United States
Department of
Agriculture

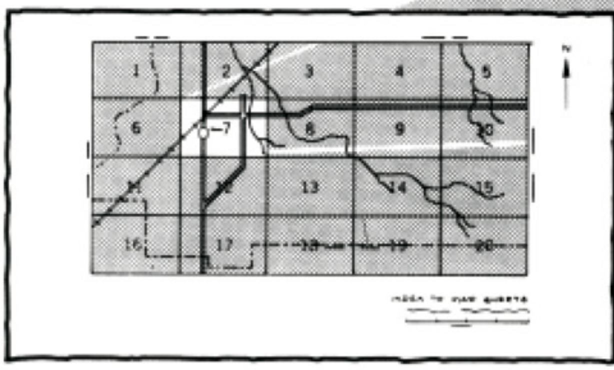
Soil
Conservation
Service

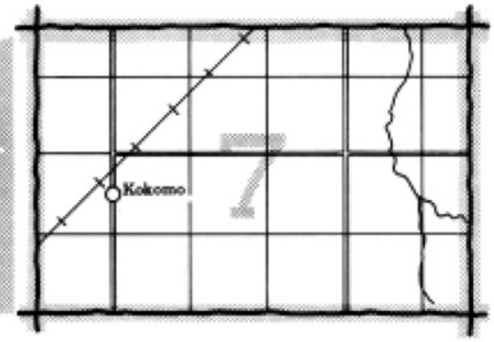
In cooperation with the
Oklahoma
Agricultural
Experiment
Station

Soil Survey of McIntosh County Oklahoma

HOW TO USE

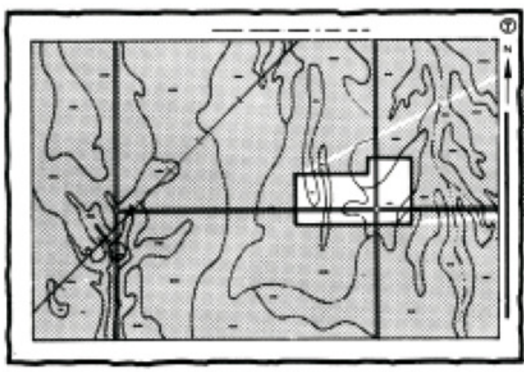
1. Locate your area of interest on the "Index to Map Sheets"

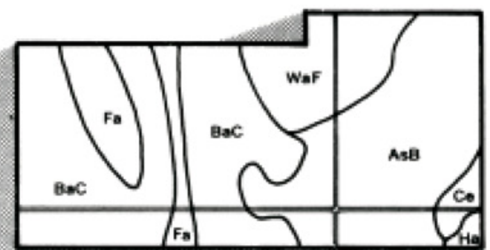




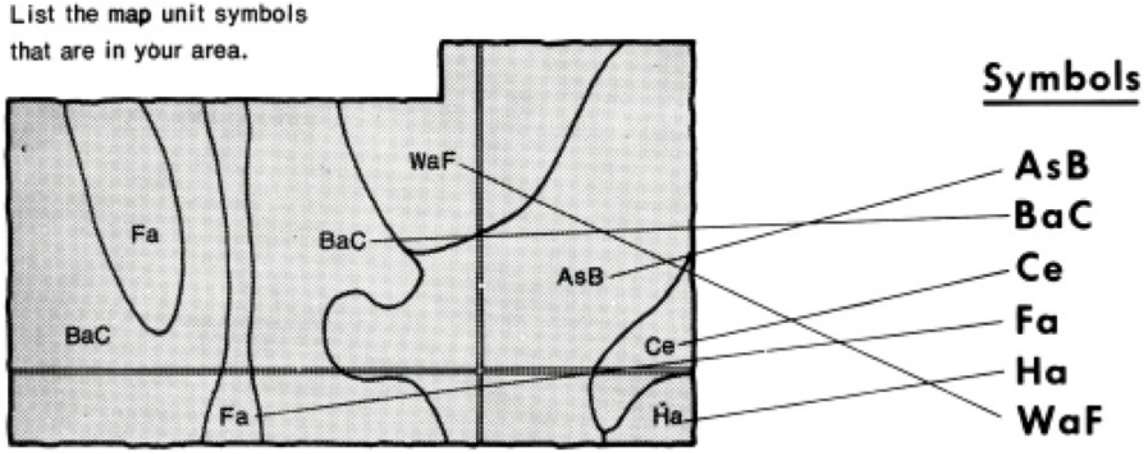
2. Note the number of the map sheet and turn to that sheet.

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



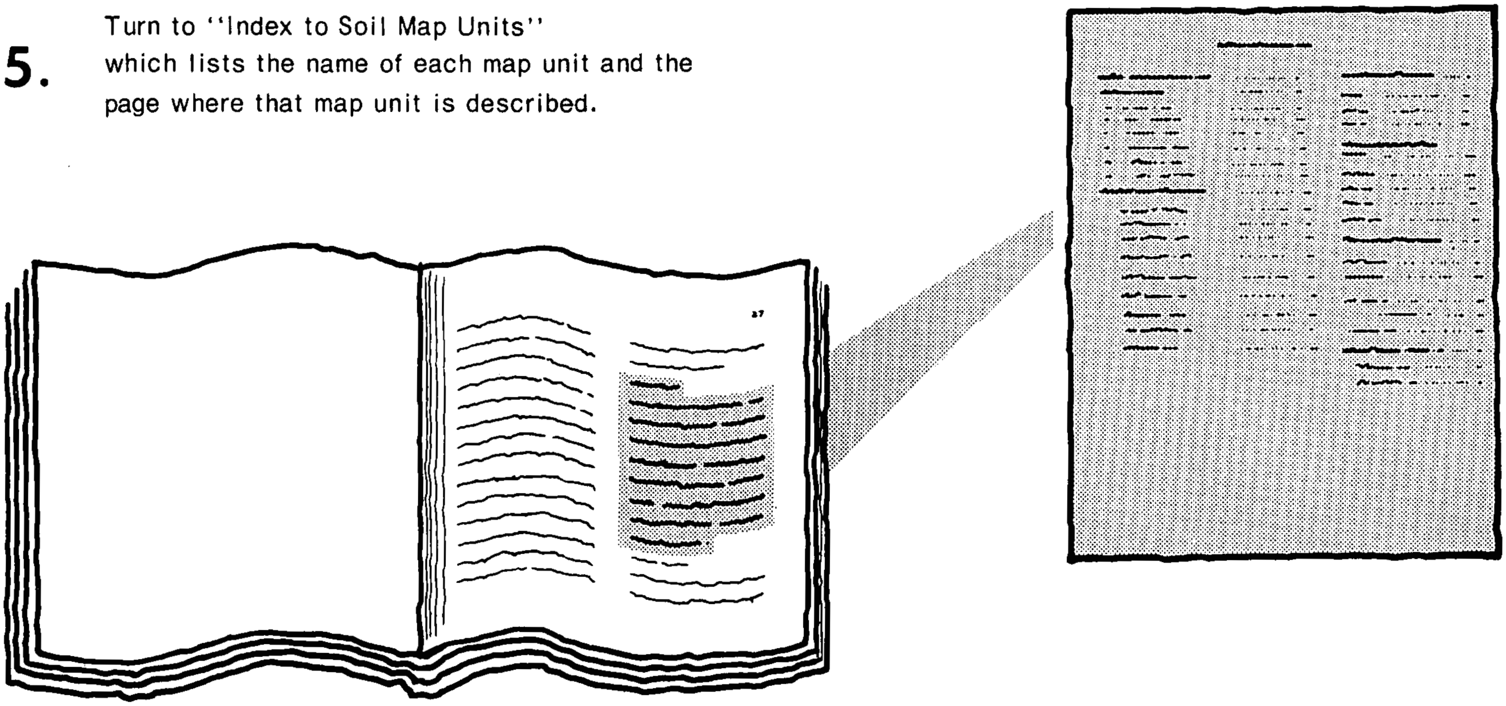


4. List the map unit symbols that are in your area.

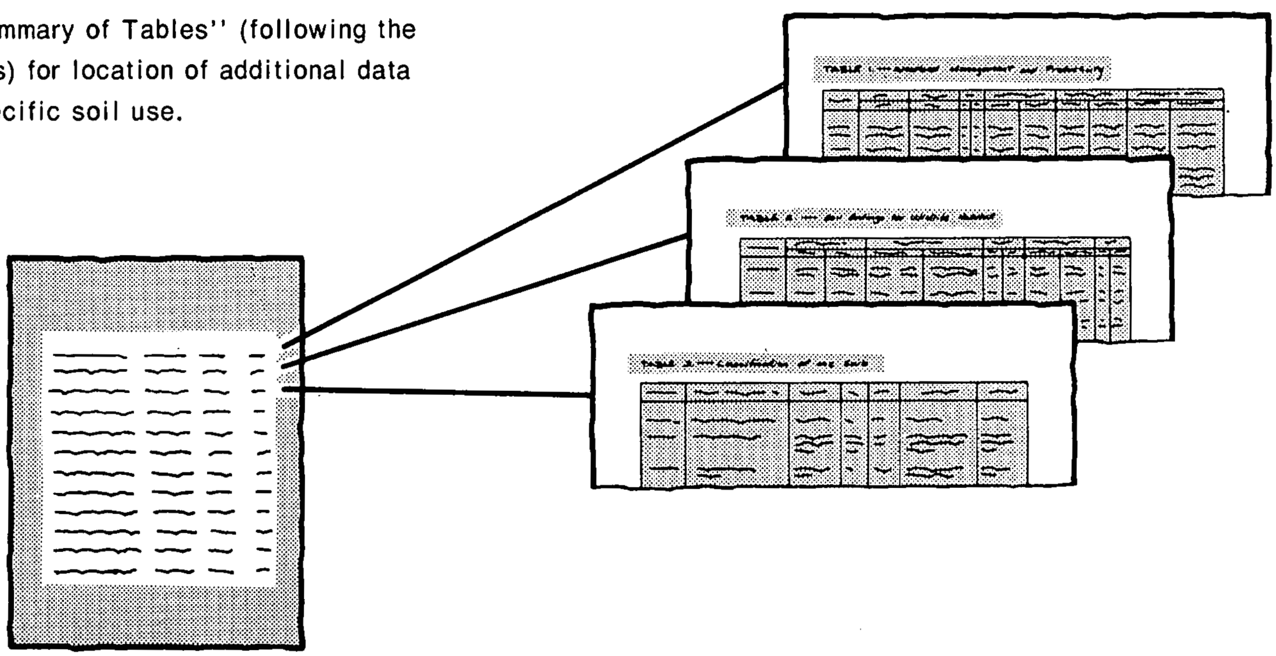


THIS SOIL SURVEY

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

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

Major fieldwork for this soil survey was performed in the period 1969-80. 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 Oklahoma Agricultural Experiment Station. It is part of the technical assistance furnished to the McIntosh County Conservation District and the Checotah Conservation District.

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

Cover: Residential and rangeland uses of Karma and Porum soils adjacent to Eufaula Lake.

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soil series

Issued December 1981

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foreword

This soil survey contains information that can be used in land-planning programs in McIntosh County. 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.

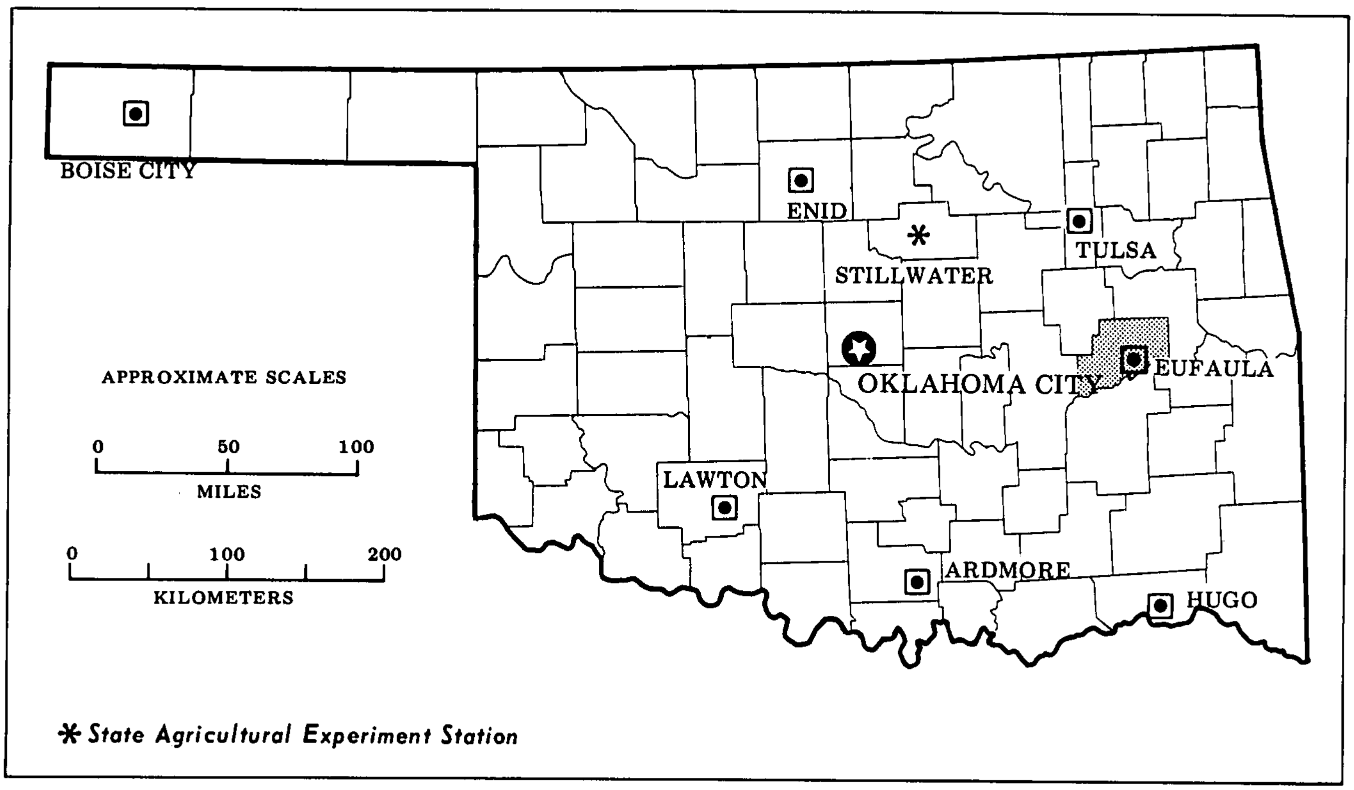
This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use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

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

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

Roland R. Willis

Roland R. Willis
State Conservationist
Soil Conservation Service



Location of McIntosh County in Oklahoma

Soil survey of
McIntosh County, Oklahoma

Soil survey by Bill G. Swafford and Ferris P. Allgood
Soil Conservation Service

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

MCINTOSH COUNTY is in the southeastern part of Oklahoma. Eufaula, the county seat, is in the southeastern part of the county. The county has an area of about 460,800 acres, or 720 square miles; the part of Eufaula Lake in the county and areas of water over 40 acres make up 44,960 acres, or 9.8 percent, of the total acreage. The county is bordered on the north by Okmulgee and Muskogee Counties; on the east by Muskogee and Haskell Counties; on the west by Hughes, Okfuskee, and Okmulgee Counties; and on the south by Haskell and Pittsburg Counties.

general nature of the county

This section gives general information concerning the county. It discusses physiography, settlement, natural resources, transportation and industry, and climate.

physiography

McIntosh County is mainly in the Arkansas Valley section of the Ouachita province and the Osage Plains section of the Central Lowlands province. Topographic differences range from the nearly level flood plains of the Canadian Rivers in the western and southwestern part of the county to the moderately steep areas in the northwestern part. The general slope is toward the south and east. Most of the drainage is into the South Canadian River and the North Canadian River. Both of these rivers flow into Eufaula Lake, which is near the central part of the county.

The elevations range from about 1,000 feet in the northwest part of the county to near 500 feet in the southwest part of the county.

settlement and development

The early settlement of McIntosh County was mostly by the Creek Indians. Land was allotted to the Indians on the basis of its cash value; the largest allotments were soils which were timbered. Land could be leased for farming if supervised by the Bureau of Indian Affairs. The sale or lease of the land attracted settlers into the county.

Most of the early settlers farmed on small subsistence acreages. In the timbered areas, the land had to be cleared before it could be cultivated. Cotton, corn, grain sorghums, peanuts, and alfalfa hay were the major cash crops. Some settlers sold out because they found the land too low in fertility, thus making it difficult to earn a living. Farmers in other areas bought the land to increase the size of their farm units. Since, farmers have specialized in certain types of crop and livestock enterprises to increase efficiency in managing larger farm units. Presently, they have mechanized machinery, are using irrigation, and have converted cultivated fields to tame pasture.

One large reservoir, Eufaula Lake, built at the confluence of the North Canadian River and the South Canadian River, is used for recreational, municipal, and industrial purposes.

natural resources

The natural resources of the county are mainly soil, water, timber, wild game and fish, and scenic beauty.

The soil is the most important natural resource in the county. It produces trees, crops, grass for livestock, and mineral resources. These support the dominant part of the economy in the county.

The water sources for towns are Eufaula Lake, other reservoirs, and wells. Two water districts serve the county. The Eufaula Lake area provides flood control and recreation. Farm ponds are the source of water for livestock.

Timber production is decreasing. Most of the timber has been cut over, and the trees that are left to propagate the stands are of poor quality. Some areas are planted to trees. The timber is used mainly for lumber.

Shale is common in the county. It is mined for use on county roads and for commercial uses. In some areas, mainly in the northeast part of the county, coal is mined. Shallow gas wells are located mainly in the north-central part of the county.

transportation and industry

McIntosh County is served by a network of state and federal highways. Federal Highway 69 and Indian Nation Turnpike cross the county in a north-south direction. Federal Highway 266, Interstate 40, and Oklahoma Highway 9 cross the county in an east-west direction. In farm areas, dirt, gravel, and paved roads provide access to state and fedral highways. A railroad transects the county north to south and another east to west in the northwest corner of the county.

Grains, peanuts, truck crops, and livestock are marketed in the survey area or in adjacent towns. Most of the industries are located near Eufaula or Checotah and are small.

climate

Prepared by the National Climatic Center, Asheville, N.C.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Muskogee, Okla., in the period 1951 to 1977. 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 41 degrees F, and the average daily minimum temperature is 31 degrees. The lowest temperature on record, which occurred at Muskogee on January 10, 1977, is -9 degrees F. In summer the average temperature is 80 degrees F, and the average daily maximum temperature is 92 degrees. The highest recorded temperature, which occurred at Muskogee on July 13, 1954, is 114 degrees.

Growing degree days are shown in table 1. They 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.

The total annual precipitation is 41 inches. Of this, 25 inches, or 60 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 19 inches. The heaviest 1-day rainfall during the period of record was 7.16 inches at Muskogee on July 15, 1961. Thunderstorms occur on about 50 days each year, and most occur in summer.

Average seasonal snowfall is 8 inches. The greatest snow depth at any one time during the period of record was 10 inches.

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 sun shines 70 percent of the time possible in summer and 55 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 12 miles per hour, in spring.

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

The general soil map 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 map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The soils in the survey area vary widely in their potential for major land uses. Soil potential ratings are based on the practices commonly used in the survey area to overcome soil limitations. These ratings reflect the ease of overcoming the limitations. They also reflect the problems that will persist even if such practices are used.

Each map unit is rated for *cultivated crops, tame pasture, native grass,* and *urban uses.* Cultivated crops are those grown on a small part of the survey area. Tame pasture is introduced pasture plants. Native grass is that native to the area. Urban uses include residential, commercial, and industrial developments.

Descriptions of the general soil map units follow.

1. Enders-Hector

Deep or shallow, moderately steep to steep, well drained soils that have a loamy surface layer and a loamy or clayey subsoil; on uplands.

This map unit consists of moderately steep to steep soils on hills and ridges. The hills have moderately long slopes that have a few rock outcrops on the ridges. The streams are deeply entrenched between the ridges. Slopes range from 12 to 30 percent.

This map unit makes up about 40 percent of the county. It is about 34 percent Enders soils, 23 percent Hector soils, and 43 percent other soils.

Enders soils are on convex side slopes on uplands below or between areas of Hector soils. Enders soils are deep, moderately steep, well drained, and very slowly permeable. They have a loamy surface layer and a clayey subsoil overlying shale.

Hector soils are on convex ridges and side slopes of uplands. The soils are shallow, moderately steep to steep, well drained, and moderately rapidly permeable. They have a loamy surface layer and subsoil overlying sandstone.

Other soils of minor extent are the moderately deep to deep Endsaw soils on steep convex side slopes, the moderately deep Linker soils on lower convex side slopes, and the deep, loamy Shermore soils on convex foot slopes.

Most of the soils of this unit are used for woodland. Some areas are used for tame pasture. These soils are well suited to recreation uses and wildlife habitat.

The soils in this map unit have low potential for most cultivated crops. Some of the minor soils with slopes of 8 percent or less are used for crops. The main concerns of management are controlling erosion and maintaining fertility.

The soils in this map unit have low potential for tame pasture and native grass. Though low in natural fertility, some of the minor soils in less sloping areas have medium potential for tame pasture. The quality of grass can be improved by proper stocking, controlling grazing, and preventing fires.

These soils have low potential for most urban uses. Soil depth, stony surfaces, slopes, and the high shrink-swell potential are the main limitations for most urban uses.

2. Dennis-Bates

Deep or moderately deep, very gently sloping to sloping, moderately well drained or well drained soils that have a loamy surface layer and a loamy or clayey subsoil; on uplands

This map unit consists of very gently sloping to sloping soils on low hills that have moderately long, smooth slopes on prairies. The soils are drained by small streams. Slopes range from 1 to 8 percent.

This map unit makes up about 21 percent of the county. About 47 percent of the area is Dennis soils, about 17 percent is Bates soils, and 36 percent is other soils.

Dennis soils are on smooth, convex sides slopes of uplands. These soils are deep, very gently sloping to sloping, moderately well drained, and slowly permeable. The Dennis soils have a loamy surface layer and a loamy or clayey subsoil.

Bates soils are on smooth, slightly convex side slopes on uplands above the Dennis soils. Bates soils are moderately deep, very gently sloping to sloping, well drained, and moderately permeable. Bates soils have a loamy surface layer and a loamy subsoil. They formed in residuum weathered from sandstone and thin layers of silty shale.

Other soils of minor extent are the Collinsville, Eram, Kanima, Talihina, and Verdigris soils. The very shallow or shallow Collinsville soils are on convex ridges. The moderately deep Eram soils are on slightly convex side slopes. The deep Kanima soils are formed in deposits of strip mine operations. The shallow Talihina soils are on convex ridges. The deep, loamy Verdigris soils are in drainageways.

Most of the soils in this map unit are used for native grass or tame pasture. A few areas of Dennis and Bates soils are used for grain sorghum, small grains, and soybeans.

The soils in this map unit have medium potential for crops. The crops on these soils respond favorably to good management. The main concerns in management are controlling erosion and maintaining soil tilth and fertility. Terraces and residue management help control erosion.

Potential of these soils is high for native grass and tame pasture. Rotational grazing and prevention of overgrazing are necessary..

These soils have medium potential for most urban uses. The shrink-swell potential of the Dennis soils and moderate soil depth in the Bates soils are the major limitations for urban uses.

3. Taloka-Carytown

Deep, nearly level to very gently sloping, somewhat poorly drained or poorly drained soils that have a loamy surface layer and a clayey subsoil; on uplands and terraces

This map unit consists of nearly level to very gently sloping soils on broad, smooth uplands and high terraces on prairies. In a few areas, small streams are entrenched in the landscape. Slopes range from 0 to 3 percent.

This map unit makes up about 18 percent of the county. It is about 53 percent Taloka soils, 20 percent Carytown soils, and 27 percent other soils.

Taloka soils are on broad smooth uplands or high terraces. These soils are deep, nearly level to very gently sloping, somewhat poorly drained, and very slowly permeable. They have a loamy surface layer and a clayey subsoil.

Carytown soils are on terrace flats and in depressional areas. These soils are deep, nearly level to very gently sloping, poorly drained, and very slowly permeable. They have a loamy surface layer and a clayey subsoil that is high in sodium.

Other soils of minor extent are Burwell, Parsons, Stigler, and Woodson soils. Burwell and Carytown soils are mapped only in a complex; the deep, moderately well drained Burwell soils are on the mounded areas. The deep Parsons soils are on the same landscape, but they do not have the high sodium content of the Carytown soils and the thick surface layer of the Taloka soils. The moderately well drained Stigler soils are on broad, nearly level, smooth terraces. The deep, somewhat poorly drained Woodson soils are on the same landscape.

The soils of this map unit have high potential for crops. Management concerns include preventing erosion, maintaining soil tilth and fertility, and improving water intake. Crops respond to fertilizer, and crop residue management helps maintain soil tilth. Terraces are needed for these soils where slopes exceed 1 percent. Rows arranged in the proper direction in concave areas assists in drainage.

The soils of this map unit have high potential for native grass and tame pasture. The management concerns are proper grazing and preventing fires.

These soils have low potential for most urban uses. Low strength, wetness, and the high shrink-swell potential are the main limitations for most urban uses.

4. Karma-Porum

Deep, very gently sloping to sloping, well drained or moderately well drained soils that have a sandy or loamy surface layer and a loamy or clayey subsoil; on high terraces

This map unit consists of very gently sloping to sloping soils on broad, smooth terraces. In some areas, streams are entrenched in the landscape. Slopes range from 1 to 8 percent.

This map unit makes up about 14 percent of the county. It is about 41 percent Karma soils, 21 percent Porum soils, and 38 percent other soils.

Karma soils are on broad, smooth terraces. These soils are deep, very gently sloping to sloping, well drained, and moderately permeable. The Karma soils have a loamy or sandy surface layer and a loamy subsoil.

Porum soils are on broad, smooth terraces. These soils are deep, very gently sloping to gently sloping, moderately well drained, and slowly permeable. The Porum soils have a loamy surface layer and a clayey or loamy subsoil.

Other soils of minor extent are the deep, sandy, excessively drained Glentosh soils; the deep, loamy or sandy, well drained Kamie soils; and the deep, sandy, well drained Larton soils. All of these soils are on broad, smooth terraces.

The soils in this map unit are used mainly for tame pasture. A few areas are in woodland, and many areas are used for cultivated crops. Truck crops and peanuts are grown on some of the more sandy soils.

The soils in this map unit have low potential for crops. The soils respond to good management. The main concerns in management are controlling erosion and maintaining soil tilth and fertility.

Potential of these soils is medium for tame pasture and medium for native grass. The main management concerns are proper grazing, preventing fires, and controlling brush.

These soils have high potential for most urban uses. The shrink-swell potential and wetness are the main limitations on the Porum soils. Seepage is a limitation for sewage lagoons on the Karma soils.

5. Verdigris-Madill

Deep, nearly level, moderately well drained or well drained soils that have a loamy surface layer and loamy and sandy underlying layers; on flood plains

This map unit consists of smooth, nearly level soils on flood plains of major streams. Slopes range from 0 to 1 percent.

This map unit makes up about 7 percent of the county. It is about 67 percent Verdigris soils, 16 percent Madill soils, and 17 percent other soils.

Verdigris soils are on smooth flood plains. These soils are deep, nearly level, and moderately well drained. They are moderately permeable. Verdigris soils are loamy throughout. They are occasionally or frequently flooded.

Madill soils are on smooth flood plains. These soils are deep, nearly level, and well drained. They are moderately rapidly permeable. Madill soils have a loamy surface layer and loamy and sandy underlying layers.

Other soils of minor extent are Caspiana, Convent Variant, Kiomatia, and Muldrow soils. Caspiana soils, on low terraces, are deep and nearly level and have a seasonal high water table below a depth of 4 feet. Convent Variant soils, on flood plains at the mouth of small streams, are deep, nearly level, and somewhat poorly drained. Kiomatia soils, on the lowest part of the flood plain, are deep, sandy, and nearly level to slightly undulating. Muldrow soils, in slightly depressional areas on low terraces, are deep, loamy, somewhat poorly drained and nearly level.

Most of the soils in this map unit are used for tame pasture or as woodland. Some areas are used for cultivated crops, and other areas have been seeded to grains that are used for feeding wildlife.

The soils of this map unit, which are not subject to frequent flooding, have high potential for crops. The main concerns in management are flooding, wetness, and maintenance of soil tilth and fertility. Fertilizing, drainage, and crop residue management are needed.

The soils of this map unit have high potential for tame pasture and low potential for native grass. Controlling brush, proper grazing, and preventing fires are the main management concerns.

These soils have low potential for most urban uses. Flooding is the main limitation.

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, 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, Karma fine sandy loam, 3 to 5 percent slopes, is one of several phases in the Karma series.

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

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. An example is Collinsville-Talihina complex, 5 to 12 percent slopes.

A *soil association* is made up of two or more geographically associated soils that are shown as one unit on the maps. Because of present or anticipated soil uses in the survey area, it was not considered practical or necessary to map the soils separately. The pattern and relative proportion of the soils are somewhat similar. Enders-Hector association, moderately steep, 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 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.

Descriptions of soils in the detailed map units follow.

1—Bates loam, 1 to 3 percent slopes. This is a moderately deep, well drained, very gently sloping soil on ridgetops on the prairies. Slopes are smooth and convex. Most areas are 15 to 60 acres, but some are smaller.

Typically, the surface layer is dark brown loam about 12 inches thick. The upper part of the subsoil is dark brown loam to a depth of about 22 inches. The lower part is strong brown clay loam to about 32 inches and brown loam that extends to a depth of about 38 inches. The underlying material is soft sandstone that has thin layers of silty shale.

This soil is high in natural fertility and in organic matter content. Reaction is medium acid or slightly acid in the surface layer except where it has been limed. Permeability is moderate, and the available water capacity is medium. This soil has good tilth and can be worked throughout a wide range in moisture content. The root zone is moderately deep.

Included with this soil in mapping are a few intermingled areas of Collinsville soils on the crest of ridges and Dennis soils on the lower parts of slopes. The included soils make up about 10 percent of this map unit, but separate areas are generally less than 3 acres.

This soil has high potential for row crops and small grains. Good tilth can be maintained by returning crop residue to the soil. If cultivated crops are grown, the hazard of erosion is moderate. Minimum tillage, the use of cover crops, terracing, and contour farming help to reduce runoff and to control erosion.

This soil has high potential for native grass and tame pasture. Bermudagrass or weeping lovegrass and clover is the most common mixture used for tame pasture. Fertilizing tame pasture grasses improves the quality and quantity of forage, which helps protect the soil from erosion. The quality of all grasses can be maintained or improved by preventing fires and by controlling grazing.

This soil has medium potential for most urban uses. There are no significant limitations for dwellings without basements. The moderate depth to rock is a limitation for septic tank absorption fields, but this can be overcome by increasing the size of the absorption area. Depth to rock is the main limitation for sewage lagoons, dwellings with basements, and sanitary landfills. The moderate low strength of this soil is the main limitation for roads and streets.

This Bates soil is in capability subclass IIe and in the Loamy Prairie range site.

2—Bates loam, 3 to 5 percent slopes. This is a moderately deep, well drained, gently sloping soil on ridgetops on the prairies. Slopes are smooth and convex. Most areas are 10 to 20 acres, but some are smaller.

Typically, the surface layer is very dark grayish brown loam about 10 inches thick. The upper part of the subsoil to a depth of about 14 inches is brown loam. The lower part of the subsoil is dark yellowish brown loam that extends to a depth of about 28 inches. The underlying material is soft sandstone that has thin layers of soft shale.

This soil is high in natural fertility and in organic matter content. Reaction is medium acid or slightly acid in the surface layer except where it has been limed. Permeability is moderate, and the available water capacity is medium. This soil has good tilth and can be worked throughout a wide range in moisture content. The root zone is moderately deep.

Included with this soil in mapping are a few intermingled areas of Collinsville soils on the crest of ridges and Dennis soils on the lower positions of slopes. The included soils make up about 15 percent of this map unit, but separate areas are generally less than 3 acres.

This soil has medium potential for row crops and small grains. Good tilth can be maintained by returning crop residue to the soil. If cultivated crops are grown the hazard of erosion is severe. Minimum tillage, the use of cover crops, terracing, and contour farming help to reduce runoff and to control erosion.

This soil has high potential for native grass and tame pasture. Bermudagrass or weeping lovegrass and clover is the most common mixture used for tame pasture. Fertilizing tame pasture grasses improves the quality and amount of forage; the additional plant growth helps protect the soil from erosion. The quality of all grasses can be maintained or improved by controlled grazing practices and by preventing fires.

This soil has medium potential for most urban uses. There is no significant limitation for dwellings without basements. The moderate depth to sandstone is a limitation for septic tank absorption fields, but this can be overcome by increasing the size of the absorption area. Depth to rock is the main limitation for sewage lagoons, dwellings with basements, and sanitary landfills.

This Bates soil is in capability subclass IIIe and in the Loamy Prairie range site.

3—Bates loam, 2 to 5 percent slopes, eroded. This is an eroded, moderately deep, well drained, very gently to gently sloping soil on uplands on prairies. In about 40 percent of the area, the surface layer and material from the upper part of the subsoil are mixed by plowing. A few crossable gullies are about 300 feet apart. Rill erosion is common between the gullies. Slopes are smooth and convex. Areas are 10 to 30 acres, but some are smaller.

Typically, the surface layer is dark brown loam about 6 inches thick. The upper part of the subsoil is dark brown loam to a depth of about 12 inches. The lower part of the subsoil is dark yellowish brown loam that extends to a depth of about 28 inches. The underlying material is soft sandstone and thin layers of soft shale.

This soil is medium in natural fertility and in organic matter content. Reaction is medium acid or slightly acid in the surface layer. Permeability is moderate, and the available water capacity is medium. This soil has good tilth and can be worked throughout a wide range in moisture content. The root zone is moderately deep.

Included with this soil in mapping are a few intermingled areas of Collinsville soils on the crest of ridges and Dennis soils in the lower positions of slopes. The included soils make up about 15 percent of the map unit, but separate areas are generally less than 5 acres.

This soil has medium potential for row crops and small grains. Good tilth can be maintained by returning crop residue to the soil. If cultivated crops are grown, the hazard of erosion is severe. Minimum tillage, the use of cover crops, terracing, and contour farming help to reduce runoff and to control erosion.

This soil has high potential for native grass and tame pasture. Bermudagrass or weeping lovegrass and clover is the most common mixture used for tame pasture. The main concerns in management are controlling grazing, proper stocking, and controlling weeds and brush. Fertilizing tame pasture grasses improves the quality and amount of forage; the additional plant growth helps protect the soil from erosion.

This soil has medium potential for most urban uses because of the moderate depth to sandstone. Depth to rock is a limitation for septic tank absorption fields. This limitation can be overcome by increasing the size of the absorption area. Depth to rock is the main limitation for sewage lagoons, dwellings with basements, and sanitary landfills.

This Bates soil is in capability subclass IIIe and in the Loamy Prairie range site.

4—Carytown silt loam, 0 to 1 percent slopes. This deep, poorly drained, nearly level soil is on upland flats. Slopes are broad and smooth and have some concave areas. Areas of this soil range from 20 to 200 acres.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsurface layer is grayish brown silt loam about 6 inches thick. The upper part of the subsoil is very dark grayish brown and dark gray clay to a depth of about 42 inches. The lower part of the subsoil to a depth of 62 inches is dark grayish brown clay.

This soil is low in natural fertility and in organic matter content. Reaction is medium acid to neutral in the surface layer. The exchangeable sodium of the subsoil is 15 percent or more. Water and air move through this soil very slowly, and the available water capacity is medium. The surface crusts easily. The root zone is deep, but the subsoil is not easily penetrated by plant roots because of clay and sodium content. A perched water table is at a depth of 1 foot or less in the winter and spring.

Included with this soil in mapping are small intermingled areas of Parsons and Taloka soils. The included soils make up about 10 percent of the map unit, but separate areas are generally less than 5 acres.

This soil has low potential for crops. The main concerns in management are wetness, surface crusting, intake of water, and the alkalinity and fertility. Crops respond to fertilizer. Returning crop residue to the soil helps maintain or improve soil fertility, soil tilth, and water intake. Rows arranged in the proper direction for surface drainage in wet areas help increase the yield of the crop and the amount of plant residue. Additions of manure and chemical amendments, such as gypsum, improve soil tilth and intake of water. Excessive tillage needs to be avoided.

This soil has medium potential for native grass or tame pasture. Because of the alkalinity of the soil, tame pastures should be seeded to salt-tolerant grasses. Proper stocking rates and pasture rotation help keep pastures in good condition. Fertilizing tame pastures increases the amount of forage for grazing and the quality of grass; the additional plant growth helps protect the soil from erosion.

This soil has low potential for most urban uses. Wetness is the main limitation. The very slow premeability limits the use of this soil for septic tank absorption fields, and the high shrink-swell potential and sodium content are limitations for dwellings, small commercial buildings, and roads and streets.

This Carytown soil is in capability subclass IIIw and in the Shallow Claypan range site.

5—Carytown silt loam, 1 to 3 percent slopes, eroded. This is a deep, poorly drained, very gently sloping soil on uplands of prairies. This eroded soil has many rills between crossable gullies that are about 300 feet apart. In about 30 percent of the area, the surface layer and material from the upper part of the subsoil have been mixed by plowing. Slopes are broad and smooth and have depressions in the eroded areas. Areas are irregular in shape and range from 5 to 60 acres.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The upper part of the subsoil is very dark gray clay to a depth of about 44 inches. The lower part to a depth of 60 inches is dark gray clay that has mottles in shades of brown and gray.

This soil is low in natural fertility and in organic matter content. Reaction is medium acid to neutral in the surface layer. The subsoil has 15 percent or more exchangeable sodium. Water and air move through this soil very slowly, and the available water capacity is medium. The surface crusts easily. Plant roots do not easily penetrate the subsoil. A perched water table is at a depth of 1 foot or less in winter and spring.

Included with this soil in mapping are small intermingled areas of Burwell, Dennis, Parsons, and Taloka soils. Included soils make up about 20 percent of this map unit, but separate areas generally are less than 5 acres.

This soil has low potential for most crops. The main concerns in management are alkalinity, erosion, surface crusting, slow intake of water, and maintaining soil tilth and fertility. Erosion can be reduced by terracing and contour farming. Crops respond to fertilizer. Returning crop residue to the soil helps maintain or improve water intake, soil tilth, and soil fertility. Cover crops, terracing, and contour farming are especially needed if row crops are grown. Additions of manure and chemical amendments, such as gypsum, improve soil tilth and water intake. Excessive tillage needs to be avoided.

This soil has medium potential for native grass or tame pasture. In formerly cultivated areas this alkaline soil can be planted to salt-tolerant grasses. Fertilizing tame pasture increases the quality and quantity of forage; the additional plant growth helps control erosion. Proper grazing, controlling weeds, and preventing fires increase the quality of grasses.

This soil has low potential for most urban uses. Wetness is the main limitation for urban uses. The very slow permeability limits the use of this soil for septic tank absorption fields and the high shrink-swell potential is a limitation for dwellings, small commercial buildings, and roads and streets.

This Carytown soil is in capability subclass IIIw and it is in the Shallow Claypan range site.

6—Carytown-Burwell complex, 0 to 3 percent slopes. This complex consists of deep, poorly drained Carytown soil and deep, moderately well drained Burwell soil on uplands on prairies. The nearly level Carytown soil is in smooth areas between convex mounds of the Burwell soil. These mounds are 2 to 6 feet high and 100 to 400 feet apart. These soils are so intricately mixed that mapping them separately was not practical. Areas of this unit range from 20 to 800 acres.

The Carytown silt loam makes up about 55 percent of the map unit. Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The subsurface layer is gray silt loam about 4 inches thick. The upper part of the subsoil is dark grayish brown and dark gray clay to a depth of about 43 inches. The lower part of the subsoil to a depth of about 62 inches is dark grayish brown clay.

This soil is low in natural fertility and in organic matter content. Reaction is medium acid to neutral. The subsoil has 15 percent or more exchangeable sodium. Permeability is very slow, and the available water capacity is medium. The surface crusts easily. Plant roots do not easily penetrate the subsoil. A perched water table is at a depth of 1 foot or less in winter and spring.

The Burwell loam makes up about 40 percent of the map unit. Typically, the surface layer is very dark grayish brown loam about 20 inches thick. The subsurface layer to a depth of about 28 inches is brown loam. The upper part of the subsoil is yellowish brown clay loam, to about 34 inches. The middle part is yellowish brown silty clay loam and clay that extends to about 58 inches. The lower part is coarsely mottled gray, yellowish brown, and red clay that extends to a depth of about 68 inches.

This soil is high in natural fertility and in organic matter content. Reaction is strongly acid or medium acid. Permeability is slow, and the available moisture content is high. Plant roots easily penetrate the subsoil. A perched water table fluctuates between depths of 2 and 3 feet in winter and spring.

Included with these soils in mapping are intermingled areas of Parsons and Taloka soils in the smooth areas between convex mounds of Burwell soils. The included areas make up about 5 percent of this map unit, but separate areas are generally less than 3 acres.

These soils have medium potential for crops. The main concerns in management are erosion, wetness, slow intake of water, and the high content of exchangeable sodium in Carytown soils, and the high mounds of the Burwell soils. Erosion can be reduced by smoothing the mound areas and terracing. Fertilizing and adding manure and gypsum will increase crop production. The additional plant growth provides crop residue to improve soil tilth and water intake. Excessive tillage needs to be avoided.

These soils have medium potential for native grass and tame pasture. Tame pasture should include salt-tolerant grasses. Fertilizing and adding chemical amendments will increase forage production. The additional plant growth helps control erosion. Proper grazing, preventing fires, and controlling weeds increase the quality of all grasses.

The soils in this complex have low potential for most urban uses. Wetness in areas between the mounds is the main limitation for all urban uses. The high shrink-swell potential is a limitation for dwellings, small commercial buildings, and roads and streets.

These Carytown and Burwell soils are in capability class IIIw. The Carytown soil is in Shallow Claypan range site and the Burwell soil is in Loamy Prairie range site.

7—Caspiana silty clay loam. This is a deep, well drained, nearly level soil on terraces. Slopes are 0 to 1 percent and are smooth and slightly convex. Areas are 15 to 150 acres.

Typically, the surface layer is dark reddish brown silty clay loam about 10 inches thick. The upper part of the subsoil to a depth of about 26 inches is very dark gray silty clay loam. The lower part, to about 50 inches, is yellowish red silty clay loam. The underlying material is yellowish red very fine sandy loam that extends to a depth of about 60 inches.

This soil is high in natural fertility and in organic matter content. Reaction is medium acid to moderately alkaline in the surface layer. Permeability is moderate, and the available water capacity is high. This soil has good tilth and can be worked throughout a wide range of moisture conditions. A high water table fluctuates up to 4 feet below the surface during the winter and spring.

Included with this soil in mapping are areas of Madill and Verdigris soils on narrow flood plains and the Muldrow soils in slight depressions on terraces. The included soils make up about 10 percent of the map unit, but separate areas are generally less than 3 acres.

This soil has high potential for row crops and small grains. Returning residue to the soil helps maintain soil tilth and fertility. Excessive tillage should be avoided.

This soil has low potential for native grass and high potential for tame pasture. A mixture of bermudagrass or tall fescue and clover is commonly used for tame pasture. Controlling brush, proper grazing, fertilizing, and preventing fires improve the quality and quantity of grasses.

This soil has medium potential for most urban uses. The main limitations are slow permeability of the soil for septic tank absorption fields, seepage for sewage lagoons, and the seasonal high water table for trench sanitary landfills. The moderate shrink-swell potential is the main limitation for dwellings and small commercial buildings. Low strength is a limitation for local roads and streets. Most of these limitations can be overcome by proper structure design or by altering the soil.

This Caspiana soil is in capability class I; it is not assigned to a range site.

8—Choteau silt loam, 1 to 3 percent slopes. This is a deep, moderately well drained, very gently sloping soil on uplands on prairies. Slopes are smooth and slightly convex. Areas are 8 to 100 acres.

Typically, the surface layer is very dark grayish brown silt loam 15 inches thick. The subsurface layer is brown silt loam to a depth of about 21 inches. The upper part of the subsoil is dark brown silty clay loam to a depth of about 26 inches. The middle part of the subsoil is yellowish brown clay to about 52 inches. The lower part of the subsoil to a depth of about 80 inches is coarsely mottled yellowish brown and gray silty clay loam.

This soil is high in natural fertility and in organic matter content. Reaction is slightly acid to strongly acid. Permeability is slow, and available water capacity is high. This soil has good tilth and can be worked throughout a wide range in moisture content. The root zone is deep. A perched water table is between depths of 2 and 3 feet in winter and spring.

Included with this soil in mapping are areas of Taloka soils on the lower slopes and intermingled areas of Dennis soils. The included soils make up about 10 percent of this map unit, but separate areas are generally less than 5 acres.

This soil has high potential for crops. Good tilth can be maintained by returning crop residue to the soil. If cultivated crops are grown, the hazard of erosion is moderate. Terraces are needed unless drilled or sown crops are grown and large amounts of crop residue are returned to the soil. Minimum tillage and the use of cover crops help to reduce runoff and to control erosion.

This soil has high potential for native grass and tame pasture. The grass can be maintained or improved by controlling grazing, preventing fires, and controlling brush. Fertilizing tame pasture grasses increases forage production; the additional plant growth helps protect the soil from erosion.

This soil has low potential for most urban uses. Because of high shrink-swell potential, most concrete structures require proper design for the building sites. Wetness limits septic tank absorption fields and sewage lagoons, but this can be overcome by proper design.

This Choteau soil is in capability subclass IIe and in the Loamy Prairie range site.

9—Collinsville-Bates complex, 3 to 8 percent slopes. This complex consists of shallow or very shallow, well drained or somewhat excessively drained Collinsville soil and moderately deep, well drained Bates soil. They are so intricately mixed, or so small in size, that mapping them separately was not practical. These soils are on broad smooth ridges and smooth convex side slopes of uplands in prairies. Areas range from about 20 to 200 acres; individual areas of each soil are about 5 acres or less.

Collinsville fine sandy loam makes up 50 to 70 percent of the map unit. Typically, the surface layer is dark brown fine sandy loam about 6 inches thick. The layer below that to a depth of 14 inches is dark yellowish brown fine sandy loam. The underlying material below 14 inches is yellowish brown hard sandstone.

This soil is medium in natural fertility and organic matter content. Reaction is slightly acid to strongly acid. Permeability is moderately rapid, and the available water capacity is very low. The root zone is shallow or very shallow.

Bates loam makes up 20 to 40 percent of the map unit. Typically, the surface layer is dark brown loam about 10 inches thick. The upper part of the subsoil to a depth of about 20 inches is dark brown clay loam. The lower part of the subsoil to about 30 inches is strong brown clay loam. The underlying layer is soft yellowish brown sandstone.

This soil is high in natural fertility and organic matter content. Reaction is medium acid or slightly acid in the surface layer except where it has been limed. Permeability is moderate, and available water capacity is medium. The root zone is moderately deep.

Included with this complex in mapping are intermingled areas of Dennis, Eram, and Talihina soils. The included soils make up about 10 percent of the complex, but separate areas are generally less than 5 acres.

These soils have low potential for row crops and small grains. The main limitations are slope, erosion hazard, and shallow depth.

These soils have medium potential for native grasses and tame pasture. A mixture of bermudagrass or weeping lovegrass and clover is commonly used for tame pasture. The main concerns in management are controlling grazing, preventing fires, and controlling weeds and brush. Fertilizing increases quality and quantity of grass; the additional plant growth helps to control erosion.

These soils have low potential for most urban uses. Depth to rock in Collinsville soils is the main limitation for septic tank absorption fields, sewage lagoons, and sanitary landfills, as well as for dwellings and small commercial structures.

These Collinsville and Bates soils are in capability subclass VIs. The Collinsville soil is in Shallow Prairie range site, and the Bates soil is in Loamy Prairie range site.

10—Collinsville-Talihina complex, 5 to 12 percent slopes. This complex consists of shallow and very shallow, well drained or excessively drained Collinsville soil and shallow, moderately well drained Talihina soil on uplands on prairies. These sloping to strongly sloping soils are on broad, smooth convex ridges. These soils are so intricately mixed, or so small in size, that mapping them separately was not practical. Most areas are 20 to 100 acres, but some areas are as small as 5 acres.

Collinsville fine sandy loam makes up 60 to 80 percent of the map unit. Typically, the surface layer is very dark grayish brown fine sandy loam about 8 inches thick. The layer below that to a depth of 14 inches is dark yellowish brown fine sandy loam that has many fragments of sandstone. The underlying material is yellowish brown hard sandstone.

This soil is medium in natural fertility and organic matter content. Reaction is slightly acid to strongly acid. Permeability is moderately rapid, and the available water capacity is very low. The root zone is shallow or very shallow.

Talihina clay loam makes up 20 to 40 percent of the map unit. Typically, the surface layer is very dark grayish brown clay loam about 8 inches thick. The layer below that layer to a depth of 18 inches is olive brown clay. The underlying layer is dark gray shale.

This soil is high in natural fertility and organic matter content. Reaction is slightly acid to strongly acid. Permeability is slow, and the available moisture capacity is very low. The root zone is shallow. A perched water table is between depths of 1/2 foot and 1 1/2 feet during the winter and spring.

Included in mapping are intermingled areas of Bates and Eram soils. The included soils make up about 10 percent of this complex, but separate areas are generally less than 5 acres.

These soils have low potential for row crops and small grains. The main limitations are slope, shallow depth, and a severe hazard of erosion.

These soils have low potential for tame pasture and medium potential for native grass. The quality of grass can be maintained or improved by controlling brush, preventing fires, and controlling grazing. Fertilizing tame pasture grasses increases the quality and quantity of grass; the additional plant growth helps to control erosion.

These soils have low potential for most urban uses. Shallow soil depth is the main limitation to nearly all urban uses.

These Collinsville and Talihina soils are in capability subclass VIs and in the Shallow Prairie range site.

11—Convent Variant silt loam, occasionally flooded. This is a deep, somewhat poorly drained, nearly level soil on flood plains. This soil is subject to occasional flooding. Slopes are 0 to 1 percent and are broad and smooth. Areas are 30 to 150 acres, but some areas are about 10 acres.

Typically, the surface layer is dark brown silt loam about 18 inches thick. The layer below that is mottled grayish brown and dark brown silt loam that extends to a depth of about 28 inches. The underlying layer is mottled gray and brown silt loam to about 46 inches and mottled gray and dark gray silt loam to a depth of about 67 inches.

This soil is high in natural fertility and medium in organic matter content. Reaction is neutral to medium acid. Permeability is moderate, and the available water capacity is high. This soil has good tilth and can be worked throughout a wide range in moisture content. The root zone is deep. A high water table fluctuates between depths of 2 and 4 feet in winter and spring.

Included with this soil in mapping are intermingled areas of Madill, Muldrow, and Verdigris soils that make up about 10 percent of the map unit. Also included are soils similar to the Convent Variant soil except that the texture below the surface layer is silty clay loam or clay loam. The included soils make up about 40 percent, but separate areas are less than 10 acres.

This soil has high potential for row crops and small grains. The main concerns in management are occasional flooding, wetness, and maintenance of soil tilth and fertility. Close-grown crops are needed during the winter and spring to prevent excessive soil loss during flooding. The planting of spring crops is often delayed until after flooding. Crops that produce large amounts of residue can be grown continuously if fertilizer is added for growth to provide maximum crop residue. Maintaining the organic matter content of this soil helps to maintain good soil tilth and increase the intake of water. Minimum tillage helps reduce soil loss. Using this soil for tame pasture or woodland reduces soil loss during the flood period.

This soil has low potential for native grass and high potential for tame pasture. Bermudagrass or tall fescue and clover is the most commonly used tame pasture. Fertilizing tame pasture grasses improves the quality and quantity of forage; the additional plant growth helps protect the soil from erosion. Tame pasture grasses can be improved by controlling grazing, proper stocking, and preventing fires.

This soil has low potential for most urban uses. Flooding and wetness are the main limitations. The hazard of flooding can be reduced, but not completely eliminated by upstream flood control structures and land treatment. The potential hazard of flooding is high for houses built on the flood plain.

This Convent Variant soil is in capability subclass IIw. It is not assigned to a range site.

12—Dennis silt loam, 1 to 3 percent slopes. This is a deep, moderately well drained, very gently sloping soil on prairie uplands. Slopes are smooth and slightly convex. Areas are 40 to 80 acres, but some are 15 acres.

Typically, the surface layer is very dark grayish brown silt loam to a depth of 12 inches. The upper part of the subsoil to a depth of about 19 inches is dark yellowish brown clay loam. The middle part to a depth of about 42 inches is yellowish brown silty clay and clay. The lower part of the subsoil to a depth of about 62 inches is yellowish brown silty clay loam that has coarse gray mottles.

This soil is high in natural fertility and in organic matter content. Reaction is medium acid or strongly acid in the surface layer. Permeability is slow, and the available water capacity is high. This soil has good tilth and can be worked throughout a wide range in moisture content. The root zone is deep. A perched water table is between depths of 2 and 3 feet during winter and spring.

Included with this soil in mapping are a few intermingled areas of Bates and Eram soils. These included soils make up about 10 percent of this map unit, but separate areas are generally less than 5 acres.

This soil has high potential for crops. Good tilth can be maintained by returning crop residue to the soil. The hazard of erosion is moderate if cultivated crops are grown. Minimum tillage and the use of cover crops help to reduce runoff and to control erosion. Terraces are needed unless drilled or sown crops are grown and large amounts of crop residue are returned to the soil.

This soil has high potential for native grass and tame pasture. The grass can be maintained or improved by controlling grazing, preventing fires, and controlling brush. Fertilizing tame pasture grasses increases production; the additional plant growth helps protect the soil from erosion.

This soil has medium potential for most urban uses. The high shrink-swell potential is the main limitation for dwellings, small commercial buildings, and roads and streets. Wetness and slow permeability are limitations for septic tank absorption fields. These limitations may be partly overcome by proper design or by altering the soil.

This Dennis soil is in capability subclass IIe and in the Loamy Prairie range site.

13—Dennis silt loam, 3 to 5 percent slopes. This is a deep, moderately well drained, gently sloping soil on uplands on prairies. Slopes are smooth and slightly convex. Areas are 30 to 60 acres, but some are 10 acres.

Typically, the surface layer is very dark grayish brown silt loam about 11 inches thick. The subsurface to a depth of about 15 inches is dark brown silt loam. The upper part of the subsoil is yellowish brown silty clay to a depth of about 42 inches. The lower part of the subsoil is coarsely mottled yellowish brown and gray silty clay to a depth of about 64 inches.

This soil is high in natural fertility and in organic matter content. Reaction is medium acid or strongly acid in the surface layer. Water and air move through this soil at a slow rate, and the available water capacity is high. Plant roots easily penetrate the subsoil. A perched water table is between depths of 2 and 3 feet during winter and spring.

Included with this soil in mapping are intermingled areas of Bates and Eram soils. Also included are similar soils to the Dennis soil, but weathered shale is at a depth of about 40 to 60 inches. The included soils make up 15 percent of the unit, but separate areas are generally less than 3 acres.

This soil has medium potential for crops. The main limitations for crops are erosion and maintaining the soil tilth. The hazard of erosion can be reduced by terraces, contour tillage, and returning crop residue to the soil. Cover crops are needed in a rotation that includes row crops.

This soil has medium potential for native grass and tame pasture. Fertilizing tame pastures improves the plant cover that helps protect the soil from erosion. All grasses can be improved by controlling grazing, preventing fires, and controlling weeds.

This soil has medium potential for most urban use. Wetness limits septic tank absorption fields and sewage lagoons, but this can be overcome by proper design. The high shrink-swell potential of this soil can be overcome by proper design of concrete structures to prevent cracking of foundations of dwellings and small commercial buildings.

This Dennis soil is in capability subclass IIIe and in the Loamy Prairie range site.

14—Dennis silt loam, 2 to 5 percent slopes, eroded. This is a deep, moderately well drained, very gently sloping to gently sloping eroded soil on uplands on prairies. In about 40 percent of the map unit, the original surface layer and material from the upper part of the subsoil are mixed by plowing. There are a few crossable gullies about 300 feet apart. Rills are common between the gullies. Slopes are smooth and convex. Areas are 20 to 80 acres, but some are 10 acres.

Typically, the surface layer is dark brown silt loam about 10 inches thick. The upper part of the subsoil is dark yellowish brown silty clay loam to a depth of about 28 inches. The middle part is yellowish brown silty clay to a depth of about 40 inches. The lower part of the subsoil to a depth of about 72 inches is clay and coarsely mottled gray, red, and brownish yellow silty clay.

This soil is low in natural fertility and in organic matter content because much of the original surface layer has been removed by erosion. Reaction is medium acid or strongly acid in the surface layer. Permeability is slow, and available water capacity is high. Surface crusting is a problem in seedbed preparation. The root zone is deep. A perched water table is between depths of 2 and 3 feet during winter and spring.

Included with this soil in mapping are a few intermingled areas of Bates and Eram soils. Also included are soils similar to the Dennis soil except that they have weathered shale at a depth of 40 to 60 inches, or they have a surface layer less than 10 inches thick. The inclusions make up about 20 percent of this map unit, but separate areas are generally less than 5 acres.

This soil has medium potential for row crops and small grains. The erosion hazard is moderate if cultivated crops are grown. Minimum tillage, cover crops, terraces, and returning crop residue to the soil help to reduce runoff, increase water intake, reduce surface crusting, and control erosion.

This soil has high potential for native grass and tame pasture. All grasses can be maintained or improved by preventing fires, controlling grazing, and controlling brush. Fertilizer increases the quality and quantity of tame pasture grasses.

This soil has medium potential for most urban uses. The high shrink-swell potential is the main limitation for dwellings, small commercial buildings, and roads and streets. Wetness and slow permeability are the main limitations for septic tank absorption fields. These limitations can be partly overcome by careful design or by altering the soil.

This Dennis soil is in capability subclass IIIe and in the Loamy Prairie range site.

15—Dennis silt loam, 2 to 5 percent slopes, severely eroded. This is a deep, moderately well drained, very gently sloping to gently sloping soil on uplands on prairies. Slopes are smooth and convex except around gullies. Areas are 5 to 80 acres.

This severely eroded soil is on convex side slopes. Gullies caused by water erosion range 1 to 5 feet in depth and 4 to 10 feet in width and are from 200 to 400 feet apart. Between gullies, in about 50 percent of the area, the surface layer has been removed by erosion. In about 20 percent of the area, the surface layer and the upper part of the subsoil have been mixed by cultivation.

Typically, the surface layer is very dark brown silt loam about 4 inches thick. The subsurface layer to a depth of about 10 inches is dark brown silt loam. The upper part of the subsoil to about 16 inches is dark yellowish brown silty clay loam. The middle part to a depth of about 42 inches is yellowish brown clay. The lower part to a depth of about 62 inches is yellowish brown silty clay.

This soil is low in natural fertility and in organic matter content because of the loss of most of the surface layer. Reaction is medium acid or strongly acid except where the surface layer has been limed. Permeability is slow, and the available water capacity is high. The root zone is deep. A perched water table is between depths of 2 and 3 feet during winter and spring.

Included with this soil in mapping are intermingled areas of Bates, Collinsville, and Eram soils. The included soils make up 20 percent of the map unit, but separate areas are generally less than 6 acres.

This soil has low potential for crops. Severe erosion makes it generally not suitable for cultivation.

This soil has medium potential for native grass and tame pasture. Cultivated areas need to be returned to tame pasture or native grass. Fertilizing, diverting upslope water, and shaping gully banks are needed to help establish tame pasture plants. The quality and quantity of all grasses can be improved by proper grazing, controlling weeds and brush, and preventing fires.

This soil has low potential for most urban uses. Severe erosion is the main limitation for all urban uses. The main limitation for dwellings, small commercial buildings, and roads and streets is the high shrink-swell potential. This limitation can be overcome by proper design and installation.

This Dennis soil is in capability subclass VIe and in the Eroded Prairie range site.

16—Dennis-Verdigris complex, 0 to 8 percent slopes. This is a complex of the deep, moderately well drained Dennis and Verdigris soils that are so intermingled that mapping them separately was not practical. These soils are in drainageways that are 180 to 600 feet in width and 10 to 40 feet below the surrounding prairie uplands. The Dennis soil is in the very gently sloping to sloping positions of the drainageways. The Verdigris soil is on the nearly level flood plain of the drainageways and is subject to occasional flooding. Areas of this unit are 100 to several hundred acres, but areas of each soil is mainly less than 5 acres.

Dennis silt loam makes up about 50 to 70 percent of the map unit. Typically, the surface layer is very dark grayish brown silt loam about 11 inches thick. The subsurface layer to a depth of about 15 inches is dark brown silt loam. The upper part of the subsoil to about 24 inches is yellowish brown silty clay loam. The middle part to about 54 inches is yellowish brown silty clay. The lower part of the subsoil that extends to a depth of about 62 inches is coarsely mottled yellowish brown, red, and gray silty clay that has a few seams of shale and siltstone.

This soil is high in natural fertility and in organic matter content. Permeability is slow, and the available moisture is high. The root zone is deep. A perched water table is between depths of 2 and 3 feet in the winter and spring.

Verdigris silt loam makes up about 20 to 40 percent of the map unit. Typically, the surface layer is very dark grayish brown silt loam about 22 inches thick. The layer below that to a depth of about 44 inches is very dark brown silt loam. The underlying layer to a depth of about 63 inches is brown silty clay loam.

This soil is high in natural fertility and in organic matter content. Reaction is medium acid or slightly acid in the surface layer. Permeability is moderate, and the available water capacity is high.

Included in this complex are intermingled areas of Bates, Choteau, Eram, Taloka, and Woodson soils. The included soils make up about 10 to 25 percent of the complex, but separate areas are generally less than 5 acres.

These soils have low potential for cultivated crops. Flooding is the main limitation.

These soils have high potential for tame pasture and native grass. Bermudagrass and clovers are well suited to the Dennis soil, and fescue or bermudagrass and clovers are suited to the Verdigris soil. Fertilizing helps to increase the quality and quantity forage; the additional plant growth helps control erosion on the sloping areas. All grasses can be maintained or improved by controlling brush, controlling grazing, and preventing fires.

These soils have low potential for most urban uses. The Dennis soil has high shrink-swell potential. Slow permeability limits the use of this soil for septic tank absorption fields. The Verdigris soil is frequently flooded. Some of these limitations can be partly overcome by proper structural design, by altering the soil, or by flood control structures.

These Dennis and Verdigris soils are in capability subclass VIe. The Dennis soil is in the Loamy Prairie range site, and the Verdigris soil is not assigned to a range site.

17—Enders-Hector association, moderately steep. This map unit consists of deep, well drained Enders soils and shallow, well drained Hector soils in a regular and repeating pattern. Slopes are dominantly 12 to 20 percent. The landscape is wooded uplands with deeply entrenched drainageways.

Enders soils are on moderately steep convex side slopes in long, narrow, repeating patterns across the slope. They are deep soils that formed in material weathered from shale. Hector soils are on convex ridges and on side slopes between areas of Enders soils. The shallow Hector soils formed in material weathered from hard sandstone. Areas range from 50 to 2,000 acres, but individual areas of each soil range from 5 to 40 acres.

The Enders fine sandy loam makes up 50 to 70 percent of this association. Typically, the surface layer is about 8 inches thick. The upper 3 inches is very dark grayish brown fine sandy loam and the lower 5 inches is brown loam. The upper part of the subsoil to about 33 inches is yellowish red and red clay. The lower part of the subsoil to a depth of about 44 inches is mottled reddish brown and dark reddish gray clay. The underlying material is dark gray shale.

The Enders soils are medium in natural fertility and low in organic matter content. The surface layer is strongly acid or very strongly acid. Permeability is very slow, and the available moisture capacity is high. The root zone is deep.

The Hector stony fine sandy loam makes up about 20 to 30 percent of this association. Typically, the surface layer is dark grayish brown stony fine sandy loam about 4 inches thick. The subsurface layer to a depth of about 10 inches is brown stony fine sandy loam. The subsoil is yellowish brown fine sandy loam to about 16 inches. The underlying material is hard massive sandstone.

The Hector soils are low in natural fertility and in organic matter content. Reaction of the surface layer is slightly acid to strongly acid. Permeability is moderately rapid, and the available moisture capacity is very low. The root zone is shallow.

Included with these soils in mapping are intermingled areas of Endsaw, Eram, Linker, and Talihina soils. The included soils make up about 10 to 20 percent of this association, but separate areas are generally less than 10 acres.

The potential is low for row crops and small grains. These soils are limited by the shallow depth, slope, stones on the surface, and a severe hazard of erosion.

The potential is low for native grass and tame pasture. Some small areas within the delineation of this association can be seeded to tame pasture. The quality of grass can be improved by controlling woody plants, controlling grazing practices, and preventing fires.

The potential is low for most urban uses. Slope, soil depth, high shrink-swell potential and the stony surface layer of the Hector soil are the main limitations of these soils for sewage lagoons, sanitary landfills, and septic tank absorption fields. Some of these limitations can be overcome by proper structural design or by altering the soil.

These Enders and Hector soils are in capability subclass VIIs. The Enders soil is in Sandy Savannah range site, and the Hector soil is in Shallow Savannah range site.

18—Endsaw-Hector association, steep. This map unit consists of deep, well drained Endsaw soils and shallow, well drained Hector soils in a regular and repeating pattern. Slopes are dominantly 12 to 30 percent. The landscape is wooded uplands with deeply entrenched drainageways (fig. 1).

Endsaw soils are on moderately steep to steep convex side slopes in long, narrow repeating patterns across the slope. They are deep soils that formed in material weathered from shale. Hector soils are on convex ridges and on side slopes between areas of Endsaw soils. They are shallow soils that formed in material weathered from hard sandstone. Areas range from 50 to 1,500 acres, but individual areas of each soil range from 5 to 40 acres.

Endsaw stony fine sandy loam makes up about 60 to 80 percent of the map unit. Typically, the surface layer is dark grayish brown stony fine sandy loam about 4 inches thick. The subsurface layer is brown stony fine sandy loam to about 9 inches. The upper part of the subsoil to a depth of about 32 inches is red clay. The lower part to a depth of about 42 inches is mottled red and gray clay. The underlying material is olive gray and gray soft shale.

This soil is low in natural fertility and in organic matter content. Reaction of the surface layer is strongly acid or medium acid. Permeability is slow, and the available water capacity is high. The root zone is moderately deep.

Hector stony fine sandy loam makes up about 15 to 25 percent of the map unit. Typically, the surface layer is dark brown stony fine sandy loam about 3 inches thick. The subsurface layer is grayish brown stony fine sandy loam to about 9 inches. The subsoil is yellowish brown loam to a depth of about 15 inches. The underlying material is hard sandstone.

This soil is low in natural fertility and in organic matter content. Reaction is slightly acid to strongly acid in the surface layer. Permeability is moderately rapid, and available water capacity is very low. The root zone is shallow.

Included with these soils in mapping are intermingled areas of Enders, Eram, Linker, and Talihina soils. Sandstone outcrop makes up 5 to 10 percent of each map unit. The included soils make up about 10 to 20 percent of the unit, but separate areas are generally less than 20 acres.

The potential is low for row crops and small grains. Large stones, rock outcrops, steep slopes, and shallow depth to rock are limitations of this soil that are very difficult to overcome.

Figure 1.—A landscape of Endsaw-Hector association, steep.

The potential is low for native grass and for tame pasture. The quality and quantity of native grass can be maintained or improved by controlling brush, proper grazing, and preventing fires. A few areas of the moderately steep Endsaw soils can be planted to tame pasture. These areas are generally less than 40 acres.

The potential is low for most urban uses. Steep slopes, large stones, and the shallow depth to rock in the Hector soils are the main limitations for dwellings, small commercial buildings, roads and streets, septic tank absorption fields, sewage lagoons, and trench sanitary landfills.

These Endsaw and Hector soils are in capability subclass VIIs. They are in the Savannah Breaks range site.

19—Eram clay loam, 1 to 3 percent slopes. This is a moderately deep, moderately well drained, very gently sloping soil on side slopes on uplands on prairies. Slopes are smooth and slightly convex. Areas are 8 to 60 acres.

Typically, the surface layer is very dark grayish brown clay loam about 10 inches thick. The upper part of the subsoil is dark grayish brown clay to a depth of about 19 inches. The middle part is grayish brown clay to about 26 inches. The lower part is grayish brown clay to a depth of about 31 inches. The underlying material is soft gray shale.

This soil is medium in natural fertility and in organic matter content. Reaction is slightly acid or medium acid in the surface layer except where it has been limed. Permeability is slow, and the available water capacity is low. This soil has fair tilth, and it can be worked within a narrow range of moisture conditions. Plant roots do not easily penetrate the subsoil. A perched water table is between depths of 2 and 3 feet during winter and spring.

Included with this soil in mapping are intermingled areas of Dennis and Talihina soils. The included soils make up 15 percent of the map unit, but separate areas are generally less than 5 acres.

This soil has low potential for growing crops. The main concerns in management are controlling erosion, improving water intake, and maintaining soil tilth and fertility. Fertilizing increases plant growth. The additional crop residue helps to improve water intake and maintain soil tilth and fertility. All crop residue should be returned to the soil. Terracing, contour farming, and using close-growing crops help control erosion. Minimum tillage is needed.

This soil has high potential for native grass and tame pasture. The main concerns in management include controlling grazing, preventing fires, and controlling erosion. Tame pasture can be fertilized to increase forage production; the additional growth helps control erosion.

This soil has low potential for most urban uses. The shallow soil limits septic tank absorption fields. The high shrink- swell potential is the main limitation for dwellings, small commercial buildings, and roads and streets.

This Eram soil is in capability subclass IIIe and in the Loamy Prairie range site.

20—Eram clay loam, 3 to 5 percent slopes. This is a moderately deep, moderately well drained, gently sloping soil on side slopes on uplands on prairies. Slopes are smooth and convex. Areas are 5 to 60 acres.

Typically, the surface layer is very dark grayish brown clay loam about 10 inches thick. The upper part of the subsoil to a depth of about 18 inches is dark grayish brown clay. The lower part is dark grayish brown clay to about 25 inches. The underlying material is gray slightly weathered, soft clayey shale.

This soil is medium in natural fertility and in organic matter content. Reaction is slightly acid or medium acid in the surface layer except where it has been limed. Permeability is slow, and the available water capacity is low. This soil has fair tilth, and it can be worked within a narrow range of moisture conditions. Plant roots do not easily penetrate the subsoil. A perched water table is between depths of 2 and 3 feet in the winter and spring.

Included with this soil in mapping are areas of Dennis soils on lower slopes and Collinsville and Talihina soils on upper slopes. The included soils make up 15 percent of the map unit, but separate areas are generally less than 5 acres.

This soil has low potential for cultivated crops. The main concerns in management are controlling erosion, improving water intake, and maintaining soil tilth and fertility. Fertilizing increases plant growth. The additional amounts of crop residue helps to improve water intake and to maintain soil tilth and fertility. All crop residue should be returned to the soil. Terracing, contour farming, and using close-growing crops help control erosion. Minimum tillage is needed. Row crops should be avoided to prevent excessive erosion.

This soil has medium potential for native grass and tame pasture. The main concerns in management include controlling grazing, preventing fires, and controlling erosion. Tame pasture needs fertilizer to improve the quality of forage. Native grass or tame pasture protects against erosion.

This soil has low potential for most urban uses. The depth of soil is the main limitation for septic tank absorption fields. The high shrink-swell potential is the main limitation for dwellings, small commercial buildings, and roads and streets.

This Eram soil is in capability subclass IVe and in the Loamy Prairie range site.

21—Eram clay loam, 1 to 5 percent slopes, eroded. This is a moderately deep, moderately well drained, very gently sloping to gently sloping soil on side slopes of uplands on prairies. In about 40 percent of the area, the original surface layer and material from the upper subsoil are mixed by plowing. There are a few crossable gullies about 500 feet apart. Rills are common between the gullies. Slopes are smooth and convex, except in eroded areas. Areas are 20 to 80 acres, but some are 10 acres.

Typically, the surface layer is very dark grayish brown clay loam about 5 inches thick. The upper part of the subsoil is very dark grayish brown clay to about 9 inches. The middle part is dark grayish brown clay to about 18 inches. The lower part to a depth of about 26 inches is olive brown clay. The underlying layer is soft gray shale.

This soil is medium in natural fertility and low in organic matter content. Reaction is slightly acid or medium acid in the surface layer except where it has been limed. Permeability is slow, and the available water capacity is low. This soil can be worked well within a narrow range of moisture conditions because of fair tilth. Plant roots do not easily penetrate the subsoil. A perched water table is between depths of 2 and 3 feet in the winter and spring.

Included with this soil in mapping are areas of Dennis soils on lower slopes and Collinsville and Talihina soils on upper slopes. Included soils make up 15 percent of the map unit, but separate areas are generally less than 8 acres.

This soil has low potential for crops. The main limitation is the hazard of erosion. The main concerns in management are erosion, maintenance of soil tilth, and soil fertility. Minimum tillage, returning crop residue to the soil, terracing, and contour farming help reduce runoff and control erosion. Row crops should not be planted.

This soil has medium potential for native grass and tame pasture. Fertilizing, diverting upslope water, and shaping gully banks are needed to help establish tame pastures. The quality and quantity of grass can be improved or maintained by controlling weeds, preventing fires, and controlling grazing.

This soil has low potential for most urban uses. Shallow soil is the main limitation for septic tank absorption fields. The hazard of erosion and the high shrink-swell potential are the main limitations for dwellings, small commercial buildings, and roads and streets.

This Eram soil is in capability subclass IVe and in the Loamy Prairie range site.

22—Glentosh loamy fine sand, 0 to 3 percent slopes. This is a deep, excessively drained, nearly level to very gently sloping soil on high terraces. Slopes are broad and smooth. Areas are 40 to 150 acres, but some smaller areas are 10 acres.

Typically, the surface layer is dark brown loamy fine sand about 10 inches thick. The next layer is yellowish brown loamy fine sand to a depth of about 26 inches and strong brown fine sand to a depth of about 48 inches. The underlying material is very pale brown fine sand that extends to a depth of about 80 inches.

This soil is low in natural fertility and in organic matter content. Reaction is medium acid or strongly acid in the surface except where it has been limed. Permeability is rapid, and the available water capacity is low. This soil has good tilth and can be worked throughout a wide range of moisture conditions. Plant roots easily penetrate the sandy layers.

Included with this soil in mapping are intermingled areas of Kamie, Karma, and Larton soils. The included soils make up about 10 percent of the map unit. Separate areas are generally less than 5 acres.

This soil has low potential for crops. Peanuts and truck crops are well suited. Management concerns include controlling erosion and maintaining soil fertility. Most crops that produce large amounts of plant residue can be grown continuously if the residue is returned to the soil. Fertilizing increases plant growth; the additional growth provides plant residue to reduce the hazard of soil blowing. Stripcropping and planting winter cover crops following row crops also protect the soil. Minimum tillage is needed.

This soil has medium potential for native grass and tame pasture. A mixture of bermudagrass and clover is most commonly used for tame pasture. This soil is well suited to weeping lovegrass. The main concerns in management are controlling grazing, preventing fires, and controlling brush. Fertilizing tame pasture improves the quality and quantity of grass; the added growth helps control erosion.

This soil has high potential for most urban uses. There are no significant limitations for dwellings, small commercial buildings, and roads and streets. This soil is a poor filter for septic tank absorption fields. Seepage is the main limitation for sewage lagoons, and sanitary landfills.

This Glentosh soil is in capability subclass IVs and in the Deep Sand Savannah range site.

23—Glentosh loamy fine sand, 3 to 8 percent slopes. This is a deep, excessively drained, gently sloping to sloping soil on high terraces. Slopes are smooth and slightly convex. Areas range from 10 to 200 acres, but some are 10 acres.

Typically, the surface layer is dark yellowish brown loamy fine sand about 4 inches thick. The layer below that is light yellowish brown loamy fine sand to a depth of about 26 inches and strong brown loamy fine sand to about 50 inches. The underlying material is very pale brown fine sand that extends to a depth of about 70 inches.

This soil is low in natural fertility and in organic matter content. Reaction is medium acid or strongly acid in the surface layer but ranges to neutral where it has been limed. Permeability is rapid, and the available water capacity is low. This soil has good tilth, and it can be worked throughout a wide range of moisture conditions. Plant roots easily penetrate the sandy layers.

Included with this soil in mapping are intermingled areas of Kamie, Karma, and Larton soils. The included soils make up about 15 percent of the map unit, but separate areas are generally less than 3 acres.

This soil has low potential for most row crops and small grains. The hazard of erosion is severe, which makes it generally not suited to cultivation.

This soil has medium potential for native grass and tame pasture. Fertilizing tame pasture grasses increases forage production; the added growth helps protect the soil from erosion. Controlling grazing, preventing fires, and controlling brush are the main concerns in management.

This soil has high potential for most urban uses. There are no significant limitations for dwellings, small commercial buildings, and roads and streets. Seepage is the main limitation for sanitary landfills and sewage lagoons.

This Glentosh soil is in capability subclass VIs and in the Deep Sand Savannah range site.

24—Kamie loamy fine sand, 1 to 3 percent slopes. This is a deep, well drained, very gently sloping soil on terraces. Slopes are smooth and slightly convex. Areas are 25 to 100 acres, but some are smaller areas of 15 acres.

Typically, the surface layer is dark brown loamy fine sand about 8 inches thick. The subsurface layer to a depth of about 16 inches is yellowish brown loamy fine sand. The upper part of the subsoil is yellowish red sandy clay loam to about 42 inches. The middle part is red clay loam to a depth of about 52 inches. The lower part is yellowish red fine sandy loam that extends to a depth of about 68 inches.

This soil is low in natural fertility and in organic matter content. Reaction is medium acid to neutral in the surface layer except where it has been limed. Permeability is moderate, and the available water holding capacity is medium. The soil has good tilth, and it can be worked throughout a wide range of moisture conditions. Plant roots easily penetrate the subsoil.

Included with this soil in mapping are intermingled areas of Glentosh, Karma, Larton, and Porum soils. The included soils make up about 15 percent of the map unit, but separate areas are generally less than 5 acres.

This soil has medium potential for most crops. Potential for truck crops and peanuts is high. The hazard of erosion is moderate if cultivated crops are grown. Minimum tillage, the use of cover crops, and contour farming help reduce runoff and control erosion. Fertilizing increases plant growth; the additional growth provides crop residue to help control wind erosion.

This soil has medium potential for native grass and high potential for tame pasture. A mixture of bermudagrass and clover is most commonly used for hay and pasture. The main concerns in management are controlling grazing, preventing fires, and controlling erosion. The quality of tame pasture can be improved by fertilizing.

This soil has high potential for most urban uses. There are no significant limitations for dwellings and small commercial buildings. Seepage is the main limitation for sewage lagoons. Permeability is a moderate limitation for the uses of this soil for septic tank absorption fields.

This Kamie soil is in capability subclass IIe and in the Deep Sand Savannah range site.

25—Kamie fine sandy loam, 1 to 3 percent slopes. This is a deep, well drained, very gently sloping soil on terraces. Slopes are smooth and slightly convex. Areas are 25 to 200 acres, but some smaller areas are 15 acres.

Typically, the surface layer is dark brown fine sandy loam about 8 inches thick. The subsurface layer is brown fine sandy loam to a depth of about 18 inches. The upper part of the subsoil to a depth of about 61 inches is yellowish red and reddish brown sandy clay loam. The lower part of the subsoil is strong brown fine sandy loam to a depth of about 78 inches.

This soil is low in natural fertility and in organic matter content. Reaction is medium acid to neutral in the surface layer except where it has been limed. Permeability is moderate, and the available water capacity is high. The soil has good tilth, and it can be worked throughout a wide range of moisture conditions. Plant roots easily penetrate the subsoil.

Included with this soil in mapping are intermingled areas of Karma, Larton, and Porum soils. The included soils make up about 15 percent of this unit, but separate areas are generally less than 5 acres.

This soil has medium potential for most crops. The hazard of water erosion is severe. If crops are clean tilled, minimum tillage, returning crop residue to the soil, fertilizing, and contour farming and terracing help reduce runoff and help control erosion. If row crops are grown, the use of winter cover crops helps protect against soil blowing and water erosion.

This soil has medium potential for native grass and high potential for tame pasture. A mixture of bermudagrass and clover is commonly used for hay and pasture. Fertilizing improves the quality and quantity of grass; the additional growth helps prevent erosion. Controlling grazing, controlling brush and weeds, preventing fires, and controlling erosion are the main concerns in management.

This soil has high potential for most urban uses. There are no significant limitations for dwellings and small commercial buildings. Seepage is the main limitation for sewage lagoons. Permeability is a moderate limitation for the use of this soil for septic tank absorption fields.

This Kamie soil is in capability subclass IIe and in the Sandy Savannah range site.

26—Kanima shaly silty clay loam, 3 to 30 percent slopes. This deep, well drained soil is on uplands, mainly in the northeast part of the county. This gently sloping to steep soil formed in spoil banks that remain after strip mining operations. The spoil banks are in a sequence of long and narrow ridges with convex crests of 10 to 30 feet in width and side slopes of 20 of 50 feet in length. Areas are long and narrow and range from 200 to 1,000 feet in width and up to 3 miles in length. Areas range from 20 to 500 acres.

Typically, the surface layer is very dark grayish brown shaly silty clay loam about 6 inches thick. The underlying material is olive gray very shaly silty clay loam that extends to a depth of about 62 inches.

This soil is medium in natural fertility and low in organic matter content. Reaction of the surface layer is medium acid to mildly alkaline. Permeability is moderate, and the available water capacity is low. Plant roots are restricted somewhat by the high amount of shale fragments.

Included in mapping and making up about 10 percent are barren areas of shale that have little or no soil material. Also included are a few small areas of Bates, Choteau, Dennis, Eram, Talihina, Taloka, and Woodson soils. Pits make up about 8 percent of the map unit and commonly are 50 to 400 feet in width, 500 to 2,000 feet in length, and 15 to 75 feet in depth. Most pits contain water that is usually within 10 to 20 feet of the surface.

Wildlife, sanitary landfills, and environmental plantings are uses for Kanima soil. The pits are sometimes used for fish farming or as a source of water for supplemental irrigation. Vegetation on older spoil banks include winged elm, sumac, black locust, and blackjack oak trees with a sparse understory of grasses and weeds. Some areas have been planted to kudzu.

This soil has low potential for cultivated crops, tame pasture, and urban uses. Potential is low because of low available water capacity and the difficulty on the steep slopes of preparing a seedbed for tame pasture plants.

This Kanima soil is in capability subclass VIIs. It is not assigned to a range site.

27—Karma loamy fine sand, 3 to 5 percent slopes. This is a deep, well drained, gently sloping soil on terraces. Slopes are smooth and slightly convex. Areas are 8 to 80 acres.

Typically, the surface layer is dark brown loamy fine sand about 6 inches thick. The subsurface layer to a depth of about 16 inches is brown loamy fine sand. The upper part of the subsoil to about 38 inches is reddish brown sandy clay loam. The middle part of the subsoil to about 52 inches is red sandy clay loam. The lower part to a depth of about 68 inches is red fine sandy loam.

This soil is low in natural fertility and in organic matter content. Reaction is medium acid to neutral in the surface layer except where it has been limed. Permeability is moderate, and the available water capacity is high. This soil has good tilth and can be worked through a wide range of moisture conditions. Plant roots easily penetrate the subsoil.

Included with this soil in mapping are intermingled areas of Glentosh, Kamie, Larton, and Porum soils. The included soils make up about 15 percent, but separate areas are generally less than 8 acres.

This soil has medium potential for growing most crops. It has high potential for truck crops and peanuts. However, if cultivated crops are grown, the hazard of erosion is severe. Management is needed to control erosion and improve fertility. Fertilizing to obtain additional plant growth and the resulting large amounts of crop residue is desirable. Crop residue helps reduce soil blowing and water erosion. Contour farming, stripcropping, cover cropping, and managing crop residue are necessary to control erosion and improve soil fertility. Row crops can be planted if the soil is fertilized, residue is managed, and a cover crop is used. Excessive tillage needs to be avoided. Tame pasture, range, or forest provides the best protection against erosion.

This soil has medium potential for native grass and high potential for tame pasture. A mixture of bermudagrass and clover is commonly used for hay and pasture (fig. 2). The main concerns in management include controlling grazing, controlling brush and weeds, preventing fires, and controlling erosion. Fertilizing improves quality and quantity of grass, and the additional plant growth helps prevent erosion.

This soil has high potential for most urban uses. There are no significant limitations for dwellings and area sanitary landfills. Seepage is the main limitation for sewage lagoons and trench sanitary landfills. Low strength limits the use of this soil for roads and streets.

This Karma soil is in capability subclass IVe and in the Deep Sand Savannah range site.

28—Karma loamy fine sand, 2 to 5 percent slopes, eroded. This is a deep, well drained, very gently sloping to gently sloping soil on terraces. In about 35 percent of the map unit, the surface layer and material from the upper part of the subsoil have been mixed by plowing. There are a few crossable gullies about 500 feet apart. Rills are common between these gullies. Slopes are smooth and convex. Areas are 10 to 100 acres, but some areas are 5 acres.

Typically, the surface layer is dark brown loamy fine sand about 6 inches thick. The subsurface layer to a depth of about 14 inches is brown loamy fine sand. The upper part of the subsoil to about 36 inches is reddish brown sandy clay loam. The middle part of the subsoil to about 50 inches is reddish brown sandy clay loam that has less clay than the upper part. The lower part of the subsoil to about 72 inches is red fine sandy loam.

This soil is low in natural fertility and in organic matter content. Reaction is medium acid to neutral in the surface layer except where it has been limed. Permeability is moderate, and the available water capacity is high. This soil has good tilth, and it can be worked throughout a wide range of moisture conditions. Plant roots easily penetrate the subsoil.

Included with this soil in mapping are intermingled areas of Glentosh, Kamie, Larton, and Porum soils. The included soils make up about 15 percent of the map unit, but separate areas are generally less than 8 acres.

This soil has low potential for most crops. If cultivated crops are grown, the hazard of erosion is severe. Fertilizing to obtain added plant growth and the resulting large amounts of crop residue is desirable. Crop residue helps reduce soil blowing and water erosion. Contour farming, stripcropping, cover cropping, and managing crop residue are necessary to control erosion and improve soil fertility. Row crops can be grown if the soil is fertilized, crop residue is managed, and a cover crop is used. Excessive tillage needs to be avoided. Tame pasture, range, or forest provides the best protection against erosion.

This soil has medium potential for native grass and high potential for tame pasture. A combination of bermudagrass and clover is commonly used for hay and pasture. Fertilizing improves the quality and quantity of grass; the additional growth helps prevent erosion. The main concerns in management include controlling grazing, controlling brush and weeds, preventing fires, and controlling erosion.

This soil has high potential for most urban uses. There

Figure 2.—Improved bermudagrass pasture on Karma loamy fine sand, 3 to 5 percent slopes.

are no significant limitations for dwellings and area sanitary landfills. Seepage is the main limitation for trench sanitary landfills and sewage lagoons. Low strength limits the use of this soil for roads and streets.

This Karma soil is in capability subclass IVe and in the Deep Sand Savannah range site.

29—Karma loamy fine sand, 5 to 8 percent slopes. This is a deep, well drained, sloping soil on terraces. Slopes are smooth and slightly convex. Areas are 15 to 60 acres.

Typically, the surface layer is dark brown loamy fine sand about 8 inches thick. The subsurface layer to a depth of about 14 inches is brown loamy fine sand. The upper part of the subsoil to about 36 inches is reddish brown sandy clay loam. The middle part of the subsoil to a depth of about 50 inches is red sandy clay loam. The lower part of the subsoil is red fine sandy loam that extends to a depth of about 64 inches.

This soil is low in natural fertility and in organic matter content. Reaction is medium acid to neutral in the surface layer except where it has been limed. Permeability is moderate, and the available capacity is high. This soil has good tilth, and it can be worked throughout a wide range of moisture conditions. Plant roots easily penetrate the subsoil.

Included with this soil in mapping are intermingled areas of Glentosh, Kamie, Larton, and Porum soils. The included soils make up about 15 percent of the unit, but separate areas are generally less than 8 acres.

This soil has low potential for most crops. The hazard of erosion is severe if cultivated. Fertilizing to obtain added plant growth and the resulting large amounts of crop residue is desirable. Crop residue helps reduce soil blowing and water erosion. Contour farming, stripcropping, cover cropping, and managing crop residue are necessary to control erosion and improve soil fertility. Row crops can be grown if the soil is fertilized, residue is managed, and a cover crop is used. Excessive tillage needs to be avoided. Tame pasture, range, or forest provides the best protection against erosion.

This soil has medium potential for native grass and high potential for tame pasture. A mixture of bermudagrass and clover is commonly used for hay and pasture. Fertilizing improves the quality and quantity of grass; the additional growth helps prevent erosion. The main concerns in management include controlling grazing, controlling brush and weeds, preventing fires, and controlling erosion.

This soil has high potential for most urban uses. There are no significant limitations for dwellings and area sanitary landfills. Seepage is the main limitation for sewage lagoons and trench sanitary landfills. Low strength limits the use of this soil for roads and streets.

This Karma soil is in capability subclass IVe and in the Deep Sand Savannah range site.

30—Karma loamy fine sand, 3 to 8 percent slopes, gullied. This is a deep, well drained, gently sloping to sloping, severely eroded soil on terraces. Slopes are smooth and slightly convex except around gullies. Areas are 20 to 80 acres, but some areas are 5 acres.

Gullies caused by water erosion range from 2 to 10 feet in depth and 10 to 20 feet in width and are 200 to 400 feet apart. Between gullies, the surface layer has been removed by erosion in 50 percent of the area. In 20 percent of the area, the surface layer and the upper part of the subsoil have been mixed by past cultivation. In this area, the surface layer is fine sandy loam, loamy fine sand, and sandy clay loam.

Typically, the surface layer is brown loamy fine sand about 3 inches thick. The subsurface layer is pale brown loamy fine sand to a depth of about 6 inches. The upper part of the subsoil is reddish brown sandy clay loam to a depth of about 18 inches. The middle part is red sandy clay loam to about 42 inches. The lower part of the subsoil is red fine sandy loam that extends to a depth of about 62 inches.

This soil is low in natural fertility and in organic matter content. Reaction is medium acid to neutral in the surface layer except where it has been limed. Permeability is moderate, and the available water capacity is high. The root zone is deep. Surface runoff is somewhat excessive.

Included with this soil in mapping are intermingled areas of Glentosh, Karma, Larton, and Porum soils. The included soils make up about 15 percent, but separate areas are generally less than 8 acres.

This soil has low potential for cultivated crops. In addition to the deep gullies, the main limitation is the very severe hazard of erosion.

This soil has medium potential for native grass and tame pasture. The main concerns in management are preventing further erosion and maintaining soil tilth and fertility. Fertilizing, diverting upslope water, and reshaping gully banks are needed for the successful establishment of tame pasture. The quality and quantity of all grasses can be improved by proper grazing, controlling weeds and brush, and preventing fires.

This soil has high potential for most urban uses. In some areas, the gullies should be shaped and filled. This soil has no significant limitations for dwellings and area sanitary landfills. Low strength limits the use of this soil for roads and streets, and seepage limits it for sewage lagoons and trench sanitary landfills.

This Karma soil is in capability subclass VIe and in the Eroded Sandy Savannah range site.

31—Karma fine sandy loam, 3 to 5 percent slopes. This is a deep, well drained, gently sloping soil on terraces. Slopes are smooth and slightly convex. Areas are 20 to 80 acres, but smaller areas are about 10 acres.

Typically, the surface layer is dark brown fine sandy loam about 7 inches thick. The subsurface layer to a depth of about 16 inches is brown fine sandy loam. The upper part of the subsoil is red sandy clay loam to about 50 inches. The lower part of the subsoil to a depth of about 64 inches is red fine sandy loam.

This soil is low in natural fertility and in organic matter content. Reaction is medium acid to neutral in the surface layer except where it has been limed. Permeability is moderate, and the available water capacity is high. Plant roots easily penetrate the subsoil. The soil has good tilth and can be worked throughout a wide range of moisture conditions.

Included with this soil in mapping are intermingled areas of Karma, Larton, and Porum soils. The included soils make up about 10 percent of this map unit, but separate areas are generally less than 5 acres.

This soil has medium potential for most crops. If clean tilled crops are grown, water erosion is a hazard. The main concerns in management are maintaining tilth and fertility and protecting the soil from erosion. Terraces, grassed waterways, and contour farming help control erosion. Using small grains in the cropping system and adding fertilizer for maximum plant growth helps provide residue for maintaining tilth and controlling erosion.

This soil has medium potential for native grass and high potential for tame pasture. A mixture of bermudagrass and clover is commonly used for hay and pasture. The main concerns in management include controlling grazing, controlling brush and weeds, preventing fires, and controlling erosion. Fertilizing improves quality and quantity of pasture, and the additional growth helps control erosion.

This soil has high potential for most urban uses. There are no significant limitations for dwellings and area sanitary landfills. Seepage is the main limitation for sewage lagoons and area sanitary landfills. Low strength limits the use of this soil for roads or streets. Permeability is a moderate limitation for septic tank absorption fields. This limitation can be overcome by design or altering the soil.

This Karma soil is in capability subclass IIIe and in the Sandy Savannah range site.

32—Karma fine sandy loam, 2 to 5 percent slopes, eroded. This is a deep, well drained, very gently sloping to gently sloping soil on terraces. In about 40 percent of the area, the surface layer and material from the upper part of the subsoil has been mixed by plowing. There are a few crossable gullies about 500 feet apart. Rill erosion is common between the gullies. Slopes are smooth and convex. Areas are 20 to 120 acres, but some areas are 5 acres.

Typically, the surface layer is dark brown fine sandy loam about 6 inches thick. The subsurface layer is brown fine sandy loam to about 16 inches. The upper part of the subsoil to a depth of about 26 inches is reddish brown sandy clay loam. The middle part of the subsoil is yellowish red sandy clay loam to about 50 inches. The lower part to a depth of about 60 inches is yellowish red fine sandy loam.

This soil is low in natural fertility and in organic matter content. Reaction is medium acid to neutral in the surface layer except where it has been limed. Permeability is moderate, and the available water capacity is high. Plant roots easily penetrate the subsoil.

Included with this soil in mapping are intermingled areas of Kamie, Larton, and Porum soils. The included soils make up about 15 percent of the map unit, but separate areas are generally less than 8 acres.

This soil has low potential for most crops. If cultivated crops are grown, water erosion is a severe hazard. The main concerns in management are maintaining tilth and fertility and protecting the soil from erosion. Terraces, waterways, and contour farming are necessary to control further erosion. Using a cropping system of small grains and adding fertilizer for maximum plant growth helps provide residue for maintaining tilth and controlling erosion. In a few areas, gullies need to be shaped and put into permanent vegetation.

This soil has medium potential for native grass and high potential for tame pasture. A mixture of bermudagrass and clover is commonly used for hay and pasture. Fertilizing improves the quantity and quality of forage, and the additional growth helps prevent further erosion. The main concerns in management to improve or maintain the pasture are controlling grazing, eliminating weeds and brush, preventing fires, and controlling erosion.

This soil has high potential for most urban uses. There are no significant limitations for dwellings and area sanitary landfills. Low strength limits the use of this soil, for streets and roads. Trench sanitary landfills and sewage lagoons are limited for use by soil seepage.

This Karma soil is in capability subclass IIIe and in the Sandy Savannah range site.

33—Karma fine sandy loam, 5 to 8 percent slopes. This is a deep, well drained, sloping soil on terraces. Slopes are smooth and convex. Areas are 15 to 60 acres, but some smaller areas are 8 acres.

Typically, the surface layer is dark grayish brown fine sandy loam about 6 inches thick. The subsurface layer to a depth of about 20 inches is brown fine sandy loam. The upper part of the subsoil to a depth of about 38 inches is red sandy clay loam. The lower part of the subsoil is red fine sandy loam that extends to a depth of about 62 inches.

This soil is low in natural fertility and in organic matter content. Reaction is medium acid to neutral in the surface layer except where it has been limed. Permeability is moderate, and the available water capacity is high. This soil has good tilth and can be worked throughout a wide range of moisture conditions. Plant roots easily penetrate the subsoil.

Included with this soil in mapping are intermingled areas of Karma, Larton, and Porum soils. The included soils make up 15 percent, but separate areas are generally less than 5 acres.

This soil has low potential for most crops. If cultivated crops are grown, water erosion is a severe hazard. Minimum tillage, returning crop residue to the soil, and contour farming and terraces help reduce runoff and help control erosion. Row crops need to be avoided.

This soil has medium potential for native grass and high potential for tame pasture. A mixture of bermudagrass and clover is commonly used for hay and pasture. Fertilizing improves the quality and quantity of forage; and the added growth helps prevent erosion. Controlling grazing, controlling brush and weeds, preventing fires, and controlling erosion are the main concerns in management.

This soil has high potential for most urban uses. Slope is a limitation factor for small commercial buildings. There are no significant limitations for dwellings and area sanitary landfill. Low strength limits the use of this soil for roads and streets. Seepage is a limitation for trench sanitary landfills and sewage lagoons. Permeability is a moderate limitation for use of this soil for septic tank absorption fields.

This Karma soil is in capability subclass IVe and in the Sandy Savannah range site.

34—Karma fine sandy loam, 3 to 8 percent slopes, gullied. This is a deep, well drained, gently sloping to sloping, severely eroded soil on terraces. Slopes are smooth and slightly convex except near the gullies. Areas are 20 to 120 acres, but some small areas are 5 acres.

Gullies caused by water erosion range from 2 to 20 feet in depth and 10 to 20 feet in width and are 200 to 400 feet apart. Between gullies, in 50 percent of the area, the surface layer has been removed by erosion. In 20 percent of the area, the surface layer and the upper part of the subsoil have been mixed by cultivation. In this area, the surface layer is fine sandy loam, loamy fine sand, or sandy clay loam.

Typically, the surface layer is dark brown fine sandy loam about 8 inches thick. The subsurface layer to a depth of about 20 inches is yellowish brown fine sandy loam. The upper part of the subsoil is red sandy clay loam to about 56 inches. The lower part to a depth of about 64 inches is yellowish red fine sandy loam.

This soil is low in natural fertility and in organic matter content. Reaction is medium acid to neutral in the surface layer except where it has been limed. Permeability is moderate, and the available water capacity is high. The soil has good tilth and can be worked throughout a wide range of moisture conditions.

Included with this soil in mapping are intermingled areas of Kamie, Larton, Porum, and Stigler soils. The included soils make up about 15 percent of the map unit, but separate areas are generally less than 5 acres.

This soil has low potential for cultivated crops. In addition to the deep gullies, the main limitation is a severe erosion hazard.

This soil has medium potential for native grass and tame pasture. The main concerns in management are prevention of further erosion and maintenance of soil tilth and fertility. Fertilizing, diverting upslope water, and reshaping gully banks are needed for establishing tame pasture grass. All grasses can be improved by proper grazing, controlling weeds and brush, and preventing fires.

This map unit has high potential for most urban uses. Gullies should be reshaped and filled in some areas. The soil has no significant limitation for dwellings and area sanitary landfills. Low strength limits the use of this soil for roads and streets. Seepage is a limitation for sewage lagoons and trench sanitary landfills. Most limitations can be overcome by proper design or by altering the soil.

This Karma soil is in capability subclass VIe and in the Eroded Sandy Savannah range site.

35—Kiomatia loamy fine sand, frequently flooded. This is a deep, well drained, nearly level soil on flood plains in wooded areas mainly along the North and South Canadian Rivers. It is frequently flooded. Slopes are slightly undulating and range from 0 to 1 percent. Areas are 20 to 200 acres.

Typically, the surface layer is brown loamy fine sand about 8 inches thick. The layer below that to a depth of about 20 inches is strong brown fine sandy loam. The layer below that to about 32 inches is reddish brown loamy fine sand that has many fine strata of very fine sandy loam and loam. The underlying material to a depth of about 62 inches is light reddish brown fine sand that has many fine strata of fine sandy loam and loam.

This soil is low in natural fertility and in organic matter content. Reaction is medium acid to mildly alkaline in the surface layer. Permeability is rapid, and the available water capacity is low. However, plant roots absorb some water from an apparent water table that fluctuates between depths of 3 and 5 feet during winter, spring, and summer.

Included with this soil in mapping are intermingled areas of Madill soils and similar soils to the Kiomatia soil except that have grayer colors. The included soils make up about 10 percent of the map unit, but separate areas are less than 5 acres.

This soil has low potential for cultivated crops. Frequent flooding is the main limitation.

This soil has medium potential for tame pasture. A mixture of bermudagrass and clover is commonly used for tame pasture. Fertilizing tame pasture grass increases forage production and improves the quantity of grass; the additional plant growth protects the soil from erosion. The quality of grass can be improved by controlling grazing, proper stocking, and preventing fires.

This soil has low potential for most urban uses because it is frequently flooded. The hazard of flooding is severe. Flooding can be reduced but not completely eliminated by upstream flood control structures.

This Kiomatia soil is in capability subclass Vw. It is not assigned to a range site.

36—Larton loamy fine sand, 1 to 3 percent slopes. This is a deep, well drained, very gently sloping soil on terraces, mainly in the central part of the county. Slopes are smooth and slightly convex. Areas are 20 to 100 acres, but some areas are about 10 acres.

Typically, the surface layer is dark yellowish brown loamy fine sand about 9 inches thick. The subsurface layer is yellowish brown loamy fine sand to a depth of about 25 inches. The upper part of the subsoil to a depth of about 36 inches is red sandy clay loam. The middle part of the subsoil to about 54 inches is yellowish red fine sandy loam. The lower part of the subsoil to a depth of about 78 inches is reddish yellow fine sandy loam that has few streaks and pockets of clean sand grains.

This soil is low in natural fertility and in organic matter content. Reaction is slightly acid or medium acid in the surface layer except where it has been limed. Permeability is moderate, and the available water capacity is medium. The soil has good tilth and can be worked throughout a wide range of moisture conditions. Plant roots easily penetrate the subsoil.

Included with this soil in mapping are intermingled areas of Kamie and Porum soils. The included soils make up about 10 percent of this map unit, but separate areas are generally less than 5 acres.

This soil has medium potential for crops. All crops common in the county can be grown on this soil. It is well suited to peanuts. The erosion hazard is moderate if cultivated crops are grown. The main concerns in management are controlling erosion and maintaining fertility. Most crops that produce a large amount of plant residue can be grown continuously if the residue is returned to the soil. Fertilizer increases plant growth that provides more residue to reduce the hazard of soil blowing. Stripcropping and planting winter cover crops furnish additional protection to the soil in areas that are in row crops. Crops that provide a low amount of plant residue should not be in the cropping system for more than 3 years in succession.

This soil has medium potential for native grass and tame pasture. A mixture of bermudagrass and clover is commonly used for hay and tame pasture. Fertilizing increases the production of grass and improves the quality of grass; the additional growth protects the soil from erosion. The main concerns in management are controlling grazing, preventing fires, and controlling erosion.

This soil has high potential for all urban uses. Seepage, however, is a main limitation for sewage lagoons and area sanitary landfills.

This Larton soil is in capability subclass IIIe and in the Deep Sand Savannah range site.

37—Linker fine sandy loam, 1 to 3 percent slopes. This is a moderately deep, well drained, very gently sloping soil on uplands. Slopes are smooth and slightly convex. Areas are 10 to 100 acres, but some smaller areas are about 5 acres.

Typically, the surface layer is dark brown fine sandy loam about 8 inches thick. The upper part of the subsoil to a depth of about 16 inches is strong brown fine sandy loam. The middle part of the subsoil to about 30 inches is yellowish red sandy clay loam. The lower part of the subsoil to about 38 inches is yellowish red sandy clay loam containing a few sandstone fragments. The underlying material is sandstone.

This soil is low in natural fertility and in organic matter content. The surface layer is very strongly acid or strongly acid. Permeability is moderate, and the available water capacity is medium. The soil has good tilth and can be worked throughout a wide range of moisture conditions.

Included with this soil in mapping are Hector soils on ridges and intermingled areas of Enders soils and soils similar to Linker soil except that they have a yellowish brown subsoil or have a slightly higher base saturation. The included soils make up 15 percent of the map unit, but separate areas are generally less than 5 acres.

This soil has medium potential for row crops and small grains. Good tilth can be maintained by fertilizing crops and returning crop residue to the soil. Minimum tillage, the use of cover crops, terracing, and contour farming help reduce runoff and help control erosion. If row crops are grown, cover crops are needed during winter and spring.

This soil has medium potential for native grass and tame pasture. The quality and quantity of grass can be improved by fertilizing, controlling weeds and brush, and proper stocking.

This soil has medium potential for most urban uses. The main limitation is depth of soil for sanitary facilities, dwellings and small commercial buildings, and roads and streets.

This Linker soil is in capability subclass IIe and in the Sandy Savannah range site.

38—Linker fine sandy loam, 3 to 5 percent slopes. This is a moderately deep, well drained, gently sloping soil on uplands. Slopes are smooth and slightly convex. Areas are 10 to 100 acres, but some smaller areas are about 5 acres.

Typically, the surface layer is dark brown fine sandy loam about 7 inches thick. The upper part of the subsoil is yellowish red fine sandy loam to a depth of about 14 inches. The lower part of the subsoil to a depth of about 36 inches is red sandy clay loam. The underlying material is hard sandstone bedrock.

This soil is low in natural fertility and in organic matter content. The surface layer is very strongly acid or strongly acid. Permeability is moderate, and the available water capacity is medium. The soil has good tilth and can be worked throughout a wide range of moisture conditions.

Included with this soil in mapping are Hector soils on ridges and intermingled areas of Enders soils and soils similar to the Linker soil except that they have yellowish brown subsoil or have a slightly higher base saturation. The included soils make up about 15 percent of this map unit, but separate areas are generally less than 5 acres.

This soil has medium potential for row crops and small grains. Good tilth can be maintained by fertilizing crops and returning crop residue to the soil. Minimum tillage, use of cover crops, terracing, and contour farming help reduce runoff and control erosion.

This soil has medium potential for native grasses and tame pasture. The quality and quantity of grasses can be improved by fertilizing, controlling weeds and brush, proper stocking, and preventing fires.

This soil has medium potential for most urban uses. The main limitation is depth of soil for dwellings, small commercial buildings, roads and streets, and all sanitary facilities.

This Linker soil is in capability subclass IIIe and in the Sandy Savannah range site.

39—Linker fine sandy loam, 2 to 5 percent slopes, severely eroded. This is a moderately deep, well drained, very gently sloping to gently sloping, severely eroded soil on uplands. Slopes are smooth and slightly convex except near the gullies. Areas are 10 to 80 acres.

Gullies caused by water erosion range from 2 to 4 feet in depth and 4 to 8 feet in width and are 200 to 400 feet apart. Between the gullies, in about 50 percent of the area, the surface layer has been removed. In 20 percent of the area, the surface layer and the upper part of the subsoil have been mixed by cultivation. In this area, the surface layer is fine sandy loam or sandy clay loam.

Typically, the surface layer is dark brown fine sandy loam about 6 inches thick. The upper part of the subsoil to a depth of about 14 inches is yellowish red sandy clay loam. The middle part of the subsoil to about 30 inches is yellowish red clay loam. The lower part of the subsoil to a depth of about 36 inches is yellowish red sandy clay loam that has a few fragments of sandstone. The underlying material is hard sandstone bedrock.

This soil is low in natural fertility and in organic matter content. Reaction is very strongly acid or strongly acid in the surface layer except where it has been limed. Permeability is moderate, and the available water capacity is medium. This soil has a moderately deep root zone.

Included with this soil in mapping are Hector soils on ridges and intermingled areas of Enders soils and soils similar to the Linker soil except that they have a yellowish brown subsoil or have a slightly higher base saturation. The included soils make up about 20 percent of this map unit, but separate areas are generally less than 5 acres.

This soil has low potential for cultivated crops. The severe erosion limits its use for native grass or tame pasture.

This soil has a low potential for native grass and tame pasture. Fertilizing, diverting upslope water, and reshaping gully banks are needed to establish tame pasture plants. The quality and quantity of all grasses can be improved by proper grazing, controlling weeds and brush, and preventing fires.

This soil has medium potential for most urban uses. Slope and erosion are significant limitations. Gullies should be reshaped and filled in some areas. Moderate soil depth is the main limitation for sanitary facilities, dwellings, small commercial buildings, and roads and streets. Most of these limitations can be overcome with difficulty by proper structural design or altering the soil.

This Linker soil is in capability subclass VIe and in the Eroded Sandy Savannah range site.

40—Linker-Hector complex, 2 to 5 percent slopes. This map unit consists of the moderately deep well drained Linker soils and the shallow well drained Hector soils on uplands in forests. These very gently sloping to gently sloping soils formed in material weathered from sandstone on ridge crests and side slopes. Slopes are smooth and slightly convex. These soils are so intermingled that mapping them separately was not practical. Areas are large, ranging up to several hundred acres. Individual areas of each soil make up 5 to 10 acres.

The Linker soil makes up about 50 percent of the map unit. Typically, the surface layer is dark grayish brown fine sandy loam about 6 inches thick. The upper part of the subsoil to about 12 inches is strong brown sandy clay loam. The middle part of the subsoil to a depth of about 32 inches is yellowish red sandy clay loam that has a few small fragments of sandstone. The lower part of the subsoil to about 39 inches is yellowish red gravelly fine sandy loam that has many fragments of sandstone. The underlying material is hard sandstone.

The Linker soil is low in natural fertility and in organic matter content. Reaction of the surface is very strongly acid or strongly acid. Permeability is moderate, and the available water capacity is medium.

The Hector soil makes up 42 percent of the map unit. Typically, the surface layer is dark brown fine sandy loam about 5 inches thick. The subsurface layer to a depth of about 12 inches is dark yellowish brown fine sandy loam. The subsoil to about 16 inches is yellowish brown fine sandy loam. It rests abruptly on hard, massive sandstone at a depth of about 16 inches.

The Hector soil is low in natural fertility and organic matter content. The surface layer is strongly acid to slightly acid. Permeability is moderate, and the available water capacity is low.

Included in mapping are intermingled areas of Enders and Endsaw soils. The included areas make up about 8 percent of the map unit, but separate areas are not more than 5 acres.

These soils have medium potential for native grass and tame pasture. A mixture of bermudagrass or weeping lovegrass and clover is commonly used for pasture or hay. Controlling brush, proper grazing, and preventing fires help improve the quantity and quality of all grasses. Fertilizing tame pasture plants increases forage production; the additional plant growth helps control erosion.

These soils have low potential for most urban uses. Soil depth is the main limitation for sanitary facilities and for building sites. This limitation can be overcome with great difficulty by proper structural design or by altering the soil.

These Linker and Hector soils are in capability subclass VIe. The Linker soil is in the Sandy Savannah range site, and the Hector soil is in the Shallow Savannah range site.

41—Madill fine sandy loam, occasionally flooded. This is a deep, well drained, nearly level soil on flood plains. This soil is subject to occasional flooding. Slopes are smooth and broad and 0 to 1 percent. Areas are 20 to 80 acres, but some smaller areas are 8 acres.

Typically, the surface layer is fine sandy loam about 20 inches thick. The upper 9 inches is dark brown and the lower 11 inches is dark grayish brown. The layer below that is brown fine sandy loam to about 42 inches. The underlying material is brown loamy fine sand that extends to a depth of about 62 inches.

This soil is high in natural fertility and medium in organic matter content. Reaction is medium acid to neutral in the surface layer. Permeability is moderately rapid, and the available water capacity is medium. The soil has good tilth and can be worked throughout a wide range of moisture conditions. Plant roots easily penetrate the subsoil.

Included with this soil in mapping are intermingled areas of Convent Variant, Kiomatia, and Verdigris soils. Also included are soils that are similar to the Madill soil but they have an apparent water table at a depth of 30 inches in areas near Eufaula Lake. The included soils make up about 15 percent of the map unit, but separate areas are generally less than 5 acres.

This soil has high potential for row crops and small grains (fig. 3). The main concerns in management are controlling occasional flooding and maintaining tilth.

Close-growing crops are needed late in fall, in winter, and in spring to prevent erosion during flooding. Planting in spring needs to be delayed until after the period of common flooding. Most crops that produce a large amount of residue can be grown continuously. If fertilizer is added, the crop residue from additional growth helps protect the soil. Maintaining the organic matter content of this soil improves tilth and intake of water. Minimum tillage is needed.

Potential is high for tame pasture. A mixture of bermudagrass and clover is commonly used for tame pasture. Controlling brush, proper grazing, fertilizing, and preventing fires help improve the quality and quantity of grass.

Potential is low for most urban uses because this soil is on the flood plain. Flooding is the main limitation for sanitary facilities and building sites. Flooding can be controlled but not completely eliminated by upstream flood control structures. The hazard of flooding is severe.

This Madill soil is in capability subclass IIw. It is not assigned to a range site.

42—Madill fine sandy loam, frequently flooded. This is a deep, well drained, nearly level soil on flood plains in wooded areas. This soil is subject to frequent flooding. It has broad smooth slopes that range from 0 to 1 percent. Areas are 20 to 80 acres, but some areas are 10 acres.

Typically, the surface layer is dark brown fine sandy loam about 8 inches thick. The next layer is brown fine sandy loam to a depth of 50 inches. The underlying material is yellowish red fine sandy loam that extends to a depth of about 60 inches.

This soil is high in natural fertility and medium in organic matter content. Reaction is medium acid to neutral in the surface layer. Permeability is moderately rapid, and the available water capacity is medium. Plant roots easily penetrate the subsoil.

Included with this soil in mapping are intermingled areas of Convent Variant and Verdigris soils. Also included are soils that are similar to the Madill soil except that they have more clay and silt throughout. The included soils make up about 25 percent of the map unit, but separate areas are generally less than 5 acres.

This soil has low potential for small grains and row crops. Flooding is the main hazard.

Potential is high for tame pasture. A combination of bermudagrass or tall fescue and clover is commonly used for tame pasture. The main concerns in management are flooding and maintenance of soil structure. Growth of tame pasture plants can be increased by adding fertilizer and using proper grazing. A good grass mulch helps to maintain soil structure, improve water intake, and protect the soil from erosion during flooding.

This soil has low potential for all urban uses. The main limitation is flooding. Flooding can be controlled but not completely eliminated by upstream flood control structures. The flood hazard is severe.

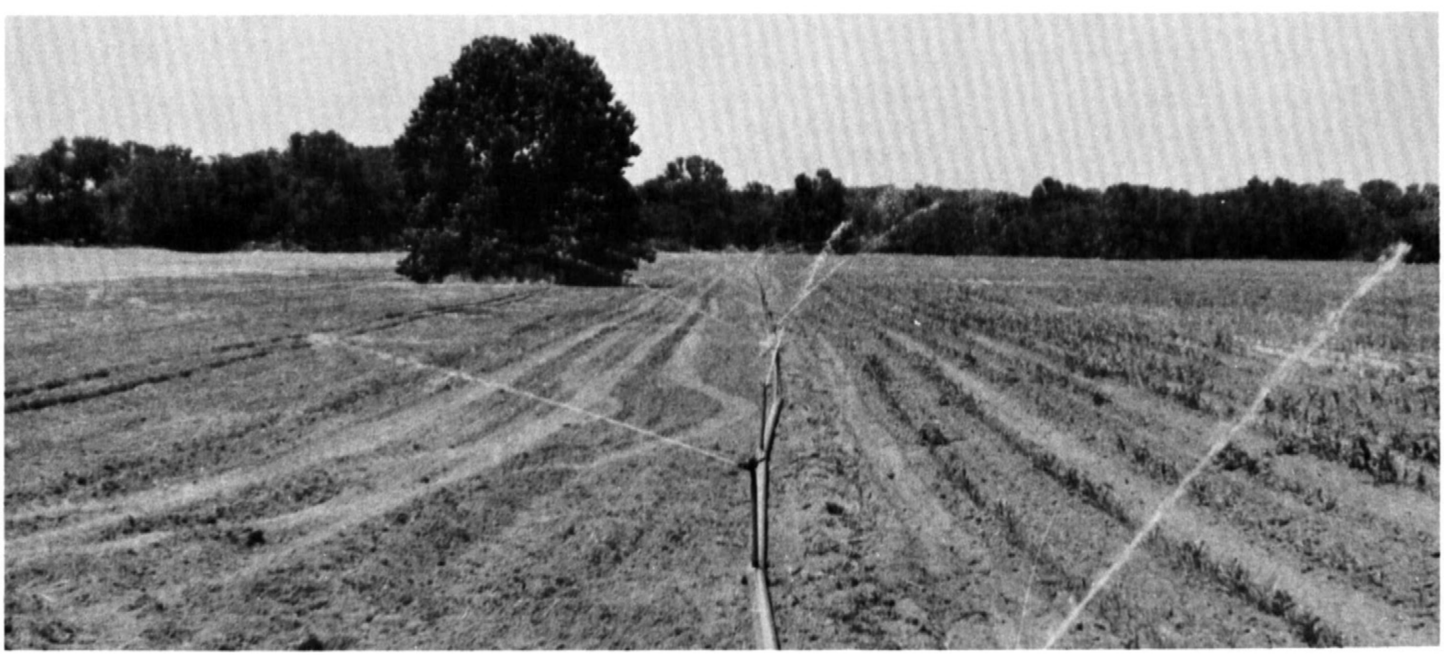


Figure 3.—Irrigating a vegetable crop on Madill fine sandy loam, occasionally flooded.

This Madill soil is in capability subclass Vw. It is not assigned to a range site.

43—Muldrow silty clay loam, rarely flooded. This is a deep, somewhat poorly drained, nearly level soil on low terraces. This soil is subject to rare flooding. Slopes are slightly concave and range from 0 to 1 percent. Most areas are 30 to 150 acres, but some areas are 10 acres.

Typically, the surface layer is very dark gray, silty clay loam about 10 inches thick. The upper part of the subsoil is very dark gray silty clay to a depth of about 34 inches. The lower part of the subsoil is gray silty clay to a depth of about 62 inches.

This soil is high in natural fertility and in organic matter content. The surface layer is strongly acid or medium acid. Permeability is very slow, and the available water capacity is high. This soil has fair tilth and can be worked within a medium range of moisture condition. The root zone is deep. An apparent water table fluctuates between a depth of 2 feet and the surface in fall, winter, and spring.

Included with this soil in mapping are a few intermingled areas of Caspiana and Verdigris soils in higher positions. The included soils make up about 10 percent, but separate areas are generally less than 5 acres.

This soil has medium potential for crops (fig. 4). The main concerns in management are surface wetness, slow water intake, and maintenance of soil tilth. A drainage system and arranging rows for drainage reduce surface wetness. Good tilth can be maintained by returning crop residue to the soil.

This soil has high potential for tame pasture. A combination of bermudagrass or fescue and clover is commonly used for hay and pasture. The main concerns in management include controlling grazing and preventing fires. Fertilizing increases forage production; the additional plant growth helps control erosion during flooding.

Potential is low for most urban uses because this soil is subject to flooding. Wetness is the main limitation for sanitary facilities and recreational areas. Flooding can be reduced but not completely eliminated by upstream flood control.

This Muldrow soil is in capability subclass IIw. It is not assigned to a range site.

44—Parsons silt loam, 0 to 1 percent slopes. This is a deep, somewhat poorly drained, nearly level soil on uplands on prairies. Slopes are broad and smooth. Areas are mostly 25 to 120 acres, but some areas are 10 acres.

Typically, the surface layer to a depth of about 8 inches is very dark grayish brown silt loam. The subsurface layer is dark grayish brown silt loam to a depth of about 12 inches. The upper part of the subsoil

Figure 4.—Soybeans on Muldrow silty clay loam, rarely flooded.

is very dark grayish brown clay to about 21 inches. The middle part is grayish brown clay to about 56 inches. The lower part of the subsoil is grayish brown clay that extends to a depth of about 76 inches.

This soil is medium in natural fertility and in organic matter content. Reaction is strongly acid to slightly acid in the surface layer except where it has been limed. Permeability is very slow, and the available water capacity is high. Plant roots do not easily penetrate the subsoil. The soil has fair tilth and can be worked within a medium range of moisture conditions. This soil is somewhat droughty during summer because of slow moisture intake. A perched water table is between depths of 1/2 foot and 1 1/2 feet during winter and spring.

Included with this soil in mapping are intermingled areas of Taloka and Woodson soils. Also included are soils similar to the Parsons soil except that they have a thin surface layer. The included soils make up about 15 percent of the map unit, but separate areas are generally less than 8 acres.

This soil has medium potential for small grains and other sown crops. The main concerns in management are maintaining tilth, increasing intake of water, and controlling surface crusting, seasonal wetness or droughtiness, and erosion on long slopes. This soil can be used continuously for clean-tilled crops if adequate fertilizer is added for crops and if crop residue is returned to the soil. A large amount of crop residue helps maintain organic matter content and tilth, increase water intake, and prevent surface crusting. Winter cover crops furnish protection against erosion. In a few areas, diversion terraces on long slopes can be used to reduce erosion. A drainage system and arranging rows for drainage reduce surface wetness and increase crop production. Tillage should be timely and kept to a minimum.

This soil has medium potential for native grass and tame pasture. A mixture of bermudagrass or tall fescue and clover is commonly used for pasture. Controlling weeds, proper grazing, and preventing fires help improve the quality and quantity of grasses. Fertilizer will improve the forage production of tame pasture.

This soil has low potential for urban uses. The high shrink-swell potential is the main limitation for dwellings, small commercial buildings, and roads and streets. Wetness limits the use of this soil for sanitary facilities. This limitation can be overcome by proper structural design or by altering the soil.

This Parsons soil is in capability subclass IIs and in the Claypan Prairie range site.

45—Pits. This miscellaneous area is pits from which soil and shale and sandstone have been excavated for building roads, dams, foundations, and similar structures. The pits are open excavations that are 5 to 30 feet deep, 300 to 1,000 feet long, and 150 to 600 feet wide. They have nearly vertical sides and very gently sloping to sloping bottoms. The material in the pits consists of combinations of shale and sandstone in upland areas and sand, loamy fine sand, loam, and sandy clay loam in areas along stream terraces. Pits are in areas of Bates, Collinsville, Enders, Hector, Glentosh, Kamie, and Karma soils. Reaction is mostly medium acid to mildly alkaline.

Areas of this map unit are suited to native grass, to improved bermudagrass, and to be used as habitat for wildlife.

The main concerns in management are grading and smoothing steep slopes, controlling erosion, and maintaining tilth and fertility. Establishing, improving and maintaining stands of plant cover, controlled grazing, and adding fertilizer are needed in places.

Pits are in capability unit VIIs. They are not assigned to a range site.

46—Porum fine sandy loam, 1 to 3 percent slopes. This is a deep, moderately well drained, very gently sloping soil on terraces. Slopes are broad and smooth. Areas are 10 to 80 acres, but some smaller areas are about 5 acres.

Typically, the surface layer is dark brown fine sandy loam to a depth of about 6 inches. The subsurface layer to a depth of about 10 inches is pale brown fine sandy loam. The upper part of the subsoil to a depth of about 18 inches is strong brown clay loam. The middle part to about 40 inches is red silty clay loam. The lower part of the subsoil to a depth of about 64 inches is yellowish red clay loam.

This soil is medium in natural fertility and in organic matter content. Reaction is strongly acid to medium acid in the surface layer except where it has been limed. Permeability is slow, and the available water capacity is high. This soil has good tilth and can be worked throughout a wide range of moisture conditions. A perched water table is between depths of 2 and 3 feet during winter and spring.

Included with this soil in mapping are intermingled areas of Kamie and Stigler soils. Also included are soils similar to the Porum soil except that the lower subsoil does not have clean sand grains. The included soils make up about 10 percent of this unit, but separate areas are generally less than 5 acres.

This soil has medium potential for crops and small grains. Good tilth can be maintained by returning crop residue to the soil. The erosion hazard is moderate if cultivated crops are grown. Minimum tillage, the use of cover crops, terracing, and contour farming help reduce runoff and control erosion.

This soil has medium potential for native grass and high potential for tame pasture. A mixture of bermudagrass and clover is commonly used for hay and pasture. The quality of all grasses can be improved by controlling weeds and brush, proper stocking, and preventing fires.

This soil has low potential for most urban uses. A seasonal high water table for brief periods is a limitation for septic tank absorption fields, sewage lagoons, and sanitary landfills. The high shrink-swell potential is the main limitation for dwellings, small commercial buildings, and roads and streets. Most of these limitations can be overcome by proper structural design or by altering the soil.

This Porum soil is in capability subclass IIe and in the Loamy Savannah range site.

47—Porum fine sandy loam, 2 to 5 percent slopes, eroded. This deep, moderately well drained, very gently sloping to gently sloping soil on terraces. In about 40 percent of the area, the surface and subsurface layers have been mixed with the upper part of the subsoil by plowing. The few crossable gullies are about 500 feet apart. Rills are common between the gullies. Slopes are broad and smooth. Individual areas are 20 to 80 acres, but some areas are 10 acres.

Typically, the surface layer is dark grayish brown fine sandy loam about 4 inches thick. The subsurface layer to a depth of about 7 inches is yellowish brown fine sandy loam. The upper part of the subsoil is strong brown clay loam to about 17 inches. The middle part of the subsoil is yellowish red clay to about 37 inches. The lower part of the subsoil to a depth of about 68 inches is yellowish red sandy clay loam.

This soil is medium in natural fertility and in organic matter content. Reaction is strongly acid to medium acid in the surface layer except where it has been limed. Permeability is slow, and the available moisture capacity is high. This soil has good tilth and can be worked throughout a wide range of moisture conditions. A perched water table is between depths of 2 and 3 feet during the winter and spring.

Included with this soil in mapping are intermingled areas of Kamie soils and nearly level areas of Stigler soils. The included soils make up about 15 percent of the map unit, but separate areas are generally less than 5 acres.

This soil has low potential for row crops and small grains. The hazard of erosion is severe. By returning crop residue to the soil, tilth can be maintained, which helps increase moisture intake at the surface. Minimum tillage, use of cover crops, terracing, and contour farming help control erosion.

This soil has medium potential for native grass and high potential for tame pasture. The quality of all grasses grown can be improved by controlling weeds and brush, proper stocking, and preventing fires. Forage production can be increased by fertilizing tame pasture.

This soil has low potential for most urban uses. A seasonal high water table for brief periods is a limitation for sanitary facilities. The high shrink-swell potential is the main limitation for dwellings, small commercial buildings, and roads and streets. Most of these limitations can be overcome by proper structural design or by altering the soil.

This Porum soil is in capability subclass IVe and in the Loamy Savannah range site.

48—Porum fine sandy loam, 2 to 5 percent slopes, severely eroded. This is a deep, moderately well drained, very gently sloping to gently sloping soil on terraces. Slopes are broad and smooth except in eroded areas. Areas are 15 to 80 acres, but some areas are 5 acres.

Gullies caused by water erosion range 2 to 10 feet in depth and 10 to 20 feet in width and are 200 to 400 feet apart. Between gullies, in 50 percent of the area, the surface layer has been removed by erosion. In 20 percent of the area, the surface layer and the upper part of the subsoil have been mixed by cultivation. In this area, the surface layer is fine sandy loam, clay loam, or sandy clay loam.

Typically, the surface layer is grayish brown fine sandy loam about 4 inches thick. The upper part of the subsoil to a depth of about 51 inches is yellowish red silty clay loam. The lower part of the subsoil is strong brown clay loam that extends to a depth of about 64 inches.

This soil is medium in natural fertility and low in organic matter content. Reaction is strongly acid to medium acid in the surface layer except where it has been limed. Permeability is slow, and the available moisture storage capacity is high. The root zone is deep. A perched water table is between depths of 2 and 3 feet during winter and spring.

Included with this soil in mapping are intermingled areas of Kamie soils and nearly level areas of Stigler soils. Also included are soils similar to the Porum soil except that their lower subsoil does not have clean sand grains. The included soils make up about 15 percent of the map unit, but separate areas are generally less than 5 acres.

This soil has low potential for row crops and small grains. The severe hazard of erosion is the main limitation.

This soil has a medium potential for native grass or tame pasture. A combination of bermudagrass and clover is commonly used for tame pastures. Fertilizing, diverting upslope water, and reshaping gully banks are needed to establish tame pasture plants. The quality and quantity of all grasses can be improved by proper grazing, controlling weeds and brush, and preventing fires.

Potential is low for most urban uses. Slope and erosion are significant limitations. In some areas, gullies should be reshaped and filled. The high shrink-swell potential can be overcome by design or by altering the soil for dwellings, small commercial buildings, and roads and streets. Wetness is the main limitation for sanitary facilities.

This Porom soil is in capability subclass VIe and in the Eroded Sandy Savannah range site.

49—Shermore loam, 3 to 8 percent slopes. This is a deep, moderately well drained, gently sloping to sloping soil that has a fragipan. This soil is on foot slopes adjacent to the mountains and ridges. Slopes are smooth and slightly convex. Areas are 50 to 160 acres.

Typically, the surface layer is dark brown loam about 8 inches thick. The subsurface layer is brown loam to a depth of about 12 inches. The subsoil to a depth of 30 inches is yellowish brown clay loam. A fragipan layer is from 30 to 50 inches; it is coarsely mottled brown, yellowish brown, and dark gray brittle clay loam. The underlying material is a brownish yellow brittle sandy clay loam layer.

This soil is medium in natural fertility and in organic matter content. The surface layer is strongly acid or medium acid. Permeability is moderately slow, and the available water capacity is medium. This soil has good tilth and can be worked throughout a wide range of moisture conditions. Plant roots do not easily penetrate the fragipan. A high water table fluctuates between depths of 1 1/2 and 3 1/2 feet during winter and spring.

Included with this soil in mapping are small areas of Linker and Stigler soils on lower adjacent areas. The included soils make up 15 percent of this map unit, but individual areas are less than 5 acres.

This soil has medium potential for small grains and low potential for row crops. Good tilth can be maintained by returning crop residue to the soil. The hazard of erosion is severe if cultivated row crops are grown. Minimum tillage, the use of cover crops, terracing, and contour farming help to reduce runoff and to control erosion.

This soil has low potential for native grass and medium potential for tame pasture. Bermudagrass, tall fescue, and weeping lovegrass are the common tame pasture plants. Fertilizing tame pasture grass improves the quality of grass and increases forage production; the added plant growth helps protect the soil from erosion. The quality of all grasses can be maintained or improved by using suitable grazing practices and by preventing fires.

This soil has medium potential for most urban uses. Wetness limits the use of the soil for septic tank absorption fields, sanitary landfills, roads and streets, dwellings, and small commercial building.

This Shermore soil is in capability subclass IVe and in the Loamy Savannah range site.

50—Stigler very fine sandy loam, 0 to 1 percent slopes. This is a deep, moderately well drained, nearly level soil on high, broad, smooth terraces. Areas are mostly 20 to 80 acres, but some areas are 10 acres.

Typically, the surface layer to a depth of about 9 inches is dark brown very fine sandy loam. The subsurface layer is pale brown very fine sandy loam to a depth of about 19 inches. The upper part of the subsoil is dark brown silty clay to a depth of about 24 inches. The middle part of the subsoil is brown clay to about 48 inches. The lower part of the subsoil is brown silty clay loam that extends to a depth of about 62 inches.

This soil is medium in natural fertility and low in organic matter content. Reaction is very strongly acid or strongly acid in the surface layer except where it has been limed. Permeability is very slow, and the available water capacity is high. This soil has fair tilth and can be worked throughout a moderate range of moisture conditions. Plant roots do not easily penetrate the clayey subsoil. A perched water table is between depths of 2 and 3 feet in winter and early in spring. Because of very slow water intake, this soil is somewhat droughty in summer months.

Included with this soil in mapping are small intermingled areas of Carytown soils and areas of Kamie and Porum soils in slightly lower positions. These soils make up about 10 percent of the map unit, but separate areas of these soils are generally less than 5 acres.

This soil has medium potential for row crops and small grains. Management concerns include maintaining soil tilth and fertility, controlling erosion, and improving water intake. The hazard of erosion can be reduced by cover crops and by returning crop residue to the soil. Crops that provide large amounts of residue are needed to improve soil tilth and increase water intake. Sown crops can be grown continuously if fertilizer is applied so that the resulting large amounts of crop growth can be returned as residue to the soil.

This soil has medium potential for native grass and high potential for tame pasture. A combination of bermudagrass or tall fescue and clover is commonly used. Controlling weeds, proper grazing, and preventing fires help improve the quality and quantity of grass. Fertilizer will increase the quantity of forage.

This soil has low potential for most urban uses. Wetness limits the use of this soil for septic tank absorption fields, sewage lagoons, and area sanitary landfills. The high shrink-swell potential is the main limitation for dwellings, small commercial buildings, and roads and streets. Most of these limitations can be overcome by proper structural design or by altering the soil.

This Stigler soil is in capability subclass IIw and in the Loamy Savannah range site.

51—Talihina clay loam, 5 to 15 percent slopes. This is a shallow, moderately well drained, sloping to moderately steep soil on upland ridges on prairies. Slopes are smooth and convex. Areas are 20 to 80 acres, but some smaller areas are 8 acres.

Typically, the surface layer is very dark grayish brown clay loam about 7 inches thick. The subsoil to a depth of 15 inches is very dark grayish brown clay. The underlying material is dark gray alkaline soft shale.

This soil is high in natural fertility and in organic matter content. Reaction is strongly acid to slightly acid in the surface layer. Permeability is slow, and the available water capacity is very low. This soil shrinks and cracks when dry and expands when wet. Plant roots do not easily penetrate the subsoil. A perched water table is between depths of 1/2 foot and 1 1/2 feet during winter and spring.

Included with this soil in mapping are intermingled areas of Eram and Collinsville soils and soils similar to the Talihina soil, but they have a thicker subsoil. The included soils make up about 20 percent of the map unit, but separate areas are generally less than 8 acres.

This soil has low potential for row crops and small grains. If this soil is cultivated, it rapidly erodes to the shale bedrock. The best use is native grass or tame pasture.

Potential is medium for native grass and is low for tame pasture. The quality and quantity of all grasses can be improved by controlling weeds and brush, proper grazing practices, and preventing fires.

Potential is low for most urban uses. Depth to shale and the high shrink-swell potential are the main limitations for use of this soil for septic tank absorption fields, sewage lagoons, and trench sanitary landfills. Wetness limits the use of this soil for dwellings, small commercial buildings, and roads and streets. Most of these limitations can be overcome by proper structural design of by altering the soil.

This Talihina soil is in capability subclass VIs and in the Shallow Prairie range site.

52—Taloka silt loam, 0 to 1 percent slopes. This is a deep, somewhat poorly drained, nearly level soil on uplands or high terraces on prairies. Slopes are broad and smooth. Areas are 20 to 300 acres, but some areas are 8 acres.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsurface layer is grayish brown silt loam to about 22 inches. The upper part of the subsoil is dark grayish brown silty clay to about 49 inches. The middle part of the subsoil is dark grayish brown silty clay to about 57 inches. The lower part of the subsoil is dark gray silty clay that extends to a depth of about 75 inches.

This soil is medium in natural fertility and in organic matter content. Reaction is strongly acid or medium acid in the surface layer except where it has been limed. Permeability is very slow, and the available water capacity is high. This soil has fair tilth and can be worked throughout a moderate range of moisture conditions. Plant roots do not easily penetrate the clayey subsoil. This soil is somewhat droughty because of its slow moisture intake. A perched water table is between depths of 1 foot and 2 feet during spring and summer.

Included with this soil in mapping are areas of Dennis and Choteau soils in higher positions and intermingled areas of Parsons soils. Also included are soils in a few intermingled mounds that are about 10 to 30 feet in diameter and 2 to 4 feet in height. The included soils make up about 15 percent of each map unit, but separate areas are generally less than 5 acres.

This soil has high potential for small grains and other sown crops. The main concerns in management are maintaining tilth, increasing intake of water, and controlling surface crusting, seasonal wetness or droughtiness, and erosion on long slopes. This soil can be used continuously for clean-tilled crops if adequate fertilizer is added and if crop residue is returned to the soil. The large amount of crop residue helps maintain organic matter content and tilth, increases water intake, and prevents surface crusting. Winter cover crops help protect against erosion. In a few areas, diversion terraces on long slopes can be used to reduce erosion. A drainage system and arranging rows for drainage reduce surface wetness and improve crop production. Tillage should be timely and kept to a minimum.

This soil has high potential for native grass and tame pasture. Bermudagrass and clover are the most commonly used pasture plants. Controlling weeds, proper grazing, and preventing fires help improve the quality and quantity of pasture.

This soil has low potential for most urban uses. The high shrink-swell potential limits the use of this soil for dwellings with basements. Low strength is the main limitation for roads and streets. Wetness is the main limitation for all urban uses except for roads and streets. All of these limitations can be overcome by proper structural design or by altering the soil.

This Taloka soil is in capability subclass IIw and in the Loamy Prairie range site.

53—Taloka silt loam, 1 to 3 percent slopes. This is a deep, somewhat poorly drained, very gently sloping soil on uplands or high terraces on prairies. Slopes are broad and smooth. Areas are 20 to 300 acres, but some areas are 8 acres.

Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsurface layer is grayish brown silt loam to about 18 inches. The upper part of the subsoil is very dark grayish brown clay to about 30 inches. The middle part of the subsoil is dark grayish brown clay to about 46 inches. The lower part of the subsoil is coarsely mottled dark grayish brown and dark yellowish brown silty clay that extends to a depth of about 75 inches.

This soil is medium in natural fertility and organic matter content. Reaction is strongly acid or medium acid in the surface layer except where it has been limed. Permeability is very slow, and the available water capacity is high. This soil has fair tilth and can be worked throughout a moderate range of moisture conditions. Plant roots do not easily penetrate the clayey subsoil. This soil is somewhat droughty because of its slow water intake. A perched water table is between depths of 1 foot and 2 feet during spring and summer.

Included with this soil in mapping are small areas of Dennis and Choteau soils in higher positions and intermingled areas of Parson soils. Also included are soils in a few intermingled mounds that are about 10 to 30 feet in diameter and 2 to 4 feet in height. The included soils make up about 15 percent of the map unit, but separate areas are generally less than 5 acres.

This soil has high potential for row crops and small grains. Management concerns include maintaining soil structure and fertility, controlling erosion, and improving water intake. The hazard of erosion can be reduced by terraces, contour tillage, and returning crop residue to the soil. Crops that provide large amounts of residue are needed to improve soil tilth and increase water intake.

This soil has high potential for native grass and tame pasture. A combination of bermudagrass or tall fescue and clover is commonly used for tame pasture. Controlling weeds, proper grazing, and preventing fires help improve the quality and quantity of pasture.

Potential is low for most urban uses. The high shrink-swell potential limits the use of this soil for dwellings with basements. Low strength is the main limitation for roads and streets. Wetness is the main limitation for all urban uses except for roads and streets. All of these limitations can be overcome by proper structural design or by altering the soil.

This Taloka soil is in capability subclass IIe and in the Loamy Prairie range site.

54—Verdigris silt loam, occasionally flooded. This is a deep, moderately well drained, nearly level soil is on flood plains. This soil is subject to occasional flooding. Slopes are broad and smooth. Areas are 15 to 120 acres, but some areas are 5 acres.

Typically, the surface layer is very dark brown silt loam about 5 inches thick. The next layer to a depth of 44 inches is very dark grayish brown and dark brown silt loam. The underlying layer is yellowish brown silt loam that extends to a depth of about 68 inches.

This soil is high in natural fertility and in organic matter content. Reaction is medium acid or slightly acid in the surface layer. Permeability is moderate, and the available water capacity is high. This soil has fair tilth and can be worked throughout a moderate range of moisture conditions. Occasionally, surface water is ponded for short periods.

Included with this soil in mapping are intermingled areas of Convent Variant, Madill soils, and soils similar to the Verdigris soil, except that they are somewhat poorly drained and have grayer colors in the lower layers. Also included are Caspiana soils in higher positions. The included soils make up 15 percent of the map unit, but separate areas of these soils are generally less than 5 acres.

This soil has high potential for row crops and small grains. The main concerns in management are controlling occasional flooding and maintaining tilth. Close-grown crops are needed late in fall, in winter, and in spring to prevent excessive erosion during flooding. Planting in spring is delayed until after the period of common flooding. Most crops that produce a large amount of residue can be grown continuously, if fertilizer is applied; the additional plant growth can help provide maximum crop residue. Maintaining the organic matter content of this soil improves tilth and intake of water. Minimum tillage is needed.

This soil has high potential for tame pasture. A combination of bermudagrass or tall fescue and clover is the commonly used tame pasture. The main concerns in management are soil tilth, soil fertility, and water intake. Growth of tame pasture plants can be increased by adding fertilizer and by controlling grazing.

Potential is low for all urban uses. Flooding is the significant limitation for dwellings, small commercial buildings, roads and streets, and all sanitary facilities. The hazard of flooding can be reduced by upstream flood control but not completely eliminated.

This Verdigris soil is in capability subclass IIw. It is not assigned to a range site.

55—Verdigris silt loam, frequently flooded. This is a deep, moderately well drained, nearly level soil on flood plains in wooded areas. This soil floods frequently. Water also stands on the surface for short periods following rains. Slopes are broad and smooth. Areas are 15 to 300 acres.

Typically, the surface layer is very dark grayish brown silt loam about 21 inches thick. The next layer to a depth of about 48 inches is dark brown silt loam. The underlying layer is brown silt loam that extends to a depth of about 68 inches.

This soil is high in natural fertility and in organic matter content. Reaction is medium acid or slightly acid in the surface layer. Permeability is moderate, and the available water capacity is high. The soil has fair tilth and can be worked throughout a moderate range of moisture conditions.

Included with this soil in mapping are intermingled areas of Convent Variant soils, and in depressional areas soils similar to the Verdigris soil except that they have a silty clay loam surface layer or have grayer colors in the lower layers. The included soils make up 15 percent of the map unit, but separate areas of these soils are generally less than 5 acres.

This soil has low potential for row crops and small grains. Flooding is the main limitation.

Potential is high for tame pasture. Bermudagrass or tall fescue and clover are most commonly used for tame pasture. The main concerns in management are surface wetness and ponding, frequent flooding, maintaining soil tilth, and improving water intake of the soil. Wet and ponded areas can be planted with water-tolerant grasses. A simple drainage system, where needed and practical, help the establishment and production of tame pastures. Growth of tame pasture plants can be increased by adding fertilizer and by controlling grazing. Overstocking causes surface compaction and decreases water intake. A good grass mulch helps to maintain soil tilth and improve water intake.

This soil has low potential for most urban uses. The main limitation is flooding. The flood hazard can be reduced but not completely eliminated by upstream flood control structures.

This Verdigris soil is in capability subclass Vw. It is not assigned to a range site.

56—Woodson silt loam, 0 to 1 percent slopes. This is a deep, somewhat poorly drained, nearly level soil on uplands on prairies. Slopes are broad and smooth. Areas are 15 to 80 acres, but some areas are about 5 acres.

Typically, the surface layer is very dark gray silt loam about 8 inches thick. The upper part of the subsoil is very dark gray silty clay to a depth of about 34 inches. The lower part of the subsoil is gray silty clay that extends to a depth of 60 inches.

This soil is high in natural fertility and in organic matter content. Reaction is medium acid or slightly acid in the surface layer except where it has been limed. Permeability is very slow, and the available water capacity is high. This soil has fair tilth and can be worked through a moderate range of moisture conditions. A perched water table is between depths of 1/2 foot and 2 feet during the winter and spring.

Included with this soil in mapping are intermingled areas of Parsons and Taloka soils. The included soils make up about 10 percent of the map unit, but separate areas of these soils are generally less than 5 acres.

This soil has medium potential for row crops and small grains. Management concerns include maintaining soil tilth and fertility, controlling erosion, and improving water intake. Crops that provide large amounts of residue are needed to improve soil tilth and increase water intake. Sown crops can be grown continuously if proper amounts of fertilizer are applied for additional plant growth so large amounts of crop residue can be returned to the soil.

This soil has high potential for native grass and tame pasture. A combination of bermudagrass or tall fescue and clover is commonly used for pasture. Controlling weeds, proper grazing, and preventing fires help improve the quality and quantity of pasture. Fertilizer will increase the quantity of forage.

Potential is low for most urban uses. There is no significant limitation for sewage lagoons. Wetness and the shrink-swell potential are the main limitations for dwellings, small commercial buildings, roads and streets. Most of these limitations can be overcome by proper structural design or by altering the soil.

This Woodson soil is in capability subclass IIs and in the Claypan Prairie range site.

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 responsible levels of government, as well as individuals, must encourage and facilitate the best use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to 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 has an adequate and dependable supply of moisture from precipitation or irrigation. It also has favorable temperature and growing season, and 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 flooded during the growing season. The slope ranges mainly from 0 to 5 percent. For more detailed information on the criteria for prime farmland consult the local staff of the Soil Conservation Service.

In this county about 144,930 acres, or 31 percent, is prime farmland. Areas are scattered throughout the county but most are in the central part, mainly in map units 2, 3, and 4 of the general soil map. Approximately 14 percent of this prime farmland is used for field crops, 72 percent is tame pasture, 8 percent is rangeland, and 6 percent is used for woodland. Crops grown on this land are mainly grain sorghum, wheat, peanuts, and soybeans.

The recent trend to urban uses of soil near Eufaula Lake has created a loss of some prime farmlands. The loss of prime farmland to such uses puts pressure on marginal lands, which generally are more erodible, droughty, and difficult to cultivate, and usually less productive.

Soil map units that make up prime farmland and their extent are listed in this section. This list does not constitute a recommendation for a particular land use. The location of the prime farmland soils 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 "Soil maps for detailed planning." The soil map units in this list are prime farmland except where the use is urban or built-up land or they fail to meet the criteria.

Urban and built-up land is defined as any contiguous unit of 10 acres or more that is used for residences, industrial sites, commercial sites, construction sites, institutional sites, public administrative sites, railroad yards, small parks, cemeteries, airports, golf courses, sanitary landfills, sewage treatment plants, water control structures and spillways, shooting ranges, and so forth.

Following is a list of prime farmland:

Bates loam, 1 to 3 percent slopes
Bates loam, 3 to 5 percent slopes
Caspiana silty clay loam
Choteau silt loam, 1 to 3 percent slopes

Convent Variant silt loam, occasionally flooded
Dennis silt loam, 1 to 3 percent slopes
Dennis silt loam, 3 to 5 percent slopes
Eram clay loam, 1 to 3 percent slopes
Eram clay loam, 3 to 5 percent slopes
Kamie loamy fine sand, 1 to 3 percent slopes
Kamie fine sandy loam, 1 to 3 percent slopes
Karma loamy fine sand, 3 to 5 percent slopes
Karma fine sandy loam, 3 to 5 percent slopes
Linker fine sandy loam, 1 to 3 percent slopes
Linker fine sandy loam, 3 to 5 percent slopes
Madill fine sandy loam, occasionally flooded
Muldrow silty clay loam, rarely flooded
Parsons silt loam, 0 to 1 percent slopes
Porum fine sandy loam, 1 to 3 percent slopes
Stigler very fine sandy loam, 0 to 1 percent slopes
Taloka silt loam, 0 to 1 percent slopes
Taloka silt loam, 1 to 3 percent slopes
Verdigris silt loam, occasionally flooded
Woodson silt loam, 0 to 1 percent slopes

use and management of the soils

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

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

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

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

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

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

crops and pasture

Odos G. Henson, conservation agronomist, and David Legg, area resource conservationist, Soil Conservation Service, helped prepare this section.

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

More than 255,982 acres in the survey area was used for crops and pasture in 1974, according to the Soil Conservation Service land use inventory. Of this total, 226,716 acres was used for pasture, 12,000 acres for row crops, 6,000 acres for close-growing crops, mainly wheat and oats, and 100,000 acres for rotation hay and pasture. The remainder was used for other crops.

The soils in McIntosh County have good potential for increased production of food. Potentially good cropland is used as rangeland or woodland, and several thousand acres are used for pasture. Food production can also be increased by using the latest crop production technology on all cropland in the survey area. This soil survey can help facilitate the application of such technology.

Acreage in crops and woodland has gradually been decreasing as more and more land is used for urban structures. In 1974, about 7,774 acres was used as urban and built-up land in the survey area, and this figure has been increasing at the rate of about 40 acres per year.

Soil erosion is a major concern on the cropland in McIntosh County. If slope is more than 1 percent, erosion is a hazard. Bates, Carytown, Dennis, Porum, and Taloka soils, for example, have slopes of 1 percent or more.

Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging on soils that have a clayey subsoil, such as Carytown, Dennis, Eram, Parsons, Stigler, Taloka, and Woodson soils. Second, soil erosion on farmland results in sedimentation of streams. Control of erosion minimizes the pollution of streams by sediment and improves the quality of water for municipal use, for recreation, and for fish and wildlife.

Control of erosion provides protective surface cover, reduces runoff, and increases infiltration. A cropping system that keeps vegetative cover on the soil for extended periods can hold soil erosion losses to amounts that will not reduce the productive capacity of the soils. Minimizing tillage and leaving crop residue on the soil help increase infiltration and reduce the hazards of runoff and erosion.

Terraces and diversions reduce the length of slope and reduce runoff and erosion. They are not practical on deep sandy soils. Dennis soils, for example, are suitable for terraces. Collinsville soils are less suitable for terraces and diversions because of bedrock at a depth of less than 20 inches.

Contouring and contour stripcropping are erosion controls in the survey area. They are best adapted to soils that have smooth uniform slopes, including most areas of Bates, Carytown, Choteau, Dennis, Eram, Parsons, Porum, and Taloka soils.

Soil blowing is a hazard on Kamie loamy fine sand in some areas. Soil blowing can damage these soils if winds are strong and the soils are dry and bare of vegetation or surface mulch. Maintaining vegetative cover, surface mulch, or rough surfaces through tillage minimizes soil blowing on these soils. Information for the design of erosion controls for each kind of soil is available in local offices of the Soil Conservation Service.

Field crops suited to the soils and climate of the survey area include many that are not now commonly grown. Peanuts, grain sorghum, and soybeans are the main row crops. Potatoes, cotton, and similar crops can be grown if economic conditions are favorable. Wheat is the common close-growing crop. Rye, barley, and oats could be grown, and fescue and weeping lovegrass seed could be produced.

Special crops grown in the survey area are vegetables, small fruits, tree fruits, and nursery plants. A small acreage throughout the survey area is used for melons, strawberries, sweet corn, tomatoes, peppers, and other vegetables and small fruits. In addition, sizeable areas are suited to other special crops such as grapes and many vegetables. Apples and peaches are the most important tree fruits grown in the survey area.

tame pasture

Much of the acreage in the county is in tame pasture plants. The trend is to convert cropland and woodland to pasture. To a lesser degree, range is also converted to pasture.

The principal grass is improved bermudagrass. Some of the better pastures of bermudagrass are overseeded with legumes, which increases the quality and quantity of forage as well as provides additional plant food (fig. 5).

Some bermudagrass pastures are overseeded with fescue. This forage mixture is especially adapted to soils on flood plains where additional moisture is available.

Fescue is an important grass in the county. It provides a sufficient quantity of forage for grazing on soils that have large amounts of available moisture. Fescue is used in the pasture program with other forages to furnish grazing and additional protein during late fall and spring. To maintain a vigorous stand, it needs to be fertilized early in spring and early in fall, and it should not be grazed during summer.

Weeping lovegrass is grown on a few acres in the county. It is a warm season perennial bunchgrass suited to well drained loamy and sandy soils. It begins growth earlier in the spring than bermudagrass and remains green later in the fall. It responds well to fertilizer, especially nitrogen. It becomes less palatable to cattle as it matures.

Some areas of cropland are used for forage plants that supplement the permanent grasses. Small grains in the pasture program provide grazing and additional protein for livestock during late fall and spring. Small grains need to be seeded and fertilized late in summer or early in fall to help obtain the maximum amount of forage. Small grains can be grazed until maturity or livestock can be removed in spring to allow the plants to grow a seed crop for harvest. Wheat, oats, barley, and rye are the main small grains used for grazing.

Forage sorghum, an annual grass, is also used on some cropland areas to supplement permanent grasses. Forage sorghum can be used in the pasture program to provide grazing during summer, or it can be harvested for hay. In some areas, forage sorghum is allowed to grow until frost and is grazed in the winter. Fertilizer should be used to help obtain maximum growth.

Pasture management.—The kinds of soil and suitable plants must be considered in tame pasture management. Good pastures can be achieved by managing to maintain the desired kind and stand of plants. Plants must have vigor to keep a proper balance in the stand. Grazing needs to be compatible with the growth of plants.

Proper grazing and rotation grazing help lengthen the life of most tame pasture plants. Deferred grazing during the time that tame pasture plants are under the most stress is beneficial. This allows the plants to regain vigor by helping to maintain a large root system where food can be stored for the next growing season; total production of forage will increase.

Fertilizer that contains the proper elements contributes to more vigorous pasture plants. This helps increase the amount of forage and lengthen the lifespan of the plants. Plant food can be added by using commercial fertilizers or legumes, or both, that furnish nitrogen to the plants. The acidity of the soil needs to be adjusted to the kinds of plants desired in the stand. Large amounts of plant food, especially nitrogen, are needed when legumes are not grown with the grass.

Desirable pasture plants can be maintained in the stand only by controlling the invasion of undesirable plants. Weeds need to be controlled. Brush control is essential on soils on which trees grow. Mowing or spraying, or both, properly used, will help reduce weeds and brush.

Figure 5.—Hay from bermudagrass grown on Kamie loamy fine sand, 1 to 3 percent slopes.

Planning a pasture program.—A pasture program can be planned so that forage will be available during every month of the year. A study of the growth habits of the different plants is necessary to assure adequate forage each month. The months in which various kinds of forage plants grow are indicated in figure 6. The percentage of growth for each kind of plant is illustrated in a graph. For example, bermudagrass makes 24 percent of its yearly growth for grazing during the month of June.

Soils vary in their capacity to produce forage for grazing. The Dennis soil produces more forage than Collinsville soil primarily because it furnishes more available moisture to the plant. The total yearly production of common pasture plants for each soil is given in animal unit months (AUM) in table 5. For example, bermudagrass on Dennis silt loam, 1 to 3 percent slopes, will furnish grazing for one animal unit for 7 months during the year.

In planning a pasture program, one must consider the total yearly production of the pasture plant in AUM and the growth the plant will make for a certain month (fig. 6). For example, bermudagrass furnishes 24 percent of its annual forage during June. Yearly production of this soil is 7 AUM. Since 24 percent X 7 AUM=1.7 AUM, one acre of Dennis soils provides grazing for 1.7 animals in June. Therefore, a 50-acre pasture would furnish grazing for 85 animals (50 acres X 1.7 AUM = 85 AUM) during June. Soil Conservation Service or County Extension Office personnel can help plan a pasture program.

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 6. 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, animal manure, and green-manure crops; and harvesting that insures the smallest possible loss.

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 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local

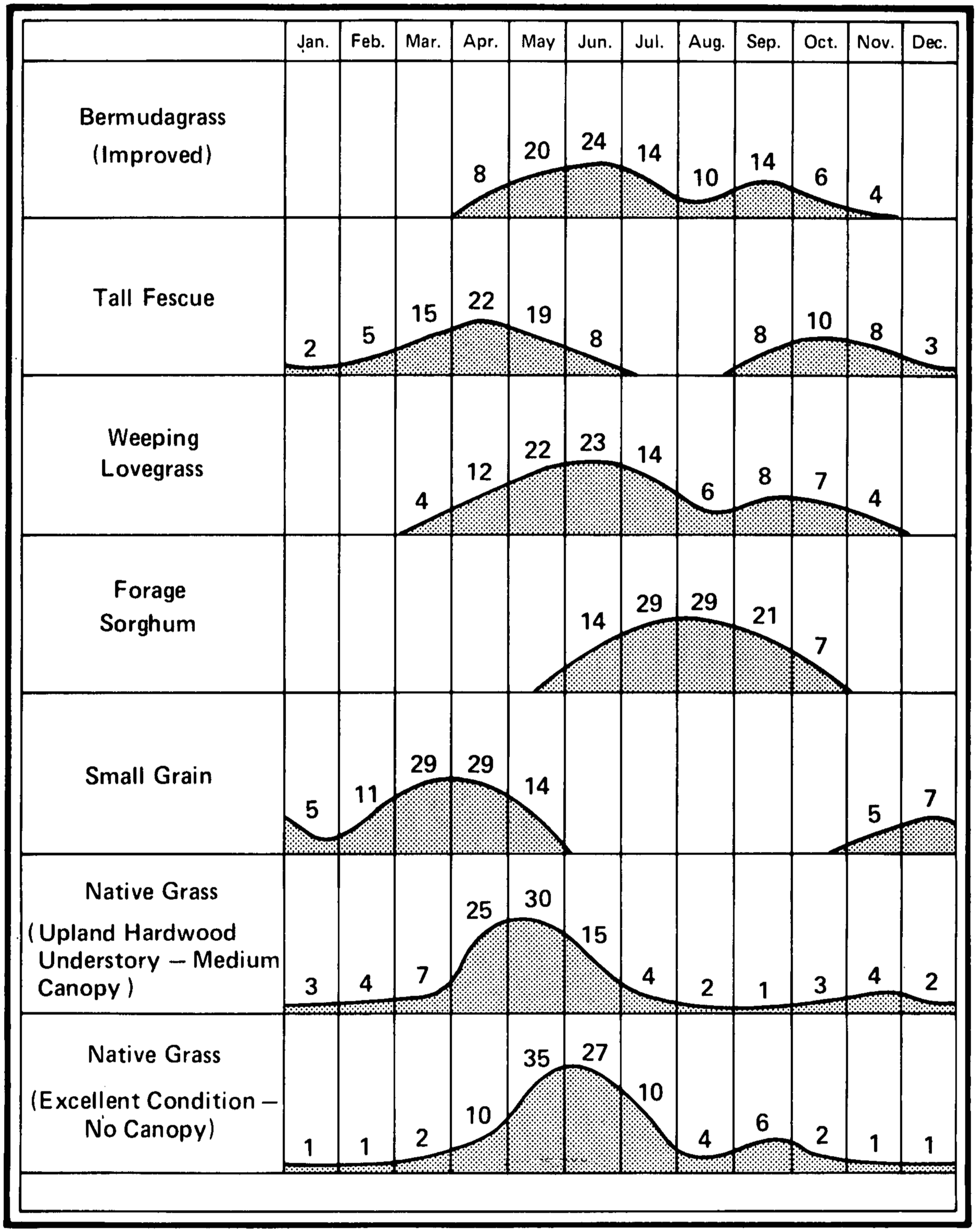


Figure 6.—Forage calendar showing monthly growth as a percentage of the forage produced annually.

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, in this survey, soils are grouped at two levels: capability class and subclass. 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.

The capability classification of each map unit is given in the section "Detailed soil map units."

rangeland

Ernest C. Snook, range conservationist, Soil Conservation Service, helped prepare this section.

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 7 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 7 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 (fig. 7). 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.

Figure 7.—Good growth of native grass on Taloka silt loam, 1 to 3 percent slopes.

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 plants, reducing undesirable brush species, conserving water, and controlling erosion water and soil blowing. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

windbreaks and environmental plantings

Norman E. Smola, forester, Soil Conservation Service, helped prepare this section.

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 broadleaved and needleleaved trees and shrubs provide the most protection.

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 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

recreation

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, 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 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 17 and interpretations for dwellings without basements and for local roads and streets in table 16.

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 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

Billy M. Teels, biologist, Soil Conservation Service, helped prepare this section.

McIntosh County soils provide habitat for good populations of wildlife that are characteristic of eastern Oklahoma. The mixture of crops, range, forest, and pasture provide for habitat diversity important to game such as dove, quail, and turkey, and furbearers such as deer, squirrel, raccoon, fox, opossum, and mink. Farm ponds and the large Eufaula Lake provide good habitat for wintering waterfowl. Most farm ponds have been stocked with bass and bluegill sunfish. Eufaula Lake provides a large fishery for white and striped bass, crappie, catfish, largemouth bass, and various sunfish.

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 10, 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, and barley.

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, lovegrass, 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 bluestem, goldenrod, beggarweed, wheatgrass, and grama.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are oak, cherry, sweetgum, apple, hawthorn, dogwood, hickory, and blackberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

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 pine, cedar, and juniper.

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, cordgrass, rushes, sedges, and reeds.

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

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

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

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

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

soil potentials for selected uses

Soil potential ratings indicate the relative potential of a soil for a particular use compared with other soils in an area. The potential is based on yield or performance level, the relative cost to minimize the soil limitations, and the adverse effects of continuing limitations, if any, on social, economic, or environmental values.

The rating classes are defined in terms of the production or performance expected of a soil if suitable measures are taken to overcome its limitations, the cost of such measures, and the limitations that remain after measures have been applied. The following class terms and definitions are used in this soil survey.

High potential. Production or performance is at or above the level of local standards. Soil conditions are exceptionally favorable or costs of measures for overcoming soil limitations are favorable in relation to the expected performance or yields. There are no soil limitations, or the continuing limitations after corrective measures are installed, do not detract from environmental quality or reduce economic returns.

Medium potential. Production or performance is somewhat below local standards. The costs of measures for overcoming soil limitations are high, or continuing limitations after corrective measures are installed detract from environmental quality or reduce economic returns.

Low potential. Production or performance is significantly below local standards. The measures required to overcome severe soil limitations are too costly to be practical or continuing limitations after corrective measures are installed detract from environmental quality or reduce economic returns.

Soil potential ratings help decision makers determine the relative suitability of soils for a given use. They are used with other resource information as a guide to planning land use. Soil potential ratings are not intended as recommendations for soil use. *Corrective measures listed are general guides for planning and are not to be applied at a specific location without onsite investigations for design and installation.*

Soil potential ratings are made by using a systematic procedure. A standard is established locally for each soil use. It defines the site condition, kind and method of construction, and the expected performance of a soil with a potential of 100. This standard has a fixed installation cost.

The performance of each map unit is compared to the standard. The means of overcoming the soil limitations are determined and the costs of the corrective measures are estimated. Also included are any continuing limitations.

Soil potential ratings are given for each soil map unit regardless of map scale or composition of a unit. Components of multitaxa map units can be evaluated separately if needed to supplement the overall evaluation of a map unit. The soil uses for which soil potential ratings are prepared are consistent with the detail of mapping.

Soil uses for which soil potential ratings are prepared can be broadly categorized as either agricultural or nonagricultural. In either category, the determination of soil potential is made with specialists in fields most closely related to that use.

Agricultural uses. Agricultural uses include cropland, pastureland, and rangeland. Ratings of soil potential for these uses help meet the needs of farmers and ranchers, conservation districts, planning commissions, government agencies, or other users of soil interpretations. In this county, soil potentials for agricultural uses are included in the section "Detailed soil map units."

Nonagricultural uses. Nonagricultural uses of the soils in the county include recreational camp areas, dwellings without basements, local roads and streets, septic tank absorption fields, and sewage lagoon areas. Soil potential ratings of these uses can be of value to farmers, conservation districts, planners, community officials, engineers, developers, builders, and home buyers.

The soil potential ratings are given for recreation camp areas in table 11, for dwellings without basements in table 12, for local roads and streets in table 13, for septic tank absorption fields in table 14, and for sewage lagoon areas in table 15. Each table provides the limitations for specific uses of the soil; the soil potential ratings, index values, and corrective treatment; and the continuing limitations or concerns. The ratings and values indicate the relative quality or performance of each map unit as compared to local standards.

engineering

Charles E. Bollinger, assistant state conservation engineer, and Forrest E. McClung, civil engineer, Soil Conservation Service, helped prepare this section.

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 before 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 16 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, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, 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, the available water capacity in the upper 40 inches, and the content of sodium 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 17 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 17 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 17 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock 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 17 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 18 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 18, 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 19 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; embankments, dikes, and levees; and aquifer-fed ponds. 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.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

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

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of 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 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 25.

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 20 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, and liquid limit. Sandy and gravelly soils are identified as GM, GC, SM, and SC; silty and clayey soils as ML, CL, and CH. and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

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 25.

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.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

physical and chemical properties

Table 21 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.

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.

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

In table 21, the estimated content of organic matter of the plow layer 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 22 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 22 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 22 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 22.

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.

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.

physical and chemical analyses of selected soils

The results of physical analysis of several typical pedons in the survey area are given in table 23 and the results of chemical analysis in table 24. The data are for soils sampled at carefully selected sites. The pedons are typical of the series and are described in the section "Soil series and their morphology." Soil samples were analyzed by the Soil Morphology, Genesis and Classification Laboratory, Department of Agronomy, Oklahoma State University.

Most determinations, except those for grain-size analysis and bulk density, were made on soil material smaller than 2 millimeters in diameter. Measurements reported as percent or quantity of unit weight were calculated on an ovendry basis. The methods used in obtaining the data are indicated in the list that follows. The codes in parentheses refer to published methods (*4*).

Sand—(0.05-2.0 mm fraction) weight percentages of materials less than 2 mm (3A1).

Silt—(0.002-0.05 mm fraction) pipette extraction, weight percentages of all materials less than 2 mm (3A1).

Clay—(fraction less than 0.002 mm) pipette extraction, weight percentages of materials less than 2 mm (3A1).

Organic matter—peroxide digestion (6A3).

Extractable cations—ammonium acetate pH 7.0, uncorrected; calcium (6N2), magnesium (602), sodium (6P2), potassium (6Q2).

Cation exchange capacity—sum of cations (5A3a).

Base saturation—sum of cations, TEA, pH 8.2 (5C3).

Reaction (pH)—1:1 water diltuion (8C1a).

Total phosphorus—perchloric acid; coloimetry (6S1a).

engineering index test data

Table 25 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 Oklahoma Department of Transportation, Materials Division.

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

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

classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*5*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 26, 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 Entisol.

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 Fluvent (*Flue*, meaning fluvial, plus *ent*, from Entisol).

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 Udifluvents (*Udi*, meaning udic horizonation, plus *fluvent*, the suborder of the Entisols that have an udic moisture regime).

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

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 coarse-loamy, mixed, nonacid, thermic Typic Udifluvents.

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 (*3*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*5*). Unless otherwise stated, colors in the descriptions are for moist 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."

Bates series

The Bates series consists of moderately deep, well drained, moderately permeable soils that formed in residuum weathered from sandstone and silty shales. These very gently sloping to sloping soils are on broad, smooth, slightly convex uplands. Slopes range from 1 to 8 percent. The soils of the Bates series are fine-loamy, siliceous, thermic Typic Argiudolls.

These soils are associated with Choteau, Collinsville, Dennis, Talihina, Taloka, and Woodson soils. Choteau, Dennis, Taloka, and Woodson soils, are in lower positions, are deeper and have a fine particle-size control section. Collinsville soils, in higher positions, are shallow over hard sandstone, and Talihina soils, in higher positions, are shallow over soft shale.

Typical pedon of Bates loam, 1 to 3 percent slopes, 200 feet north and 400 feet east of the southwest corner of sec. 7, T. 12 N., R. 17 E.

A1—0 to 12 inches; dark brown (10YR 3/3) loam; weak medium granular structure; friable; medium acid; gradual smooth boundary.

B1—12 to 22 inches; dark brown (10YR 4/3) loam; few fine faint dark yellowish brown mottles; moderate medium granular structure; friable; few fine and medium black and brown concretions and few fine fragments of sandstone; medium acid; gradual smooth boundary.

B2t—22 to 32 inches; strong brown (7.5YR 5/6) clay loam; weak fine subangular blocky structure; thin discontinuous clay films on faces of peds; few fine fragments of sandstone; few medium black and brown concretions; medium acid; clear smooth boundary.

B3—32 to 38 inches; brown (7.5YR 5/4) loam; weak fine subangular blocky structure; few fine fragments of sandstone; few fine black concretions; strongly acid; abrupt smooth boundary.

Cr—38 to 40 inches; yellowish brown (10YR 5/6) fine grained sandstone; with few thin layers of silty shale.

Thickness of solum and depth to sandstone ranges from 20 to 40 inches. Fragments of sandstone less than 3 inches in diameter make up 0 to 10 percent of the solum.

The A1 horizon is very dark grayish brown (10YR 3/2) or dark brown (10YR 3/3; 7.5YR 3/2). Reaction is medium acid or slightly acid.

The B1 horizon is dark brown (7.5YR 4/2, 10YR 4/3) or brown (7.5YR 5/2). It is loam, sandy clay loam, or clay loam. Reaction ranges from strongly acid to slightly acid.

The B2t horizon is brown (7.5YR 5/4; 10YR 4/3, 5/3), strong brown (7.5YR 5/6), dark yellowish brown (10YR 4/4,4/6), or yellowish brown (10YR 5/4, 5/6). It is clay loam or loam. Reaction ranges from strongly acid to slightly acid.

The B3 horizon is brown (7.5YR 4/4, 5/4), strong brown (7.5YR 5/6); dark yellowish brown (10YR 4/4, 4/6), or yellowish brown (10YR 5/4, 5/6). In some places, this horizon has mottles that have values of 4 or more and chromas of 2 or less. This horizon is loam or clay loam. Reaction ranges from strongly acid to slightly acid.

Burwell series

The Burwell series consists of deep, moderately well drained, slowly permeable soils that formed in loamy and clayey sediments. These nearly level to very gently sloping soils are on smooth, convex, circular, or oblong mounds of upland. They have a perched water table at a depth between 2 and 3 feet in winter and spring. Slopes range from 0 to 3 percent. The soils of the Burwell series are fine-silty, mixed, thermic Aquic Paleudolls.

The Burwell soils are associated with Carytown soils, which are in areas between mounds, and with Parsons and Stigler soils, which are in nearby positions. Carytown soils have a natric horizon. Parsons and Stigler soils have a clayey control section.

Typical pedon of Burwell loam, in an area of Carytown-Burwell complex, 0 to 3 percent slopes, 2,100 feet east and 950 north of the southwest corner of sec. 2, T. 10 N., R. 15 E.

A1—0 to 20 inches; very dark grayish brown (10YR 3/2) loam; weak fine granular structure; friable; medium acid; gradual smooth boundary.

A2—20 to 28 inches; brown (10YR 5/3) loam; few fine faint gray mottles; moderate medium granular structure; friable; medium acid; gradual wavy boundary.

B1—28 to 34 inches; yellowish brown (10YR 5/4) clay loam; few fine faint gray and common fine prominent red mottles; moderate fine subangular blocky structure; friable; medium acid; gradual smooth boundary.

B21t—34 to 48 inches; yellowish brown (10YR 5/4) silty clay loam; common medium faint gray (10YR 6/1) and common medium prominent red (2.5YR 4/6) mottles; moderate medium subangular blocky structure; firm; clay films on faces of peds; medium acid; gradual smooth boundary.

B22t—48 to 58 inches; yellowish brown (10YR 5/4) clay; common medium faint gray (10YR 6/1) and common medium prominent red (2.5YR 4/8) mottles; moderate strong subangular blocky structure; firm; common fine black concretions; clay films on faces of peds; medium acid; gradual smooth boundary.

B23t—58 to 68 inches, coarsely mottled gray (10YR 6/1), yellowish brown (10YR 5/8), and red (2.5YR 4/8) clay; weak coarse blocky structure; firm; common fine black concretions; clay film on faces of peds; medium acid.

Thickness of solum is more than 60 inches. The A horizon ranges from 20 to 40 inches.

The A1 horizon is very dark grayish brown (10YR 3/2) or dark brown (10YR 3/3). Reaction is medium acid or strongly acid.

The A2 horizon is dark brown (10YR 4/3), dark yellowish brown (10YR 4/4), brown (10YR 5/3), or yellowish brown (10YR 5/4). Reaction is medium acid or strongly acid.

The B1 horizon is brown (10YR 5/3), yellowish brown (10YR 5/4, 5/6, 5/8), brown (7.5YR 5/4), or strong brown (7.5YR 5/6, 5/8). It is clay loam or silty clay loam. Reaction is medium acid or strongly acid.

The B21t horizon is dark gray (10YR 4/1), gray (10YR 5/1, 6/1), dark grayish brown (10YR 4/2; 2.5Y 4/2), grayish brown (10YR 5/2; 2.5Y 5/2), light brownish gray (10YR 6/2), brown (10YR 4/3, 5/3), pale brown (10YR 6/3), light yellowish brown (10YR 6/4), dark yellowish brown (10YR 4/4), yellowish brown (10YR 5/4), or light olive brown (2.5Y 5/4). In most places, the horizon has gray, red, or brown mottles. It is clay loam or silty clay loam that has fragments of sandstone from 2 to 75 millimeters in diameter which make up 0 to 5 percent, by volume. Reaction ranges from neutral to strongly acid.

The B22t horizon is similar to the B21t in color. Texture is a clay loam or clay that has fragments of sandstone from 2 to 75 millimeters in diameter which make up 1 to 10 percent, by volume. Reaction ranges from mildly alkaline to medium acid.

The B23t horizon is coarsely mottled in red, gray or brown. It is clay loam or clay. Fragments of sandstone or shale from 2 to 75 millimeters in diameter make up 0 to 10 percent, by volume. Reaction horizon ranges from moderately alkaline to medium acid.

Carytown series

The Carytown series consists of deep, poorly drained, very slowly permeable soils that formed in clayey sodium rich materials. These nearly level to very gently sloping soils are on terrace flats and in depressional areas. The soils have a perched water table at a depth less than 1 foot during the winter and spring. Slopes range from 0 to 3 percent. The soils of the Carytown series are fine, mixed, thermic Albic Natraqualfs.

The Carytown soils are associated with Burwell, Parsons, and Stigler soils. The Parsons and Stigler soils are in positions similar to those of Carytown soils, and the Burwell soils are on mounds. These soils lack a natric horizon.

Typical pedon of Carytown silt loam, 0 to 1 percent slopes, 1,500 feet south and 300 feet east of the northwest corner of sec. 21, T. 10 N., R. 16 E.

A1—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam; moderate fine granular structure; friable; slightly acid; clear smooth boundary.

A2—8 to 14 inches; grayish brown (10YR 5/2) silt loam; few fine distinct brown mottles; fine granular structure; friable; medium acid; abrupt wavy boundary.

B21t—14 to 28 inches; very dark grayish brown (10YR 3/2) clay; few fine distinct brown mottles; moderate coarse columnar structure parting to fine blocky; extremely firm; thin grayish brown (10YR 5/2) silt streaks at structure cleavage angles; continuous clay films on faces of peds; slightly acid; gradual smooth boundary.

B22t—28 to 42 inches; dark gray (10YR 4/1) clay; few medium distinct yellowish brown (10YR 5/8) mottles; weak medium columnar structure parting to strong fine blocky; extremely firm; continuous clay films on faces of peds; neutral; gradual smooth boundary.

B23t—42 to 62 inches; dark grayish brown (10YR 4/2) clay; common medium distinct strong brown (7.5YR 5/6) mottles; weak coarse blocky structure; very firm; thin discontinuous clay films on faces of peds; moderately alkaline.

Thickness of solum ranges from 40 to more than 60 inches. The A1 horizon is very dark grayish brown (10YR 3/2) or dark grayish brown (10YR 4/2). This horizon is less than 6 inches thick where it is very dark grayish brown. Reaction ranges from medium acid to neutral.

The A2 horizon is grayish brown (10YR 5/2), gray (10YR 5/1, 6/1), or light brownish gray (10YR 6/2). Mottles are in shades of gray or brown. Reaction ranges from strongly acid to neutral.

The B2t horizon is very dark grayish brown (10YR 3/2; 2.5Y 3/2), dark grayish brown (10YR 4/2; 2.5Y 4/2), or dark gray (10YR 4/1; N 4/0). It is mottled in shades of brown, red, or gray. Reaction ranges from medium acid to moderately alkaline at a depth of 30 inches or less and from neutral to moderately alkaline below a depth of 30 inches. The exchangeable sodium is 15 percent or more.

Caspiana series

The Caspiana series consists of deep, well drained, moderately permeable soils that formed in loamy alluvium. These nearly level soils are on broad, smooth terraces. They have an apparent water table at a depth of 4 feet or more during the winter and spring. Slopes are 1 percent or less. The soils of the Caspiana series are fine-silty, mixed, thermic Typic Argiudolls.

Caspiana soils are associated with Convent Variant, Madill, Muldrow, and Verdigris soils. These soils are in lower positions. The Convent Variant soils are somewhat poorly drained, lack a mollic epipedon and an argillic horizon. Madill and Verdigris soils do not have an argillic horizon. Madill soils are coarse-loamy. Muldrow soils have a fine particle-size control section.

Typical pedon of Caspiana silty clay loam, 300 feet north and 2,200 feet east of the southwest corner of sec. 20, T. 11 N., R. 15 E.

A1—0 to 10 inches; dark reddish brown (5YR 3/2) silty clay loam; moderate fine granular structure; friable; slightly acid; clear smooth boundary.

B1—10 to 16 inches; very dark gray (5YR 3/1) silty clay loam; weak fine subangular blocky structure; friable; slightly acid; clear smooth boundary.

B21t—16 to 26 inches; very dark gray (5YR 3/1) silty clay loam; moderate fine subangular blocky structure; firm; thin discontinuous clay films on faces of peds; neutral; gradual smooth boundary.

B22t—26 to 50 inches; yellowish red (5YR 4/6) silty clay loam; weak coarse blocky structure; firm; clay films on faces of peds; neutral; clear wavy boundary.

C—50 to 60 inches; yellowish red (5YR 4/6) very fine sandy loam; massive; friable; mildly alkaline.

Thickness of solum ranges from 40 to 60 inches. The A horizon is dark brown (10YR 3/3; 7.5YR 3/2), very dark grayish brown (10YR 3/2), very dark gray (5YR 3/1), or dark reddish brown (5YR 3/2, 3/3). Reaction ranges from medium acid to moderately alkaline.

The upper part of the B horizon is dark reddish brown (5YR 3/2, 3/3), very dark gray (5YR 3/1) or dark reddish brown (5YR 3/2). The lower part of the B horizon is yellowish red (5YR 4/6, 5/6), reddish brown (5YR 4/3, 4/4, 5/3, 5/4), or red (2.5YR 4/6, 5/6). This horizon is silt loam or silty clay loam. Reaction ranges from slightly acid to moderately alkaline.

The C horizon has the same colors and reaction as the lower B horizon. It is very fine sandy loam, loam, or silty clay loam.

Choteau series

Choteau series consists of deep, moderately well drained, slowly permeable soils that formed in loamy and clayey sediments. These very gently sloping soils are on broad, smooth, slightly convex uplands. They have a perched water table at a depth between 2 and 3 feet in the winter and spring. Slopes range from 1 to 3 percent. The soils of the Choteau series are fine, mixed, thermic Aquic Paleudolls.

Choteau soils are associated with Bates, Dennis, Parsons, and Taloka soils. Bates soils, on higher slopes, are moderately deep and fine-loamy. Dennis soils, on similar slopes, do not have a thick A horizon. Parsons and Taloka soils, on lower slopes, have an abrupt change in texture from the A horizon to the B horizon.

Typical pedon of Choteau silt loam, 1 to 3 percent slopes, 2,400 feet east and 1,300 feet south of the northwest corner of sec. 29, T. 12 N., R. 16 E.

A1—0 to 15 inches; very dark grayish brown (10YR 3/2) silt loam; weak fine granular structure; friable; slightly acid; clear smooth boundary.

A2—15 to 21 inches; brown (10YR 5/3) silt loam; moderate medium granular structure; friable; medium acid; clear smooth boundary.

B1—21 to 26 inches; dark brown (10YR 4/3) silty clay loam; common medium distinct strong brown (7.5YR 5/6) and many fine prominent red mottles; weak medium subangular blocky structure; firm; strongly acid; clear smooth boundary.

B21t—26 to 38 inches; yellowish brown (10YR 5/6) clay; few fine distinct gray and strong brown mottles; moderate medium blocky structure; very firm; thin clay films on faces of peds; slightly acid; gradual smooth boundary.

B22t—38 to 52 inches; yellowish brown (10YR 5/6) clay; many coarse prominent gray (10YR 6/1) mottles; weak coarse blocky structure; very firm; discontinuous clay films on faces of peds; slightly acid; gradual smooth boundary.

B23t—52 to 80 inches; coarsely mottled yellowish brown (10YR 5/6) and gray (10YR 6/1) silty clay loam; weak coarse blocky structure; very firm; neutral.

Thickness of solum is more than 60 inches thick. Thickness of A horizon ranges from 16 to 28 inches.

The A horizon is very dark brown (10YR 2/2), dark brown (10YR 3/3), or very dark grayish brown (10YR 3/2). Reaction ranges from strongly acid to slightly acid.

The A2 horizon is dark grayish brown (10YR 4/2), brown (10YR 4/3, 5/3), grayish brown (10YR 5/2), light brownish gray (10YR 6/2), or pale brown (10YR 6/3). Reaction is strongly acid or medium acid.

The B1 horizon is dark brown (10YR 3/3, 4/3), brown (10YR 5/3), dark yellowish brown (10YR 3/4, 4/4), dark grayish brown (10YR 4/2), or yellowish brown (10YR 5/4). It is silty clay loam or clay loam. Reaction is strongly acid or medium acid.

The B2t horizon is brown (10YR 4/3, 5/3; 7.5YR 4/4, 5/4), yellowish brown (10YR 5/4, 5/6), strong brown (7.5YR 5/6), or dark yellowish brown (10YR 4/4). It has mottles in shades of gray or brown. This horizon is silty clay loam or clay. Reaction ranges from strongly acid to slightly acid.

The B23t horizon is coarsely mottled in shades of yellow, brown, red, and gray. It is silty clay loam or clay. Reaction ranges from medium acid to mildly alkaline.

Collinsville series

This series consists of very shallow and shallow, well drained or somewhat excessively drained, moderately rapidly permeable soils that formed in residuum weathered from sandstone. These gently sloping to strongly sloping soils are on convex ridges of uplands. Slopes range from 3 to 12 percent. The soils of the Collinsville series are loamy, siliceous, thermic Lithic Hapludolls.

Collinsville soils are associated with Bates and Talihina soils. Bates soils, on lower slopes, are deeper and have an argillic horizon. Talihina soils, on similar landscapes, have a clayey control section.

Typical pedon of the Collinsville fine sandy loam from an area of Collinsville-Talihina complex, 5 to 12 percent slopes, 1,400 feet north and 2,300 feet west of the southeast corner of sec. 33, T. 10 N., R. 15 E.

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

C—8 to 14 inches; dark yellowish brown (10YR 4/4) fine sandy loam; massive; friable; about 30 percent by volume of hard and soft fragments of sandstone; medium acid; abrupt smooth boundary.

R—14 to 24 inches; hard, yellowish brown sandstone.

Depth to sandstone ranges from 4 to 20 inches. Reaction is strongly acid to slightly acid.

The A horizon is very dark brown (10YR 2/2), very dark grayish brown (10YR 3/2), or dark brown (10YR 3/3; 7.5YR 3/2). In some places, a few coarse sandstone fragments are on the surface and in the A horizon. If present, the B horizon is dark brown (10YR 3/3, 4/3; 7.5YR 4/4) or dark yellowish brown (10YR 3/4, 4/4).

The C horizon has similar colors to the B horizon. This horizon is fine sandy loam or stony fine sandy loam. Coarse fragments of hard and soft sandstone make up about 3 to 35 percent, by volume, of this horizon.

Convent Variant

The Convent Variant consists of deep, somewhat poorly drained, moderately permeable soils that formed in loamy alluvium. These nearly level soils are on smooth flood plains. They have an apparent water table at a depth between 2 and 4 feet during the winter and spring. Slopes are less than 1 percent. Soils of the Convent Variant are coarse-silty, mixed, nonacid, thermic Aeric Fluvaquents.

Convent Variant soils are associated with Caspiana, Madill, and Verdigris soils. Caspiana soils are on terraces. Madill and Verdigris soils are in higher positions on small streams. Caspiana and Verdigris soils are better drained and have a mollic epipedon. Madill soils have a coarse-loamy control section.

Typical pedon of Convent Variant silt loam, occasionally flooded, 1,500 feet south and 200 feet east of the northwest corner of sec. 19, T. 12 N., R. 15 E.

Ap—0 to 7 inches; dark brown (10YR 4/3) silt loam; few fine distinct strong brown mottles; weak fine granular structure; friable; slightly acid; clear smooth boundary.

A1—7 to 18 inches; dark brown (10YR 4/3) silt loam, about 40 percent grayish brown (10YR 5/2); few fine distinct strong brown mottles; weak fine granular structure; friable; organic staining in root channels; few fine and medium black concretions; few medium strong brown bodies; few thin strata of fine sandy loam and fine sand; slightly acid; clear wavy boundary.

C1—18 to 28 inches; mottled grayish brown (10YR 5/2) and dark brown (7.5YR 4/4) silt loam; common medium distinct yellowish red (5YR 5/6) mottles; massive; firm; few fine black concretions; few fine slightly hard strong brown bodies; organic staining in root channels; strongly acid; gradual smooth boundary.

C2g—28 to 46 inches; mottled gray (10YR 5/1) and brown (7.5YR 5/4) silt loam; common medium distinct yellowish red (5YR 5/6) mottles; massive; firm; few fine black concretions; few medium slightly hard strong brown bodies; few fine strata of sand; strongly acid; gradual smooth boundary.

C3g—46 to 67 inches; mottled gray (10YR 5/1) and dark gray (10YR 4/1) silt loam; few fine distinct yellowish red and strong brown mottles; massive; firm; few fine strong brown and black concretions; few fine strata of sand; strongly acid.

Depth of the soil is more than 60 inches. The A horizon is grayish brown (10YR 5/2), dark grayish brown (10YR 4/2), dark brown (10YR 3/3, 4/3), or dark yellowish brown (10YR 4/4). This horizon less than 6 inches thick where value is 3.5 or less. This horizon ranges from medium acid to neutral.

The C1 horizon is pale brown (10YR 6/3), light brownish gray (10YR 6/2), dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), or gray (10YR 5/1, 6/1) or mottled in shades of gray, brown, red, or yellow. This horizon is very fine sandy loam, loam, or silt loam. The clay content ranges from 10 to 24 percent, but the average is 18 percent or less. Reaction ranges from strongly acid to mildly alkaline.

The C2g or C3g horizon is grayish brown (10YR 5/2), dark gray (10YR 4/1), dark grayish brown (10YR 4/2), or gray (10YR 5/1, 6/1) or mottled in shades of gray, brown, red, or yellow. This horizon is very fine sandy loam, loam, or silt loam. Reaction ranges from strongly acid to moderately alkaline.

Dennis series

Dennis series consists of deep, moderately well drained, slowly permeable soils that formed in residuum weathered from silty shales and clays. These very gently sloping to sloping soils are on slightly convex side slopes of uplands. They have a perched water table at a depth between 2 and 3 feet in winter and early in spring. Slopes range from 1 to 8 percent. The soils of the Dennis series are fine, mixed, thermic Aquic Paleudolls.

Dennis soils are associated with Bates and Eram soils in higher positions, Chocteau soils in similar positions, and Parsons, Talokla, and Woodson soils in lower positions on the landscape. Kanima soils are in any position on the landscape. Bates soils are moderately deep and are fine-loamy. Choteau soils have an A horizon of 16 inches or more. Eram soils are moderately deep. Kanima soils are loamy-skeletal. Parsons, Taloka, and Woodson soils have an abrupt change in texture between the A horizon and B horizon.

Typical pedon of Dennis silt loam, 1 to 3 percent slopes, 1,500 feet north and 2,100 feet east of the southwest corner of sec. 28, T. 12 N., R. 17 E.

A1—0 to 12 inches; very dark grayish brown (10YR 3/2) silt loam; moderate medium granular structure; friable; medium acid; clear smooth boundary.

B1—12 to 19 inches; dark yellowish brown (10YR 4/4) clay loam; many fine distinct yellowish brown mottles; moderate fine subangular blocky structure; firm; medium acid; gradual smooth boundary.

B21t—19 to 25 inches; yellowish brown (10YR 5/6) silty clay; common medium distinct gray (10YR 5/1) and many fine prominent red (2.5YR 4/6) mottles; moderate medium blocky structure; very firm; few medium black concretions; strongly acid; gradual smooth boundary.

B22t—25 to 42 inches; yellowish brown (10YR 5/6) clay; many medium and fine distinct grayish brown (10YR 5/2) mottles; strong medium blocky structure; extremely firm; continuous clay films on faces of peds; medium acid; gradual smooth boundary.

B23t—42 to 62 inches; yellowish brown (10YR 5/6) silty clay loam; many coarse and medium distinct gray (10YR 6/1) mottles; weak coarse blocky structure; very firm; patchy clay films on faces of peds; common medium black concretions; slightly acid.

Thickness of solum is more than 60 inches. Thickness of A horizon ranges from 10 to 15 inches.

The A1 horizon is very dark brown (10YR 2/2), dark brown (10YR 3/3) or very dark grayish brown (10YR 3/2). If present, the A2 horizon is dark brown (10YR 4/3). The A horizon is strongly acid or medium acid.

The B1 horizon is dark brown (10YR 3/3, 4/3; 7.5YR 4/4) or dark yellowish brown (10YR 3/4, 4/4). It is clay loam or silty clay loam. Reaction is strongly acid or medium acid.

The B2t horizon is brown or dark brown (10YR 4/3, 5/3; 7.5YR 4/4), dark yellowish brown (10YR 4/4), yellowish brown (10YR 5/4, 5/6), strong brown (7.5YR 5/6), olive brown (2.5Y 4/4), or light olive brown (2.5Y 5/4, 5/6). The horizon has mottles in shades of gray, red, brown, or yellow. Gray mottles are in the upper 20 inches of the argilic horizon. This horizon is silty clay loam, clay, or silty clay. Reaction ranges from strongly acid to slightly acid.

The B23t horizon has many coarse mottles in shades of brown, red, gray, and yellow. It is silty clay loam, silty clay, or clay. Reaction is medium acid to mildly alkaline.

Enders series

The Enders series consists of deep, well drained, very slowly permeable soils that formed in loamy and clayey residuum weathered from shale. These moderately steep soils are on convex side slopes on uplands. Slopes range from 12 to 20 percent. The soils of the Enders series are clayey, mixed, thermic Typic Hapludults.

Enders soils are associated with Endsaw, Hector, and Linker soils. Endsaw soils are in similar positions, but the solum is 30 to 60 inches over shale, and the thickness of the A horizon is 9 to 20 inches. Hector soils are on ridges and are shallow to sandstone. Linker soils are on less sloping areas, and they are fine-loamy.

Typical pedon of Enders fine sandy loam from an area of Enders-Hector association, moderately steep, 2,640 feet west and 400 feet north of the southeast corner of sec. 12, T. 11 N., R. 15 E.

A11—0 to 3 inches; very dark grayish brown (10YR 3/2) fine sandy loam; weak fine granular structure; friable; few fragments of sandstone less than 3 inches in diameter; very strongly acid; clear wavy boundary.

A12—3 to 8 inches; brown (10YR 5/3) loam; weak fine granular structure; friable; few fine fragments of sandstone; very strongly acid; clear wavy boundary.

B21t—8 to 20 inches; yellowish red (5YR 4/6) clay; weak medium subangular blocky structure; very firm; continuous clay films on faces of peds; few fine fragments of sandstone; very strongly acid; gradual wavy boundary.

B22t—20 to 33 inches; red (2.5YR 4/6) clay; few fine distinct reddish gray mottles; moderate medium blocky structure; very firm; thick continuous clay films on faces of peds; few fine fragments of sandstone; very strongly acid; gradual wavy boundary.

B3—33 to 44 inches; mottled reddish brown (5YR 4/4) and dark reddish gray (5YR 4/2) clay; moderate medium and fine blocky structure; very firm; thin continuous clay films on faces of peds; fragments of sandstone make up 10 percent by volume; very strongly acid; gradual wavy boundary.

Cr—44 to 65 inches; dark gray (5YR 4/1) shale; massive; extremely acid.

Thickness of solum and depth to shale range from 40 to 60 inches. The thickness of the A horizon ranges from 4 to 8 inches.

The A11 horizon is very dark brown (10YR 2/2; 7.5YR 2/2), dark grayish brown (10YR 4/2), or very dark grayish brown (10YR 3/2). The A12 horizon is brown (10YR 4/3, 5/3), yellowish brown (10YR 5/4), or dark yellowish brown (10YR 4/4). The A horizon has fragments of sandstone more than 3 inches in diameter, which make up 0 to 15 percent, by volume. Reaction is very strongly acid or strongly acid.

The B2t horizon is yellowish red (5YR 4/6, 4/8, 5/6, 5/8) or red (2.5YR 4/6, 4/8, 5/6, 5/8). In most places, the lower part of this horizon is mottled in shades of brown, red, or gray, but the gray mottles do not indicate wetness. This horizon is silty clay or clay. Reaction is very strongly acid or strongly acid.

The B3 horizon is mottled in shades of red, brown, and gray; but the gray is absent in some places. It is clay or silty clay and has fragments of sandstone less than 3 inches in diameter, which make up 5 to 20 percent, by volume. This horizon is very strongly acid or strongly acid.

Endsaw series

The Endsaw series consists of deep, well drained, slowly permeable soils that formed in a thin layer of loamy colluvial material and clayey residuum weathered from shale. These soils are on moderately steep to steep, convex side slopes of uplands. Slopes range from 12 to 30 percent. The soils of the Endsaw series are clayey, mixed, thermic Typic Hapludults.

Endsaw soils are associated with Enders, Hector, and Linker soils. Enders soils are on the same landscapes but they have an A horizon with a thickness of 8 inches or less. Hector and Linker soils are on ridges and side slopes. Hector soils are shallow over sandstone and Linker soils are fine-loamy.

Typical pedon of Endsaw stony fine sandy loam in an area of Endsaw-Hector association, steep, 1,800 feet west and 1,800 feet south of the northeast corner of sec. 33, T. 10 N., R. 17 E.

A1—0 to 4 inches; dark grayish brown (10YR 4/2) stony fine sandy loam; weak fine granular structure; very friable; gravel and cobbles of sandstone make up 20 percent by volume, few stones; medium acid; clear smooth boundary.

A2—4 to 9 inches; brown (10YR 5/3) stony fine sandy loam; weak fine granular structure; very friable; gravel and cobbles of sandstone make up 20 percent by volume; few stones; medium acid; clear smooth boundary.

B21t—9 to 22 inches; red (2.5YR 4/6) clay; moderate medium blocky structure; very firm; thick continuous clay films on faces of peds; few fine fragments of sandstone; very strongly acid; clear wavy boundary.

B22t—22 to 32 inches; red (2.5YR 4/8) clay; many medium prominent reddish yellow (5YR 6/8) mottles; moderate medium blocky structure; very firm; thick continuous clay film on faces of peds; few fine fragments of sandstone; very strongly acid; clear smooth boundary.

B3—32 to 42 inches; mottled red (2.5YR 5/8) and gray (10YR 5/1) clay; weak coarse blocky structure; very firm; few thin clay films on faces of peds, very strongly acid; gradual wavy boundary.

Cr—42 to 60 inches; olive gray (5Y 5/2) and gray (10YR 5/1) soft shale; slightly acid; tilted 10 degrees from the horizontal.

Thickness of solum and depth to shale range from 30 to 60 inches. Thickness of the A horizon ranges from 9 to 20 inches.

The A1 horizon is dark grayish brown (10YR 4/2), dark brown (10YR 3/3, 4/3), or very dark grayish brown (10YR 3/2). Fragments of sandstone from 2 to 76 millimeters in diameter make up 5 to 20 percent, by volume. Fragments of sandstone from 76 millimeters to 25 centimeters in diameter make up 0 to 10 percent. Stones make up 0 to 5 percent, by volume. Reaction is medium acid or strongly acid.

The A2 horizon is brown (10YR 5/3), pale brown (10YR 6/3), very pale brown (10YR 7/3), yellowish brown (10YR 5/4, 5/6), light yellowish brown (10YR 6/4), brownish yellow (10YR 6/6), yellow (10YR 7/6). This horizon is similar to the A1 horizon in texture, content of coarse fragments, and reaction.

The B2t horizon is (2.5YR 4/6, 5/6, 4/8, 5/8), or yellowish red (5YR 4/6, 5/6, 5/8). In some places, this horizon has mottles in shades of red, brown, or gray. It is silty clay or clay. Fragments of sandstone from 2 to 76 millemeters in diameter make up 0 to 10 percent, by volume. Fragments of sandstone from 76 millimeters to 25 centimeters make up 0 to 5 percent, by volume. Reaction horizon is very strongly acid or strongly acid.

The B3 horizon is weak red (2.5YR 4/2, 5/2), reddish brown (2.5YR 4/4, 5/4), red (2.5YR 4/6, 5/6, 4/8, 5/8), dark reddish gray (5YR 4/2), reddish brown (5YR 4/3, 5/3, 4/4, 5/4), yellowish red (5YR 4/6, 5/6, 5/8), gray (10YR 5/1, 6/1; 5YR 5/1, 6/1), brown (7.5YR 5/2, 4/2), strong brown (7.5YR 5/6, 5/8), dark gray (10YR 4/1), and grayish brown (10YR 5/2) or mottled in shades of brown, red, or gray. Texture, coarse fragments, and reaction are similar to those of the B2t horizon.

Eram series

The Eram series consists of moderately deep, moderately well drained, slowly permeable soils that formed in residuum weathered from shales. These very gently sloping to gently sloping soils are on slightly convex side slopes on uplands. They have a perched water table at a depth between 2 and 3 feet during the winter and spring. Slopes range from 1 to 5 percent. Soils of the Eram series are fine, mixed, thermic Aquic Argiudolls.

Eram soils are associated with Dennis, Kanima, and Talihina soils. Dennis soils, in lower positions on the landscape, are deep. Talihina soils, on ridges, are shallow. Kanima soils, on many areas of the landscape, are loamy-skeletal.

Typical pedon of Eram clay loam, 1 to 3 percent slopes, 715 feet south and 200 feet east of the northwest corner of sec. 17, T. 12 N., R. 17 E.

A1—0 to 10 inches; very dark grayish brown (10YR 3/2) clay loam; weak medium granular structure; friable; slightly acid; gradual smooth boundary.

B21t—10 to 19 inches; dark grayish brown (10YR 4/2) clay; few fine faint dark brown mottles; moderate fine subangular blocky structure; firm; thin patchy clay films on faces of peds; slightly acid; gradual smooth boundary.

B22t—19 to 26 inches; grayish brown (10YR 5/2) clay; few fine distinct yellowish brown and few fine distinct very dark gray mottles; moderate fine subangular blocky structure; very firm; slightly acid; gradual smooth boundary.

B3—26 to 31 inches; grayish brown (10YR 5/2) clay; common fine distinct yellowish brown (10YR 5/4) mottles; weak fine blocky structure; firm; seams of weakly weathered shale; slightly acid; clear smooth boundary.

Cr—31 to 36 inches; gray (10YR 5/1) shale; noncalcareous, mildly alkaline.

Thickness of solum and depth to shale ranges from 20 to 40 inches.

The A horizon is very dark grayish brown (10YR 3/2; 2.5Y 3/2). Reaction is medium acid or slightly acid.

The B horizon is very dark grayish brown (2.5Y 3/2; 10YR 3/2), dark grayish brown (2.5Y 4/2; 10YR 4/2), grayish brown (2.5Y 5/2; 10YR 5/2), olive brown (2.5Y 4/4), dark yellowish brown (10YR 4/4), or yellowish brown (10YR 5/4). Where this horizon has chromas of 3 or more, it is mottled within 16 inches of the surface and has chromas of 2 or less. Reaction ranges from medium acid to neutral.

Glentosh series

The Glentosh series consists of deep, excessively drained, rapidly permeable soils that formed in sandy eolian and alluvial deposits. These nearly level to sloping soils are on broad, smooth terraces. Slopes range from 0 to 8 percent. Soils of the Glentosh series are thermic, coated Typic Quartzipsamments.

Glentosh soils are associated with Kamie, Karma, Larton, and Porum soils. All of these soils are in the same positions or are on higher adjacent terraces. Kamie, Karma, and Larton soils have a loamy subsoil. Porum soils have a fine particle-size control section.

Typical pedon of Glentosh loamy fine sand, 0 to 3 percent slope, 1,200 feet south and 700 feet west of the northeast corner of sec. 20, T. 11 N., R. 15 E.

A1—0 to 10 inches; dark brown (10YR 4/3) loamy fine sand; weak fine granular structure; very friable; medium acid; clear smooth boundary.

C1—10 to 26 inches; yellowish brown (10YR 5/4) loamy fine sand; single grained; loose; strongly acid; clear wavy boundary.

C2—26 to 48 inches; strong brown (7.5YR 5/6) fine sand; single grained; loose; common medium yellowish red (5YR 5/6) stains; strongly acid; gradual wavy boundary.

C3—48 to 80 inches; very pale brown (10YR 7/3) fine sand; single grained; loose; common coarse yellowish brown (10YR 5/6) stains; very strongly acid.

Thickness of sandy texture is more than 80 inches. The A horizon is dark brown (7.5YR 4/4; 10YR 3/3, 4/3) or dark yellowish brown (10YR 4/4). Reaction is strongly acid or medium acid.

The C horizon is brown (7.5YR 5/4, 10YR 5/3), strong brown (7.5YR 5/6), reddish yellow (7.5YR 6/6), light brown (7.5YR 6/4), yellowish brown (10YR 5/4, 5/6), light yellowish brown (10YR 6/4), very pale brown (10YR 7/3), or brownish yellow (10YR 6/6). It is loamy fine sand or fine sand. Reaction ranges from very strongly acid to slightly acid.

Hector series

The Hector series consists of shallow, well drained, moderately rapidly permeable soils that formed in residuum weathered from sandstone. These moderately steep to steep soils are on convex ridges and side slopes on uplands. Slopes range from 12 to 30 percent. The soils of the Hector series are loamy, siliceous, thermic Lithic Dystrochrepts.

Hector soils are associated with Enders, Endsaw, and Linker soils. Enders, Endsaw, and Linker soils are on side slopes in lower positions, and they are deeper and have an argillic horizon.

Typical pedon of the Hector stony fine sandy loam from an area of the Enders-Hector association, moderately steep, 2,600 feet west and 400 feet north of the southeast corner of sec. 12, T. 11 N., R. 15 E.

A1—0 to 4 inches; dark grayish brown (10YR 4/2) stony fine sandy loam; weak fine granular structure; friable; fragments of sandstone 3 to 10 inches in diameter make up 15 percent by volume; few stones; strongly acid; clear smooth boundary.

A2—4 to 10 inches; brown (10YR 5/3) stony fine sandy loam; weak fine granular structure; friable; few fragments of sandstone 3 to 10 inches in diameter make up 15 percent by volume; few stones; strongly acid; clear smooth boundary.

B2—10 to 16 inches; yellowish brown (10YR 5/4) fine sandy loam; weak medium granular structure; friable; fragments of sandstone less than 3 inches in diameter make up 5 percent by volume; very strongly acid; abrupt smooth boundary.

R—16 to 20 inches; hard, massive sandstone bedrock; very strongly acid.

Thickness of solum and depth to sandstone range from 10 to 20 inches. Coarse fragments less than 3 inches in diameter range from 0 to 30 percent, by volume, and fragments from 3 to 10 inches in diameter range from 0 to 15 percent. Stone fragments range from 0 to 5 percent.

The A1 horizon is dark grayish brown (10YR 4/2) or dark brown (7.5YR 4/2; 10YR 3/3). The A2 horizon is brown (10YR 5/3, 4/3), grayish brown (10YR 5/2), yellowish brown (10YR 5/4), or dark yellowish brown (10YR 4/4). The A horizon is stony fine sandy loam or fine sandy loam. Reaction ranges from strongly acid to slightly acid.

The B horizon is yellowish brown (10YR 5/4), brown (10YR 5/3), reddish brown (5YR 4/4), or yellowish red (5YR 4/6). It is fine sandy loam, gravelly fine sandy loam, gravelly loam, or loam. Reaction is very strongly acid or strongly acid.

Kamie series

The Kamie series consists of deep, well drained, moderately permeable soils that formed in loamy sediments. These very gentle sloping soils are on broad, smooth terraces. Slopes range from 1 to 3 percent. Soils of the Kamie series are fine-loamy, mixed, thermic Typic Paleudalfs.

Kamie soils are associated with Glentosh, Larton, Porum, and Stigler soils. All of these soils except the Glentosh soils are in similar positions on the landscape. Glentosh soils are on the same terrace level or on lower terraces. Glentosh soils are sandy throughout. Larton soils have an A horizon ranging from 20 to 40 inches in thickness of loamy fine sand. Porum and Stigler soils have a fine particle-size control section.

Typical pedon of Kamie fine sandy loam, 1 to 3 percent slopes, 1,950 feet south and 325 feet west of the northeast corner of sec. 22, T. 12 N., R. 14 E.

A1—0 to 8 inches; dark brown (7.5YR 4/2) fine sandy loam; weak fine granular structure; friable; medium acid; clear smooth boundary.

A2—8 to 18 inches; brown (7.5YR 5/4) fine sandy loam; weak fine granular structure; friable; medium acid; clear smooth boundary.

B21t—18 to 36 inches; yellowish red (5YR 5/6) sandy clay loam; weak medium subangular blocky structure; firm; few patchy clay films on faces of peds; strongly acid; gradual wavy boundary.

B22t—36 to 61 inches; reddish brown (5YR 5/4) sandy clay loam; weak fine subangular blocky structure; friable; clay films bridging sand grains; strongly acid; gradual wavy boundary.

B3—61 to 78 inches; strong brown (7.5YR 5/6) fine sandy loam; weak coarse prismatic structure parting to weak fine subangular blocky; clay films bridging sand grains; pockets of clean sand grains occupy 2 to 4 percent of the volume; strongly acid.

Thickness of solum is more than 60 inches. Thickness of the A horizon ranges from 8 to 20 inches. This horizon is loamy fine sand or fine sandy loam. Reaction ranges from medium acid to neutral.

The A1 horizon is dark brown or brown (10YR 4/3, 5/3; 7.5YR 4/2) or dark grayish brown (10YR 4/2). The A2 horizon is brown (10YR 4/3, 5/3; 7/5YR 4/4, 5/4), strong brown (7.5YR 5/6), dark yellowish brown (10YR 4/4), yellowish brown (10YR 5/4, 5/6), light yellowish brown (10YR 6/4), or pale brown (10YR 6/3).

The B21t horizon is yellowish red (5YR 4/6, 5/6), red (2.5YR 4/6, 5/6), or dark red (2.5YR 3/6). It is sandy clay loam or clay loam. Reaction is strongly acid or medium acid.

The B22t horizon is reddish brown (5YR 4/4, 5/4; 2.5YR 5/4), red (2.5YR 4/6, 4/8, 5/6, 5/8). It is sandy clay loam or clay loam. Reaction ranges from strongly acid to medium acid.

The B3 horizon is light red (2.5YR 6/6, 6/8), red (2.5YR 4/6, 4/8, 5/6, 5/8), reddish yellow (5YR 6/6, 6/8), yellowish red (5YR 4/6, 4/8, 5/6, 5/8), strong brown (7.5YR 5/6, 5/8). It is sandy clay loam or fine sandy loam. Reaction is strongly acid to medium acid.

Kanima series

The Kanima series consists of deep, well drained, moderately permeable shaly soils that formed in material weathered from shale and thin interbedded sandstone deposited by recent strip mine operations. These gently sloping to steep soils occur in spoil banks adjacent to strip pits. Slope ranges from 3 to 30 percent. Soils of the Kanima series are loamy-skeletal, mixed, nonacid, thermic Udalfic Arents.

Kanima soils are associated with Bates, Choteau, Dennis, Eram, Talihina, Taloka, and Woodson soils. All of the associated soils are on the same general landscape, but they are in lower positions. They have an argillic horizon except for the Talihina soils, which are shallow to shale.

Typical pedon of Kanima shaly silty clay loam, 3 to 30 percent slopes, 800 feet south and 1,200 feet east of the northwest corner of sec. 5, T. 11 N., R. 18 E.

A1—0 to 6 inches; very dark grayish brown (10YR 3/2) shaly silty clay loam; massive; firm; 3 percent fragments of coal by volume; 30 percent by volume fragments of shale; neutral; diffuse wavy boundary.

C—6 to 62 inches; olive gray (5Y 4/2) very shaly silty clay loam; massive; firm; fragments of gray shale less than 3 inches in diameter make up 75 percent by volume; few pockets of light yellowish brown (10YR 6/4) and yellowish brown (10YR 5/4) silty clay having thin patchy clay films on faces of peds; few fine fragments of coal; neutral.

The A horizon is very dark grayish brown (10YR 3/2; 2.5Y 3/2), dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2). Fragments of shale less than 3 inches in diameter, range from 15 to 50 percent, by volume. Fragments of coal, by volume, make up 0 to 5 percent. This horizon ranges from medium acid to mildly alkaline.

The C horizon is very dark grayish brown (2.5Y 3/2, 10YR 3/2), dark grayish brown (10YR 4/2; 2.5Y 4/2), olive gray (5Y 4/2, 5/2), or olive brown (2.5Y 4/4), with pockets of soil that has colors of higher chroma. Fragments of shale less than 3 inches in diameter range from 50 to 90 percent, by volume. Fragments of shale more than 3 inches in diameter make up 5 to 20 percent, by volume. This horizon has pockets and fragments of an argillic horizon. Reaction ranges from slightly acid to moderately alkaline.

Karma series

The Karma series consists of deep, well drained, moderately permeable soils that formed in loamy sediments. These very gently sloping to sloping soils are on broad smooth terraces. Slopes range from 2 to 8 percent. Soils of the Karma series are fine-loamy, mixed, thermic Typic Hapludalfs.

Karma soils are associated with Kamie, Glentosh, Larton, Porum, and Stigler soils. Except for Glentosh soils, these soils are on the same terrace level. Glentosh soils are on the same terrace or lower terrace levels. Glentosh soils are sandy throughout, and Larton soils have an A horizon of loamy fine sand ranging from 20 to 40 inches in thickness. Kamie soils do not decrease in clay content by as much as 20 percent of the maximum within a depth of 60 inches. Porum and Stigler soils have a fine control section.

Typical pedon of Karma loamy fine sand, 3 to 5 percent slopes, 1,500 feet east and 1,200 feet south of the northwest corner of sec. 31, T. 11 N., R. 14 E.

A1—0 to 6 inches; dark brown (10YR 3/3) loamy fine sand; weak fine granular structure; friable; medium acid; clear smooth boundary.

A2—6 to 16 inches; brown (10YR 5/3) loamy fine sand; weak fine granular structure; friable; medium acid; clear smooth boundary.

B21t—16 to 38 inches; reddish brown (2.5YR 4/4) sandy clay loam; moderate medium subangular blocky structure; firm; discontinuous clay films on faces of peds; medium acid; gradual smooth boundary.

B22t—38 to 52 inches; red (2.5YR 4/8) sandy clay loam; weak medium subangular blocky structure; firm; few patchy clay films on faces of peds; medium acid; gradual wavy boundary.

B3—52 to 68 inches; red (2.5YR 5/8) fine sandy loam; weak medium subangular blocky structure; friable; pockets of clean sand grains occupy about 6 percent of the volume; medium acid.

Thickness of solum ranges from 40 inches to more than 60 inches.

The A1 horizon is dark brown (7.5YR 3/2, 4/2, 4/4; 10YR 3/3), brown (7.5YR 5/4; 10YR 5/3), very dark grayish brown (10YR 3/2), or dark grayish brown (10YR 4/2). In places, this horizon is less than 7 inches thick, and the value is 3 and the chroma is 2 or 3. This horizon is fine sandy loam or loamy fine sand. Reaction ranges from medium acid to neutral.

The A2 horizon is dark brown (7.5YR 4/4; 10YR 3/3, 4/3), brown (10YR 5/3), pale brown (10YR 6/3), dark yellowish brown (10YR 4/4), light yellowish brown (10YR 6/4), light brown (7.5YR 6/4), or yellowish brown (10YR 5/4, 5/6). It is loamy fine sand or fine sandy loam. Reaction ranges from medium acid to neutral.

The B2t horizon is reddish brown (5YR 4/4, 5/4), yellowish red (5YR 4/6, 5/6, 4/8, 5/8), reddish brown (2.5YR 4/4, 5/4), or red (2.5YR 4/6, 5/6, 4/8, 5/8). It is clay loam or sandy clay loam. Reaction is medium acid or slightly acid.

The B3 horizon is similar in color to the B2t horizon. It is fine sandy loam, loam, or sandy clay loam. Reaction ranges from medium acid to neutral.

If present, the C horizon has colors similar to those in the B2t horizon. The C horizon is stratified and textures range from loamy fine sand to sandy clay loam.

Kiomatia series

Kiomatia series consists of deep, well drained, rapidly permeable soils that formed in sandy alluvium. These nearly level soils are on slightly undulating flood plains. They have an apparent water table at a depth between 3 and 5 feet during the winter, spring, and summer months. Slopes are 1 percent or less. Soils of the Kiomatia series are sandy, mixed, thermic Typic Udifluvents.

Kiomatia soils are associated with Madill and Verdigris soils. Madill and Verdigris are in higher positions. Madill soils are coarse- loamy. Verdigris soils have a mollic epipedon and are fine-silty.

Typical pedon of Kiomatia loamy fine sand, frequently flooded, 2,200 feet south and 2,400 feet west of the northeast corner of sec. 3, T. 8 N., R. 14 E.

A1—0 to 8 inches; brown (7.5YR 4/4) loamy fine sand; weak fine granular structure; friable; slightly acid; clear smooth boundary.

C1—8 to 20 inches; strong brown (7.5YR 5/6) fine sandy loam; weak fine granular structure; friable; slightly acid; gradual smooth boundary.

C2—20 to 32 inches; reddish brown (5YR 5/4) loamy fine sand; single grained; loose; many fine strata of very fine sandy loam and loam; neutral; clear smooth boundary.

C3—32 to 62 inches; light reddish brown (5YR 6/4) fine sand; single grained; loose; many fine strata of fine sandy loam and loam; slightly acid.

Depth of soil is 60 inches or more. The A horizon is brown (7.5YR 4/4, 5/4), strong brown (7.5YR 5/6), light brown (7.5YR 6/4), or reddish brown (5YR 4/3, 4/4). Reaction ranges from slightly acid to mildly alkaline. The horizon is noncalcareous.

The C horizon is reddish brown (5YR 5/4), light reddish brown (5YR 6/4), pink (5YR 7/3, 8/3), brown (7.5YR 4/4, 5/4), light brown (7.5YR 6/4), or strong brown (7.5YR 5/6). It is fine sand or loamy fine sand that has strata of fine sandy loam, loam, very fine sandy loam, or silt loam. Reaction ranges from slightly acid to mildly alkaline. The horizon is noncalcareous.

Larton series

The Larton series consists of deep, well drained, moderately permeable soils that formed in sandy or loamy alluvium and eolian materials (fig. 8). These very gently sloping soils are broad smooth terraces. Slopes range from 1 to 3 percent. Soils of the Larton series are loamy, siliceous, thermic Arenic Paleudalfs.

Larton soils are associated with Glentosh, Kamie, Porum, and Stigler soils. Except for Glentosh, these soils are on the same terrace level. The Glentosh soils are on the same terrace or on lower terraces. Glentosh soils have a sandy particle-size control section. Kamie soils

Figure 8.—Profile of Larton loamy fine sand showing the lighter colored thick A2 horizon that extends from about 9 to 25 inches.

do not have a thick A horizon. Porum and Stigler soils have a fine particle-size control section.

Typical pedon of Larton loamy fine sand, 1 to 3 percent slopes, 2,400 feet north and 850 east of the southwest corner of sec. 22, T. 11 W., R. 14 E.

A1—0 to 9 inches; dark yellowish brown (10YR 3/4) loamy fine sand; weak fine granular structure; friable; slightly acid; clear smooth boundary.

A2—9 to 25 inches; yellowish brown (10YR 5/4) loamy fine sand; weak fine granular structure; friable; medium acid; clear wavy boundary.

B21t—25 to 36 inches; red (2.5YR 4/6) sandy clay loam; common medium distinct strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; firm; thin continuous clay films on faces of peds; medium acid; gradual smooth boundary.

B22t—36 to 46 inches; yellowish red (5YR 4/6) fine sandy loam; moderate medium subangular blocky structure; firm; thin discontinuous clay films on faces of peds; medium acid; gradual smooth boundary.

B32t—46 to 54 inches; yellowish red (5YR 5/8) fine sandy loam; weak medium subangular blocky structure; firm; thin discontinuous clay film on faces of peds; medium acid; gradual smooth boundary.

B24t—54 to 78 inches; reddish yellow (7.5YR 7/8) fine sandy loam; weak coarse blocky structure; friable; few skeletons of loamy fine sand with clean sand grains; slightly acid.

Thickness of solum is more than 60 inches. Thickness of the A horizon ranges from 20 to 34 inches.

The A1 horizon is very dark grayish brown (10YR 3/2), brown (10YR 4/3, 5/3; 7.5YR 4/2, 5/2, 4/4, 5/4), dark brown (10YR 3/3; 7.5YR 3/2), dark yellowish brown (10YR 3/4, 4/4), or grayish brown (10YR 5/2). The A2 horizon is grayish brown (10YR 5/2), light brownish gray (10YR 6/2), yellowish brown (10YR 5/4), pale brown (10YR 6/3), very pale brown (10YR 7/3), light brown (7.5YR 6/4), or light yellowish brown (10YR 6/4). The A horizon is medium acid or slightly acid.

The B2t horizon is red (2.5YR 4/6, 4/8, 5/6, 5/8), reddish yellow (5YR 6/6, 6/8), or yellowish red (5YR 4/6, 4/8, 5/6, 5/8). It is sandy clay loam, fine sandy loam, or loam. Reaction is strongly acid or medium acid. The B24t horizon is similar to the B2t horizon in color and texture, but it contains pockets of clean sand that make up 4 to 10 percent. Reaction ranges from strongly acid to slightly acid.

Linker series

The Linker series consists of moderately deep, well drained, moderately permeable soils that formed in residuum weathered from sandstone. These very gently sloping to gently sloping soils are on broad, slightly convex side slopes of uplands. They have slopes ranging from 1 to 5 percent. Soils of the Linker series are fine-loamy, siliceous, thermic Typic Hapludults.

Linker soils are associated with Enders, Endsaw, Hector, and Shermore soils. Enders and Endsaw soils, on steeper side slopes, have more than 35 percent clay in the argillic horizon. Hector soils, on ridges, are shallow. Shermore soils, on foot slopes, have a fragipan.

Typical pedon of Linker fine sandy loam, 3 to 5 percent slopes, 1,250 feet east and 500 feet north of the southwest corner of sec. 9, T. 11 N., R. 18 E.

A1—0 to 7 inches; dark brown (7.5YR 4/4) fine sandy loam; weak fine granular structure; friable; strongly acid; clear wavy boundary.
B1—7 to 14 inches; yellowish red (5YR 4/6) fine sandy loam; weak medium subangular blocky structure; friable; strongly acid; clear wavy boundary.
B2t—14 to 26 inches; red (2.5YR 4/6) sandy clay loam; moderate medium subangular blocky structure; firm; thin patchy clay films on faces of peds; strongly acid; gradual wavy boundary.
B3—26 to 36 inches; red (2.5YR 4/6) sandy clay loam; few fine brown mottles; weak medium subangular blocky structure; friable; thin discontinuous clay films on faces of peds; few fine fragments of sandstone; very strongly acid; abrupt wavy boundary.
R—36 to 42 inches; red (2.5YR 4/6) hard sandstone.

Thickness of solum and depth to bedrock ranges from 20 to 40 inches. Fragments of sandstone less than 3 inches in diameter make up 0 to 10 percent, by volume. The solum is very strongly acid or strongly acid.

The A1 horizon is very dark grayish brown (10YR 3/2), dark grayish brown (10YR 4/2), dark yellowish brown (10YR 4/4), dark brown (10YR 4/3; 7.5YR 4/2, 4/4), or in cultivated areas, brown (7.5YR 5/4). If present, the A2 horizon is brown (7.5YR 5/2, 5/4).

The B1 horizon is yellowish red (5YR 4/6, 5/6, 5/8), or strong brown (7.5YR 5/6). It is fine sandy loam, loam, or sandy clay loam.

The B2t horizon is yellowish red (5YR 4/6, 5/6, 5/8) or red (2.5YR 4/6, 4/8, 5/6, 5/8). It is sandy clay loam or clay loam.

The B3 horizon has colors similar to those of the B2t horizon and also has mottles of red, brown, or yellow. It is fine sandy loam, loam, sandy clay loam, or clay loam that has fragments of sandstone which make up 0 to 25 percent, by volume.

Madill series

The Madill series consists of deep, well drained, moderately rapidly permeable alluvial soils that formed in loamy sediments. These nearly level soils are on smooth flood plains. Slopes are 0 to 1 percent. Soils of the Madill series are coarse-loamy, mixed, nonacid, thermic Typic Udifluvents.

The Madill soils are associated with Caspiana, Convent Variant, Kiomatia, Muldrow, and Verdigris soils. All of these soils except Caspiana soils are in lower positions. Caspiana soils are on terraces. Caspiana, Muldrow, and Verdigris soils have a mollic epipedon. Convent Variant soils are somewhat poorly drained and are coarse-silty. Kiomatia soils have a sandy particle-size control section.

Typical pedon of Madill fine sandy loam, occasionally flooded, 500 feet north and 900 feet west of the southeast corner of sec. 24, T. 11 N., R. 14 E.

A11—0 to 9 inches; dark brown (10YR 4/3) fine sandy loam; weak fine granular structure; friable; slightly acid; clear smooth boundary.
A12—9 to 20 inches; dark grayish brown (10YR 4/2) fine sandy loam; weak fine granular structure; friable; neutral; gradual smooth boundary.
C1—20 to 42 inches; brown (7.5YR 4/4) fine sandy loam; massive; friable; few thin strata of loam and loamy fine sand; neutral; gradual smooth boundary.
C2—42 to 62 inches; brown (7.5YR 5/4) loamy fine sand; massive; friable; moderately alkaline.

Depth of soil is more than 60 inches. The A horizon is dark brown (10YR 4/3, 3/3; 7.5YR 3/2), dark grayish brown (10YR 4/2), dark reddish brown (5YR 3/3, 3/4), or reddish brown (5YR 4/3, 4/4, 5/3, 5/4). Where values are 3 or less, this horizon is less than 6 inches thick. Reaction ranges from medium acid to neutral.

The C horizon is strong brown (7.5YR 5/6, 5/8), brown (7.5YR 4/2, 4/4, 5/2, 5/4; 10YR 4/3, 5/3), reddish brown (5YR 4/3, 4/4, 5/3, 5/4), or yellowish red (5YR 5/6). It is fine sandy loam, loam, or loamy fine sand below a depth of 40 inches and has thin strata of finer or coarser material. This horizon ranges from medium acid to neutral above a depth of 40 inches and from slightly acid to moderately alkaline below.

Muldrow series

The Muldrow series consists of deep, somewhat poorly drained, very slowly permeable soils that formed in clayey sediments. These nearly level soils are in slightly depressional areas on terraces. They have a high water table that fluctuates between the surface and depths to 2 feet during the fall and spring. Slopes are 1 percent or less. Soils of the Muldrow series are fine, mixed, thermic Typic Argiaquolls.

Muldrow soils are associated with Caspiana, Madill, and Verdigris soils. Caspiana soils, on the same terrace level in slightly higher positions, are fine-silty and well drained. Madill soils, on a flood plain, are coarse-loamy and do not have a mollic epipedon or an agrillic horizon. Verdigris soils, on a flood plain, and are fine-silty and do not have an argillic horizon.

Typical pedon of Muldrow silty clay loam, rarely flooded, 1,400 feet west and 400 feet south of the northeast corner of sec. 24, T. 11 N., R. 14 E.

A1—0 to 10 inches; very dark gray (10YR 3/1) silty clay loam; moderate fine granular structure; friable; medium acid; clear smooth boundary.
B2tg—10 to 34 inches; very dark gray (10YR 3/1) silty clay; common fine distinct strong brown (7.5YR 5/6) mottles; strong medium subangular blocky structure; very firm; faces of peds are shiny; slightly acid; gradual smooth boundary.
B3g—34 to 62 inches; gray (10YR 5/1) silty clay; common fine distinct yellowish brown (10YR 5/4)

mottles; strong course blocky structure; very firm; faces of peds are shiny; neutral.

Thickness of solum ranges from 50 to more than 60 inches. The A horizon is very dark grayish brown (10YR 3/2), very dark gray (10YR 3/1), very dark brown (10YR 2/2), or black (10YR 2/1). Reaction is strongly acid or medium acid.

The B2tg horizon is similar to the A horizon in color. It also has mottles in shades of strong brown, or reddish brown. This horizon is silty clay loam, silty clay, or clay. Reaction ranges from slighty acid to neutral.

The B3g horizon is dark brown (7.5YR 4/2, 4/4; 10YR 4/3), gray (10YR 5/1), dark gray (10YR 4/1), dark grayish brown (10YR 4/2), or grayish brown (10YR 5/2). It is silty clay or clay. Reaction ranges from neutral to moderately alkaline.

Parsons series

The Parsons series consists of deep, somewhat poorly drained, very slowly permeable soils that formed in material predominantly weathered from clayey valley fill material. These nearly level soils are on broad smooth uplands. They have a perched water table between depths of 1/2 foot and I I/2 feet during the winter and spring. Slopes range from 0 to 1 percent. Soils of the Parsons series are fine, mixed, thermic Mollic Albaqualfs.

Parsons soils are associated with Carytown, Choteau, Dennis, Taloka, and Woodson soils. Carytown soils, on the same landscape, have more than 15 percent sodium in the argillic horizon. Choteau and Dennis soils, in higher positions, do not have an abrupt change in texture between the A horizon and B horizon. Taloka soils, in the same positions, have an A horizon of 16 inches or more. Woodson soils, in lower positions, have a mollic epipedon and do not have an A2 horizon.

Typical pedon of Parsons silt loam, 0 to 1 percent slopes, 1,400 feet south and 1,300 feet west of the northeast corner of sec. 6, T. 12 N., R. 16 E.

A1—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam; common fine distinct dark brown (7.5YR 4/4) mottles; weak medium granular structure; friable; strongly acid; abrupt smooth boundary.

A2—8 to 12 inches; dark grayish brown (10YR 4/2) silt loam; common fine distinct dark brown (7.5YR 4/4) mottles; weak medium granular structure; friable; strongly acid; abrupt wavy boundary.

B21tg—12 to 21 inches; very dark grayish brown (10YR 3/2) clay; common medium distinct dark brown (7.5YR 4/4) mottles; strong coarse blocky structure parting to strong fine blocky; extremely firm; thin continuous clay films on faces of peds; thin light gray coatings on faces of peds; few fine black concretions; strongly acid; gradual smooth boundary.

B22tg—21 to 37 inches; grayish brown (10YR 5/2) clay; common medium distinct strong brown (7.5YR 5/6) mottles; strong coarse blocky structure; extremely firm; grayish brown (10YR 5/2) coatings on faces of peds; thin continuous clay films on faces of peds; few fine black concretions; strongly acid, gradual smooth boundary.

B23t—37 to 56 inches; grayish brown (10YR 5/2) clay; common medium faint yellowish brown (10YR 5/8) mottles; weak coarse blocky structure; extremely firm; coatings of silt on faces of some peds; patchy clay films on faces of peds; few fine gypsum crystals; few fine black concretions; slightly acid; gradual smooth boundary.

B3—56 to 76 inches; grayish brown (10YR 5/2) clay; many coarse prominent yellowish brown (10YR 5/6) mottles; weak coarse blocky structure; very firm; patchy clay films on faces of peds; few fine gypsum crystals; neutral.

Thickness of solum ranges from 40 to more than 60 inches. The A horizon is less than 16 inches thick.

The A1 horizon is very dark grayish brown (10YR 3/2) and is less than 10 inches thick, is less than 1 percent organic matter, or the base saturation is less than 50 percent. The A2 horizon is dark gray (10YR 4/1), dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), or gray (10YR 5/1). The A horizon ranges from strongly acid to slightly acid.

The B2t horizon is very dark grayish brown (10YR 3/2), dark grayish brown (10YR 4/2), or grayish brown (10YR 5/2) and has mottles in shades of gray, brown, or red. It is clay or silty clay. Reaction ranges from strongly acid to slightly acid. The B3 horizon has texture and color similar to the B2t horizon. Reaction ranges from strongly acid to mildly alklaine.

Porum series

The Porum series consists of deep, moderately well drained, slowly permeable soils that formed in loamy and clayey alluvium. These very gently sloping to gently sloping soils are on broad smooth terraces. A perched water table is between depths of 2 to 3 feet during the winter and spring. Slopes range from 1 to 5 percent. Soils of the Porum series are fine, mixed, thermic Glossaquic Paleudalfs.

Porum soils are associated with Glentosh, Kamie, Karma, Larton, and Stigler soils. All of these soils are in the same terrace position. The Glentosh soils are also on lower terraces. Glentosh soils are sandy, and Kamie and Karma soils are fine-loamy in the control section. Larton soils have an A horizon of 20 inches or more in thickness and a loamy particle-size control section. Stigler soils do not have clean sand and silt grains in the lower part of the argillic horizon.

Typical pedon of Porum fine sandy loam, 1 to 3 percent slopes, 1,800 feet west and 600 feet north of the southeast corner of sec. 20, T. 10 N., R. 16 E.

A1—0 to 6 inches; dark brown (10YR 4/3) fine sandy loam; weak medium granular structure; very friable; strongly acid; clear smooth boundary.

A2—6 to 10 inches; pale brown (10YR 6/3) fine sandy loam; weak medium granular structure; friable; strongly acid; clear smooth boundary.

B1—10 to 18 inches; strong brown (7.5YR 5/6) clay loam; weak medium subangular blocky structure; firm; strongly acid; gradual smooth boundary.

B21t—18 to 40 inches; red (2.5YR 4/6) silty clay loam; few fine prominent gray mottles; moderate medium blocky structure; very firm; thin clay films on faces of peds; few fine black and brown concretions; medium acid; gradual smooth boundary.

B22t—40 to 64 inches; yellowish red (5YR 4/6) clay loam; many medium distinct light gray (10YR 6/1) mottles; weak medium blocky structure; firm; few thin clay films on faces of peds; about 8 percent, by volume, pockets of clean sand and silt grains; medium acid.

Thickness of solum ranges from 60 inches to more than 80 inches.

The A1 horizon is dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), brown or dark brown (10YR 3/3, 4/3, 5/3). The A2 horizon is pale brown (10YR 6/3), brown (10YR 4/3, 5/3; 7.5YR 5/4), or yellowish brown (10YR 5/4). The A horizon is strongly acid or medium acid.

The B1 horizon is strong brown (7.5YR 5/6), brown (7.5YR 5/4), or yellowish brown (10YR 5/4) loam, clay loam, or silt loam. Reaction is very strongly acid or strongly acid.

The B21t horizon is red (2.5YR 4/6, 5/6), reddish yellow (7.5YR 6/6), reddish brown (5YR 4/4), strong brown (7.5YR 5/6), or yellowish red (5YR 4/6, 4/8, 5/6). It is mottled in shades of gray, and in some places it is mottled in shades of brown or red. This horizon is clay loam, silty clay loam, or clay. Reaction is acid or medium acid.

The B22t horizon is red to strong brown and is mottled in shades of gray and brown or red silty. It is clay loam, clay loam, or sandy clay loam. Reaction ranges from medium acid to mildly alkaline. Clean sand and silt grains make up 5 to 15 percent, by volume.

Shermore series

The Shermore series consists of deep, moderately well drained, moderately slowly permeable soils that formed in loamy colluvial material and are underlain with interbedded sandstones and shales. These gently sloping to sloping soils are on broad, smooth, convex foot slopes. They have a perched water table between depths of 1 1/2 and 3 1/2 feet in the winter and spring. Slopes range from 3 to 8 percent. Soils of the Shermore series are fine-loamy, siliceous, thermic Typic Fragiudalfs.

Shermore soils are associated with Enders, Endsaw, Hector, and Linker soils. None of the associated soils have a fragipan. Enders and Endsaw soils, in higher positions, have a clayey particle-size control section. Hector soils, on ridges, have sandstone at depths of less than 20 inches. Linker soils, on broad slightly convex side slopes of ridges mostly in higher positions, have a solum of 20 to 40 inches.

Typical pedon of Shermore loam, 3 to 8 percent slopes, 650 feet west and 950 feet north of the southeast corner of sec. 2, T. 10 N., R. 17 E.

A1—0 to 8 inches; dark brown (10YR 4/3) loam; weak medium granular structure; friable; few fine black concretions; medium acid; clear smooth boundary.

A2—8 to 12 inches; brown (10YR 5/3) loam; weak medium granular structure; friable; few fine black concretions; medium acid; clear smooth boundary.

B1—12 to 18 inches; yellowish brown (10YR 5/4) clay loam; few medium distinct dark brown (7.5YR 4/4) and strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; friable; few fine fragments of sandstone; common fine black concretions; medium acid; gradual smooth boundary.

B2t—18 to 30 inches; yellowish brown (10YR 5/6) clay loam; common medium distinct strong brown (7.5YR 5/6) and few medium distinct brown (10YR 5/3) mottles; weak medium subangular blocky structure; friable; patchy clay films on faces of peds; common fine black and strong brown concretions; few fine fragments of sandstone; strongly acid; clear wavy boundary.

Bx1—30 to 50 inches; coarsely mottled brown (10YR 5/3), yellowish brown (10YR 5/6), dark gray (10YR 4/1) clay loam; moderate coarse prismatic structure parting to moderate fine subangular blocky; brittle; patchy clay films on faces of peds; common medium strong brown black and red concretions; gray streaks in seams between polygons; very strongly acid; gradual wavy boundary.

Bx2—50 to 70 inches; brownish yellow (10YR 6/8) sandy clay loam, few fine prominent red and distinct strong brown mottles; moderate coarse prismatic structure parting to weak medium subangular blocky; brittle; thin patchy clay films on faces of peds; common fine black, red, and yellowish brown concretions; few small fragments of sandstones; strongly acid.

The solum thickness is more than 60 inches. Depth to the fragipan is 20 to 40 inches. Yellowish brown and black concretions range from 1 to 10 percent, by volume, throughout the solum and are 2 to 10 millimeters in diameter. Red concretions range from 1 to 10 percent, by volume, in the B22t and Bx horizons.

The A1 horizon is dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), dark brown (7.5YR 4/2, 4/4; 10YR 4/3), brown (7.5YR 5/2, 5/4), dark yellowish brown (10YR 4/4), or yellowish brown (10YR 5/4). Fragments of sandstone less than 76 millimeters in diameter make up 0 to 10 percent, by volume. This horizon is strongly acid or medium acid.

The A2 horizon is brown (10YR 5/3), yellowish brown (10YR 5/4, 5/6), light yellowish brown (10YR 6/4), brownish yellow (10YR 6/6), brown (7.5YR 5/4), strong brown (7.5YR 5/6), reddish yellow (7.5YR 6/6). It is fine sandy loam or loam, and this horizon is less than 6 inches thick. This horizon is strongly acid or medium acid.

Some places do not have a B1 horizon. If present, it has colors and textures similar to those the B2t horizon, and reaction is similar to the A horizon.

The B2t horizon is dark yellowish brown (10YR 4/6, 4/8), yellowish brown (10YR 5/4, 5/6, 5/8), brownish yellow (10YR 6/6, 6/8), strong brown (7.5YR 5/6, 5/8), or reddish yellow (7.5YR 6/6, 6/8). In some places, the horizon has mottles in shades of brown. It is loam, clay loam, or sandy clay loam. Fragments of sandstone less than 76 millimeters in diameter make up 0 to 15 percent, by volume. This horizon is very strongly acid to medium acid.

The Bx horizon is brown (7.5YR 5/4), strong brown (7.5YR 5/6, 5/8), light brown (7.5YR 6/4), reddish yellow (7.5YR 6/6, 6/8), yellowish brown (10YR 5/4, 5/6, 5/8), light yellowish brown (10YR 6/4), or brownish yellow (10YR 6/6, 6/8). Mottles are fine to coarse in shades of red, brown, and gray. This horizon is loam, sandy clay loam, or clay loam that has a clay content of 18 to 35 percent. Reaction is very strongly acid or strongly acid. The gray vertical streaks in seams between polygons range from 1 millimeter to 15 millimeters and are usually more clayey than the matrix.

If present, the B3 horizon has colors similar to those in the Bx horizon. Texture is loam, sandy clay loam, or clay loam.

Stigler series

The Stigler series consists of deep, moderately well drained, very slowly permeable soils that formed in loamy and clayey alluvium over interbedded shales and sandstones. These nearly level soils are on high, broad, smooth terraces. They have a perched water table between depths of 2 and 3 feet during winter and spring. Slopes range from 0 to 1 percent. Soils of the Stigler series are fine, mixed, thermic Aquic Paleudalfs.

Stigler soils are associated with Burwell, Carytown, Kamie, Larton, and Porum soils. All of these soils are on the same terrace positions. Burwell soils are fine-silty, Kamie soils are fine-loamy, and the Larton soils are loamy. Porum soils have clean sand and silt grains in the lower part of the argillic horizon.

Typical pedon of Stigler very fine sandy loam, 0 to 1 percent slopes, 1,200 feet west and 100 feet north of the southeast corner of sec. 7, T. 11 N., R. 16 E.

A1—0 to 9 inches; dark brown (10YR 4/3) very fine sandy loam; weak fine granular structure; friable; strongly acid; gradual smooth boundary.

A2—9 to 19 inches; pale brown (10YR 6/3) very fine sandy loam; weak fine granular structure; friable; strongly acid; clear wavy boundary.

B21t—19 to 24 inches; dark brown (10YR 4/3) silty clay; few fine prominent red and few fine distinct dark gray mottles; moderate medium blocky structure; very firm; pale brown coatings on faces of peds; nearly continuous clay films on faces of peds; strongly acid; gradual wavy boundary.

B22t—24 to 48 inches; brown (10YR 5/3) clay; common medium prominent red (2.5YR 4/8) and yellowish brown (10YR 5/6) mottles; strong coarse blocky structure; very firm; brown coatings on faces of peds; nearly continuous clay films on faces of peds; medium acid; gradual wavy boundary.

B23t—48 to 62 inches; brown (10YR 5/3) silty clay loam; common coarse distinct yellowish brown (10YR 5/8) mottles; weak coarse blocky structure; very firm; pale brown coatings on faces of peds; thin patchy clay films on faces of peds; mildly alkaline.

Thickness of solum and depth to shale and sandstone is more than 60 inches. Thickness of the A horizon ranges from 16 to 28 inches.

The A1 horizon is dark grayish brown (10YR 4/2), dark brown (10YR 3/3, 4/3), or grayish brown (10YR 5/2). The A2 horizon is grayish brown (10YR 5/2), brown (10YR 5/3), pale brown (10YR 6/3), light brownish gray (10YR 6/2), yellowish brown (10YR 5/4), or light yellowish brown (10YR 6/4). The A horizon is very strongly acid or strongly acid.

The B2t horizon is brown (10YR 4/3, 5/3), pale brown (10YR 6/3), light yellowish brown (10YR 6/4), yellowish brown (10YR 5/6, 5/8), or brownish yellow (10YR 6/6, 6/8). It is mottled in shades of gray, brown or red. This horizon is silty clay loam, silty clay, or clay. Reaction is strongly acid or medium acid. Below a depth of 40 inches, this horizon has chroma of 2, and reaction ranges from medium acid to mildly alkaline.

Talihina series

The Talihina series consists of shallow, moderately well drained, slowly permeable soils that formed in loamy and clayey residuum weathered from shale and thin layers of siltstone and sandstone. These sloping to moderately steep soils are on convex ridges of uplands. They have a perched water table between depths of 1/2 foot and 1 1/2 feet during the winter and spring. Slopes range from 5 to 15 percent. Soils of the Talihina series are clayey, mixed, thermic, shallow Aquic Hapludolls.

Talihina soils are associated with Bates, Collinsville, and Eram soils. Bates and Eram soils are on lower side slopes and are moderately deep. Also Bates soils are fine-loamy. Collinsville soils are in positions similar to those of Talihina soils and have a loamy particle-size control section.

Typical pedon of Talihina clay loam, 5 to 15 percent slopes, 2,400 feet west and 2,100 feet north of the southeast corner of sec. 13, T. 12 N., R. 15 E.

A1—0 to 7 inches; very dark grayish brown (10YR 3/2) clay loam; moderate medium granular structure; friable; medium acid; clear wavy boundary.

B2—7 to 15 inches; very dark grayish brown (2.5Y 3/2) clay; few fine faint brown mottles; moderate medium blocky structure; very firm; few fine fragments of shale in lower part; slightly acid; clear smooth boundary.

Cr—15 to 20 inches; dark gray (10YR 4/1) mildly alkaline soft shale.

Thickness of solum and depth to the Cr horizon ranges from 10 to 20 inches. Fragments of shale less than 3 inches in diameter make up 0 to 10 percent of the solum, by volume.

The A1 horizon is very dark grayish brown (10YR 3/2), very dark brown (10YR 2/2), or dark brown (10YR 3/3). Reaction ranges from strongly acid to slightly acid.

The B2 horizon is very dark graysih brown (10YR 3/2; 2.5Y 3/2), dark brown or brown (10YR 3/3, 4/3, 5/3), dark yellowish brown (10YR 3/4, 4/4), grayish brown (10YR 5/2; 2.5Y 5/2). It is mottled in shades of brown, olive, or gray. This horizon ranges from medium acid to mildly alkaline.

The Cr horizon is dark gray (10YR 4/1), grayish brown (2.5Y 5/2; 10YR 5/2), light yellowish brown (2.5Y 6/4; 10YR 6/4), olive gray (5Y 4/2, 5/2), or olive (5Y 4/3, 5/3, 5/4). It is mottled in shades of olive, brown, gray, and yellow. In some places, this horizon has thin strata of sandstone. Reaction ranges from slightly acid to moderately alkaline.

Figure 9.—Profile of Taloka soil showing the boundary of the albic horizon and an argillic horizon.

Taloka series

The Taloka series consists of deep, somewhat poorly drained, very slowly permeable soils that formed in clayey alluvium (fig. 9). These nearly level to very gently sloping soils are on broad smooth uplands or high terraces. They have a perched water table between depths of 1 foot and 2 feet during the spring and summer. Slopes range from 0 to 3 percent. Soils of the Taloka series are fine, mixed, thermic Mollic Albaqualfs.

Taloka soils are associated with Bates, Choteau, Dennis, Parsons and Woodson soils. Bates, Choteau, and Dennis soils are in higher positions on the landscape. Parsons and Woodson soils are on the same positions as Taloka soils. Bates soils are moderately deep and have a fine-loamy control section. Choteau and Dennis soils do not have an abrupt change in texture between the A horizon and B horizon. Parsons soils have an A horizon less than 16 inches thick. Woodson soils have a mollic epipedon.

Typical pedon of Taloka silt loam, 0 to 1 percent slopes, 1,100 feet south and 250 feet west of the northeast corner of sec. 5, T. 12 N., R. 17 E.

A1—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam; weak fine granular structure; friable; medium acid; clear smooth boundary.

A2—7 to 22 inches; grayish brown (10YR 5/2) silt loam; few fine distinct dark brown mottles; weak fine granular structure; friable; medium acid; abrupt smooth boundary.

B21t—22 to 49 inches; dark grayish brown (10YR 4/2) silty clay; common medium faint grayish brown (10YR 5/2) mottles; weak coarse prismatic structure parting to strong medium blocky; very firm; thin continuous clay films on faces of peds; neutral; gradual smooth boundary.

B22t—49 to 57 inches; dark grayish brown (10YR 4/2) silty clay; few fine faint grayish brown mottles; strong medium blocky structure; very firm; films of very dark grayish brown (10YR 3/2) silt loam on faces of peds; continuous clay films on faces of peds; few fine black concretions; neutral; gradual smooth boundary.

B3—57 to 75 inches; dark gray (10YR 4/1) silty clay; many coarse distinct dark yellowish brown (10YR 4/4) mottles; weak coarse blocky structure; very firm; thin discontinous clay films on ped faces; few fine black concretions; neutral.

Thickness of solum ranges from 40 to more than 60 inches. Thickness of A horizon ranges from 16 inches to 30 inches.

The A1 horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). The horizon ranges from 6 to 14 inches in thickness. Where it is more than 10 inches thick, the organic matter is less than 1 percent, or the base saturation is less than 50 percent. The A2 horizon is dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2). The A horizon is strongly acid or medium acid.

The B2t horizon is dark gray (10YR 4/1), dark grayish brown (10YR 4/2), very dark gray (10YR 3/1), dark brown (10YR 4/3), or dark yellowish brown (10YR 3/4, 4/4) and has mottles in shades of gray, brown, or red. Pedons that have chromas of 3 and 4 have dominant values of 2 or less. This horizon is silty clay or clay. Reaction ranges from strongly acid to neutral.

The B3 horizon is similar in color and texture to the B2t horizon, but it is mottled in shades of gray, brown, or yellowish brown. Reaction ranges from slightly acid to moderately alkaline.

Verdigris series

The Verdigris series consists of deep, moderately well drained, moderately permeable soils that formed in loamy alluvium. These nearly level soils are on smooth flood plains. Slopes range from 0 to 1 percent. Soils of the Verdigris series are fine-silty, mixed, thermic Cumulic Hapludolls.

These soils are associated with Caspiana, Convent Variant, Kiomatia, Madill, and Muldrow soils. All of these soils are in lower positions except the Caspiana and Madill soils. Caspiana and Muldrow soils have an argillic horizon. Convent Variant, Madill, and Kiomatia soils do not have a mollic epipedon.

Typical pedon of Verdigris silt loam, frequently flooded, 2,600 feet south and 1,200 feet west of the northeast corner of sec. 29, T. 12 N., R. 17 E.

A—0 to 21 inches; very dark grayish brown (10YR 3/2) silt loam; weak fine granular structure; friable; slightly acid; gradual smooth boundary.

AC—21 to 48 inches; dark brown (10YR 3/3) silt loam; few fine distinct yellowish brown mottles; weak fine granular structure; friable; medium acid; gradual smooth boundary.

C—48 to 68 inches; brown (10YR 5/3) silt loam; few fine distinct yellowish brown mottles; massive; friable; few fine black concretions; medium acid.

Thickness of mollic epipedon ranges from 24 inches to more than 40 inches. The A horizon is very dark grayish brown (10YR 3/2), very dark brown (10YR 2/2), or dark brown (10YR 3/3; 7.5YR 3/2). Reaction is medium acid or slightly acid. The AC horizon is similar in color and reaction to those of the A horizon. In most places, it has faint mottles in shades of higher chroma and lower value below a depth of 20 inches.

The C horizon is dark brown (10YR 4/3; 7.5YR 5/2, 5/4) or brown (10YR 5/3). In some places, it contains strata of slightly darker or lighter colors of sandy loam, silty clay loam, or clay loam below a depth of 40 inches. This horizon ranges from medium acid to neutral.

Woodson series

The Woodson series consists of deep, somewhat poorly drained, very slowly permeable soils that formed in material weathered from silty and clayey sediments. These nearly level soils are on broad smooth uplands. They have a perched water table between depths of 1/2 foot and 2 feet during the winter and spring. Slopes range from 0 to 1 percent. Soils of the Woodson series are fine, montmorillonitic, thermic Abruptic Argiaquolls.

Woodson soils are associated with Bates, Dennis, Kanima, Parsons, and Taloka soils. Bates and Dennis soils are in higher positions on the landscape. Kanima soils are on the same general landscape but in higher positions. Parsons and Taloka soils are on the same landscape. Bates soils are moderately deep and fine-loamy in the control section. Dennis soils do not have an abrupt change in texture from the A horizon to the B horizon. Kanima soils are loamy-skeletal. Parsons and Taloka soils do not have a mollic epipedon.

Typical pedon of Woodson silt loam, 0 to 1 percent slopes, 2,500 feet west and 200 feet south of the northeast corner of sec. 24, T. 11 N., R. 14 E.

A1—0 to 8 inches; very dark gray (10YR 3/1) silt loam; moderate fine granular structure; friable; slightly acid; abrupt smooth boundary.

B21t—8 to 20 inches; very dark gray (10YR 3/1) silty clay; few fine faint brown mottles; moderate fine blocky structure; very firm; slightly acid; gradual smooth boundary.

B22t—20 to 34 inches; very dark gray (10YR 3/1) silty clay; strong medium blocky structure; very firm; few fine black concretions; slightly acid; gradual smooth boundary.

B23t—34 to 60 inches; gray (10YR 5/1) silty clay; common medium distinct yellowish brown (10YR 5/6) and few fine distinct olive brown mottles; weak coarse blocky structure; very firm; neutral.

Thickness of solum ranges from 30 to 60 inches. The A horizon is very dark gray (10YR 3/1) or black (10YR 2/1). It is medium acid or slightly acid.

The B2t horizon is very dark gray (10YR 3/1; N 3/) in the upper part but also includes black (10YR 2/1; N 2/), or gray (5Y 5/1; N 5/) in the lower part. This horizon has few to many and faint or distinct mottles. It is silty clay or clay. Reaction ranges from medium acid to neutral.

The C horizon, if present, is dark gray (10YR 4/1; N 4/ ; 5Y 4/1), gray (10YR 5/1; N 5/ ; 5Y 5/1), dark grayish brown (10YR 4/2; 2.5Y 4/2), grayish brown (10YR 5/2; 2.5Y 5/2), or olive (5Y 4/3, 5/3). This horizon has mottles ranging from few to many and are faint or distinct. It is silty clay or clay. Reaction ranges from medium acid to neutral.

formation of the soils

The characteristics of the soil at any given point are determined by (1) the physical properties and mineralogical composition of the parent material, (2) the climate under which the parent material has existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief or lay of the land, and (5) length of time the last three factors of soil development have acted on the parent material. Few generalizations can be made regarding the effects of any one factor because the effects of each is modified by the other four.

parent material

Parent material is one of the most influential factors of soil formation in the county. It set the limits of the physical properties and chemical and mineral composition of the soil, and it influences the rate of soil development. Parent material is the unconsolidated material from which soil is formed.

The parent materials of the county are grouped into two classes, namely residual or transported. Residual parent material is formed in place from the weathering of consolidated bedrock. Transported parent material is unconsolidated material that has been transported and redeposited by wind or water from the site of its parent bedrock.

The soils in this county have formed in residuum from bedrock of the Pennsylvanian System and from transported material of the Quaternary System.

The Pennsylvanian bedrock consists mainly of alternating sandstones and shales of the Atoka and Des Moines Series. The formations crop out in bands trending slightly east of north as follows (from east to west, oldest to youngest): the Atoka, McAlester, Savanna, Boggy, Stuart, and Senora Formations.

The structure of the bedrock in the eastern part of the county is dominated by east-west trending folds and faults that involve the Boggy and older formations. In the western part of the county, the Stuart and Senora Formations cover the older bedrock, and this younger bedrock dips to the northwest about 1 degree.

The oldest formation, the Atoka, outcrops in the Warner uplift southwest of the community of Shady Grove. The McAlester Formation overlies the Atoka and outcrops in the western part of the Warner uplift. This Formation has maximum thickness of 450 feet and consists of silty shale, thin sandstone, and coal layers. The Savanna Formation, which is predominantly shale, is 200 to 300 feet thick and outcrops in a narrow band in the northeastern part of the county. The Boggy Formation overlies the Savanna and outcrops in a wide area in the eastern part of the county. This formation is 700 to 1,400 feet thick. The upper part of the formation consists predominantly of sandy and silty shale that has interbedded scrap-forming sandstone units. The Bluejacket Sandstone is in the lower 100 to 200 feet.

The soils that formed in parent material of the Atoka, McAlester, Savanna, and Boggy Formations are the Enders, Endsaw, Hector, Linker and Shermore soils. The Hector soils are on the narrow crest of sandstone ridges; the Enders and Endsaw soils are underlain by shale on hill slopes below the Hector soils, and the Linker and Shermore are on the foot slopes.

The Stuart Formation outcrops in a narrow band west of the Boggy Formation. It consists of approximately 380 feet of silty shale that has some thin interbedded silty sandstones.

The Senora Formation has outcrops that cover most of the western part of the county. The formation is about 950 feet thick. The upper 350 feet is dominantly silty shale and the lower 600 feet is sandstone interbedded with shale.

Soils that formed in parent material weathered from the Stuart and the lower Senora Formations are the Bates, Cherokee, Chocteau, Collinsville, Dennis, Eram, Parsons, Taloka, and Woodson soils. Soil that formed in the upper Senora Formation are the Enders, Endsaw, Hector, Linker, and Shermore soils.

The Quaternary System includes recent sandy and loamy alluvial deposits in the flood plains of small streams and major rivers. The largest areas of sandy deposits are in the lowest part of the flood plains of rivers. The Kiomatia soils formed in these materials. The loamy deposits mostly are in flood plains of small streams. The Convent Variant and Madill soils formed in areas draining woodlands and the Verdigris soils in areas draining prairies.

Loamy alluvial deposits and sandy wind blown deposits are on terraces above the flood plains of the major rivers. The Karma soils developed in loamy deposits on the more sloping areas of terraces and the Kamie soils are on broad, smooth areas. The Glentosh soils formed in the sandy eolian deposits.

Clayey alluvial deposits are also on terraces of major streams but at a distance farther from the river than the loamy deposits or on terraces slightly higher in elevation.

The soils that formed in these clayey parent materials are the Carytown, Muldrow, Parsons, Porum, Stigler, and Taloka soils.

climate

The moist, subhumid continental climate of McIntosh County is characterized by high-intensity rainfall. Moisture and warm temperatures have promoted the formation of distinct horizons in many of the soils. Differences in soils, however, cannot be attributed to climate because the climate is uniform throughout the county. Heavy rains have caused rapid runoff that has eroded many of the soils. This erosion is an indirect effect of climate.

plants and animals

Plants, burrowing animals, insects, and soil micro-organisms have a direct influence on the formation of soil. For example, native vegetation, such as forest or prairie, or a combination of both, influences the amount of organic matter, the amounts and kinds of plant nutrients, and soil structure. Prairie vegetation adds more organic matter to the soil, causes a stronger grade of structure to develop in the A horizon, and recycles more nutrients to the upper horizons than does forest vegetation. For example, the Dennis and Taloka soils have a thicker, darker colored, more nutrient rich A horizon that has a more developed granular structure than do the Glentosh and Enders soils, which formed under forest vegetation.

During the past century, man has altered this soil-forming factor by removing the native vegetation over much of the county. Lack of adequate conservation measures has resulted in much soil loss through sheet and gully erosion. Where some of the surface layer has been removed and gullies have formed, eroded phases of soils are mapped. An example is Karma fine sandy loam, 3 to 8 percent slopes, gullied.

relief

Relief affects soil formation through its influence on moisture, drainage, erosion, temperature, and plant cover. The relief of McIntosh County is determined largely by the varying resistance of underlying bedrocks to weathering and geological erosion.

The effects of relief on soil formation are illustrated by two different soils, namely Dennis and Hector. Dennis soils are in areas of less sloping relief than the Hector soils. Dennis soils have a thicker solum that has more developed horizons than do Hector soils. These differences primarily result from Dennis soils having less surface runoff and more water percolating into the soil to influence the loss, gain, or transfer of soil constituents than Hector soils.

time

Time as a factor cannot be measured strictly in years. The length of time needed for the development of genetic horizons depends on the intensity and interactions of the soil-forming factors in promoting the loss, gain, transfer, or transformation of soil constituents that are necessary to form soil horizons. Soils that do not have definite horizons are young or immature. Mature soils have approached equilibrium with their enviroment and tend to have well defined horizons.

The soils of McIntosh County range from young to old. Some of the mature soils are the Dennis and Woodson soils on uplands. Kamie and Karma soils are younger but they, too, have clearly defined horizons. Hector soils are young soils. Because they are sloping, geological erosion has removed soil material almost as fast as it has formed. Madill and Verdigris soils on flood plains have been developing for such a short time that they show little development of horizons.

active processes of soil formation

Active processes that have influenced the formation of horizons in the soils of McIntosh County are accumulation of organic matter, leaching of calcium carbonate and bases, and translocation of silicate clay minerals. In most soils, more than one of these processes have been active in the development of horizons.

Prairie vegetation adds more organic matter to the surface layer and contributes to a more developed granular structure than does forest vegetation. Dennis soils formed under prairie vegetation, and they have a surface layer high in content of organic matter. This kind of surface layer is called a mollic epipedon in the soil classification system. Kamie soils formed under forest vegetation and contain less organic matter than Dennis soils; their surface layer is called an ochric epipedon in the classification system.

Leaching of carbonates and bases is active in the formation of soils. The accumulation of bases in the lower part of the B horizon of Parsons soils indicates the depth to which water has percolated. Enders soils have leached to the extent that they lack accumulation of calcium carbonate. Also, more bases have been leached from the B horizon of Enders soils, and this is reflected by their base saturation. Soils on flood plains, such as Verdigris soils, are recharged with bases when flooding occurs. The more acid Madill soils have not been leached, but they receive sediments from neutral to acid soils. Eran soils formed over shales and are high in bases. Bases in Eram soils are related to the nature of the native vegetation.

The translocation of silicate clay minerals is a very important factor affecting the properties and classification of soils. Clay films on faces of peds, bridging sand grains, and increases in total clay are used in the field as evidence of argillic horizons. The varying degrees of translocation of silicate clay minerals and the kind of parent material in which a soil formed have resulted in wide variations in the texture and other properties of the argillic horizon in different soils. Parsons and Taloka soils have a sub-subsurface layer that is more intensely leached of silicate clay minerals than the surface layer of other soils in the county.

Prairie vegetation brings bases to the surface, and this retards leaching and the formation of an A2 horizon. Geologic erosion on soils such as Hector soils hinders horizon development through soils losses. The sediment in which Madill, Kiomatia and other soils on flood plains formed was deposited so recently that not enough time has lapsed for the formation of horizons.

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glossary

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

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

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.

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

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

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.

Bisequum. Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

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

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Broad-base terrace. A ridge-type terrace built to control erosion by diverting runoff along the contour at a nonscouring velocity. The terrace is 10 to 20 inches high and 15 to 30 feet wide and has gently sloping sides, a rounded crown, and a dish-shaped channel along the upper side. It may be nearly level or have a grade toward one or both ends.

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

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.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

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

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

Cement rock. Shaly limestone used in the manufacture of cement.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a fragment.

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

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

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15.2 to 38.1 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

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.

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.

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.

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.

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 alkali (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

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 lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

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

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

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

Fine textured soil. Sandy clay, silty clay, and clay.

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.

Fragile (in tables). A soil that is easily damaged by use or disturbance.

Fragipan. A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

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.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

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

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.

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.

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

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

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 capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

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.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

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.

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

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

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.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan.*

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

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

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

Percolation. The downward movement of water through the soil.

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

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

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 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.

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

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

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

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

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

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

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

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

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

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

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

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

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

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.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Saprolite (soil science). Unconsolidated residual material underlying the soil and grading to hard bedrock below.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

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

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

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.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

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.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

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

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

Slow intake (in tables). The slow movement of water into the soil.

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

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium absorption ratio (SAR) of a saturation extract, or the ratio of Na^{+} to $Ca^{++} + Mg^{++}$. The degrees of sodicity are—

	SAR
Slight	Less than 13:1
Moderate	13-30:1
Strong	More than 30:1

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.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

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.

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.

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

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."

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

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

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

Toxicity (in tables). Excessive amount of toxic substances, such as sodium or sulfur, that severely hinder establishment of vegetation or severely restrict plant growth.

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.

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

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

tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded 1951-77 at Muskogee, Okla.]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	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----	49.0	27.7	38.4	75	2	17	1.65	0.75	2.37	4	2.4
February---	55.0	32.4	43.8	79	9	41	2.16	.93	3.15	4	3.0
March------	62.8	39.6	51.2	87	16	171	3.22	1.39	4.70	6	.8
April------	73.7	50.3	62.1	90	28	367	4.72	2.82	6.41	7	.0
May--------	80.6	58.6	69.6	92	39	608	4.96	2.60	6.88	7	.0
June-------	88.1	66.8	77.5	98	50	825	4.37	2.14	6.18	6	.0
July-------	93.8	70.9	82.4	106	56	1,004	3.29	.83	5.23	5	.0
August-----	93.1	69.4	81.3	104	57	970	3.14	1.29	4.62	5	.0
September--	85.3	62.4	73.9	100	43	717	4.36	1.67	6.53	6	.0
October----	74.8	50.9	62.9	92	31	407	3.52	.67	5.71	4	.0
November---	61.0	39.4	50.2	81	16	108	2.94	.99	4.50	4	.5
December---	51.7	31.3	41.5	75	5	20	2.32	1.09	3.31	4	.9
Yearly:											
Average--	72.4	50.0	61.2	---	---	---	---	---	---	---	---
Extreme--	---	---	---	106	0	---	---	---	---	---	---
Total----	---	---	---	---	---	5,255	40.65	31.51	49.22	62	7.6

[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

[Recorded 1951-77 at Muskogee, Okla.]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 1	April 5	April 11
2 years in 10 later than--	March 24	March 31	April 7
5 years in 10 later than--	March 9	March 20	March 31
First freezing temperature in fall:			
1 year in 10 earlier than--	October 30	October 29	October 19
2 years in 10 earlier than--	November 6	November 4	October 23
5 years in 10 earlier than--	November 20	November 14	November 2

TABLE 3.--GROWING SEASON

[Recorded 1951-77 at Muskogee, Okla.]

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	220	214	198
8 years in 10	232	223	204
5 years in 10	256	239	215
2 years in 10	279	255	225
1 year in 10	292	264	231

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

Map symbol	Soil name	Acres	Percent
1	Bates loam, 1 to 3 percent slopes	7,415	1.6
2	Bates loam, 3 to 5 percent slopes	4,315	0.9
3	Bates loam, 2 to 5 percent slopes, eroded	2,480	0.5
4	Carytown silt loam, 0 to 1 percent slopes	7,905	1.7
5	Carytown silt loam, 1 to 3 percent slopes, eroded	6,270	1.4
6	Carytown-Burwell complex, 0 to 3 percent slopes	2,025	0.4
7	Caspiana silty clay loam	335	0.1
8	Choteau silt loam, 1 to 3 percent slopes	3,085	0.7
9	Collinsville-Bates complex, 3 to 8 percent slopes	4,920	1.1
10	Collinsville-Talihina complex, 5 to 12 percent slopes	7,960	1.7
11	Convent Variant silt loam, occasionally flooded	930	0.2
12	Dennis silt loam, 1 to 3 percent slopes	16,835	3.7
13	Dennis silt loam, 3 to 5 percent slopes	2,710	0.6
14	Dennis silt loam, 2 to 5 percent slopes, eroded	8,490	1.8
15	Dennis silt loam, 2 to 5 percent slopes, severely eroded	980	0.2
16	Dennis-Verdigris complex, 0 to 8 percent slopes	21,355	4.6
17	Enders-Hector association, moderately steep	96,785	20.8
18	Endsaw-Hector association, steep	14,295	3.1
19	Eram clay loam, 1 to 3 percent slopes	1,840	0.4
20	Eram clay loam, 3 to 5 percent slopes	1,420	0.3
21	Eram clay loam, 1 to 5 percent slopes, eroded	1,225	0.3
22	Glentosh loamy fine sand, 0 to 3 percent slopes	3,210	0.7
23	Glentosh loamy fine sand, 3 to 8 percent slopes	4,945	1.1
24	Kamie loamy fine sand, 1 to 3 percent slopes	2,265	0.5
25	Kamie fine sandy loam, 1 to 3 percent slopes	4,900	1.1
26	Kanima shaly silty clay loam, 3 to 30 percent slopes	735	0.2
27	Karma loamy fine sand, 3 to 5 percent slopes	1,920	0.4
28	Karma loamy fine sand, 2 to 5 percent slopes, eroded	2,295	0.5
29	Karma loamy fine sand, 5 to 8 percent slopes	1,755	0.4
30	Karma loamy fine sand, 3 to 8 percent slopes, gullied	6,460	1.4
31	Karma fine sandy loam, 3 to 5 percent slopes	1,455	0.3
32	Karma fine sandy loam, 2 to 5 percent slopes, eroded	5,090	1.1
33	Karma fine sandy loam, 5 to 8 percent slopes	975	0.2
34	Karma fine sandy loam, 3 to 8 percent slopes, gullied	4,625	1.0
35	Kiomatia loamy fine sand, frequently flooded	2,195	0.5
36	Larton loamy fine sand, 1 to 3 percent slopes	3,540	0.8
37	Linker fine sandy loam, 1 to 3 percent slopes	7,225	1.6
38	Linker fine sandy loam, 3 to 5 percent slopes	15,275	3.3
39	Linker fine sandy loam, 2 to 5 percent slopes, severely eroded	2,000	0.4
40	Linker-Hector complex, 2 to 5 percent slopes	27,540	6.0
41	Madill fine sandy loam, occasionally flooded	2,725	0.6
42	Madill fine sandy loam, frequently flooded	2,825	0.6
43	Muldrow silty clay loam, rarely flooded	910	0.2
44	Parsons silt loam, 0 to 1 percent slopes	14,090	3.1
45	Pits	300	0.1
46	Porum fine sandy loam, 1 to 3 percent slopes	3,045	0.7
47	Porum fine sandy loam, 2 to 5 percent slopes, eroded	6,455	1.4
48	Porum fine sandy loam, 2 to 5 percent slopes, severely eroded	3,445	0.7
49	Shermore loam, 3 to 8 percent slopes	2,980	0.6
50	Stigler very fine sandy loam, 0 to 1 percent slopes	4,150	0.9
51	Talihina clay loam, 5 to 15 percent slopes	865	0.2
52	Taloka silt loam, 0 to 1 percent slopes	26,700	5.8
53	Taloka silt loam, 1 to 3 percent slopes	13,335	2.9
54	Verdigris silt loam, occasionally flooded	7,260	1.6
55	Verdigris silt loam, frequently flooded	13,985	3.0
56	Woodson silt loam, 0 to 1 percent slopes	790	0.2
	Water	44,960	9.8
	Total	460,800	100.0

TABLE 5.--GRAZING YIELDS

[Grazing yields per acre (AUM*) of crops and pasture. Yields are estimated for a high level of management. Absence of a yield figure indicates the crop or grass is seldom grown or is not suited]

Map symbol and soil name	Improved bermudagrass	Tall fescue	Lovegrass	Forage sorghum	Small grain
	AUM[1]	AUM	AUM	AUM	AUM
1. Bates	6.5	5.5	7.0	4.5	4.0
2. Bates	6.0	5.0	7.0	4.5	3.5
3. Bates	5.5	4.5	5.5	3.5	3.0
4. Carytown	4.0	---	---	3.0	3.0
5. Carytown	3.0	---	---	2.5	2.5
6[2]. Carytown-Burwell	4.5	4.0	---	3.0	3.0
7. Caspiana	9.0	8.0	---	6.0	5.0
8. Choteau	7.0	6.0	7.0	5.0	4.5
9[2]. Collinsville-Bates	3.0	---	3.0	---	---
10[2]. Collinsville-Talihina	2.0	---	2.5	---	---
11. Convent Variant	9.0	8.0	---	5.5	4.0
12. Dennis	7.0	6.0	7.0	5.0	4.5
13. Dennis	6.5	5.5	7.0	5.0	4.0
14. Dennis	5.5	4.5	6.0	4.5	3.5
15. Dennis	4.0	---	3.5	---	---
16[2]. Dennis-Verdigris	7.0	6.0	---	---	---
17[2]. Enders-Hector	---	---	---	---	---
18[2]. Endsaw-Hector	---	---	---	---	---
19. Eram	6.5	5.0	---	4.0	3.5
20. Eram	6.0	4.5	---	4.0	3.0
21. Eram	5.0	---	---	2.0	2.5
22. Glentosh	5.5	---	6.0	3.0	2.5

See footnotes at end of table.

TABLE 5.--GRAZING YIELDS--Continued

Map symbol and soil name	Improved bermudagrass	Tall fescue	Lovegrass	Forage sorghum	Small grain
	AUM[1]	AUM	AUM	AUM	AUM
23----------------------------- Glentosh	4.5	---	5.5	2.0	2.5
24----------------------------- Kamie	6.0	---	6.5	4.0	4.0
25----------------------------- Kamie	6.5	---	7.0	4.0	4.0
26----------------------------- Kanima	---	---	---	---	---
27----------------------------- Karma	6.0	---	6.5	4.0	3.5
28----------------------------- Karma	5.0	---	5.5	3.0	3.0
29----------------------------- Karma	5.0	---	5.5	2.0	3.0
30----------------------------- Karma	4.0	---	4.0	---	---
31----------------------------- Karma	6.5	---	7.0	4.0	3.5
32----------------------------- Karma	5.0	---	5.5	3.0	3.0
33----------------------------- Karma	5.5	---	6.0	2.0	3.0
34----------------------------- Karma	4.0	---	4.0	---	---
35----------------------------- Kiomatia	7.0	---	---	---	---
36----------------------------- Larton	6.0	---	7.0	4.0	4.0
37----------------------------- Linker	6.5	---	6.5	4.0	3.5
38----------------------------- Linker	5.5	---	6.0	4.0	3.5
39----------------------------- Linker	4.0	---	4.5	---	---
40[2]---------------------------- Linker-Hector	3.5	---	4.5	---	---
41----------------------------- Madill	8.0	6.0	6.5	5.5	4.5
42----------------------------- Madill	7.5	6.0	---	---	---
43----------------------------- Muldrow	8.0	8.0	---	4.5	4.5
44----------------------------- Parsons	6.0	5.0	---	4.0	4.0
45----------------------------- Pits	---	---	---	---	---
46----------------------------- Porum	6.5	4.5	6.0	4.0	4.0

See footnotes at end of table.

TABLE 5.--GRAZING YIELDS--Continued

Map symbol and soil name	Improved bermudagrass	Tall fescue	Lovegrass	Forage sorghum	Small grain
	AUM[1]	AUM	AUM	AUM	AUM
47: Porum	5.5	4.0	5.0	3.0	2.5
48: Porum	4.0	---	4.0	---	---
49: Shermore	5.0	4.0	---	3.5	2.5
50: Stigler	7.0	5.0	---	4.5	4.5
51: Talihina	3.5	---	---	---	---
52: Taloka	7.0	6.0	---	5.0	4.5
53: Taloka	6.5	5.5	---	5.0	4.5
54: Verdigris	9.0	8.0	---	6.0	5.0
55: Verdigris	9.0	8.0	---	---	---
56: Woodson	6.0	5.0	---	4.5	4.0

[1] AUM (animal-unit-month) is used to express the amount of forage or feed required to feed one animal unit (one cow, one horse, five sheep, five goats) for 30 days.

[2] See description of the map unit for the behavior and composition characteristics of this soil.

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Map symbol and soil name	Wheat	Grain sorghum	Soybeans	Peanuts
	Bu	Bu	Bu	Lb
1: Bates	30	55	25	1,300
2: Bates	25	50	20	1,050
3: Bates	20	40	15	---
4: Carytown	20	40	---	---
5: Carytown	15	35	---	---
6: Carytown-Burwell	25	45	25	---
7: Caspiana	45	75	40	1,600
8: Choteau	35	60	30	1,400
9: Collinsville-Bates	---	---	---	---
10: Collinsville-Talihina	---	---	---	---
11: Convent Variant	30	60	30	---
12: Dennis	35	60	30	1,300
13: Dennis	30	55	25	1,100
14: Dennis	25	45	20	---
15: Dennis	---	---	---	---
16: Dennis-Verdigris	---	---	---	---
17:*				
Enders	---	---	---	---
Hector	---	---	---	---
18:*				
Endsaw	---	---	---	---
Hector	---	---	---	---
19: Eram	25	45	25	---
20: Eram	20	35	20	---
21: Eram	15	30	15	---

See footnote at end of table.

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Map symbol and soil name	Wheat	Grain sorghum	Soybeans	Peanuts
	Bu	Bu	Bu	Lb
22 Glentosh	15	25	---	1,000
23 Glentosh	---	---	---	---
24 Kamie	30	45	20	1,300
25 Kamie	35	50	25	1,400
26 Kanima	---	---	---	---
27 Karma	25	45	20	1,200
28 Karma	20	40	---	---
29 Karma	20	40	---	---
30 Karma	---	---	---	---
31 Karma	30	45	25	1,300
32 Karma	25	40	20	---
33 Karma	25	40	---	---
34 Karma	---	---	---	---
35 Kiomatia	---	---	---	---
36 Larton	25	35	20	1,300
37 Linker	25	45	20	1,100
38 Linker	20	40	15	1,000
39 Linker	---	---	---	---
40 Linker-Hector	---	---	---	---
41 Madill	35	60	35	1,400
42 Madill	---	---	---	---
43 Muldrow	35	60	35	---
44 Parsons	30	45	25	---

See footnote at end of table.

TABLE 6.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Map symbol and soil name	Wheat	Grain sorghum	Soybeans	Peanuts
	Bu	Bu	Bu	Lb
45.* Pits	---	---	---	---
46 Porum	30	40	25	1,200
47 Porum	15	25	20	---
48 Porum	---	---	---	---
49 Shermore	20	30	---	---
50 Stigler	30	45	25	---
51 Talihina	---	---	---	---
52 Taloka	35	60	30	---
53 Taloka	30	55	25	---
54 Verdigris	45	70	40	1,600
55 Verdigris	---	---	---	---
56 Woodson	35	60	30	---

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

TABLE 7.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

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

Map symbol and soil name	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
1, 2, 3 Bates	Loamy Prairie	Favorable	7,000	Big bluestem	35
		Normal	5,500	Little bluestem	25
		Unfavorable	4,500	Indiangrass	10
				Switchgrass	10
4, 5 Carytown	Shallow Claypan	Favorable	3,800	Little bluestem	20
		Normal	2,600	Switchgrass	15
		Unfavorable	1,800	Big bluestem	10
				Indiangrass	10
				Tall dropseed	5
6 *:					
Carytown	Shallow Claypan	Favorable	3,800	Little bluestem	20
		Normal	2,600	Switchgrass	15
		Unfavorable	1,800	Big bluestem	10
				Indiangrass	10
				Tall dropseed	5
Burwell	Loamy Prairie	Favorable	7,000	Big bluestem	35
		Normal	5,200	Switchgrass	15
		Unfavorable	4,000	Little bluestem	10
				Indiangrass	10
				Scribner panicum	5
				Tall dropseed	5
8 Choteau	Loamy Prairie	Favorable	7,000	Big bluestem	35
		Normal	5,200	Switchgrass	15
		Unfavorable	4,000	Little bluestem	10
				Indiangrass	10
				Scribner panicum	5
9:*					
Collinsville	Shallow Prairie	Favorable	3,500	Little bluestem	30
		Normal	2,300	Big bluestem	15
		Unfavorable	1,500	Indiangrass	10
				Switchgrass	10
				Sideoats grama	10
				Tall dropseed	5
				Heath aster	5
Bates	Loamy Prairie	Favorable	5,500	Big bluestem	35
		Normal	4,500	Little bluestem	25
		Unfavorable	3,500	Indiangrass	10
				Switchgrass	10
10:*					
Collinsville	Shallow Prairie	Favorable	3,500	Little bluestem	30
		Normal	2,300	Big bluestem	15
		Unfavorable	1,500	Indiangrass	10
				Switchgrass	10
				Sideoats grama	10
				Tall dropseed	5
				Heath aster	5
Talihina	Shallow Prairie	Favorable	3,800	Little bluestem	25
		Normal	2,600	Big bluestem	10
		Unfavorable	1,800	Indiangrass	10
				Switchgrass	5
				Tall dropseed	5
				Sideoats grama	5

See footnote at end of table.

TABLE 7.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Map symbol and soil name	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
12, 13, 14 Dennis	Loamy Prairie	Favorable	7,000	Big bluestem	35
		Normal	5,500	Switchgrass	15
		Unfavorable	4,500	Little bluestem	10
				Indiangrass	10
				Scribner panicum	5
				Purpletop	5
				Tall dropseed	5
				Catclaw sensitivebrier	5
				Goldenrod	5
15 Dennis	Eroded Prairie	Favorable	4,000	Little bluestem	30
		Normal	2,900	Switchgrass	15
		Unfavorable	1,800	Indiangrass	10
				Tall dropseed	10
				Big bluestem	5
				Scribner panicum	5
				Purpletop	5
				Catclaw sensitivebrier	5
16:*					
Dennis	Loamy Prairie	Favorable	7,000	Big bluestem	35
		Normal	5,500	Switchgrass	15
		Unfavorable	4,500	Little bluestem	10
				Indiangrass	10
				Scribner panicum	5
				Purpletop	5
				Tall dropseed	5
				Catclaw sensitivebrier	5
				Goldenrod	5
17:*					
Enders	Sandy Savannah	Favorable	4,000	Little bluestem	35
		Normal	3,000	Indiangrass	10
		Unfavorable	2,000	Canada wildrye	10
				Big bluestem	5
				Tickclover	5
				Lespedeza	5
				Panicum	5
Hector	Shallow Savannah	Favorable	3,000	Little bluestem	30
		Normal	2,000	Indiangrass	15
		Unfavorable	1,400	Big bluestem	10
				Blackjack oak	10
				Post oak	10
				Switchgrass	5
18:*					
Endsaw	Savannah Breaks	Favorable	3,600	Little bluestem	25
		Normal	2,600	Big bluestem	10
		Unfavorable	2,000	Indiangrass	10
				Scribner panicum	5
				Free Huckleberry	5
				Lespedeza	5
				Post oak	5
				Sedge	5
				Canada wildrye	5
				Blackjack oak	10
				Post oak	10
Hector	Savannah Breaks	Favorable	2,000	Little bluestem	45
		Normal	1,200	Indiangrass	15
		Unfavorable	700	Big bluestem	8

See footnote at end of table.

TABLE 7.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Map symbol and soil name	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
19, 20, 21 Eram	Loamy Prairie	Favorable	6,000	Big bluestem	30
		Normal	4,200	Little bluestem	15
		Unfavorable	3,000	Switchgrass	15
				Indiangrass	10
				Scribner panicum	5
				Purpletop	5
				Tall dropseed	5
				Catclaw sensitivebrier	5
				Goldenrod	5
22, 23 Glentosh	Deep Sand Savannah	Favorable	4,000	Little bluestem	25
		Normal	2,800	Big bluestem	20
		Unfavorable	2,000	Indiangrass	10
				Switchgrass	5
24 Kamie	Deep Sand Savannah	Favorable	4,000	Little bluestem	15
		Normal	2,800	Big bluestem	15
		Unfavorable	2,000	Indiangrass	5
				Switchgrass	5
				Purple lovegrass	5
				Scribner panicum	5
				Purpletop	5
				Sunflower	5
				Arrowfeather threeawn	5
25 Kamie	Sandy Savannah	Favorable	4,500	Little bluestem	20
		Normal	3,300	Big bluestem	15
		Unfavorable	2,500	Indiangrass	10
				Switchgrass	10
				Purple lovegrass	5
				Scribner panicum	5
				Purpletop	5
				Tall dropseed	5
				Sunflower	5
				Goldenrod	5
27, 28, 29 Karma	Deep Sand Savannah	Favorable	4,000	Big bluestem	20
		Normal	2,800	Little bluestem	15
		Unfavorable	2,000	Indiangrass	10
				Switchgrass	5
30 Karma	Eroded Sandy Savannah	Favorable	2,500	Little bluestem	35
		Normal	1,600	Indiangrass	10
		Unfavorable	1,250	Switchgrass	5
31, 32, 33 Karma	Sandy Savannah	Favorable	5,000	Big bluestem	25
		Normal	3,800	Indiangrass	15
		Unfavorable	2,600	Little bluestem	10
				Switchgrass	5
				Scribner panicum	5
34 Karma	Eroded Sandy Savannah	Favorable	2,500	Little bluestem	35
		Normal	1,600	Indiangrass	10
		Unfavorable	1,250	Switchgrass	5
36 Larton	Deep Sand Savannah	Favorable	4,000	Little bluestem	25
		Normal	2,800	Big bluestem	15
		Unfavorable	2,000	Indiangrass	10
				Switchgrass	5
37, 38 Linker	Sandy Savannah	Favorable	4,800	Little bluestem	25
		Normal	3,700	Indiangrass	15
		Unfavorable	3,000	Big bluestem	15
				Wildrye	8
				Sunflower	8
				Panicum	5

See footnote at end of table.

TABLE 7.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Map symbol and soil name	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
39: Linker	Eroded Sandy Savannah	Favorable	2,500	Little bluestem	30
		Normal	2,000	Indiangrass	12
		Unfavorable	1,700	Wildrye	10
				Sunflower	8
				Panicum	6
				Switchgrass	5
40:*					
Linker	Sandy Savannah	Favorable	4,600	Little bluestem	25
		Normal	3,500	Indiangrass	12
		Unfavorable	2,800	Big bluestem	10
				Wildrye	8
				Sunflower	8
				Panicum	5
Hector	Shallow Savannah	Favorable	3,000	Little bluestem	30
		Normal	2,000	Indiangrass	15
		Unfavorable	1,000	Big bluestem	10
				Post oak	10
				Blackjack oak	10
				Switchgrass	5
44: Parsons	Claypan Prairie	Favorable	4,500	Little bluestem	25
		Normal	3,000	Big bluestem	20
		Unfavorable	2,000	Switchgrass	15
				Indiangrass	10
				Sideoats grama	5
				Goldenrod	5
				Indiancurrant coralberry	5
46, 47: Porum	Loamy Savannah	Favorable	5,000	Big bluestem	25
		Normal	3,500	Indiangrass	15
		Unfavorable	2,500	Little bluestem	10
				Switchgrass	5
				Longspike tridens	5
				Panicum	5
				Tickclover	5
				Compassplant	5
				Sedge	5
48: Porum	Eroded Sandy Savannah	Favorable	3,000	Little bluestem	35
		Normal	2,100	Indiangrass	10
		Unfavorable	1,500	Switchgrass	5
				Longspike tridens	5
				Panicum	5
49: Shermore	Loamy Savannah	Favorable	4,200	Big bluestem	25
		Normal	2,800	Indiangrass	15
		Unfavorable	1,800	Little bluestem	10
				Post oak	5
				Switchgrass	5
				Blackjack oak	5
50: Stigler	Loamy Savannah	Favorable	5,000	Big bluestem	25
		Normal	3,500	Indiangrass	15
		Unfavorable	2,500	Little bluestem	10
				Blackjack oak	10
				Switchgrass	5
				Tickclover	5
				Purpletop	5
				Post oak	5

See footnote at end of table.

TABLE 7.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Map symbol and soil name	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
51-----------------Talihina	Shallow Prairie---------------	Favorable	3,800	Little bluestem---------------	25
		Normal	2,600	Big bluestem------------------	10
		Unfavorable	1,800	Indiangrass-------------------	10
				Switchgrass-------------------	5
				Tall dropseed-----------------	5
				Sideoats grama----------------	5
52, 53-------------Taloka	Loamy Prairie-----------------	Favorable	6,800	Big bluestem------------------	35
		Normal	5,100	Switchgrass-------------------	15
		Unfavorable	4,000	Little bluestem---------------	10
				Indiangrass-------------------	10
				Scribner panicum--------------	5
56-----------------Woodson	Claypan Prairie---------------	Favorable	4,500	Big bluestem------------------	25
		Normal	3,000	Little bluestem---------------	20
		Unfavorable	2,000	Switchgrass-------------------	15
				Indiangrass-------------------	10
				Tall dropseed-----------------	5

* For composition and behavior characteristics of the map unit, see description in "Detailed soil map units."

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Map symbol and soil name	Trees having predicted 20-year average heights, in feet, of--			
	Less than 16	16-25	26-35	More than 35
1, 2, 3. Bates	Amur honeysuckle, American plum, flowering dogwood.	Eastern redcedar, redbud.	Autumn olive, Austrian pine, Scotch pine, red mulberry, bur oak, green ash, common hackberry, osageorange.	Chinese elm, slash pine, silver maple, loblolly pine, shortleaf pine, pin oak, pecan.
4, 5. Carytown	Athel, tamarisk, redbud.	Eastern redcedar, Arizona cypress.	---	---
6:*				
Carytown	Redbud, athel, tamarisk.	Oriental arborvitae, eastern redcedar.	---	---
Burwell	Amur honeysuckle, American plum.	Eastern redcedar, Scotch pine, redbud.	Autumn olive, honeylocust, common hackberry, red mulberry silver maple, osageorange.	Chinese elm, loblolly pine, shortleaf pine; slash pine, pin oak, honeylocust.
7. Caspiana	American plum, Amur honeysuckle.	Oriental arborvitae, eastern redcedar, redbud.	Red mulberry, honeylocust, Scotch pine, Austrian pine, osageorange, common hackberry.	Silver maple, green ash, honeylocust, American sycamore, black walnut, Chinese elm, pecan, loblolly pine, eastern cottonwood, shortleaf pine.
8. Choteau	American honeysuckle, redbud.	Bur oak, eastern redcedar Scotch pine, oriental arborvitae, common hackberry, Austrian pine, osageorange.	Honeylocust, Chinese elm, red mulberry.	Shortleaf pine.
9:*				
Collinsville	Oriental arborvitae, Amur honeysuckle.	Eastern redcedar, osageorange.	---	---
Bates	Amur honeysuckle	Eastern redcedar, redbud.	Austrian pine, Scotch pine, red mulberry, bur oak, green ash, common hackberry, osageorange.	Chinese elm, slash pine, silver maple loblolly pine, shortleaf pine, pecan.
10:*				
Collinsville	Oriental arborvitae, Amur honeysuckle.	Eastern redcedar, osageorange.	---	---
Talihina	Oriental arborvitae, redbud, Rocky Mountain juniper.	Eastern redcedar, osageorange, Arizona cypress.	---	---

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average heights, in feet, of--			
	Less than 16	16-25	26-35	More than 35
11 Convent Variant	Amur honeysuckle, American plum.	American plum, redbud.	Common hackberry, green ash, osageorange, eastern redcedar, Austrian pine, Scotch pine.	American sycamore, honeylocust, eastern cottonwood, silver maple, Chinese elm, loblolly pine, shortleaf pine, black walnut, pecan.
12, 13, 14, 15 Dennis	Amur honeysuckle, redbud.	Common hackberry, eastern redcedar, Austrian pine, bur oak, osageorange.	Honeylocust, Chinese elm, red mulberry,	Shortleaf pine.
16:*				
Dennis	Amur honeysuckle, redbud.	Common hackberry, eastern redcedar, bur oak, Austrian pine.	Honeylocust, Chinese elm, red mulberry.	Shortleaf pine.
Verdigris	American plum, Amur honeysuckle.	Redbud	Austrian pine, red mulberry, pin oak, green ash, common hackberry, bur oak, eastern redcedar, Scotch pine.	Chinese elm, loblolly silver maple, shortleaf pine, honeylocust, black locust, eastern cottonwood, American sycamore.
17:*				
Enders	Redbud, Amur honeysuckle, ponderosa pine.	Eastern redcedar, oriental arborvitae, osageorange, common hackberry.	Chinese elm, silver maple.	
Hector	Amur honeysuckle, oriental arborvitae.	Eastern redcedar	---	---
18:*				
Endsaw	Ponderosa pine, redbud, American honeysuckle.	Bur oak, eastern redcedar, oriental arborvitae, common hackberry, osageorange.	Chinese elm, silver maple, honeylocust.	---
Hector	Rocky Mountain juniper	Osageorange	---	---

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIROMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average heights, in feet, of--			
	Less than 16	16-25	26-35	More than 35
19, 20, 21 Eram	Redbud, Amur honeysuckle.	Eastern redcedar, common hackberry, bur oak, Russian-olive, osageorange.	Chinese elm, honeylocust, silver maple.	---
22, 23 Glentosh	Rocky Mountain juniper, American plum, redbud.	Oriental arborvitae, eastern redcedar, red mulberry.	Shortleaf pine	---
24, 25 Kamie	Flowering dogwood, Amur honeysuckle, American plum.	Eastern redcedar, redbud, Austrian pine, Scotch pine.	Autumn-olive, osageorange, red mulberry, common hackberry.	Chinese elm, loblolly pine, silver maple, shortleaf pine.
26 Kanima	Amur honeysuckle, Austrian pine, redbud.	Bur oak, black locust, Chinese elm, honeylocust, eastern redcedar, osageorange.	---	---
27, 28, 29, 30, 31, 32, 33 Karma	American plum, Amur honeysuckle,	Redbud, Rocky Mountain juniper.	Bur oak, autumn-olive, eastern redcedar, oriental arborvitae, Chinese elm, red mulberry, common hackberry, green ash, ponderosa pine.	Silver maple, black locust, honeylocust, loblolly pine, shortleaf pine.
34 Karma	American plum	Eastern redcedar	Black locust	---
35 Kiomatia	Amur honeysuckle, American plum.	Autumn-olive, eastern redcedar, Austrian pine.	Silver maple, Chinese elm, common hackberry, osageorange, Russian-olive.	Eastern cottonwood, American sycamore, loblolly pine.
36 Larton	American plum, Amur honeysuckle, redbud, flowering dogwood.	Eastern redcedar, Austrian pine, Scotch pine, common hackberry, green ash.	Autumn-olive, Chinese elm, bur oak, oriental arborvitae, black locust, Russian-olive, silver maple, red mulberry.	Loblolly pine, shortleaf pine.
37, 38 Linker	American plum, Amur honeysuckle.	Scotch pine, Austrian pine, eastern redcedar, redbud, osageorange.	Common hackberry, red mulberry, bur oak, silver maple, Chinese elm, honeylocust.	Loblolly pine, shortleaf pine.
39 Linker.	American plum, Hawthorn.	Eastern redcedar, osageorange.	Shortleaf pine	---

See footnote at end of table.

TABLE 8.---WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average heights, in feet, of-- Less than 16	16-25	26-35	More than 35
40:*				
Linker	Amur honeysuckle, American plum, flowering dogwood.	Scotch pine, Austrian pine, eastern redcedar, redbud, osageorange.	Common hackberry, red mulberry, bur oak, silver maple, Chinese elm, honeylocust.	Loblolly pine, shortleaf pine.
Hector	Oriental arborvitae, redbud.	Eastern redcedar, osageorange.	---	---
41, 42 Madill	Amur honeysuckle, American plum, flowering dogwood.	Redbud, Rocky Mountain juniper.	Green ash, scotch pine, ponderosa pine, common hackberry, red mulberry autumn-olive, eastern redcedar, oriental arborvitae, Russian-olive.	Chinese elm, American sycamore honeylocust, pecan, silver maple eastern cottonwood shortleaf pine, loblolly pine.
43 Muldrow	Redbud, Amur honeysuckle.	Oriental arborvitae, osageorange, red mulberry.	Eastern redcedar, bur oak, common hackberry.	Eastern cottonwood, green ash, honeylocust, American sycamore, Chinese elm.
44 Parsons	Redbud, hawthron, Amur honeysuckle.	Eastern redcedar, common hackberry, Russian-olive, Austrian pine, osageorange.	Honeylocust, silver maple, Chinese elm.	Shortleaf pine.
45.* Pits				
46, 47, Porum	Amur honeysuckle, flowering dogwood, American plum, redbud.	Eastern redcedar, bur oak, common hackberry, Austrian pine, osageorange, oriental arborvitae.	Southern red oak, honeylocust, Chinese elm, silver maple, red mulberry, bur oak.	Loblolly pine, shortleaf pine.
48 Porum	Amur honeysuckle	Osageorange, eastern redcedar.	Honeylocust	---
49 Shermore	Redbud, American plum.	Osageorange, bur oak, Austrian pine, red mulberry.	Silver maple, autumn-olive, honeylocust.	Shortleaf pine, loblolly pine.
50 Stigler	Amur honeysuckle, redbud.	Eastern redcedar, Austrian pine, red mulberry, bur oak, common hackberry.	Chinese elm, silver maple, honeylocust.	Loblolly pine, shortleaf pine.
51 Talihina	Amur honeysuckle, Rocky Mountain juniper, redbud.	Easter redcedar, osageorange, Arizona cypress.	---	---

See footnote at end of table.

TABLE 8.--WINBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Map symbol and soil name	Trees having predicted 20-year average heights, in feet, of--			
	Less than 16	16-25	26-35	More than 35
52, 53 Taloka	Amur honeysuckle, redbud, hawthorn.	Common hackberry, eastern redcedar, osageorange, Austrian pine.	Honeylocust, Chinese elm, silver maple.	Shortleaf pine.
54, 55 Verdigris	American plum, Amur honeysuckle.	Redbud	Austrian pine, pin oak, green ash, common hackberry, bur oak, eastern redcedar, scotch pine, red mulberry.	Chinese elm, loblolly pine, silver maple, shortleaf pine, honeylocust, blacklocust, American sycamore, eastern cottonwood.
56 Woodson	Amur honeysuckle, hawthorn.	Common hackberry, eastern redcedar, Russian-olive, Austrian pine.	Honeylocust, Chinese elm, silver maple.	Shortleaf pine.

*For composition and behavior characteristics of the map unit, see description in "Detailed soil map units."

TABLE 9.--RECREATIONAL DEVELOPMENT

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

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1, 2, 3 Bates	Slight	Slight	Moderate: slope, small stones, depth to rock.	Slight	Moderate: thin layer.
4, 5 Carytown	Severe: wetness, percs slowly, excess sodium.	Severe: wetness, excess sodium, percs slowly.	Severe: wetness, percs slowly, excess sodium.	Severe: wetness, erodes easily.	Severe: excess sodium, wetness.
6:*					
Carytown	Severe: wetness, percs slowly, excess sodium.	Severe: wetness, excess sodium, percs slowly.	Severe: wetness, percs slowly, excess sodium.	Severe: wetness, erodes easily.	Severe: excess sodium, wetness.
Burwell	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: erodes easily.	Slight.
7 Caspiana	Slight	Slight	Slight	Slight	Slight.
8 Choteau	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Severe: erodes easily.	Slight.
9:*					
Collinsville	Severe: depth to rock.	Severe: depth to rock.	Severe: small stones.	Slight	Severe: thin layer.
Bates	Slight	Slight	Moderate: slope, small stones, depth to rock.	Slight	Moderate: thin layer.
10:*					
Collinsville	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, small stones.	Slight	Severe: thin layer.
Talihina	Severe: wetness.	Severe: wetness.	Severe: slope, wetness.	Severe: wetness.	Severe: wetness, thin layer.
11 Convent Variant	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: erodes easily.	Slight.
12, 13, 14, 15 Dennis	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Severe: erodes easily.	Slight.
16:*					
Dennis	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Severe: erodes easily.	Slight.
Verdigris	Severe: floods.	Slight	Moderate: floods.	Slight	Moderate: floods.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
17:*					
Enders	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: erodes easily.	Severe: slope.
Hector	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: large stones, depth to rock, slope.	Moderate: large stones, slope.	Severe: small stones, large stones, slope.
18:*					
Endsaw	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope.	Severe: large stones, slope.
Hector	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: large stones, depth to rock, slope.	Moderate: large stones, slope.	Severe: small stones, large stones, slope.
19, 20, 21 Eram	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, small stones, wetness.	Severe: erodes easily.	Moderate: thin layer.
22 Glentosh	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Severe: droughty.
23 Glentosh	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Severe: droughty.
24 Kamie	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
25 Kamie	Slight	Slight	Moderate: slope.	Slight	Slight.
26 Kanima	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: small stones.	Severe: small stones, droughty, slope.
27, 28 Karma	Slight	Slight	Moderate: slope.	Slight	Slight.
29 Karma	Slight	Slight	Severe: slope.	Slight	Slight.
30, 31, 32 Karma	Slight	Slight	Moderate: slope.	Slight	Slight.
33 Karma	Slight	Slight	Severe: slope.	Slight	Slight.
34 Karma	Slight	Slight	Moderate: slope.	Slight	Slight.
35 Kiomatia	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.	Severe: floods.
36 Larton	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
37, 38, 39 Linker	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: thin layer.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
40:*					
Hector	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, small stones.	Slight	Severe: thin layer.
Linker	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: thin layer.
41 Madill	Severe: floods.	Slight	Moderate: floods.	Slight	Moderate: floods.
42 Madill	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.	Severe: floods.
43 Muldrow	Severe: floods, wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, erodes easily.	Severe: wetness.
44 Parsons	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe; wetness, erodes easily.	Severe: wetness.
45.* Pits					
46, 47, 48 Porum	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Severe: erodes easily.	Slight.
49 Shermore	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, slope.	Slight	Moderate: wetness
50 Stigler	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Severe: erodes easily.	Slight.
51 Talihina	Severe: wetness.	Severe: wetness.	Severe: slope, wetness.	Severe: wetness.	Severe: wetness, thin layer.
52, 53 Taloka	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Severe: erodes easily.	Moderate: wetness.
54 Verdigris	Severe: floods.	Slight	Moderate: floods.	Slight	Moderate: floods.
55 Verdigris	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.	Severe: floods.
56 Woodson	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.

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

TABLE 10.--WILDLIFE HABITAT

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

Map symbol and soil name	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
1, 2, 3 Bates	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
4, 5 Carytown	Poor	Fair	Fair	Poor	Poor	Good	Good	Fair	Poor	Good.
6:*										
Carytown	Poor	Fair	Fair	Poor	Poor	Good	Good	Fair	Poor	Good.
Burwell	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
7 Caspiana	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
8 Choteau	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
9:*										
Collinsville	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
Bates	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
10:*										
Collinsville	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
Talihina	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
11 Convent Variant	Fair	Good	Good	Good	Good	Poor	Poor	Fair	Good	Poor.
12 Dennis	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
13, 14, 15 Dennis	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
16:*										
Dennis	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
Verdigris	Good	Good	Good	Good	Good	Poor	Fair	Good	Good	Poor.
17:*										
Enders	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Hector	Very poor.	Very poor.	Poor	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Poor	Very poor.
18:*										
Endsaw	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
Hector	Very poor.	Very poor.	Poor	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Poor	Very poor.
19 Eram	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Map symbol and soil name	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
20, 21 Eram	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
22, 23 Glentosh	Fair	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.
24 Kamie	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
25 Kamie	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
26 Kanima	Poor	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.
27, 28 Karma	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
29, 30 Karma	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
31, 32 Karma	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
33, 34 Karma	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
35 Kiomatia	Poor	Fair	Fair	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.
36 Larton	Fair	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
37, 38, 39 Linker	Fair	Good	Good	Fair	Fair	Poor	Very poor.	Good	Fair	Very poor.
40:*										
Linker	Fair	Good	Good	Fair	Fair	Poor	Very poor.	Good	Fair	Very poor.
Hector	Very poor	Poor	Poor	Poor	Very poor	Very poor	Very poor.	Poor	Poor	Very poor.
41 Madill	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
42 Madill	Poor	Fair	Fair	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
43 Muldrow	Fair	Good	Fair	Good	Good	Fair	Good	Fair	Good	Fair.
44 Parsons	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
45.* Pits										
46 Porum	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
47, 48 Porum	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
49 Shermore	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Map symbol and soil name	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
50------------------ Stigler	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
51------------------ Talihina	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
52------------------ Taloka	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
53------------------ Taloka	Fair	Good	Good	Good	Good	Fair	Poor	Good	Good	Poor.
54------------------ Verdigris	Good	Good	Good	Good	Good	Poor	Fair	Good	Good	Poor.
55------------------ Verdigris	Poor	Fair	Fair	Good	Good	Poor	Fair	Fair	Good	Poor.
56------------------ Woodson	Good	Good	Fair	Poor	Poor	Poor	Good	Fair	Fair	Fair.

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

TABLE 11.--SOIL POTENTIAL FOR RECREATION CAMP AREAS

[All information in columns 1 and 3 applies to entire map unit; limitations in column 2 are listed separately for each soil]

Map symbol and soil name	Potential, index and corrective treatment	Limitations	Continuing limitations
1, 2, 3 Bates	High: 93 Excavate bedrock for sanitary and utility facilities.	Soil depth.	Maintain vegetation.
4, 5 Carytown	Medium: 76 Use drainage system, plant salt-tolerant species, add gypsum, enlarge absorption field, stabilize surface layer.	Surface wetness, percs slowly, corrosive.	Maintain drainage system, and sanitary facilities, maintain vegetation.
6:* Carytown	Medium: 78 Use drainage system, level area, plant salt-tolerant species, enlarge absorption area.	Surface wetness, percs slowly, corrosive.	Maintain vegetation, maintain drainage system, and sanitary facilities.
Burwell		Wetness, percs slowly.	
7 Caspiana	High: 93 Add surface fill, landscape to drain low areas.	Surface texture, dampness in low areas.	Maintain system. maintain vegetation.
8 Choteau	Medium: 85 Use surface drainage system, stabilize surface layer, enlarge absorption areas.	Percs slowly, wetness.	Maintain drainage system and sanitary facilities, maintain vegetation.
9:* Collinsville	Medium: 88 Add fill and level in rocky areas, excavate bedrock for sanitary and utility facilities.	Rock outcrops, soil depth.	Maintain vegetation.
Bates		Soil depth.	
10:* Collinsville	Low: 70 Add fill for sanitary facilities, level and landscape, stabilize surface layer.	Slope, rock outcrop, soil depth.	Maintain vegetation.
Talihina		Wetness, texture, soil depth, slope.	
11 Convent Variant	Low: 30 Use flood warning system, a drainage system, and a flood control project; enlarge absorption area.	Floods endanger lives, wetness, percs slowly.	Maintain drainage system and sanitary facilities, maintain vegetation, floods.
12, 13, 14 Dennis	Medium: 85 Use surface drainage system, stabilize surface layer, enlarge absorption field.	Percs slowly, wetness.	Maintain vegetation, drainage and sanitary facilities.
15 Dennis	Medium: 78 Fill gullies and landscape, stabilize surface layers, enlarge absorption field.	Percs slowly, gullies, wetness.	Maintain vegetation to prevent erosion, maintain sanitary facilities.
16:* Dennis	Low: 71 Use flood warning system and a flood control project, level and landscape, stabilize surface layer, enlarge absorption field.	Percs slowly, wetness, slope.	Maintain flood warning system and sanitary facilities, maintain vegetation, floods.
Verdigris		Floods along streams.	

See footnote at end of table.

TABLE 11.--SOIL POTENTIAL FOR RECREATION CAMP AREAS--Continued

Map symbol and soil name	Potential, index, and corrective treatment	Limitations	Continuing limitations
17:*	Low: 59		
Enders	Remove large stones, cut and fill for camp sites and roads, excavate bedrock where needed, enlarge absorption field.	Slope, percs slowly.	Prevent burning, maintain vegetation and roads, maintain sanitary facilities.
Hector		Depth to rock, stones, slope.	
18:*	Low: 59		
Endsaw	Remove large stones, cut and fill for camp sites and roads, excavate bedrock where needed, enlarge absorption field.	Slope, percs slowly.	Prevent burning, maintain vegetation and roads, maintain sanitary facilities.
Hector		Slope, depth to rock, stones.	
19, 20, 21 Eram	Medium: 78 Stabilize surface layer, enlarge absorption field.	Percs slowly, surface texture, wetness.	Maintain vegetation, maintain sanitary facilities.
22, 23 Glentosh	High: 97 Establish vegetation, stabilize surface layer.	Droughty, sandy surface.	Maintain vegetation.
24 Kamie	High: 97 Establish vegetation, stabilize surface layer.	Sandy surface layer.	Maintain vegetation.
25 Kamie	High: 100 Establish vegetation.	None.	Maintain vegetation.
26 Kanima	Low: 40 Level land, construct drainage outlet for water areas.	Slope, stones, water areas.	Maintain vegetation and drainage outlet.
27, 28, 29 Karma	High: 97 Establish vegetation, stabilize surface layer.	Sandy surface layer.	Maintain vegetation.
30 Karma	Medium: 85 Fill gullies and landscape, establish vegetation.	Sandy surface layer, gullies.	Maintain vegetation.
31, 32, 33 Karma	High: 100 Establish vegetation.	None.	Maintain vegetation.
34 Karma	Medium: 88 Fill gullies and landscape, establish permanent vegetation.	Gullies.	Maintain vegetation.
35 Kiomatia	Low: 0 Not feasible to establish flood control project.	Floods endanger lives, apparent water table, major drainage.	None.
36 Larton	High: 97 Establish vegetation, stabilize surface layer.	Sandy surface layer.	Maintain vegetation.
37, 38 Linker	High: 93 Excavate bedrock for sanitary and utility facilities.	Soil depth.	Maintain vegetation.

See footnote at end of table.

TABLE 11.--SOIL POTENTIAL FOR RECREATION CAMP AREAS--Continued

Map symbol and soil name	Potential, index, and corrective treatment	Limitations	Continuing limitations
39: Linker	Medium: 81 Fill gullies and landscape, establish vegetation, excavate bedrock for sanitary and utility facilities.	Soil depth, gullies.	Maintain vegetation.
40:* Linker	Medium: 88 Excavate bedrock for sanitary and utility facilities, add fill in very shallow areas.	Soil depth.	Maintain vegetation.
Hector		Soil depth.	
41, 42: Madill	Low: 34 Use flood warning system, and flood control project.	Floods endanger lives.	Maintain system, floods.
43: Muldrow	Low: 31 Add fill, use drainage system, enlarge absorption fields, stabilize surface layer, use flood control project.	Texture, wetness, percs slowly, floods endanger lives.	Maintain vegetation, maintain drainage system and absorption field, floods.
44: Parsons	Medium: 78 Surface drainage system, enlarge absorption field, stabilize surface drainage.	Percs slowly, wetness.	Maintain drainage system, maintain vegetation and absorption field.
45*: Pits	Low: 0 Not feasible.	Floods, ponding.	None.
46, 47: Porum	Medium: 88 Enlarge absorption field.	Percs slowly.	Maintain vegetation and absorption field.
48: Porum	Medium: 76 Establish vegetation, fill gullies, enlarge absorption field.	Percs slowly, erodes easily, gullies.	Maintain vegetation and absorption field.
49: Shermore	High: 95 Add 1 foot of suitable material in moist areas.	Dampness.	Maintain vegetation.
50: Stigler	Medium: 77 Use surface drainage system, enlarge absorption field, stabilize surface layer.	Wetness, percs slowly.	Maintain drainage system, maintain vegetation and absorption field.
51: Talihina	Low: 65 Add fill for sanitary facilities, level and landscape, stabilize surface layer.	Texture, slope, soil depth, wetness.	Maintain vegetation.
52, 53: Taloka	Medium: 79 Surface drainage system, enlarge absorption field, stabilize surface layer.	Percs slowly, wetness.	Maintain drainage system and absorption field.
54, 55: Verdigris	Low: 34 Use flood warning system, and flood control project.	Floods endangers lives.	Maintain warning systems and vegetation, floods.
56: Woodson	Medium: 76 Surface drainage system, enlarge absorption field, stabilize surface layer.	Wetness, percs slowly.	Maintain drainage system, maintain absorption field and vegetation.

* For composition and behavior characteristics of the map unit, see description in "Detailed soil map units."

TABLE 12.--SOIL POTENTIAL FOR DWELLINGS WITHOUT BASEMENTS

[All information in columns 1 and 3 applies to entire map unit; limitations in column 2 are listed separately for each soil]

Map symbol and soil name	Potential, index and corrective treatment	Limitations	Continuing limitations
1, 2, 3: Bates	High: 91 Add extra reinforcement.	None.	None.
4, 5: Carytown	Low: 64 Add sand blanket, thicker walls and extra reinforcement, use seasonal construction, add guttering.	Shrink-swell, wetness.	Maintain surface drainage.
6:	Medium: 76		
Carytown	Add sand blanket, thicker walls and extra reinforcement, use seasonal construction, add guttering.	Shrink-swell, wetness.	Maintain surface drainage.
Burwell		Wetness.	
7: Caspiana	Medium: 87 Add sand blanket, thicker walls and extra reinforcement.	Shrink-swell.	None.
8: Choteau	Medium: 72 Add sand blanket, thicker walls and extra reinforcement.	Shrink-swell.	None.
9:	Medium: 88		
Collinsville	Have extra excavation.	Soil depth.	None.
Bates		None.	
10:	Medium: 72		
Collinsville	Add extra reinforcement and sand blanket, add guttering, have extra excavation.	Soil depth, slope.	Maintain surface drainage.
Talihina		Wetness, shrink-swell.	
11: Convent Variant	Low: 27 Construct flood control, add guttering, add fill material.	Wetness, floods.	Maintain flood protection and surface drainage.
12, 13, 14: Dennis	Medium: 72 Add thicker walls, extra reinforcement and sand blanket.	Shrink-swell.	None.
15: Dennis	Medium: 70 Add thicker walls, extra reinforcement and sand blankets, fill gullies.	Shrink-swell, gullies.	None.
16:	Low: 49		
Dennis	Construct flood control, add thicker walls, extra reinforcement and sand blanket.	Shrink-swell.	Maintain flood protection.
Verdigris		Floods.	
17:	Low: 63		
Enders	Have extra excavation, add extra reinforcement and sand blanket.	Slope, shrink-swell.	None.
Hector		Slope, depth to rock, rocky surface layer.	
18:	Low: 63		
Endsaw	Have extra excavation, add extra reinforcement and sand blanket.	Slope, shrink-swell.	None.
Hector		Soil depth, rocky surface layer, slope.	

TABLE 12.--SOIL POTENTIAL FOR DWELLINGS WITHOUT BASEMENTS--Continued

Map symbol and soil name	Potential, index and corrective treatment	Limitations	Continuing limitations
19, 20, 21---------- Eram	Low: 68 Have extra excavation, add extra reinforcement, thicker walls and sand blanket.	Shrink-swell.	None.
22, 23-------------- Glentosh	High: 100 None.	None.	None.
24, 25-------------- Kamie	High: 100 None.	None.	None.
26------------------ Kanima	Medium: 86 Have extra excavation, cut and fill.	Slope.	None.
27, 28, 29---------- Karma	High: 100 None.	None.	None.
30------------------ Karma	High: 97 Fill gullies.	Gullies.	None.
31, 32, 33---------- Karma	High: 100 None.	None.	None.
34------------------ Karma	High: 97 Fill gullies.	Gullies.	None.
35------------------ Kiomatia	Low: 29 Construct flood control system, add fill.	Floods, high water table.	Maintain flood control system.
36------------------ Larton	High: 100 None.	None.	None.
37, 38-------------- Linker	Medium: 88 Have extra excavation.	Soil depth.	None.
39------------------ Linker	Medium: 85 Have extra excavation, fill gullies.	Soil depth, gullies.	None.
40:	Medium: 80		
Linker------------	Have extra excavation.	Soil depth.	None.
Hector------------		Soil depth.	
41, 42-------------- Madill	Low: 31 Construct flood control system, add fill.	Floods.	Maintain flood protection system.
43------------------ Muldrow	Low: 45 Add thicker walls, extra reinforcement and sand blanket; remove water during construction, add extra guttering, construct dike.	Floods, shrink-swell, wetness.	Maintain surface drainage system.
44------------------ Parsons	Low: 66 Add thicker walls, extra reinforcement and sand blanket, construct surface drainage.	Wetness, shrink-swell.	Maintain surface drainage system.
45------------------ Pits	Low: 20 Construct drainage and flood control system, add fill material.	Floods, ponds, no material.	None.
46, 47-------------- Porum	Low: 68 Add thicker walls, extra reinforcement and sand blanket.	Shrink-swell.	None.

TABLE 12.--SOIL POTENTIAL FOR DWELLINGS WITHOUT BASEMENTS--Continued

Map symbol and soil name	Potential, index and corrective treatment	Limitations	Continuing limitations
48----------------- Porum	Low: 65 Add thicker walls, extra reinforcement and sand blanket, fill gullies.	Shrink-swell, gullies.	None.
49----------------- Shermore	High: 92 Construct surface drainage, add extra reinforcement and sand blanket.	Wetness, low strength.	Maintain surface drainage system.
50----------------- Stigler	Low: 68 Add thicker walls, extra reinforcement and sand blanket.	Shrink-swell.	None.
51----------------- Talihina	Low: 50 Have extra excavation, add thicker walls, extra reinforcement and sand blanket; construct surface drainage.	Slope, wetness, shrink-swell.	Maintain surface drainage system.
52, 53------------- Taloka	Low: 66 Add thicker walls, extra reinforcement and sand blanket, construct surface drainage.	Shrink-swell, wetness.	Maintain surface drainage system.
54, 55------------- Verdigris	Low: 31 Construct flood control project, remove water during construction, add fill.	Floods.	Maintain flood control system.
56----------------- Woodson	Low: 66 Add thicker walls, extra reinforcement and sand blanket, construct surface drainage.	Shrink-swell, wetness.	Maintain surface drainage system.

TABLE 13.--SOIL POTENTIAL FOR LOCAL ROADS AND STREETS

[All information in columns 1 and 3 applies to entire map unit; limitations in column 2 are listed separately for each soil]

Map symbol and soil name	Potential, index and corrective treatment	Limitations	Continuing limitations
1, 2, 3: Bates	Medium: 75 Add extra excavation, extra base material.	Soil depth, moderate load bearing strength.	None.
4, 5: Carytown	Low: 67 Process subgrade, add extra base material, and install subsurface drainage.	Low strength, water table, highly corrosive.	Maintain drainage system.
6:*	Low: 67		
Carytown	Process subgrade, add extra base material, and install subsurface drainage.	Low strength, shrink-swell, water table, highly corrosive.	Maintain drainage system.
Burwell		Wetness.	
7: Caspiana	Medium: 88 Add extra base material, add sand to surface.	Low strength, surface cracking and buckling.	None.
8: Choteau	Medium: 85 Add extra base material.	Low strength, shrink-swell.	None.
9:*	Low: 60		
Collinsville	Have extra excavation, add fill.	Soil depth.	None.
Bates		Low strength.	
10:*	Low: 58		
Collinsville	Have excavation, add fill.	Soil depth, slope.	None.
Talihina		Low strength, wetness, slope.	
11: Convent Variant	Medium: 30 Install subsurface drainage, raise roadbed, protect shoulders.	Floods, low strength, wetness.	Maintain shoulders and roadbed.
12, 13, 14: Dennis	Medium: 85 Add extra base material.	Low strength, shrink-swell.	None.
15	Medium: 85 Add extra base material, add fill.	Shrink-swell, low strength, gullies.	None.
16:*	Low: 50		
Dennis	Have extra excavation, raise roadbed, add extra base material.	Low strength, shrink-swell.	None.
Verdigris		Floods.	
17:*	Low: 60		
Enders	Have extra excavation, add fill.	Low strength, slope, shrink-swell.	None.
Hector		Depth to rock, slope.	
18:*	Low: 60		
Endsaw	Have extra excavation, add fill.	Low strength, slope, shrink-swell.	None.
Hector		Depth to rock, slope.	

See footnote at end of table.

TABLE 13.--SOIL POTENTIAL FOR LOCAL ROADS AND STREETS--Continued

Map symbol and soil name	Potential, index and corrective treatment	Limitations	Continuing limitations
19, 20, 21: Eram	Low: 65 Add extra base material, process subgrade.	Soil depth, low strength, shrink-swell.	None.
22, 23: Glentosh	High: 100 Sod shoulders.	None.	Maintain cover.
24, 25: Kamie	High: 98 Add extra base material, sod shoulders.	Moderate load bearing strength, easily eroded surface.	Maintain shoulder cover.
26: Kanima	Medium: 72 Have extra excavation, add extra base material.	Slope.	Maintain shoulder cover.
27, 28, 29: Karma	High: 98 Extra base material, sod shoulders.	Moderate load bearing strength, easily eroded surface.	Maintain shoulder cover.
30: Karma	High: 96 Add fill, sod shoulders, add extra base material.	Moderate load bearing strength, easily eroded surface, gullies.	Maintain shoulder cover.
31, 32, 33: Karma	High: 88 Add extra base material, sod shoulders.	Moderate load bearing strength, easily eroded surface.	Maintain shoulder cover.
34: Karma	High: 96 Add fill, sod shoulders, add extra base material.	Moderate load bearing strength, easily eroded surface, gullies.	Maintain shoulder cover.
35: Kiomatia	Low: 50 Raise roadbed, install subsurface drainage.	Floods.	Maintain drainage system.
36: Larton	High: 100 Sod shoulders.	None.	Maintain shoulder cover.
37, 38: Linker	Medium: 72 Have extra excavation, add fill, add extra base material.	Soil depth, moderate load bearing strength.	None.
39: Linker	Medium: 70 Have extra excavation cost, add fill, add extra base material.	Soil depth, moderate load bearing strength, gullies.	None.
40:*			
Linker	Low: 60 Have extra excavation, add fill, add extra base material.	Soil depth, moderate load bearing strength.	None.
Hector		Soil depth.	
41: Madill	Medium: 80 Raise roadbed, protect shoulders, install flood control system.	Floods.	Maintain flood control system.
42: Madill	Low: 50 Raise roadbed, protect shoulders, install flood control system.	Floods.	Maintain flood control system.
43: Muldrow	Low: 68 Raise roadbed, install subsurface drainage, add extra base material, process subgrade.	Low strength, wetness, surface cracking and buckling.	Maintain drainage system.

See footnote at end of table.

TABLE 13.--SOIL POTENTIAL FOR LOCAL ROADS AND STREETS--Continued

Map symbol and soil name	Potential, index and corrective treatment	Limitations	Continuing limitations
44 Parsons	Medium: 80 Add extra base material, process subgrade, install subsurface drainage.	Low strength, wetness, shrink-swell.	None.
45* Pits	Low: 10 Add fill.	Soil depth, shrink-swell, low strength, no material, floods.	None.
46, 47 Porum	Medium: 85 Add extra base material, process subgrade.	Low strength, shrink-swell.	Maintain drainage system.
48 Porum	Medium: 83 Add fill, extra base material, process subgrade.	Low strength, shrink-swell, gullies.	Maintain drainage system.
49 Shermore	Medium: 78 Have extra excavation, add extra base material, install subsurface drainage.	Depth to pan, moderate load bearing strength, water table.	Maintain drainage system.
50 Stigler	Medium: 80 Add extra base material, process subgrade.	Low strength, shrink-swell.	None.
51 Talihina	Low: 60 Have extra excavation, add fill, extra base material.	Soil depth, slope, low strength, wetness.	None.
52, 53 Taloka	Medium: 85 Add extra base material, process subgrade.	Low strength.	None.
54 Verdigris	Medium: 80 Add extra base material.	Floods.	None.
55 Verdigris	Low: 50 Raise roadbed, add extra base material, install flood control system.	Floods.	Maintain flood control system.
56 Woodson	Medium: 80 Add extra base material, process subgrade, install subsurface drainage.	Low strength, shrink-swell, wetness.	None.

* For composition and behavior characteristics of the map unit, see description of it in "Detailed soil map units."

TABLE 14.--SOIL POTENTIAL FOR SEPTIC TANK ABSORPTION FIELDS

[All information in columns 1 and 3 applies to entire map unit; limitations in column 2 are listed separately for each soil]

Map symbol and soil name	Potential, index and corrective treatment	Limitations	Continuing limitations
1, 2, 3: Bates	Medium: 88 Add fill where needed.	Soil depth.	None.
4, 5: Carytown	Low: 60 Enlarge absorption field, add more distribution boxes.	Percs slowly, high sodium, wetness.	Occasional pumping, surfacing of effluent, replace tank.
6:*	Low: 68		
Carytown	Enlarge absorption field, add more distribution boxes.	Percs slowly, high sodium, wetness.	Occasional pumping, surfacing of effluent, replace tank.
Burwell		Percs slowly, wetness.	
7: Caspiana	Medium: 88 Enlarge absorption field.	Percs slowly, wetness.	Possible contamination of ground water, occasional pumping.
8: Choteau	Low: 70 Enlarge absorption field.	Percs slowly, wetness.	None.
9:*	Low: 60		
Collinsville	Add fill where needed.	Soil depth, slope.	Possible surfacing of effluent.
Bates		Soil depth, slope.	
10:*	Low: 60		
Collinsville	Add fill.	Soil depth, slope.	Possible surfacing of effluent.
Talihina		Soil depth, wetness, slope.	
11: Convent Variant	Low: 65 Add fill.	Percs slowly, water table, floods.	Occasional pumping, surfacing of effluent, floods.
12, 13, 14: Dennis	Medium: 84 Enlarge absorption field.	Percs slowly, wetness.	None.
15: Dennis	Medium: 80 Add fill, enlarge absorption field.	Percs slowly, wetness, gullies.	Possible surfacing of effluent.
16:*	Low: 50		
Dennis	Add fill, difficult to install tank.	Slope, wetness, percs slowly.	Surfacing of effluent, floods.
Verdigris		Floods.	
17*	Low: 60		
Enders	Add fill where needed, enlarge absorption field, difficult to install tank.	Slope, percs slowly.	Possible surfacing of effluent.
18:*	Low: 60		
Endsaw	Add fill where needed, enlarge absorption field, difficult to install tank.	Slope, percs slowly.	Possible surfacing of effluent.
Hector		Slope, soil depth.	
19, 20, 21: Eram	Low: 70 Add fill where needed, enlarge absorption field.	Percs slowly, soil depth, wetness.	Possible surfacing of effluent.

See footnote at end of table.

TABLE 14.--SOIL POTENTIAL FOR SEPTIC TANK ABSORPTION FIELDS--Continued

Map symbol and soil name	Potential, index and corrective treatment	Limitations	Continuing limitations
22, 23 Glentosh	Low: 70 None.	Percs rapidly.	Possible contamination of ground water.
24, 25 Kamie	High: 95 None.	Percs moderately.	None.
26 Kanima	Medium: 85 Difficult to install tank and absorption field.	Slope.	Possible surfacing of effluent.
27, 28, 29 Karma	High: 95 None.	Percs moderately.	None.
30 Karma	High: 90 Fill gullies.	Slope, gullies, percs moderately.	None.
31, 32, 33 Karma	High: 95 None.	Percs moderately.	None.
34 Karma	High: 90 Fill gullies.	Slope, gullies, percs moderately.	None.
35 Kiomatia	Low: 50 Add fill.	Floods, water table, percs rapidly.	Occasional pumping, contamination of ground water, surfacing of effluent, floods.
36 Larton	High: 100 None.	None.	None.
37, 38 Linker	Medium: 88 Add fill.	Soil depth.	Possible surfacing of effluent.
39 Linker	Medium: 85 Add fill where needed.	Soil depth, gullies.	Possible surfacing of effluent.
40:* Linker	Low: 60 Add fill where needed.	Soil depth.	Possible surfacing of effluent.
Hector		Soil depth.	
41 Madill	Medium: 85 Add fill.	Floods.	Occasional pumping, contamination of ground water, floods.
42 Madill	Low: 50 Add fill.	Floods.	Frequent pumping, contamination of ground water, surfacing of effluent, floods.
43 Muldrow	Low: 50 Enlarge absorption field, add fill, add distribution boxes.	Percs slowly, wetness, water table, floods.	Contamination of ground water, surfacing of effluent, occasional pumping necessary.
44 Parsons	Low: 60 Enlarge absorption field, add fill, add distribution boxes.	Percs slowly, wetness.	Surfacing of effluent.
45 Pits	Low: 10	Nonfunctioning system.	

See footnote at end of table.

TABLE 14.--SOIL POTENTIAL FOR SEPTIC TANK ABSORPTION FIELDS--Continued

Map symbol and soil name	Potential, index and corrective treatment	Limitations	Continuing limitations
46, 47 Porum	Low: 65 Enlarge absorption field.	Percs slowly, wetness.	Possible surfacing of effluent.
48 Porum	Low: 60 Enlarge absorption field, fill gullies.	Percs slowly, wetness, gullies.	Possible surfacing of effluent.
49 Shermore	Low: 73 Enlarge absorption field.	Percs slowly, restrictive layer.	None.
50 Stigler	Low: 60 Enlarge absorption field, add distribution boxes, add fill where needed.	Percs slowly, wetness.	Occasional pumping necessary, possible surfacing of effluent.
51 Talihina	Low: 50 Difficult to install tank, add fill, enlarge absorption field.	Soil depth, slope, percs slowly, wetness.	Occasional surfacing of effluent.
52, 53 Taloka	Low: 65 Enlarge absorption field.	Percs slowly, wetness.	Possible surfacing of effluent.
54 Verdigris	Medium: 85 Add fill.	Floods.	Contamination of ground water, possible surfacing of effluent, occasional pumping necessary, floods.
55 Verdigrys	Low: 50 Add fill.	Floods.	Contamination of ground water, surfacing of effluent, occasional pumping necessary, floods.
56 Woodson	Low: 55 Enlarge absorption field, add fill, add extra distribution boxes.	Percs slowly, wetness.	Occasional pumping necessary, possible surfacing of effluent.

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

TABLE 15.--SOIL POTENTIAL FOR SEWAGE LAGOON AREAS

[All information in columns 1 and 3 applies to entire map unit; limitations in column 2 are listed separately for each soil]

Map symbol and soil name	Potential, index and corrective treatment	Limitations	Continuing limitations
1, 2, 3 Bates	Medium: 87 Line area.	Soil depth, seepage, slope.	Maintain liner.
4, 5 Carytown	High: 90 None.	Wetness.	None.
6:*	Medium: 85		
Carytown	Level.	Slope, wetness.	None.
Burwell		Wetness.	
7 Caspiana	Medium: 75 Install drainage system.	Wetness, seeage.	Maintain drainage system.
8 Choteau	High: 90 Level, install drainage system.	Slope, wetness.	Maintain drainage system.
9:*	Low: 72		
Collinsville	Dike, line area.	Soil depth, slope.	Maintain dike, maintain liner.
Bates		Soil depth, slope.	
10:*	Low: 61		
Collinsville	Dike, line area.	Soil depth, slope.	Maintain dike, maintain liner.
Talihina		Soil depth, wetness, slope.	
11 Convent Variant	Low: 50 Install drainage system, install flood control system.	Floods, wet"ess.	Maintain drainage system, maintain flood control system, floods.
12, 13, 14 Dennis	High: 90 Install drainage system, level.	Slope, wetness.	Maintain drainage system.
15 Dennis	Medium: 85 Install drainage system, level, fill gullies.	Slope, erosion, wetness.	Maintain drainage system.
16:*	Low: 50		
Dennis	Dike.	Slope, wetness.	Maintain dike.
Verdigris		Floods.	
17:*	Low: 60		
Enders	Level area in Ender soil.	Slope.	Maintain system.
Hector		Soil depth, seepage, slope.	
18:*	Low: 60		
Endsaw	Level area in Endsaw soil.	Slope.	Maintain system.
Hector		Soil depth, seepage, slope.	
19, 20, 21 Eram	Low: 70 Level, line area.	Soil depth, slope, wetness.	Maintain dike.
22, 23 Glentosh	Low: 60 Level, line area.	Percs rapidly, slope, seepage.	Maintain liner.

See footnote at end of table.

TABLE 15.--SOIL POTENTIAL FOR SEWAGE LAGOON AREAS--Continued

Map symbol and soil name	Potential, index and corrective treatment	Limitations	Continuing limitations
24, 25 Kamie	Low: 65 Level, line area.	Seepage, slope.	Maintain liner.
26 Kanima	Low: 65 Level, dike area.	Seepage, slope.	Maintain dike.
27, 28, 29 Karma	Low: 70 Level, dike area.	Slope, seepage.	Maintain dike.
30 Karma	Low: 65 Level, line area, fill gullies.	Seepage, slope, erosion.	Maintain liner.
31, 32, 33 Karma	Low: 70 Level, line area.	Seepage, slope.	Maintain liner.
34 Karma	Low: 65 Level, line area, fill gullies.	Seepage, slope, erosion.	Maintain liner.
35 Kiomatia	Low: 30 Install flood control system, line area.	Floods, permanent high water table, seepage.	Maintain liner, maintain flood control system, floods.
36 Larton	Low: 70 Level, line area.	Seepage, slope.	Maintain liner.
37, 38 Linker	Medium: 85 Level, dike, line area.	Soil depth, slope, seepage.	Maintain liner, maintain dike.
39 Linker	Medium: 80 Level, dike, line area, fill gullies.	Soil depth, slope, seepage, erosion.	Maintain liner, maintain dike.
40:* Linker	Medium: 75 Level, dike, line area.	Soil depth, slope, seepage.	Maintain liner, maintain dike.
Hector		Soil depth, seepage.	
41 Madill	Low: 60 Install flood control system, line area.	Floods, seepage.	Maintain liner, maintain flood control system, floods.
42 Madill	Low: 50 Install flood control system, line area.	Floods, seepage.	Maintain liner, maintain flood control system, floods.
43 Muldrow	Low: 70 Install drainage system.	Surface wetness, high water table.	Maintain drainage system.
44 Parsons	High: 95 Install drainage system.	Wetness.	Maintain drainage system.
45:* Pits	Low: 50 Line, drain area.	Seepage, ponds, floods, no material.	Maintain liner and drainage.
46, 47 Porum	Medium: 80 Level area.	Slope, wetness.	Maintain system.
48 Porum	Medium: 75 Level, fill gullies, install drainage system.	Slope, erosion, wetness.	Maintain drainage system.

See footnote at end of table.

TABLE 15.--SOIL POTENTIAL FOR SEWAGE LAGOON AREAS--Continued

Map symbol and soil name	Potential, index and corrective treatment	Limitations	Continuing limitations
49 Shermore	Medium: 85 Level area.	Slope, wetness.	None.
50 Stigler	High: 95 Install drainage system.	Wetness.	Maintain system.
51 Talihina	Low: 60 Dike, level, line area.	Soil depth, slope, wetness.	Maintain dike and liner.
54 Verdigris	Low: 60 Install flood control system, drainage system.	Floods.	Maintain drainage system and flood control system, floods.
55 Verdigris	Low: 50 Install flood control system, drainage system.	Floods.	Maintain drainage system and flood control system, floods.
56 Woodson	High: 100 None.	None.	None.

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

TABLE 16.--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]

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1 Bates	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Slight	Moderate: low strength.	Moderate: thin layer.
2 Bates	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Moderate: slope.	Moderate: low strength.	Moderate: thin layer.
3 Bates	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Slight	Moderate: low strength.	Moderate: thin layer.
4, 5 Carytown	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: excess sodium, wetness.
6:*						
Carytown	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: excess sodium, wetness.
Burwell	Severe: wetness.	Moderate: wetness.	Severe: wetness, shrink-swell.	Moderate: wetness.	Moderate: wetness.	Slight.
7 Caspiana	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness.	Moderate: shrink-swell.	Severe: low strength.	Slight.
8 Choteau	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
9:*						
Collinsville	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: thin layer.
Bates	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Moderate: slope.	Moderate: low strength.	Moderate: thin layer.
10:*						
Collinsville	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: thin layer.
Talihina	Severe: depth to rock, wetness.	Severe: wetness, shrink-swell.	Severe: wetness, depth to rock.	Severe: wetness, shrink-swell, slope.	Severe: low strength, wetness.	Severe: wetness, thin layer.
11 Convent Variant	Severe: wetness.	Moderate: wetness, floods.	Severe: wetness, floods.	Moderate: wetness, floods.	Moderate: low strength, wetness, floods.	Severe: floods.
12, 13, 14, 15 Dennis	Moderate: too clayey, wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
16:*						
Dennis	Moderate: too clayey, wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
Verdigris	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods.

See footnote at end of table.

TABLE 16.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
17:*						
Enders	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: slope.
Hector	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: small stones, large stones, slope.
18*:						
Endsaw	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.	Severe: large stones, slope.
Hector	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: small stones, large stones, slope.
19, 20, 21 Eram	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Moderate: thin layer.
22 Glentosh	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Severe: droughty.
23 Glentosh	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Severe: droughty.
24 Kamie	Slight	Slight	Slight	Slight	Moderate: low strength.	Moderate: droughty.
25 Kamie	Slight	Slight	Slight	Slight	Moderate: low strength.	Slight.
26 Kanima	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: small stones, droughty, slope.
27, 28, 29, 30, 31, 32, 33, 34 Karma	Slight	Slight	Slight	Moderate: slope.	Moderate: low strength.	Slight.
35 Kiomatia	Severe: floods, cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
36 Larton	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
37 Linker	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: thin layer.
38, 39 Linker	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock.	Moderate: thin layer.
40:*						
Linker	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock.	Moderate: thin layer.
Hector	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: thin layer.

See footnote at end of table.

TABLE 16.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
41----------------- Madill	Severe: cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods.
42----------------- Madill	Severe: cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
43----------------- Muldrow	Severe: wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness.
44----------------- Parsons	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness.
45.* Pits						
46, 47, 48--------- Porum	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
49----------------- Shermore	Severe: wetness.	Moderate: wetness, low strength.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, low strength.	Moderate: wetness.
50----------------- Stigler	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
51----------------- Talihina	Severe: depth to rock, wetness.	Severe: wetness, shrink-swell.	Severe: wetness, depth to rock.	Severe: wetness, shrink-swell, slope.	Severe: low strength, wetness.	Severe: wetness, thin layer.
52, 53------------- Taloka	Severe: wetness.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: low strength.	Moderate: wetness.
54----------------- Verdigris	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods.
55----------------- Verdigris	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
56----------------- Woodson	Severe: wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, wetness.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.

* For composition and behavior characteristics of the map unit, see description in "Detailed soil map units."

TABLE 17.--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]

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1, 2, 3 Bates	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
4, 5 Carytown	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey, excess sodium.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
6:*					
Carytown	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey, excess sodium.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
Burwell	Severe: wetness, percs slowly.	Severe: wetness.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack, large stones.
7 Caspiana	Moderate: wetness, percs slowly.	Moderate: seepage, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
8 Choteau	Severe: wetness, percs slowly.	Severe: wetness.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
9:*					
Collinsville	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock.	Poor: area reclaim.
Bates	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
10:*					
Collinsville	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock, seepage.	Severe: depth to rock.	Poor: area reclaim.
Talihina	Severe: depth to rock, wetness.	Severe: depth to rock, slope, wetness.	Severe: depth to rock, wetness.	Severe: depth to rock, wetness.	Poor: area reclaim.
11 Convent Variant	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
12, 13, 14, 15 Dennis	Severe: percs slowly, wetness.	Severe: wetness.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
16:*					
Dennis	Severe: percs slowly, wetness.	Severe: wetness.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
Verdigris	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Fair: too clayey.

See footnote at end of table.

TABLE 17.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
17:*					
Enders	Severe: percs slowly, slope.	Severe: slope.	Severe: depth to rock, slope, too clayey.	Severe: slope.	Poor: too clayey, hard to pack, slope.
Hector	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, thin layer, slope.
18:*					
Endsaw	Severe: percs slowly, slope.	Severe: slope.	Severe: depth to rock, slope, too clayey.	Severe: slope.	Poor: too clayey, hard to pack, slope.
Hector	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, thin layer, slope.
19, 20, 21 Eram	Severe: depth to rock, wetness, percs slowly.	Severe: depth to rock, wetness.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
22, 23 Glentosh	Severe: poor filter.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: seepage.
24, 25 Kamie	Moderate: percs slowly.	Severe: seepage.	Moderate: too clayey.	Severe: seepage.	Fair: too clayey.
26 Kanima	Severe: slope.	Severe: seepage, slope.	Severe: seepage, slope, large stones.	Severe: seepage, slope.	Poor: small stones, slope.
27, 28, 29, 30, 31, 32, 33, 34 Karma	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Slight	Fair: too clayey.
35 Kiomatia	Severe: floods, wetness.	Severe: seepage, floods, wetness.	Severe: floods, seepage, wetness.	Severe: floods, seepage, wetness.	Poor: too sandy.
36 Larton	Slight	Severe: seepage.	Slight	Severe: seepage.	Good.
37, 38, 39 Linker	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, thin layer.
40:*					
Linker	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, thin layer.
Hector	Severe: depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: area reclaim, thin layer.
41, 42 Madill	Severe: floods.	Severe: seepage, floods.	Severe: floods, seepage.	Severe: floods, seepage.	Good.

See footnote at end of table.

TABLE 17.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
43 Muldrow	Severe: wetness, percs slowly.	Severe: floods, wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
44 Parsons	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
45.* Pits					
46, 47, 48 Porum	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
49 Shermore	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.	Moderate: wetness.	Fair: wetness, too clayey.
50 Stigler	Severe: wetness, percs slowly.	Severe: wetness.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
51 Talihina	Severe: depth to rock, wetness.	Severe: depth to rock, slope, wetness.	Severe: depth to rock, wetness.	Severe: depth to rock, wetness.	Poor: area reclaim.
52, 53 Taloka	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
54, 55 Verdigris	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Fair: too clayey.
56 Woodson	Severe: percs slowly, wetness.	Slight	Severe: too clayey, wetness.	Severe: wetness.	Poor: too clayey, wetness, hard to pack.

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

TABLE 18.--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]

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
1, 2, 3: Bates	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones, thin layer.
4, 5: Carytown	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, excess sodium.
6:*				
Carytown	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, excess sodium.
Burwell	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
7: Caspiana	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
8: Choteau	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
9:*				
Collinsville	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
Bates	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones, thin layer.
10:*				
Collinsville	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
Talihina	Poor: area reclaim, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones.
11: Convent Variant	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
12, 13, 14, 15: Dennis	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, thin layer.
16:*				
Dennis	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, thin layer.
Verdigris	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.

See footnote at end of table.

TABLE 18.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
17:*				
Enders	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, slope.
Hector	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
18:*				
Endsaw	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
Hector	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
19, 20, 21 Eram	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
22, 23 Glentosh	Good	Probable	Improbable: too sandy.	Fair: too sandy.
24 Kamie	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
25 Kamie	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
26 Kanima	Fair: large stones, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
27, 28, 29, 30, 31, 32, 33, 34 Karma	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
35 Kiomatia	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
36 Larton	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
37, 38, 39 Linker	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
40:*				
Linker	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Hector	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, thin layer.
41, 42 Madill	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
43 Muldrow	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.

See footnote at end of table.

TABLE 18.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
44 Parsons	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
45.* Pits				
46, 47, 48 Porum	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
49 Shermore	Fair: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
50 Stigler	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
51 Talihina	Poor: area reclaim, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, large stones.
52, 53 Taloka	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
54, 55 Verdigris	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
56 Woodson	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.

* For composition and behavior characteristics of the map unit, see description in "Detailed soil map units."

TABLE 19.--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]

Map symbol and soil name	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Limitations for-- Aquifer-fed excavated ponds	Features affecting-- Drainage	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
1 Bates	Moderate: seepage, depth to rock.	Severe: piping.	Severe: no water.	Deep to water	Depth to rock	Depth to rock.
2, 3 Bates	Moderate: seepage, depth to rock, slope.	Severe: piping.	Severe: no water.	Deep to water	Depth to rock	Depth to rock.
4, 5 Carytown	Slight	Severe: hard to pack, wetness, excess sodium.	Severe: no water.	Percs slowly, excess sodium.	Erodes easily, wetness, percs slowly.	Wetness, excess sodium, erodes easily.
6:*						
Carytown	Slight	Severe: hard to pack, wetness, excess sodium.	Severe: no water.	Percs slowly, excess sodium.	Erodes easily, wetness, percs slowly.	Wetness, excess sodium, erodes easily.
Burwell	Moderate: seepage.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly, large stones.	Erodes easily, wetness, percs slowly.	Erodes easily, rooting depth, percs slowly.
7 Caspiana	Moderate: seepage.	Severe: piping.	Moderate: deep to water, slow refill.	Deep to water	Favorable	Favorable.
8 Choteau	Slight	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly	Erodes easily, wetness, percs slowly.	Erodes easily, rooting depth, percs slowly.
9:*						
Collinsville	Severe: depth to rock.	Slight	Severe: no water.	Deep to water	Depth to rock	Depth to rock.
Bates	Moderate: seepage, depth to rock, slope.	Severe: piping.	Severe: no water.	Deep to water	Depth to rock	Depth to rock.
10:*						
Collinsville	Severe: depth to rock, slope.	Slight	Severe: no water.	Deep to water	Slope, depth to rock.	Slope, depth to rock.
Talihina	Severe: depth to rock, slope.	Severe: wetness.	Severe: no water.	Percs slowly, depth to rock, slope.	Slope, depth to rock, erodes easily.	Wetness, slope, erodes easily.
11 Convent Variant	Slight	Severe: piping.	Severe: slow refill.	Favorable	Erodes easily, wetness.	Erodes easily.
12 Dennis	Slight	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly	Erodes easily, wetness, percs slowly.	Erodes easily, rooting depth, percs slowly.
13, 14, 15 Dennis	Moderate: slope.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly, slope.	Erodes easily, wetness, percs slowly.	Erodes easily, rooting depth, percs slowly.
16:*						
Dennis	Moderate: slope.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly, slope.	Erodes easily, wetness, percs slowly.	Erodes easily, rooting depth, percs slowly.

See footnote at end of table.

TABLE 19.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Terraces and diversions	Grassed waterways
16:*						
Verdigris	Moderate: seepage.	Moderate: piping.	Severe: no water.	Deep to water	Favorable	Favorable.
17:*						
Enders	Severe: slope.	Severe: hard to pack.	Severe: no water.	Deep to water	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.
Hector	Severe: depth to rock, slope, seepage.	Severe: thin layer, piping.	Severe: no water.	Deep to water	Slope, large stones, depth to rock.	Large stones, slope, droughty.
18:*						
Endsaw	Severe: slope.	Moderate: thin layer, hard to pack, large stones.	Severe: no water.	Deep to water	Slope, large stones.	Large stones, slope.
Hector	Severe: depth to rock, slope, seepage.	Severe: thin layer, piping.	Severe: no water.	Deep to water	Slope, large stones, depth to rock.	Large stones, slope, droughty.
19 Eram	Moderate: depth to rock.	Moderate: thin layer, hard to pack, wetness.	Severe: no water.	Percs slowly, depth to rock.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
20, 21 Eram	Moderate: depth to rock, slope.	Moderate: thin layer, hard to pack, wetness.	Severe: no water.	Percs slowly, depth to rock, slope.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
22, 23 Glentosh	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Too sandy	Droughty.
24 Kamie	Moderate: seepage.	Severe: piping.	Severe: no water.	Deep to water	Favorable	Droughty.
25 Kamie	Moderate: seepage.	Severe: piping.	Severe: no water.	Deep to water	Favorable	Favorable.
26 Kanima	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, large stones.	Large stones, slope, droughty.
27, 28, 29, 30, 31, 32, 33, 34 Karma	Moderate: seepage.	Moderate: thin layer, piping.	Severe: no water.	Deep to water	Favorable	Rooting depth.
35 Kiomatia	Severe: seepage.	Severe: seepage, piping.	Severe: cutbanks cave.	Deep to water	Too sandy	Droughty.
36 Larton	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water	Favorable	Droughty.
37, 38, 39 Linker	Moderate: seepage, depth to rock.	Severe: piping.	Severe: no water.	Deep to water	Depth to rock	Depth to rock.
40:*						
Linker	Moderate: seepage, depth to rock.	Severe: piping.	Severe: no water.	Deep to water	Depth to rock	Depth to rock.

See footnote at end of table.

TABLE 19.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Terraces and diversions	Grassed waterways
40:*						
Hector	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Deep to water	Depth to rock	Depth to rock.
41, 42 Madill	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water	Favorable	Favorable.
43 Muldrow	Slight	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
44 Parsons	Slight	Severe: wetness.	Severe: no water.	Percs slowly	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
45.* Pits						
46 Porum	Slight	Moderate: hard to pack, wetness.	Severe: slow refill.	Percs slowly	Erodes easily, wetness.	Erodes easily, percs slowly.
47, 48 Porum	Slight	Moderate: hard to pack, wetness.	Severe: slow refill.	Percs slowly, slope.	Erodes easily, wetness.	Erodes easily, percs slowly.
49 Shermore	Moderate: seepage.	Moderate: wetness.	Severe: no water.	Favorable	Favorable	Favorable.
50 Stigler	Moderate: seepage.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly	Erodes easily, wetness, percs slowly.	Erodes easily, percs slowly.
51 Talihina	Severe: depth to rock, slope.	Severe: wetness.	Severe: no water.	Percs slowly, depth to rock, slope.	Slope, depth to rock, erodes easily.	Wetness, slope, erodes easily.
52, 53 Taloka	Moderate: seepage.	Severe: hard to pack.	Severe: no water.	Percs slowly	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
54, 55 Verdigris	Moderate: seepage.	Moderate: piping.	Severe: no water.	Deep to water	Favorable	Favorable.
56 Woodson	Slight	Severe: wetness.	Severe: no water.	Percs slowly	Erodes easily, wetness, percs slowly.	Percs slowly, wetness, erodes easily.

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

TABLE 20.--ENGINEERING INDEX PROPERTIES

[Absence of an entry indicates that data were not estimated]

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag-ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
1, 2, 3---------- Bates	0-12	Loam-------------	ML, CL, CL-ML	A-4, A-6	0	90-100	85-100	80-100	55-90	20-40	3-15
	12-38	Loam, clay loam, sandy clay loam.	ML, CL, SC, SM	A-4, A-6, A-7	0	85-100	85-100	80-100	45-85	25-45	3-20
	38-40	Weathered bedrock.	---	---	---	---	---	---	---	---	---
4, 5------------- Carytown	0-14	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	95-100	95-100	80-95	20-30	5-15
	14-62	Clay, silty clay	CH	A-7	0	100	95-100	90-100	90-100	51-70	30-45
6:* Carytown--------	0-14	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	95-100	95-100	80-95	20-30	5-15
	14-62	Clay, silty clay	CH	A-7	0	100	95-100	90-100	90-100	51-70	30-45
Burwell---------	0-28	Loam-------------	CL, ML, CL-ML	A-4	0	100	100	94-100	60-97	22-30	2-10
	28-34	Clay loam, silty clay loam.	CL	A-6, A-7	0	90-100	90-100	90-100	80-98	33-43	12-20
	34-68	Clay loam, clay	CL, CH	A-6, A-7	0-30	70-100	70-100	70-100	70-95	37-60	16-34
7--------------- Caspiana	0-10	Silty clay loam	CL	A-6, A-7-6	0	100	100	100	85-100	32-50	11-25
	10-50	Silty clay loam, silt loam.	CL, CL-ML	A-6, A-7-6, A-4	0	100	100	100	85-100	23-43	4-20
	50-60	Silt loam, very fine sandy loam, silty clay loam.	CL-ML, CL	A-4, A-6	0	100	100	100	80-100	23-37	4-15
8--------------- Choteau	0-21	Silt loam--------	CL	A-4, A-6	0	100	100	96-100	65-97	30-37	8-14
	21-26	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	96-100	80-98	33-43	12-20
	26-80	Silty clay loam, clay loam, silty clay.	CL, CH	A-6, A-7	0	100	100	96-100	80-99	37-70	15-38
9:* Collinsville----	0-6	Fine sandy loam	SM, SC, ML, CL	A-4	0-3	80-100	60-100	60-95	36-75	<30	NP-10
	6-14	Fine sandy loam, stony fine sandy loam.	SM, SC, ML, CL	A-4	3-35	80-100	60-100	60-95	36-75	<30	NP-10
	14-24	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Bates-----------	0-10	Loam-------------	ML, CL, CL-ML	A-4, A-6	0	90-100	85-100	80-100	55-90	20-40	3-15
	9-30	Loam, clay loam, sandy clay loam.	ML, CL, SC, SM	A-4, A-6, A-7	0	85-100	85-100	80-100	45-85	25-45	3-20
	30-42	Weathered bedrock.	---	---	---	---	---	---	---	---	---
10:* Collinsville----	0-8	Fine sandy loam	SM, SC, ML, CL	A-4	0-3	80-100	60-100	60-95	36-75	<30	NP-10
	8-14	Fine sandy loam, loam, extremely stony fine sandy loam.	SM, SC, ML, CL	A-4	3-40	80-100	60-100	60-95	36-75	<30	NP-10
	14-24	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Talihina--------	0-18	Clay loam--------	CL	A-6, A-7	0-15	87-100	87-100	85-100	70-98	37-50	15-26
	18-24	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 20.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	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	
11---------------- Convent Variant	0-18	Silt loam--------	CL-ML, ML	A-4	0	100	100	96-100	80-97	22-30	2-7
	18-67	Very fine sandy loam, loam, silt loam.	CL-ML, ML, CL	A-4, A-6	0	100	100	94-100	65-95	<40	NP-16
12, 13, 14, 15--- Dennis	0-12	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	96-100	65-97	20-37	1-15
	12-19	Silty clay loam, clay loam.	CL	A-6, A-7	0	98-100	98-100	94-100	75-98	33-48	13-25
	19-62	Clay, silty clay, silty clay loam.	CL, CH	A-7, A-6	0	98-100	98-100	94-100	75-98	37-65	15-35
16:*											
Dennis-----------	0-11	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	96-100	65-97	20-37	1-15
	11-15	Silty clay loam, clay loam.	CL	A-6, A-7	0	98-100	98-100	94-100	75-98	33-48	13-25
	15-62	Clay, silty clay, silty clay loam.	CL, CH	A-7, A-6	0	98-100	98-100	94-100	75-98	37-65	15-35
Verdigris--------	0-22	Silt loam--------	CL, CL-ML, ML	A-4, A-6	0	100	100	95-100	65-100	22-38	2-13
	22-63	Silt loam, silty clay loam.	CL	A-4, A-6, A-7	0	100	100	95-100	80-100	30-45	8-23
17:*											
Enders-----------	0-8	Fine sandy loam	ML, SM, SM-SC, CL-ML	A-4	0	80-100	80-97	75-90	40-85	20-35	2-10
	8-20	Clay loam, silty clay loam, loam.	CL	A-6	0	80-100	80-100	80-100	75-95	30-40	11-17
	20-33	Silty clay, clay	CH	A-7	0	95-100	85-100	85-100	70-95	65-80	35-45
	33-44	Silty clay, stony silty clay.	CH	A-7	0-15	95-100	90-100	85-100	70-95	65-80	35-45
	44-65	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Hector-----------	0-10	Very stony fine sandy loam.	GM, GM-GC	A-2, A-1-B	35-50	40-50	35-45	30-40	20-30	<30	NP-7
	10-16	Fine sandy loam, gravelly fine sandy loam, gravelly loam.	SM, ML, GM, GM-GC	A-4, A-2	0-20	55-100	55-100	45-100	30-65	<30	NP-7
	16-20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
18:*											
Endsaw-----------	0-9	Stony fine sandy loam.	ML, CL-ML, SM, SM-SC	A-2, A-4	15-35	65-95	60-90	50-80	20-55	<26	NP-7
	9-42	Silty clay, clay	CL, CH	A-7	0-15	75-100	70-98	68-96	65-95	41-60	18-32
	42-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Hector-----------	0-9	Very stony fine sandy loam.	GM, GM-GC	A-2, A-1-B	35-50	40-50	35-45	30-40	20-30	<30	NP-7
	9-15	Fine sandy loam, gravelly fine sandy loam, gravelly loam.	SM, ML, GM, GM-GC	A-4, A-2	0-20	55-100	55-100	45-100	30-65	<30	NP-7
	15-24	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
19, 20, 21-------- Eram	0-10	Clay loam--------	CL	A-6, A-7	0	85-100	85-100	85-100	75-95	33-48	12-25
	10-31	Clay, silty clay, clay loam.	CL, CH	A-7, A-6	0	95-100	95-100	90-100	85-98	37-65	15-35
	31-36	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 20.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	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	
22, 23----------- Glentosh	0-10	Loamy fine sand	SM, SP-SM	A-2	0	100	98-100	85-100	11-35	---	NP
	10-80	Loamy fine sand, fine sand, sand.	SM, SP-SM	A-2, A-3	0	100	98-100	80-100	5-35	---	NP
24--------------- Kamie	0-16	Loamy fine sand	SM	A-2	0	100	98-100	90-100	15-35	---	NP
	16-52	Sandy clay loam, clay loam.	CL, SC, CL-ML, SM-SC	A-4, A-6	0	100	100	90-100	36-90	25-40	7-18
	52-68	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4, A-6	0	100	98-100	90-100	36-90	<37	NP-16
25--------------- Kamie	0-18	Fine sandy loam	SM, ML, SC, CL	A-4	0	100	98-100	94-100	36-80	<30	NP-10
	18-61	Sandy clay loam, clay loam.	CL, SC, CL-ML, SM-SC	A-4, A-6	0	100	100	90-100	36-90	25-40	7-18
	61-78	Fine sandy loam, sandy clay loam.	SM, ML, SC, CL	A-4, A-6	0	100	98-100	90-100	36-90	<37	NP-16
26--------------- Kanima	0-6	Shaly silty clay loam.	ML, CL, SM, SC	A-2, A-4, A-6	0-7	10-80	5-75	5-70	5-70	18-35	1-14
	6-62	Very shaly clay loam, very shaly silt loam, very shaly silty clay loam.	ML, CL, SM, SC	A-2, A-4, A-6	7-40	10-60	5-55	5-55	5-55	18-35	1-14
27, 28, 29, 30--- Karma	0-16	Loamy fine sand	SM	A-2	0	100	98-100	90-100	15-35	---	NP
	16-52	Sandy clay loam, clay loam.	CL, SC	A-4, A-6	0	100	100	90-100	36-90	25-40	7-18
	52-68	Fine sandy loam, loam, sandy clay loam.	ML, CL, SM, SC	A-4, A-6	0	100	98-100	90-100	36-85	<37	NP-16
31, 32, 33, 34--- Karma	0-16	Fine sandy loam	ML, CL, SM, SC	A-4	0	100	98-100	94-100	36-85	<31	NP-10
	16-50	Sandy clay loam, clay loam.	CL, SC	A-4, A-6	0	100	100	90-100	36-90	25-40	7-18
	50-64	Fine sandy loam, loam, sandy clay loam.	ML, CL, SM, SC	A-4, A-6	0	100	98-100	90-100	36-85	<37	NP-16
35--------------- Kiomatia	0-8	Loamy fine sand	SM, SM-SC	A-4, A-2-4	0	100	95-100	80-100	30-45	<26	NP-7
	8-62	Stratified fine sand to loam.	SM, SM-SC	A-2-4	0	100	95-100	80-90	13-30	<22	NP-5
36--------------- Larton	0-25	Loamy fine sand	SM	A-2	0	100	98-100	90-100	15-35	---	NP
	25-78	Fine sandy loam, loam, sandy clay loam.	SM, ML, SC	A-4	0	100	98-100	94-100	36-85	<31	NP-10
37, 38, 39------- Linker	0-7	Fine sandy loam	SM, ML	A-4	0	85-100	80-100	70-100	40-70	<30	NP-7
	7-26	Fine sandy loam, sandy clay loam, loam.	CL, SC, SM, ML	A-4, A-6	0-10	90-100	80-100	70-100	40-80	<40	NP-18
	26-36	Gravelly sandy clay loam, gravelly fine sandy loam, sandy clay loam.	CL, SC, GC, ML	A-4, A-6	0-10	65-100	60-100	55-100	40-80	<40	NP-18
	36-42	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 20.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
40:*											
Linker----------	0-6	Fine sandy loam	SM, ML	A-4	0	85-100	80-100	70-100	40-70	<30	NP-7
	6-32	Fine sandy loam, sandy clay loam, loam.	CL, SC, SM, ML	A-4, A-6	0-10	90-100	80-100	70-100	40-80	<40	NP-18
	32-39	Gravelly sandy clay loam, gravelly fine sandy loam, sandy clay loam.	CL, SC, GC, ML	A-4, A-6	0-10	65-100	60-100	55-100	40-80	<40	NP-18
	39-46	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Hector----------	0-5	Fine sandy loam	SM, ML	A-4	0	85-100	80-100	70-100	40-70	<30	NP-7
	5-16	Fine sandy loam, loam.	SM, SC, SM, ML	A-4, A-2	0-10	55-100	55-100	45-100	30-80	<30	NP-7
	16-24	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
41, 42----------- Madill	0-9	Fine sandy loam	SM, SC, ML, CL	A-4	0	100	98-100	94-100	36-85	<30	NP-10
	9-42	Fine sandy loam, loam.	SM, SC, ML, CL	A-4	0	100	98-100	94-100	36-85	<30	NP-10
	42-62	Fine sandy loam, loam, loamy fine sand.	SM, SC, ML, CL	A-2, A-4	0	100	98-100	90-100	15-85	<30	NP-10
43--------------- Muldrow	0-10	Silty clay loam	CL	A-6, A-7-6	0	100	100	96-100	80-98	33-43	12-20
	10-62	Silty clay loam, silty clay, clay.	CL, CH, ML, MH	A-6, A-7	0	100	100	96-100	80-98	37-70	15-40
44--------------- Parsons	0-12	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	96-100	96-100	80-97	20-37	1-12
	12-76	Clay loam, silty clay loam, silty clay.	CL, CH	A-6, A-7	0	100	96-100	96-100	80-99	37-70	15-40
45.* Pits											
46, 47, 48------- Porum	0-10	Fine sandy loam	SM, SC, ML, CL	A-4	0	100	98-100	94-100	36-85	<30	NP-10
	10-18	Loam, silt loam, clay loam.	CL	A-4, A-6	0	100	100	96-100	65-90	30-40	9-18
	18-40	Clay loam, silty clay loam, silty clay.	CL, CH	A-6, A-7	0	100	100	96-100	80-99	37-70	15-38
	40-64	Silty clay loam, clay loam, sandy clay loam.	CL	A-6, A-7	0	100	100	90-100	51-98	25-50	11-26
49--------------- Shermore	0-12	Loam-------------	ML, CL-ML	A-4	0	100	100	96-100	65-85	22-29	2-7
	12-30	Sandy clay loam, clay loam, loam.	CL, SC	A-4, A-6	0	95-100	95-100	95-100	36-65	20-37	5-16
	30-70	Sandy clay loam, loam, clay loam.	CL, SC	A-4, A-6	0	85-98	80-90	60-80	36-60	20-37	5-16
50--------------- Stigler	0-19	Very fine sandy loam.	CL, ML, CL-ML	A-4, A-6	0	100	100	94-100	60-97	20-37	2-14
	19-62	Silty clay loam, silty clay, clay.	CL, CH	A-6, A-7	0	100	100	96-100	80-99	37-70	15-38

See footnote at end of table.

TABLE 20.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	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	
51----------------- Talihina	0-15	Clay loam---------	CL	A-6, A-7	0-15	87-100	87-100	85-100	70-98	37-50	15-26
	15-20	Weathered bedrock	---	---	---	---	---	---	---	---	---
52, 53------------ Taloka	0-22	Silt loam---------	ML, CL	A-4, A-6	0	100	100	96-100	80-97	30-37	8-13
	22-75	Clay loam, silty clay loam, silty clay.	CL, CH	A-6, A-7	0	100	100	96-100	80-99	37-70	15-38
54, 55------------ Verdigris	0-21	Silt loam---------	CL, CL-ML, ML	A-4, A-6	0	100	100	95-100	65-100	22-38	2-13
	21-68	Silt loam, silty clay loam.	CL	A-4, A-6, A-7	0	100	100	95-100	80-100	30-45	8-23
56----------------- Woodson	0-8	Silt loam---------	CL, CL-ML	A-4, A-6	0	100	100	90-100	85-100	25-40	5-20
	8-60	Silty clay, clay	CH	A-7-6	0	100	95-100	95-100	90-100	50-65	30-45

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

TABLE 21.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[Entries under "Erosion factors--T" apply to the entire profile. Entries under "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Map symbol and soil name	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH				Pct
1, 2, 3---------- Bates	0-12	15-27	1.40-1.50	0.6-2.0	0.20-0.24	5.1-6.5	Low----------	0.28	4	1-4
	12-38	18-35	1.50-1.60	0.6-2.0	0.15-0.19	5.1-6.5	Low----------	0.28		
	38-40	---	---	---	---	---	-------------	----		
4, 5------------- Carytown	0-14	12-25	1.20-1.40	0.6-2.0	0.19-0.24	5.1-7.3	Low----------	0.43	3	.5-2
	14-62	40-60	1.45-1.65	<0.06	0.08-0.11	5.6-8.4	High---------	0.43		
6:* Carytown--------	0-14	12-25	1.20-1.40	0.6-2.0	0.19-0.24	5.1-7.3	Low----------	0.43	3	.5-2
	14-62	40-60	1.45-1.65	<0.06	0.08-0.11	5.6-8.4	High---------	0.43		
Burwell---------	0-28	18-24	1.30-1.60	0.6-2.0	0.15-0.20	5.1-6.0	Low----------	0.43	5	1-3
	28-34	27-35	1.45-1.75	0.2-0.6	0.15-0.20	5.1-7.3	Moderate-----	0.37		
	34-68	35-40	1.45-1.75	0.06-0.2	0.12-0.20	5.6-8.4	High---------	0.32		
7---------------- Caspiana	0-10	27-35	1.30-1.75	0.6-2.0	0.20-0.22	5.6-8.4	Moderate-----	0.32	5	1-4
	10-50	20-35	1.30-1.75	0.6-2.0	0.20-0.22	5.6-8.4	Moderate-----	0.32		
	50-60	10-35	1.30-1.65	0.6-2.0	0.15-0.23	6.1-8.4	Low----------	0.32		
8---------------- Choteau	0-21	18-24	1.30-1.55	0.6-2.0	0.16-0.20	4.5-6.5	Low----------	0.43	5	1-3
	21-26	27-35	1.45-1.70	0.2-0.6	0.15-0.22	4.5-6.0	Moderate-----	0.37		
	26-80	35-45	1.35-1.70	0.06-0.2	0.12-0.22	5.1-7.8	High---------	0.37		
9:* Collinsville----	0-6	5-20	1.30-1.65	2.0-6.0	0.12-0.16	5.1-6.5	Low----------	0.32	2	1-2
	6-14	5-20	1.30-1.65	2.0-6.0	0.09-0.13	5.1-6.5	Low----------	0.20		
	14-24	---	---	---	---	---	-------------	----		
Bates-----------	0-10	15-27	1.40-1.50	0.6-2.0	0.20-0.24	5.1-6.5	Low----------	0.28	4	1-4
	9-30	18-35	1.50-1.60	0.6-2.0	0.15-0.19	5.1-6.5	Low----------	0.28		
	30-42	---	---	---	---	---	-------------	----		
10:* Collinsville----	0-8	5-20	1.30-1.65	2.0-6.0	0.12-0.16	5.1-6.5	Low----------	0.32	2	1-2
	8-14	5-20	1.30-1.65	2.0-6.0	0.09-0.13	5.1-6.5	Low----------	0.20		
	14-24	---	---	---	---	---	-------------	----		
Talihina--------	0-18	35-40	1.30-1.60	0.06-0.2	0.15-0.19	5.1-7.8	High---------	0.37	2	1-3
	18-24	---	---	---	---	---	-------------	----		
11--------------- Convent Variant	0-18	12-18	1.30-1.50	0.6-2.0	0.16-0.24	5.6-7.3	Low----------	0.37	5	.5-1
	18-67	10-24	1.35-1.65	0.6-2.0	0.15-0.20	5.1-8.4	Low----------	0.37		
12, 13, 14, 15--- Dennis	0-12	10-27	1.30-1.55	0.6-2.0	0.15-0.20	5.1-6.0	Low----------	0.43	5	1-3
	12-19	27-35	1.45-1.70	0.2-0.6	0.15-0.20	4.5-6.0	Moderate-----	0.37		
	19-62	35-55	1.35-1.65	0.06-0.2	0.15-0.20	5.1-8.4	High---------	0.37		
16:* Dennis----------	0-11	10-27	1.30-1.55	0.6-2.0	0.15-0.20	5.1-6.0	Low----------	0.43	5	1-3
	11-15	27-35	1.45-1.70	0.2-0.6	0.15-0.20	4.5-6.0	Moderate-----	0.37		
	15-62	35-55	1.35-1.65	0.06-0.2	0.15-0.20	5.1-8.4	High---------	0.37		
Verdigris-------	0-22	15-27	1.30-1.40	0.6-2.0	0.20-0.24	5.6-7.3	Low----------	0.32	5	2-4
	22-63	18-35	1.40-1.65	0.6-2.0	0.17-0.22	5.6-7.3	Moderate-----	0.32		
17:* Enders----------	0-8	10-25	1.25-1.60	0.6-2.0	0.10-0.20	3.6-5.5	Low----------	0.37	3	---
	8-20	15-35	1.25-1.60	0.2-0.6	0.15-0.22	3.6-5.5	Low----------	0.43		
	20-33	35-60	1.15-1.45	<0.06	0.12-0.18	3.6-5.5	High---------	0.37		
	33-44	35-60	1.20-1.45	<0.06	0.08-0.10	3.6-5.5	Moderate-----	0.37		
	44-65	---	---	---	---	---	-------------	----		

See footnote at end of table.

TABLE 21.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Map symbol and soil name	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH				Pct
17:*										
Hector----------	0-10	5-20	1.30-1.60	2.0-6.0	0.05-0.10	5.1-6.5	Low----------	0.17	1	.5-2
	10-16	10-25	1.30-1.60	2.0-6.0	0.08-0.15	4.5-5.5	Low----------	0.17		
	16-20	---	---	---	---	---	-------------	----		
18:*										
Endsaw----------	0-9	12-20	1.30-1.60	0.6-2.0	0.06-0.14	5.1-6.0	Low----------	0.32	4	.5-1
	9-42	40-60	1.35-1.60	0.06-0.2	0.08-0.18	4.5-5.5	High---------	0.32		
	42-60	---	---	---	---	---	-------------	----		
Hector----------	0-9	5-20	1.30-1.60	2.0-6.0	0.05-0.10	5.1-6.5	Low----------	0.17	1	.5-2
	9-15	10-25	1.30-1.60	2.0-6.0	0.08-0.15	4.5-5.5	Low----------	0.17		
	15-24	---	---	---	---	---	-------------	----		
19, 20, 21------- Eram	0-10	27-32	1.30-1.60	0.2-0.6	0.15-0.19	5.6-6.5	Moderate-----	0.37	3	1-3
	10-31	35-55	1.45-1.75	0.06-0.2	0.14-0.18	5.1-7.3	High---------	0.37		
	31-36	---	---	---	---	---	-------------	----		
22, 23----------- Glentosh	0-10	5-12	1.35-1.50	6.0-20	0.07-0.11	5.1-6.0	Low----------	0.15	5	<1
	10-80	5-12	1.35-1.65	6.0-20	0.05-0.11	4.5-6.5	Low----------	0.15		
24--------------- Kamie	0-16	5-10	1.35-1.50	2.0-6.0	0.07-0.11	5.6-7.3	Low----------	0.20	5	.5-1
	16-52	20-35	1.35-1.65	0.6-2.0	0.12-0.20	4.5-6.0	Low----------	0.32		
	52-68	18-32	1.35-1.65	0.6-2.0	0.11-0.17	4.5-6.0	Low----------	0.32		
25--------------- Kamie	0-18	10-18	1.30-1.60	2.0-6.0	0.11-0.15	5.6-7.3	Low----------	0.24	5	.5-1
	18-61	20-35	1.35-1.65	0.6-2.0	0.12-0.20	4.5-6.0	Low----------	0.32		
	61-78	18-32	1.35-1.65	0.6-2.0	0.11-0.17	4.5-6.0	Low----------	0.32		
26--------------- Kanima	0-6	20-35	1.30-1.60	0.6-6.0	0.02-0.15	5.6-8.4	Low----------	0.28	4	.5-1
	6-62	20-35	1.30-1.60	0.6-6.0	0.02-0.12	5.6-8.4	Low----------	0.28		
27, 28, 29, 30--- Karma	0-16	5-12	1.35-1.50	2.0-6.0	0.07-0.11	5.6-7.8	Low----------	0.20	5	.5-1
	16-52	24-35	1.45-1.75	0.6-2.0	0.12-0.20	5.6-7.8	Low----------	0.32		
	52-68	10-24	1.35-1.65	0.6-6.0	0.07-0.11	5.6-7.8	Low----------	0.37		
31, 32, 33, 34--- Karma	0-16	10-20	1.30-1.60	0.6-2.0	0.11-0.20	5.6-7.8	Low----------	0.24	5	.5-1
	16-50	24-35	1.45-1.75	0.6-2.0	0.12-0.20	5.6-7.8	Low----------	0.32		
	50-64	10-24	1.35-1.65	0.6-6.0	0.07-0.11	5.6-7.8	Low----------	0.37		
35--------------- Kiomatia	0-8	5-15	1.30-1.60	0.6-2.0	0.10-0.15	6.1-8.4	Low----------	0.17	5	<1
	8-62	2-15	1.40-1.65	6.0-20	0.05-0.10	6.1-8.4	Low----------	0.17		
36--------------- Larton	0-25	5-10	1.35-1.50	2.0-6.0	0.07-0.11	5.6-6.5	Low----------	0.20	5	.5-1
	25-78	15-25	1.40-1.70	2.0-6.0	0.11-0.20	5.1-6.0	Low----------	0.24		
37, 38, 39------- Linker	0-7	5-20	1.30-1.60	0.6-2.0	0.11-0.20	3.6-5.5	Low----------	0.28	3	.5-3
	7-26	18-35	1.30-1.60	0.6-2.0	0.11-0.20	3.6-5.5	Low----------	0.32		
	26-36	18-35	1.30-1.60	0.6-2.0	0.08-0.20	3.6-5.5	Low----------	0.28		
	36-42	---	---	---	---	---	-------------	----		
40:*										
Linker----------	0-6	5-20	1.30-1.60	0.6-2.0	0.11-0.20	3.6-5.5	Low----------	0.28	3	.5-3
	6-32	18-35	1.30-1.60	0.6-2.0	0.11-0.20	3.6-5.5	Low----------	0.32		
	32-39	18-35	1.30-1.60	0.6-2.0	0.08-0.20	3.6-5.5	Low----------	0.28		
	39-46	---	---	---	---	---	-------------	----		
Hector----------	0-5	5-20	1.30-1.60	0.6-2.0	0.11-0.20	3.6-5.5	Low----------	0.28	3	.5-3
	5-16	18-35	1.30-1.60	0.6-2.0	0.11-0.20	3.6-5.5	Low----------	0.32		
	16-24	---	---	---	---	---	-------------	----		
	---	---	---	---	---	---	-------------	----		
41, 42----------- Madill	0-9	10-18	1.30-1.60	2.0-6.0	0.11-0.16	5.6-7.3	Low----------	0.32	5	.5-1
	9-42	10-18	1.30-1.60	2.0-6.0	0.11-0.16	5.6-7.3	Low----------	0.32		
	42-62	5-18	1.30-1.60	2.0-6.0	0.07-0.16	5.6-8.4	Low----------	0.32		

See footnote at end of table.

TABLE 21.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Map symbol and soil name	Depth	Clay <2mm	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH				Pct
43----------------	0-10	30-40	1.30-1.60	0.2-0.6	0.15-0.22	5.1-6.0	Moderate-----	0.43	5	1-3
Muldrow	10-62	35-50	1.35-1.65	<0.06	0.12-0.22	6.1-8.4	High---------	0.43		
44----------------	0-12	15-25	1.30-1.50	0.6-2.0	0.16-0.24	5.1-6.5	Low----------	0.49	4	.5-1
Parsons	12-76	35-60	1.40-1.70	<0.6	0.14-0.22	5.1-7.8	High---------	0.43		
45.*										
Pits										
46, 47, 48--------	0-10	10-20	1.30-1.60	0.6-2.0	0.11-0.15	4.5-6.0	Low----------	0.32	5	.5-1
Porum	10-18	25-35	1.35-1.65	0.6-2.0	0.15-0.24	4.5-5.5	Low----------	0.43		
	18-40	35-45	1.35-1.65	0.06-0.2	0.14-0.22	4.5-6.0	High---------	0.37		
	40-64	35-45	1.35-1.65	0.2-0.6	0.17-0.22	5.6-7.8	Moderate-----	0.32		
49----------------	0-12	12-18	1.30-1.55	0.6-2.0	0.15-0.20	5.1-6.0	Low----------	0.37	5	<1
Shermore	12-30	18-25	1.45-1.70	0.6-2.0	0.11-0.17	4.5-6.0	Low----------	0.32		
	30-70	18-38	1.55-1.75	0.2-0.6	0.05-0.10	4.5-6.0	Low----------	0.32		
50----------------	0-19	10-20	1.30-1.55	0.6-2.0	0.13-0.24	4.5-5.5	Low----------	0.49	5	.5-1
Stigler	19-62	35-50	1.35-1.65	<0.06	0.14-0.22	4.5-7.8	High---------	0.43		
51----------------	0-15	35-40	1.30-1.60	0.06-0.2	0.15-0.19	5.1-7.8	High---------	0.37	2	1-3
Talihina	15-20	---	---	---	---	---	-------------	----		
52, 53------------	0-22	15-25	1.30-1.50	0.6-2.0	0.16-0.24	5.1-6.0	Low----------	0.49	5	.5-1
Taloka	22-75	35-60	1.40-1.70	<0.06	0.12-0.22	5.1-8.4	High---------	0.43		
54, 55------------	0-21	15-27	1.30-1.40	0.6-2.0	0.20-0.24	5.6-7.3	Low----------	0.32	5	2-4
Verdigris	21-68	18-35	1.40-1.65	0.6-2.0	0.17-0.22	5.6-7.3	Moderate-----	0.32		
56----------------	0-8	18-30	1.25-1.45	0.2-0.6	0.22-0.24	5.6-6.5	Low----------	0.43	4	1-4
Woodson	8-60	40-60	1.30-1.45	<0.06	0.12-0.15	5.6-7.3	High---------	0.32		

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

TABLE 22.--SOIL AND WATER FEATURES

[The definitions of "flooding" and "water table" in the Glossary explain terms such as "rare," "brief," "apparent," and "perched." The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern]

Map symbol and soil name	Hydro-logic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard-ness	Uncoated steel	Concrete
					Ft			In			
1, 2, 3------------ Bates	B	None---------	---	---	>6.0	---	---	20-40	Soft	Low-------	Moderate.
4, 5--------------- Carytown	D	None---------	---	---	0-1.0	Perched	Dec-Apr	>60	---	High------	Moderate.
6:*											
Carytown----------	D	None---------	---	---	0-1.0	Perched	Dec-Apr	>60	---	High------	Moderate.
Burwell-----------	C	None---------	---	---	2.0-3.0	Perched	Nov-Apr	>60	---	High------	Moderate.
7----------------- Caspiana	B	None---------	---	---	>4.0	Apparent	Dec-Apr	>60	---	Moderate	Low.
8----------------- Choteau	C	None---------	---	---	2.0-3.0	Perched	Dec-Apr	>60	---	High------	Moderate.
9:*											
Collinsville------	C	None---------	---	---	>6.0	---	---	4-20	Hard	Low-------	Moderate.
Bates-------------	B	None---------	---	---	>6.0	---	---	20-40	Soft	Low-------	Moderate.
10:*											
Collinsville------	C	None---------	---	---	>6.0	---	---	4-20	Hard	Low-------	Moderate.
Talihina----------	D	None---------	---	---	0.5-1.5	Perched	Nov-Apr	10-20	Soft	High------	Moderate.
11---------------- Convent Variant	C	Occasional	Very brief	Feb-Jul	2.0-4.0	Apparent	Nov-Apr	>60	---	Moderate	Moderate.
12, 13, 14, 15---- Dennis	C	None---------	---	---	2.0-3.0	Perched	Dec-Apr	>60	---	High------	Moderate.
16:*											
Dennis------------	C	None---------	---	---	2.0-3.0	Perched	Dec-Apr	>60	---	High------	Moderate.
Verdigris---------	B	Occasional	Very brief	Dec-Jun	>6.0	---	---	>60	---	Low-------	Low.
17:*											
Enders------------	C	None---------	---	---	>6.0	---	---	40-60	Soft	High------	High.
Hector------------	D	None---------	---	---	>6.0	---	---	10-20	Hard	Low-------	Moderate.
18:*											
Endsaw------------	C	None---------	---	---	>6.0	---	---	30-60	Soft	High------	High.
Hector------------	D	None---------	---	---	>6.0	---	---	10-20	Hard	Low-------	Moderate.
19, 20, 21-------- Eram	C	None---------	---	---	2.0-3.0	Perched	Dec-Apr	20-40	Soft	High------	Moderate.
22, 23------------ Glentosh	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	High.
24, 25------------ Kamie	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate.
26---------------- Kanima	C	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low.
27, 28, 29, 30, 31, 32, 33, 34--- Karma	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	Moderate.

See footnote at end of table.

TABLE 22.--SOIL AND WATER FEATURES--Continued

Map symbol and soil name	Hydrologic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Uncoated steel	Concrete
					Ft			In			
35 Kiomatia	A	Frequent	Brief	Feb-Jun	3.0-5.0	Apparent	Jan-Jul	>60	---	Low	Low.
36 Larton	B	None	---	---	>6.0	---	---	>60	---	Low	Moderate.
37, 38, 39 Linker	B	None	---	---	>6.0	---	---	20-40	Hard	Low	High.
40:*											
Linker	B	None	---	---	>6.0	---	---	20-40	Hard	Low	High.
Hector	B	None	---	---	>6.0	---	---	10-20	Hard	Low	Moderate
41 Madill	B	Occasional	Very brief	Feb-Jul	>6.0	---	---	>60	---	Low	Moderate.
42 Madill	B	Frequent	Very brief	Feb-Jul	>6.0	---	---	>60	---	Low	Moderate.
43 Muldrow	D	Rare	---	---	0-2.0	Apparent	Sep-Mar	>60	---	High	Moderate.
44 Parsons	D	None	---	---	0.5-1.5	Perched	Dec-Apr	>60	---	High	Moderate.
45.* Pits											
46, 47, 48 Porum	C	None	---	---	2.0-3.0	Perched	Dec-Apr	>60	---	High	High.
49 Shermore	B	None	---	---	1.5-3.5	Perched	Nov-May	>60	---	Moderate	Moderate.
50 Stigler	C	None	---	---	2.0-3.0	Perched	Nov-Jun	>60	---	High	High.
51 Talihina	D	None	---	---	0.5-1.5	Perched	Nov-Apr	10-20	Soft	High	Moderate.
52, 53 Taloka	D	None	---	---	1.0-2.0	Perched	Mar-Jun	>60	---	High	Moderate.
54 Verdigris	B	Occasional	Very brief	Dec-Jun	>6.0	---	---	>60	---	Low	Low.
55 Verdigris	B	Frequent	Very brief	Dec-Jun	>6.0	---	---	>60	---	Low	Low.
56 Woodson	D	None	---	---	0.5-2.0	Perched	Dec-Apr	>60	---	High	Moderate.

*For composition and behavior characteristics of the map unit, see description in "Detailed soil map units."

TABLE 23.--PHYSICAL ANALYSES OF SELECTED SOILS

Soil series and sample number	Depth	Horizon	Particle size distribution: Very coarse sand (2.0-1.0 mm)	Coarse sand (1.0-0.5 mm)	Medium sand (0.5-0.25 mm)	Fine sand (0.25-0.10 mm)	Very fine sand (0.10-0.05 mm)	Total sand (2.0-0.05 mm)	Silt (0.05-0.002 mm)	Clay (<0.002 mm)
	In		Percent less than 2.0 millimeters							
Glentosh loamy fine sand: 78-OK-91-1(1-5)	0-7	Ap	0.1	9.1	57.8	24.4	1.3	92.8	2.2	5.0
	7-28	C1	0.1	7.4	58.9	22.8	1.0	90.2	2.3	7.5
	28-47	C2	0.1	8.3	57.7	24.4	0.9	91.4	1.1	7.5
	47-70	C3	0.2	5.4	59.6	23.2	0.9	89.3	3.8	6.9
	70-80	C4	0.2	6.6	58.1	23.5	1.9	90.3	2.8	6.9
Convent Variant silt loam: 78-OK-91-2(1-5)	0-7	Ap	0.1	0.1	0.1	5.6	18.5	24.4	63.7	11.9
	7-18	A1	0.1	0.1	0.2	8.3	23.7	32.4	56.3	11.3
	18-28	C1	0.1	0.1	0.1	6.5	18.3	25.1	62.4	12.5
	28-46	C2g	1.0	0.8	0.9	7.1	13.2	23.0	59.3	17.7
	46-67	C3g	1.6	1.2	1.3	8.8	14.9	27.8	54.4	17.8
Kamie fine sandy loam: 78-OK-91-4(1-5)	0-7	Ap	0.1	0.5	2.8	27.1	23.2	57.7	41.3	5.0
	7-11	A2	0.2	0.5	3.6	31.1	23.2	58.6	35.1	6.3
	11-38	B21t	0.1	0.4	2.2	20.8	16.6	40.1	30.9	29.0
	38-48	B22t	0.1	0.2	1.6	15.5	16.0	33.4	32.6	34.0
	48-60	B3	0.1	0.2	1.3	13.4	14.1	29.1	42.5	28.4

TABLE 24.--CHEMICAL ANALYSES OF SELECTED SOILS

Soil series and sample number	Depth	Horizon	Extractable bases				Cation exchange capacity	Reaction (1:1 soil to water)	Organic matter	Total phosphorus
			Ca	Mg	K	Na				
	In		---Milliquivalents per 100 grams---					pH	Pct	P/m
Glentosh loamy fine sand: 78-OK-91-1(1-5)	0-7	Ap	0.58	0.18	0.05	0.04	1.3	6.1	0.28	146.0
	7-28	C1	0.63	0.09	0.03	0.04	1.0	5.8	0.13	77.5
	28-47	C2	0.63	0.09	0.03	0.04	1.1	5.6	0.14	111.5
	47-70	C3	0.54	0.09	0.05	0.05	0.7	6.4	0.11	38.5
	70-80	C4	0.49	0.13	0.02	0.07	1.0	6.0	0.13	66.0
Convent Variant silt loam: 78-OK-91-2(1-5)	0-7	Ap	5.24	3.36	0.14	0.22	11.5	6.1	1.54	302.5
	7-18	A1	3.76	2.42	0.10	0.36	9.5	6.2	0.53	253.0
	18-28	C1	3.45	3.09	0.10	0.43	9.4	5.4	0.54	302.5
	28-46	C2g	5.47	4.88	0.17	0.34	15.0	5.4	0.84	277.7
	46-67	C3g	4.53	3.85	0.16	0.24	11.9	5.4	0.48	134.5
Kamie fine sandy loam: 78-OK-91-4(1-5)	0-7	Ap	6.90	0.99	0.67	0.07	8.2	7.2	1.31	151.8
	7-11	A2	2.06	0.72	0.10	0.08	4.2	6.2	0.69	83.0
	11-38	B21t	3.67	2.24	0.38	0.07	13.0	5.0	0.59	123.0
	38-48	B22t	4.21	3.76	0.36	0.08	16.3	5.2	0.31	100.0
	48-60	B3	4.30	3.14	0.40	0.08	13.9	5.4	0.24	100.0

TABLE 25.--ENGINEERING TEST DATA

[Dashes indicate data were not available. NP means nonplastic]

Soil name, report number, horizon, and depth in inches	Classification		Grain size distribution: Percentage passing sieve--				Percentage smaller than--			Liquid limit	Plasticity index	Moisture density		Shrinkage		
	AASHTO	Unified	No. 4	No. 10	No. 40	No. 200	.02 mm	.005 mm	.002 mm			Max. dry density	Optimum moisture	Limit	Linear	Ratio
										Pct		Lb/ft3	Pct	Pct	Pct	Pct
Convent Variant silt loam:[1] (S780K-091-002)																
Ap------- 0 to 7	A-4 (02)	ML	100	100	99	86	--	17	13	28	3	--	--	18.2	0.0	1.7
A1------- 7 to 18	A-4 (01)	ML	100	100	99	85	--	16	14	26	2	--	--	20.4	0.0	1.7
C1--------18 to 28	A-4 (03)	ML	100	100	100	83	--	19	15	27	5	--	--	17.6	0.0	1.7
C2g-------28 to 46	A-4 (01)	CL-ML	100	100	99	78	--	22	16	24	4	--	--	15.9	0.0	1.8
C3g-------46 to 67	A-4 (00)	ML	100	100	99	80	--	18	15	--	NP	--	--	0.0	0.0	--
Glentosh loamy fine sand:[2] (S780K-091-001)																
Ap------- 0 to 7	A-2-4(00)	SP-SM	100	100	88	11	--	3	2	--	NP	--	--	0.0	0.0	0.0
C1------- 7 to 28	A-3 (00)	SP-SM	100	100	90	9	--	4	3	--	NP	--	--	0.0	0.0	0.0
C2--------28 to 47	A-3 (00)	SP-SM	100	100	90	8	--	3	2	--	NP	--	--	0.0	0.0	0.0
C3--------47 to 70	A-3 (00)	SP-SM	100	100	80	5	--	2	1	--	NP	--	--	0.0	0.0	0.0
C4--------70 to 80	A-3 (00)	SP-SM	100	100	87	8	--	4	3	--	NP	--	--	0.0	0.0	0.0
Kamie fine sandy loam:[3] (S780K-091-004)																
A1------- 0 to 11	A-4 (00)	ML	100	100	99	77	--	8	7	--	NP	--	--	0.0	0.0	0.0
B21t------11 to 38	A-6 (07)	CL	100	100	99	84	--	27	26	30	14	--	--	13.8	0.0	1.8
B22t------38 to 48	A-6 (09)	CL	100	100	99	87	--	31	29	37	16	--	--	13.6	0.0	1.8
B3--------48 to 60	A-6 (14)	CL	100	100	99	88	--	30	28	36	16	--	--	13.4	0.0	1.8
Linker fine sandy loam:[4] (S780K-091-003)																
Ap------- 0 to 8	A-4 (00)	ML	100	100	99	63	--	14	12	--	NP	--	--	0.0	0.0	0.0
B2t-------13 to 29	A-4 (02)	CL-ML	100	100	98	75	--	25	21	26	5	--	--	14.8	0.0	1.8
B3--------29 to 34	A-4 (03)	CL-ML	100	95	93	71	--	25	22	28	7	--	--	13.6	0.0	1.8

[1]Convent Variant silt loam:
1,500 feet south and 200 feet east of northwest corner of sec. 19, T. 12 N., R. 15 E.

[2]Glentosh loamy fine sand:
1,200 feet south and 700 feet west of northeast corner of sec. 20, T. 11 N., R. 15 E.

[3]Kamie fine sandy loam:
600 feet south and 100 feet east of northwest corner of sec. 30, T. 11 N., R. 16 E.

[4]Linker fine sandy loam:
1,300 feet west and 600 feet north of southeast corner of sec. 22, T. 11 N., R. 17 E.

TABLE 26.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Bates	Fine-loamy, siliceous, thermic Typic Argiudolls
Burwell	Fine-silty, mixed, thermic Aquic Paleudolls
Carytown	Fine, mixed, thermic Albic Natraqualfs
Caspiana	Fine-silty, mixed, thermic Typic Argiudolls
Choteau	Fine, mixed, thermic Aquic Paleudolls
Collinsville	Loamy, siliceous, thermic Lithic Hapludolls
Convent Variant	Coarse-silty, mixed, nonacid, thermic Aeric Fluvaquents
Dennis	Fine, mixed, thermic Aquic Paleudolls
Enders	Clayey, mixed, thermic Typic Hapludults
Endsaw	Clayey, mixed, thermic Typic Hapludults
Eram	Fine, mixed, thermic Aquic Argiudolls
Glentosh	Thermic, coated Typic Quartzipsamments
Hector	Loamy, siliceous, thermic Lithic Dystrochrepts
Kamie	Fine-loamy, mixed, thermic Typic Paleudalfs
Kanima	Loamy-skeletal, mixed, nonacid, thermic Udalfic Arents
Karma	Fine-loamy, mixed, thermic Typic Hapludalfs
Kiomatia	Sandy, mixed, thermic Typic Udifluvents
Larton	Loamy, siliceous, thermic Arenic Paleudalfs
Linker	Fine-loamy, siliceous, thermic Typic Hapludults
Madill	Coarse-loamy, mixed, nonacid, thermic Typic Udifluvents
Muldrow	Fine, mixed, thermic Typic Argiaquolls
Parsons	Fine, mixed, thermic Mollic Albaqualfs
Porum	Fine, mixed, thermic Glossaquic Paleudalfs
Shermore	Fine-loamy, siliceous, thermic Typic Fragiudalfs
Stigler	Fine, mixed, thermic Aquic Paleudalfs
Talihina	Clayey, mixed, thermic, shallow Aquic Hapludolls
Taloka	Fine, mixed, thermic Mollic Albaqualfs
Verdigris	Fine-silty, mixed, thermic Cumulic Hapludolls
Woodson	Fine, montmorillonitic, thermic Abruptic Argiaquolls

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