.64
B21----15 to 24	A-4(04)	ML			100	56	37	17	15	25	5	2.65
B22----24 to 36	A-4(03)	ML			100	51	29	16	15	24	3	2.65
C------36 to 60	A-4(01)	SM			100	42	20	11	10	21	1	2.68
Sarben loamy very fine sand: (S76NE-085-010)												
A1-------0 to 6	A-4(01)	SM			100	40	26	11	9	21	NP	2.63
AC------6 to 14	A-2-4(00)	SM			100	31	17	10	9	22	NP	2.65
C------14 to 60	A-2-4(00)	SM			100	26	12	8	8	22	NP	2.67

* NP means nonplastic.

TABLE 20.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Bankard	Sandy, mixed, mesic Ustic Torrifluvents
Bridget	Coarse-silty, mixed, mesic Torriorthentic Haplustolls
Canyon	Loamy, mixed (calcareous), mesic, shallow Ustic Torriorthents
Colby	Fine-silty, mixed (calcareous), mesic Ustic Torriorthents
Duroc	Fine-silty, mixed, mesic Pachic Haplustolls
Fluvaquents	Silty, mixed, mesic Fluvaquents
*Gannett	Coarse-loamy, mixed, mesic Typic Haplaquolls
*Gibbon	Fine-silty, mixed (calcareous), mesic Fluvaquentic Haplaquolls
Jayem	Coarse-loamy, mixed, mesic Aridic Haplustolls
Keith	Fine-silty, mixed, mesic Aridic Argiustolls
Kuma	Fine-silty, mixed, mesic Pachic Argiustolls
McCash	Coarse-silty, mixed, mesic Pachic Haplustolls
McCook	Coarse-silty, mixed, mesic Fluventic Haplustolls
Otero	Coarse-loamy, mixed (calcareous), mesic Ustic Torriorthents
Sarben	Coarse-loamy, mixed, nonacid, mesic Ustic Torriorthents
Scott Variant	Fine-silty, mixed, mesic Typic Argiaquolls
Ulysses	Fine-silty, mixed, mesic Aridic Haplustolls
Valent	Mixed, mesic Ustic Torripsamments

* The soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series.

☆ U.S. GOVERNMENT PRINTING OFFICE : 1982 O—367-441 QL3

NRCS Accessibility Statement

This document is not accessible by screen-reader software. The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at 1-800-457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at http://offices.sc.egov.usda.gov/locator/app.