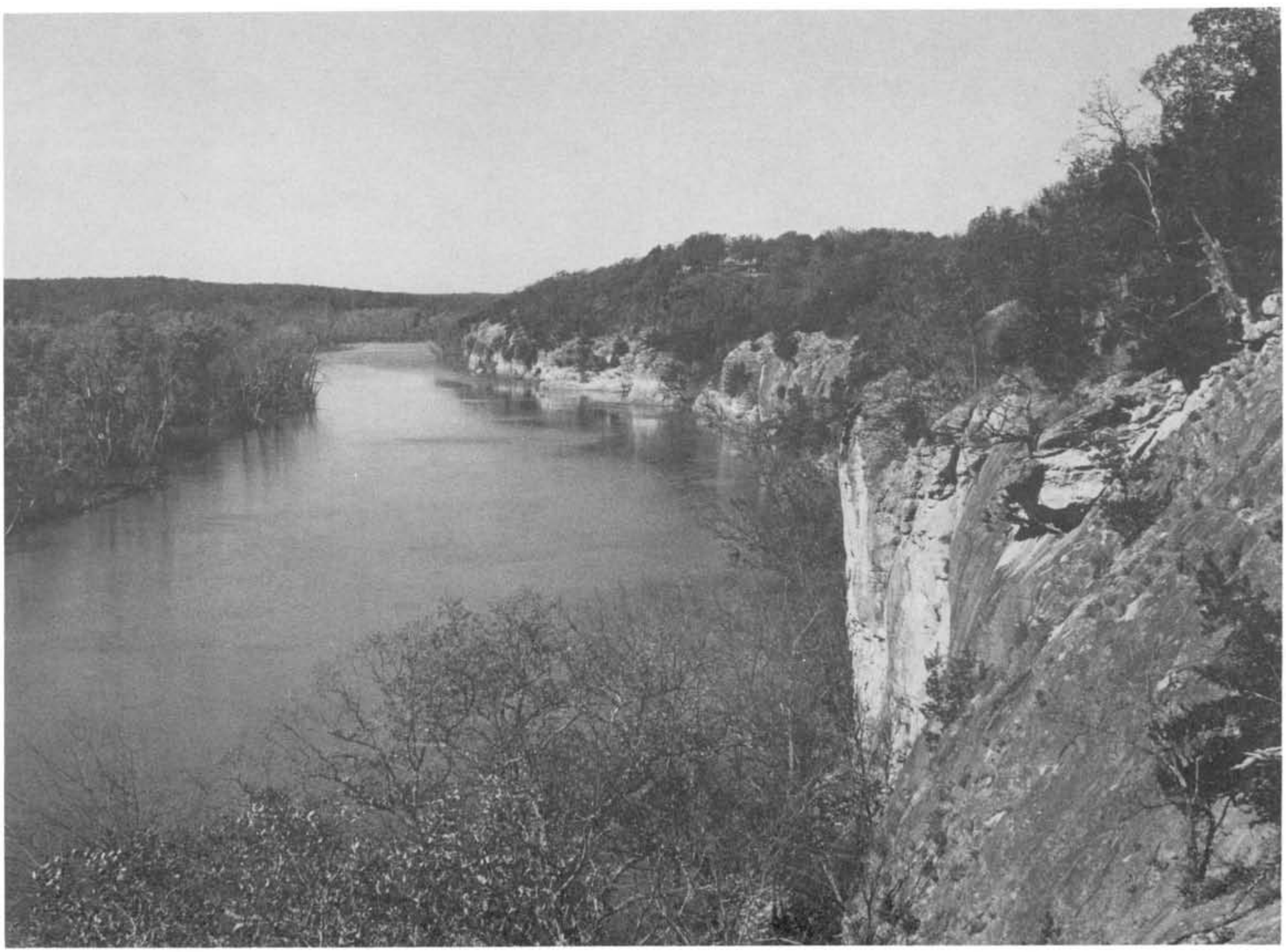
United States
Department of
Agriculture

Soil
Conservation
Service

In cooperation with
the Missouri Agricultural
Experiment Station

Soil Survey of St. Clair County, Missouri



How To Use This Soil Survey

General Soil Map

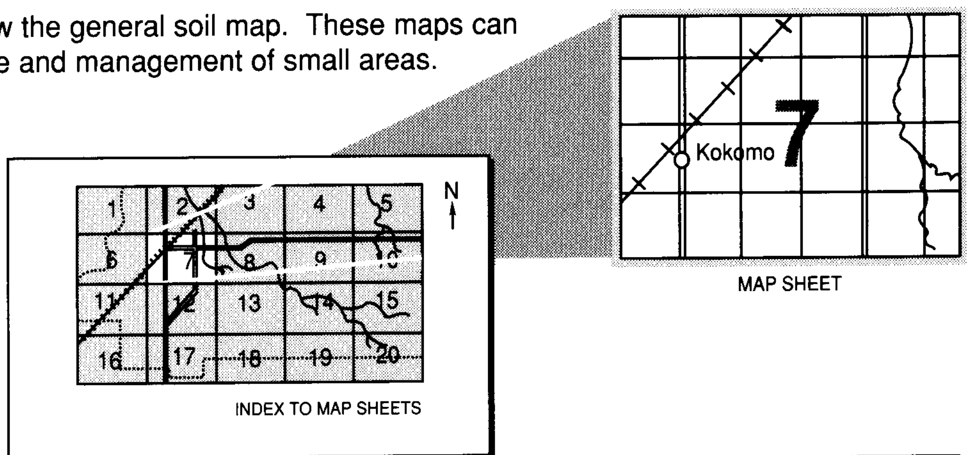
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

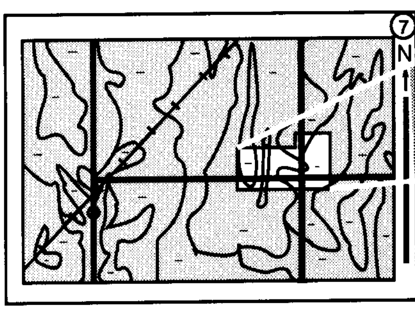
Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

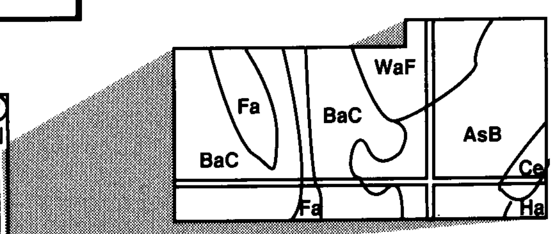
To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.



Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



MAP SHEET



AREA OF INTEREST

NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

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

Major fieldwork for this soil survey was completed in 1983. Soil names and descriptions were approved in 1983. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1983. This survey was made cooperatively by the Soil Conservation Service and the Missouri Agricultural Experiment Station. The Missouri Department of Natural Resources provided a soil scientist to assist with the fieldwork. The county court provided funds through the St. Clair County Soil and Water Conservation District for a soil scientist to assist with the fieldwork. The survey is part of the technical assistance provided to the St. Clair County Soil and Water Conservation District.

Cover: Backwater of the Harry S. Truman Reservoir, along the Osage River. This impoundment has greatly increased the recreational opportunities in St. Clair County.

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Soil Series

Issued August 1987

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Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in St. Clair 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, 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 ensure 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.

Paul F. Larson
State Conservationist
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Soil Survey of St. Clair County, Missouri

By David A. Howard, Soil Conservation Service

Fieldwork by David A. Howard, Soil Conservation Service,
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United States Department of Agriculture, Soil Conservation Service,
in cooperation with
the Missouri Agricultural Experiment Station

ST. CLAIR COUNTY is in the west-central part of Missouri (fig. 1). It has a total area of 448,838 acres, or 701.3 square miles. Osceola, the county seat, is in the central part of the county. According to the 1980 census, it has a population of 841. The population of the county is 8,622. Other towns in the county are Appleton City, Collins, Lowry City, Iconium, Roscoe, and Taberville.

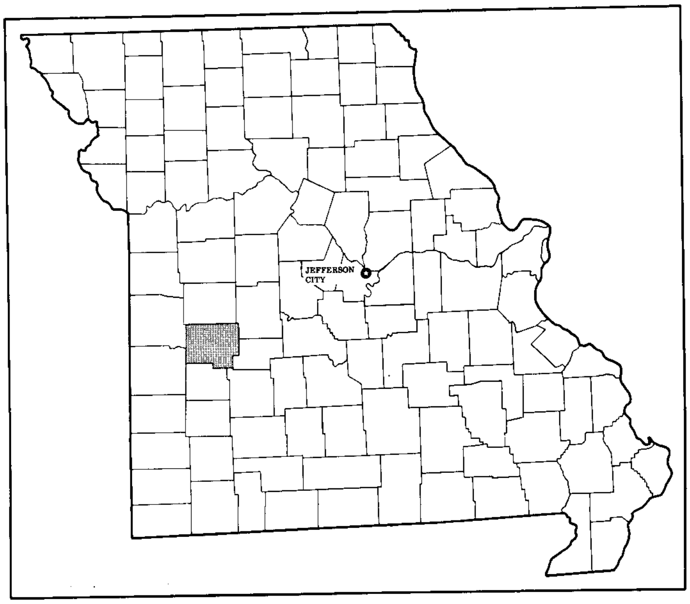

Figure 1.—Location of St. Clair County in Missouri.

Soybeans, grain sorghum, and wheat are the principal cash crops grown in the county. Beef cattle, dairy cattle, and hogs are the dominant livestock. The prairie region, in the northwestern part of the county, is used for both livestock and cash-grain farming. The southwestern part of the county is rolling cropland and pasture, and the eastern part is a mixture of rolling pasture and wooded Ozark highlands.

General Nature of the County

This section gives general information concerning the county. It describes climate, natural resources, physiography and drainage, and transportation facilities.

Climate

Prepared by the National Climatic Center, Asheville, North Carolina.

St. Clair County is hot in summer, especially at low elevations. It is moderately cool in winter. Rainfall is fairly heavy and well distributed throughout the year. Snow falls nearly every winter, but the snow cover lasts only a few days.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Appleton City in the period 1951 to 1980. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 34 degrees F, and the average daily minimum temperature is 23 degrees. The lowest temperature on record, which occurred at Appleton City on February 9, 1979, is -19 degrees. In summer the average temperature is 77 degrees, and the average daily maximum temperature is 90 degrees. The highest recorded temperature, which occurred on July 14, 1954, is 116 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 average precipitation is 38.29 inches. Of this, about 25 inches, or 65 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 18 inches. The heaviest 1-day rainfall during the period of record was 5.78 inches at Appleton City on September 13, 1961. Thunderstorms occur on about 49 days each year.

The average seasonal snowfall is about 18 inches. The greatest snow depth at any one time during the period of record was 14 inches. On the average, 15 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 55 percent. Humidity is higher at night, and the average at dawn is about 70 percent. The sun shines 70 percent of the time possible in summer and 50 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 12 miles per hour, in spring.

Natural Resources

Soil is the most important natural resource in St. Clair County. It provides a growing medium for the cultivated crops, forage crops, and trees grown in the county. Also, it can be a source of topsoil and gravel.

Another abundant resource in the county is the water supply. The confluence of the Osage and Sac Rivers is in the county. As a result, a good supply of surface water is available. The Harry S. Truman Reservoir impounds an abundant volume of water for a variety of uses. The bedrock underlying the county also is a source of water. Some of this underground water is highly mineralized, but most of it is of fairly good quality. The bedrock units in St. Clair County generally are assigned to various aquifer groups. If the aquifer groups in a given area are ascertained, the yield and quality of water from wells can be anticipated.

Mineral resources in the county include coal, limestone, and shale. Of these, only coal and limestone are currently mined.

Physiography and Drainage

St. Clair County is characterized by three major physiographic areas. These are the flood plains along the Osage and Sac Rivers, the prairie areas in the northern and central parts of the county, and the Ozark highlands in the eastern part. Elevation ranges from the normal level of the Harry S. Truman Reservoir, which is 706 feet above sea level, to 1,060 feet on the highest ridges.

The Osage River and its tributaries, which include the Sac River, drain about 90 percent of the county. The northern 10 percent is drained by Deepwater Creek.

Transportation Facilities

St. Clair County has good transportation facilities. The chief thoroughfares are State Highways 13, 82, and 54. Many farm-to-market roads are throughout the county. The volume of highway traffic is high during the tourist season.

How This Survey Was Made

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

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

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

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

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

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

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

Map Unit Composition

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

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

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

General Soil Map Units

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

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

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

The descriptions, names, and delineations of the soils identified on the general soil map in this survey do not fully agree or join with those of the soils identified on the maps of adjacent counties published at a different date. Differences are the result of additional soil data, variations in the intensity of mapping, and correlation decisions that reflect local variations. In some areas combining small acreages of similar soils that respond to use and management in much the same way is more practical than mapping these soils separately.

Soil Descriptions

1. Barden-Deepwater-Hartwell Association

Deep, nearly level to moderately sloping, moderately well drained and somewhat poorly drained soils formed in a thin mantle of loess or silty sediments and in shale residuum; on uplands

This association is in the northwestern part of the county. It is mainly on high, wide divides, which separate watersheds. A few areas are adjacent to the flood plains and terraces along the major streams.

This association makes up about 12 percent of the county. It is about 37 percent Barden soils, 28 percent Deepwater soils, 17 percent Hartwell soils, and 18 percent minor soils (fig. 2).

Barden soils are gently sloping and moderately well drained. They are in areas between the Hartwell and Deepwater soils. Typically, the surface layer is dark brown silt loam. The subsoil is dark brown silty clay loam in the upper part; dark brown and dark grayish brown, mottled silty clay in the next part; and grayish brown, mottled silty clay loam in the lower part. The substratum is mottled light brownish gray, yellowish brown, and strong brown silty clay loam.

Deepwater soils are gently sloping and moderately sloping and are moderately well drained. They are on narrow ridgetops and side slopes below the Barden and Hartwell soils. Typically, the surface layer is very dark grayish brown silt loam. The subsurface layer is dark brown silt loam. The subsoil is dark yellowish brown and yellowish brown, mottled silty clay loam in the upper part; strong brown, mottled silty clay in the next part; and mottled light brownish gray, brown, and strong brown silty clay loam in the lower part.

Hartwell soils are nearly level and somewhat poorly drained. They are on the divides above the Barden and Deepwater soils. Typically, the surface layer is very dark grayish brown silt loam. The subsurface layer is grayish brown silt loam. The subsoil is very dark grayish brown and dark grayish brown, mottled silty clay in the upper part; dark brown, mottled silty clay in the next part; and strong brown, mottled silty clay loam in the lower part.

The minor soils in this association are the Barco, Collinsville, Kanima, Quarles, and Verdigris soils. The moderately deep Barco and shallow Collinsville soils are on ridgetops and side slopes. The strongly sloping to steep Kanima soils are in areas that formerly were strip mined for coal. The poorly drained Quarles soils are on terraces. The well drained Verdigris soils are on flood plains.

About 80 percent of the acreage is cleared and is used for row crops. Corn, grain sorghum, soybeans, and wheat are the main crops. Some areas are used for pasture and hay. The uncleared acreage consists of uneven, moderately steep and steep areas of minor soils that generally support hardwoods.

The soils in this association are suited to cultivated crops, small grain, and grasses and legumes. Controlling water erosion and improving and maintaining fertility and tilth are the main concerns in managing the areas used for row crops. The main concerns in managing pasture are water erosion during seedbed preparation and overgrazing. The seasonal wetness of the Hartwell soils also is a concern in row cropped or pastured areas. In

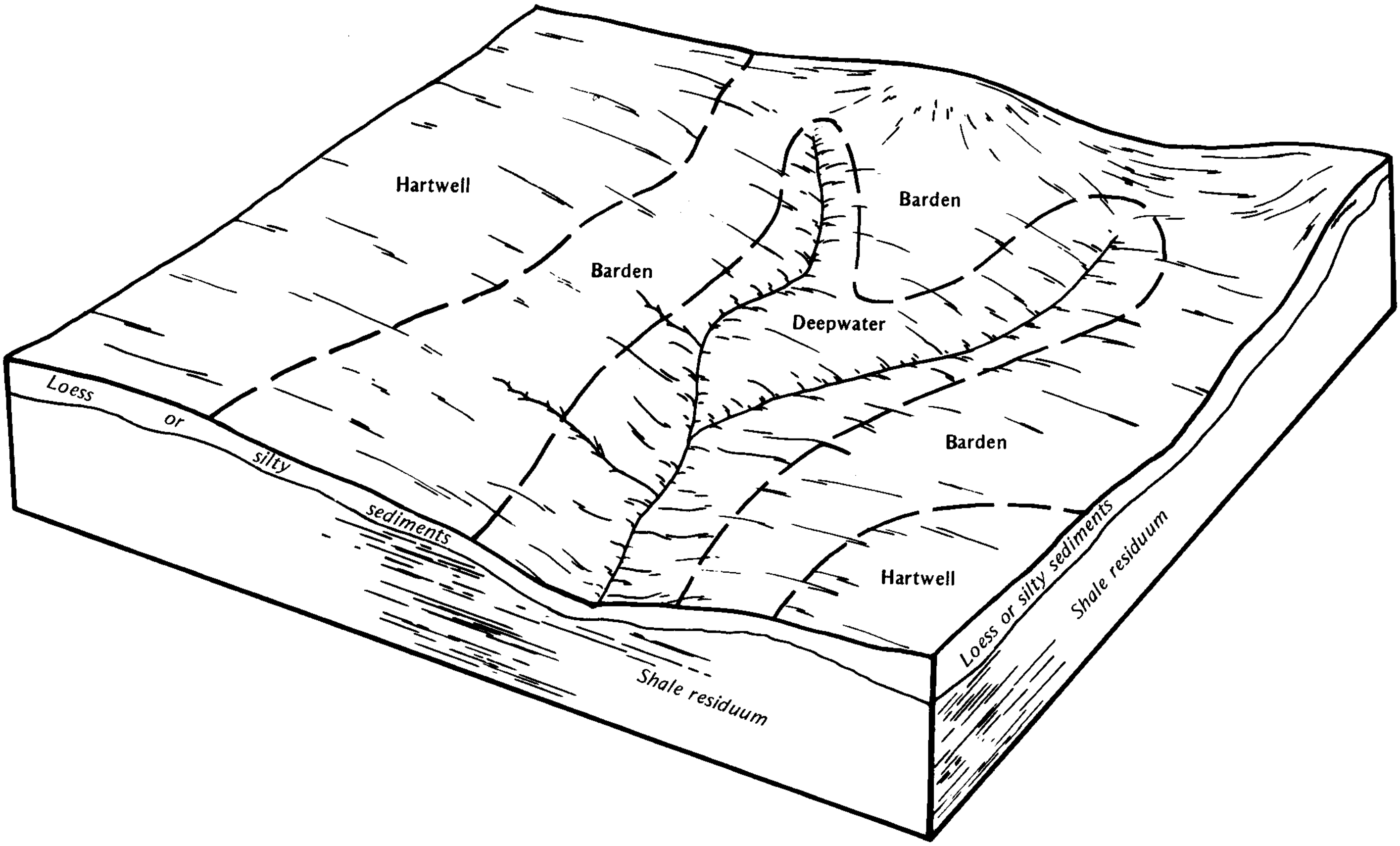

Figure 2.—Typical pattern of soils and parent material in the Barden-Deepwater-Hartwell association.

areas that do not have flowing water, ponds provide water for livestock.

These soils are suitable as sites for buildings and sanitary facilities. The high shrink-swell potential in the clayey subsoil and the wetness are the main limitations on sites for dwellings and septic tank absorption fields. Also, the slow permeability of the Barden and Hartwell soils is a limitation on sites for septic tank absorption fields. These two soils generally are better suited to sewage lagoons.

2. Barden-Barco-Collinsville Association

Deep to shallow, gently sloping to moderately steep, moderately well drained to somewhat excessively drained soils formed in a thin mantle of loess or silty sediments and in shale or sandstone residuum; on uplands

This association is on wide divides, benches, ridgetops, and knobs and on side slopes and breaks along drainageways. It makes up about 28 percent of the county. It is about 39 percent Barden and similar soils, 36 percent Barco soils, 12 percent Collinsville soils, and 13 percent minor soils (fig. 3).

The deep, gently sloping, moderately well drained Barden soils are on divides and side slopes. Typically, the surface layer is dark brown silt loam. The subsoil is dark brown silty clay loam in the upper part; dark brown and dark grayish brown, mottled silty clay in the next part; and grayish brown, mottled silty clay loam in the lower part. The substratum is mottled light brownish gray, yellowish brown, and strong brown silty clay loam.

The moderately deep, gently sloping and moderately sloping, well drained Barco soils are on ridgetops, knobs, and side slopes. Typically, the surface layer is dark brown fine sandy loam. The subsoil is brown fine sandy loam in the upper part and dark yellowish brown, mottled sandy clay loam in the lower part. It is underlain by multicolored, soft sandstone bedrock. Below this is hard sandstone bedrock.

The shallow, gently sloping to moderately steep, somewhat excessively drained Collinsville soils are on narrow ridgetops, on knobs, and on side slopes and breaks along drainageways. Typically, the surface layer is very dark brown fine sandy loam. The subsoil is dark brown loam. It is underlain by hard sandstone bedrock.

The minor soils in this association are the Deepwater, Quarles, and Verdigris soils. Deepwater soils are deep and have less clay than the Barden soils. They are on the lower side slopes. The poorly drained Quarles soils are on terraces. Verdigris soils are silty throughout. They are on flood plains.

About 70 percent of the acreage is cleared and is used mostly for pasture, hay, small grain, or grain sorghum. Corn and soybeans are grown in some of the gently sloping areas. The uncleared acreage consists mainly of steep, uneven areas that support mixed hardwoods.

The Barden and Barco soils are suited to row crops. The Collinsville soils are best suited to pasture. Controlling water erosion and improving and maintaining fertility and tilth are the main concerns in managing the areas used for row crops. Gullying is a problem in some areas.

All the major soils are suited to grasses and legumes. Erosion during seedbed preparation and overgrazing are concerns in managing pasture. Droughtiness is a concern in areas of the Barco and Collinsville soils during the hot summer months. In areas that do not have flowing water, ponds provide water for livestock.

The Barden and Barco soils are suitable as sites for buildings and sanitary facilities. The shrink-swell potential in the clayey subsoil and restricted permeability are limitations. The wetness in the Barden soils and the moderate depth to bedrock in the Barco soils also are limitations. The Collinsville soils generally are unsuitable as building sites because of the shallow depth to bedrock.

3. Verdigris-Moniteau-Osage Association

Deep, nearly level, well drained and poorly drained soils

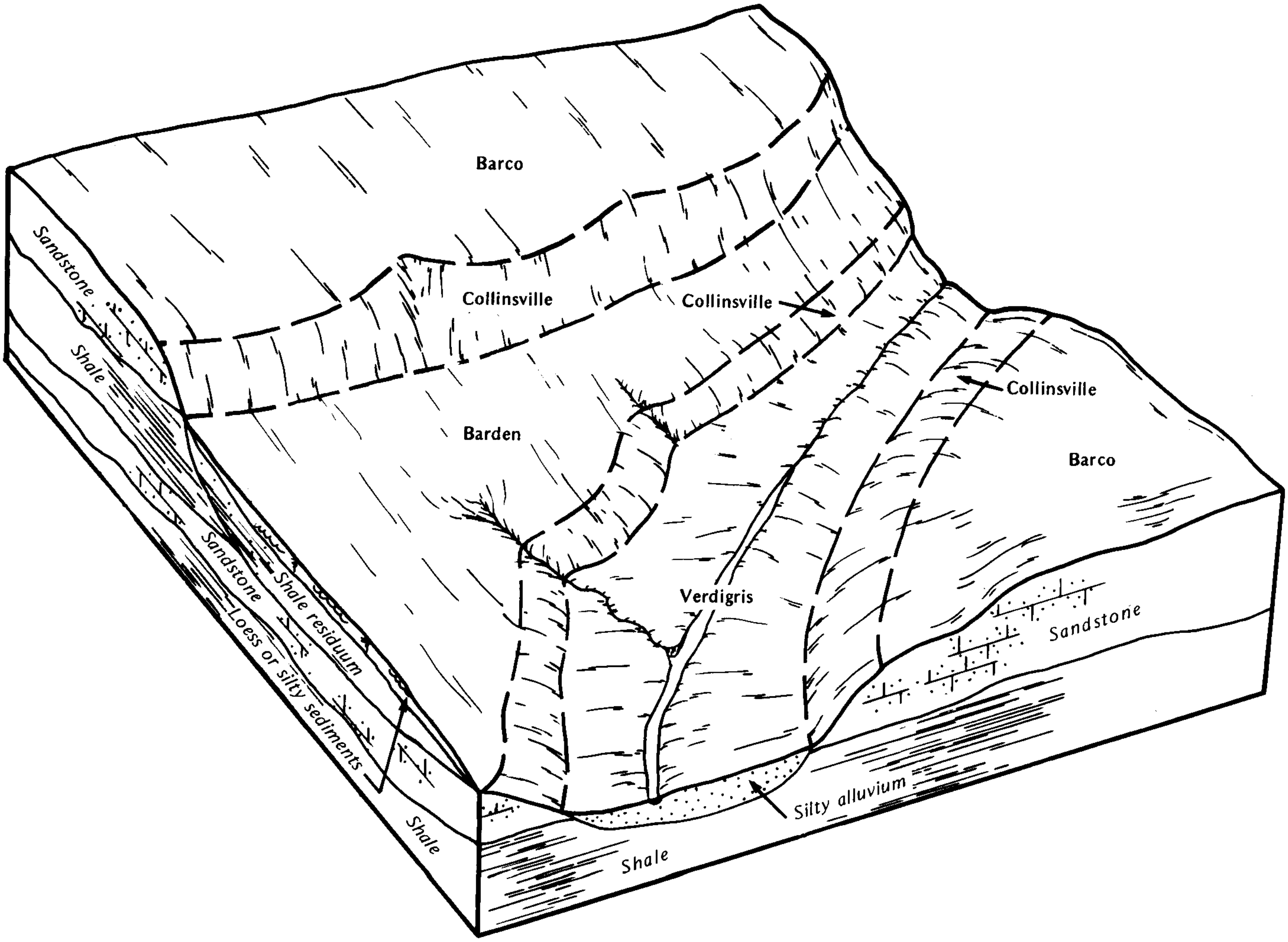

Figure 3.—Typical pattern of soils and parent material in the Barden-Barco-Collinsville association.

formed in silty or clayey alluvium on flood plains and terraces

This association is on the flood plains and terraces along medium and large streams throughout the county. The width of the flood plains ranges from about 200 feet to 2 miles.

This association makes up about 5 percent of the county. It is about 36 percent Verdigris soils, 18 percent Moniteau soils, 13 percent Osage soils, and 33 percent minor soils.

Verdigris soils are well drained. They are on low flood plains adjacent to streams. Typically, the surface layer is very dark grayish brown silt loam. The subsurface layer also is very dark grayish brown silt loam. Below this is a transition layer of dark brown silt loam. The substratum is brown silt loam.

Moniteau soils are poorly drained. They are on terraces adjacent to the flood plains. Typically, the surface layer is dark grayish brown silt loam. The subsurface layer is grayish brown, mottled silt loam. The subsoil is dark grayish brown, mottled silty clay loam.

Osage soils are poorly drained. They are on flood plains adjacent to the uplands. Typically, the surface layer is black silty clay. The subsurface layer is very dark gray silty clay. Below this is a buried layer of dark gray, mottled silty clay loam. The subsoil is dark grayish brown, mottled silty clay.

The minor soils in this association are the Cedargap, Cotter, Hartville, and Quarles soils. Cedargap soils have chert in the lower part. They are on narrow flood plains. Cotter, Hartville, and Quarles soils are on terraces. Cotter soils have more clay in the subsoil than the Verdigris soils, and Hartville and Quarles have less clay in the surface layer. Also, Hartville soils are gently sloping and have chert in the subsoil.

The soils in this association are used mainly for row crops, pasture, or hay. They are suited to small grain, soybeans, grain sorghum, and grasses and legumes. Occasional flooding, wetness, and maintenance of fertility and tilth are the main concerns in managing the areas used for cultivated crops. Overgrazing and the wetness are the main concerns in managing pasture.

The soils in this association are suitable for trees. Many areas that are too small for farming remain wooded. Existing stands are dominantly oak and hickory. The equipment limitation, seedling mortality, and the windthrow hazard are the main management concerns. The windthrow hazard is caused by the wetness.

These soils generally are unsuitable as sites for buildings and sanitary facilities. Overcoming the occasional flooding and the wetness is difficult.

4. Hector-Bolivar Association

Shallow and moderately deep, gently sloping to steep, well drained soils formed in sandstone residuum on uplands

This association is on ridgetops, foot slopes, and the somewhat broken and stony parts of side slopes. Scattered rock outcrop is on the side slopes.

This association makes up about 21 percent of the county. It is about 54 percent Hector soils, 35 percent Bolivar soils, and 11 percent minor soils (fig. 4).

Hector soils are shallow and are moderately sloping to steep. They are on ridgetops and side slopes. Typically, the surface layer is dark brown fine sandy loam. The subsoil is yellowish brown gravelly fine sandy loam. It is underlain by hard sandstone bedrock.

Bolivar soils are moderately deep and are gently sloping and moderately sloping. They are on ridgetops and side slopes above the Hector soils. Typically, the surface layer is dark brown fine sandy loam. The subsurface layer is yellowish brown fine sandy loam. The subsoil is sandy clay loam. The upper part is strong brown, the next part is yellowish brown and mottled, and the lower part is grayish brown, strong brown, and dark red and is mottled. Sandstone bedrock underlies the subsoil.

The minor soils in this association are the Cleora, Liberal, and Verdigris soils. The deep, nearly level Cleora and Verdigris soils are on flood plains. The moderately well drained Liberal soils are higher on the ridges than the Bolivar soils.

More than 50 percent of this association is used for pasture or hay, and about 40 percent supports trees or brush. Most of the remaining acreage is cultivated. The Bolivar soils are suited to small grain and grain sorghum, which are the major cultivated crops. Controlling water erosion, overcoming droughtiness, and improving fertility are the main concerns in managing the cultivated areas. Erosion, droughtiness, and overgrazing are the major concerns in managing pasture. In areas that do not have flowing water, ponds provide water for livestock.

The soils in this association are suitable for trees. The erosion hazard, the equipment limitation, seedling mortality, and the windthrow hazard are the major management concerns.

The Bolivar soils are suitable as sites for buildings. The shrink-swell potential, the depth to bedrock, and moderate permeability are the main limitations. The Hector soils generally are unsuitable as building sites because of the shallow depth to bedrock and the slope.

5. Goss-Gasconade Association

Deep and shallow, gently sloping to very steep, well drained and somewhat excessively drained soils formed in limestone residuum on uplands

This association is on highly dissected ridges separated by very narrow drainageways. Flagstones and scattered rock outcrop are on the lower side slopes.

This association makes up 28 percent of the county. It is about 51 percent Goss soils, 22 percent Gasconade soils, and 27 percent minor soils (fig. 5).

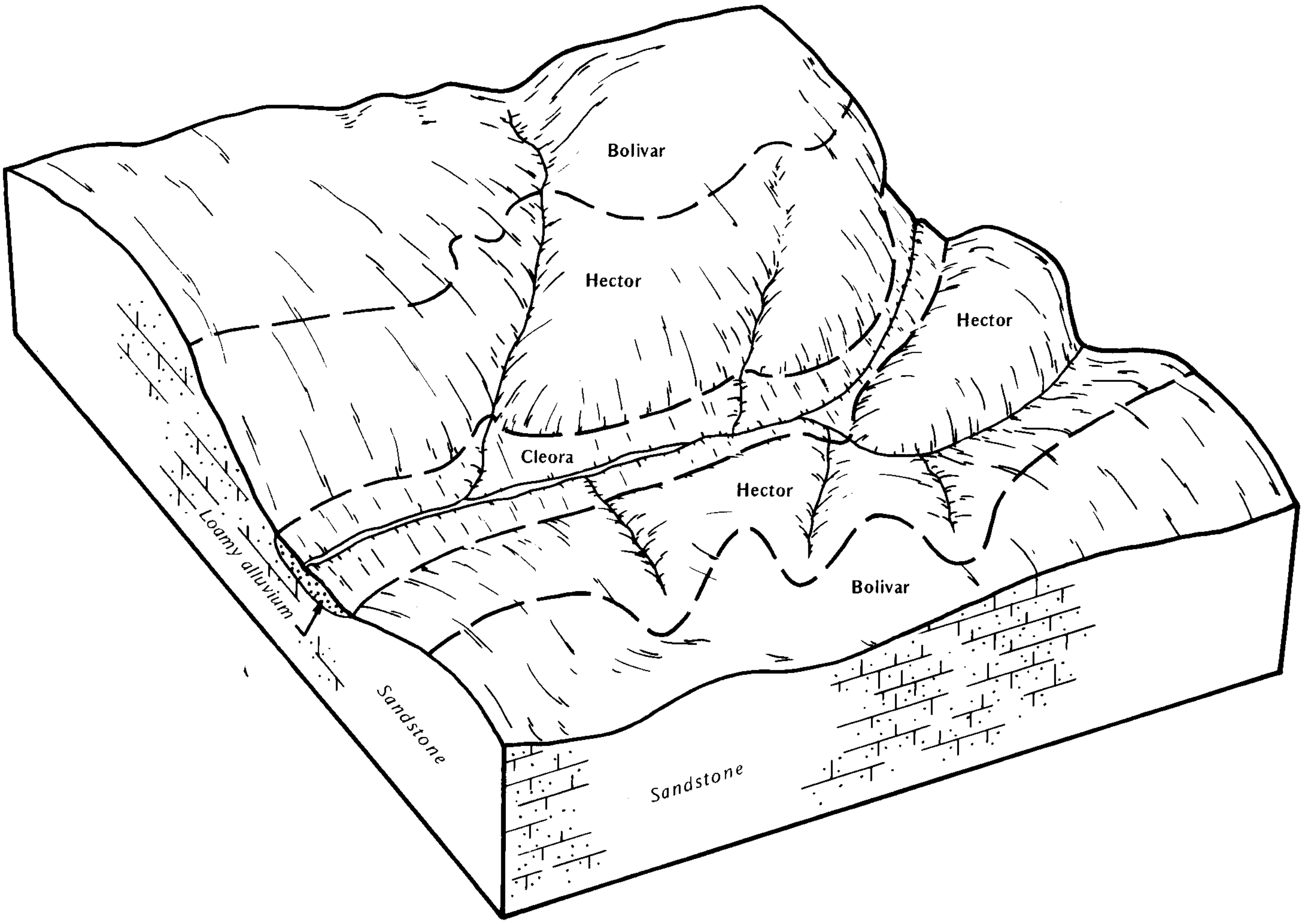

Figure 4.—Typical pattern of soils and parent material in the Hector-Bolivar association.

The deep, well drained, gently sloping to steep Goss soils are on ridgetops and side slopes. Typically, the surface layer is very dark grayish brown cherty silt loam. The subsurface layer is yellowish brown very cherty silt loam. The subsoil is yellowish red very cherty silty clay loam in the upper part, red and dark red cherty and very cherty silty clay in the next part, and red silty clay in the lower part.

The shallow, somewhat excessively drained, gently sloping to very steep Gasconade soils are in glades on ridgetops and side slopes. Typically, the surface layer is very dark brown flaggy silty clay loam. The subsoil is dark brown very flaggy silty clay. It is underlain by hard limestone bedrock.

The minor soils in this association are the Bardley, Bucklick, Cedargap, Hartville, and Moniteau soils. The moderately deep Bardley soils are on side slopes. Bucklick, Hartville, and Moniteau soils are on terraces. Bucklick soils have no chert. Hartville soils are somewhat poorly drained. Moniteau soils are poorly drained. Cedargap soils formed in alluvium that has a high content of chert. They are on flood plains.

About 80 percent of this association is native hardwood forest, dominantly of oak and hickory. The cleared areas, which are mainly on ridgetops, foot slopes, and narrow flood plains, are used for cultivated crops or for hay and pasture.

The Goss soils are suited to trees. Water erosion, the slope, and seedling mortality are the main management concerns. Because of the slope, the use of logging equipment is restricted and erosion is a hazard along logging roads and skid trails. The shallow Gasconade soils are not suited to commercial timber production because of their low productivity.

Livestock production is the major farm enterprise. The less sloping areas generally are cleared and are suitable

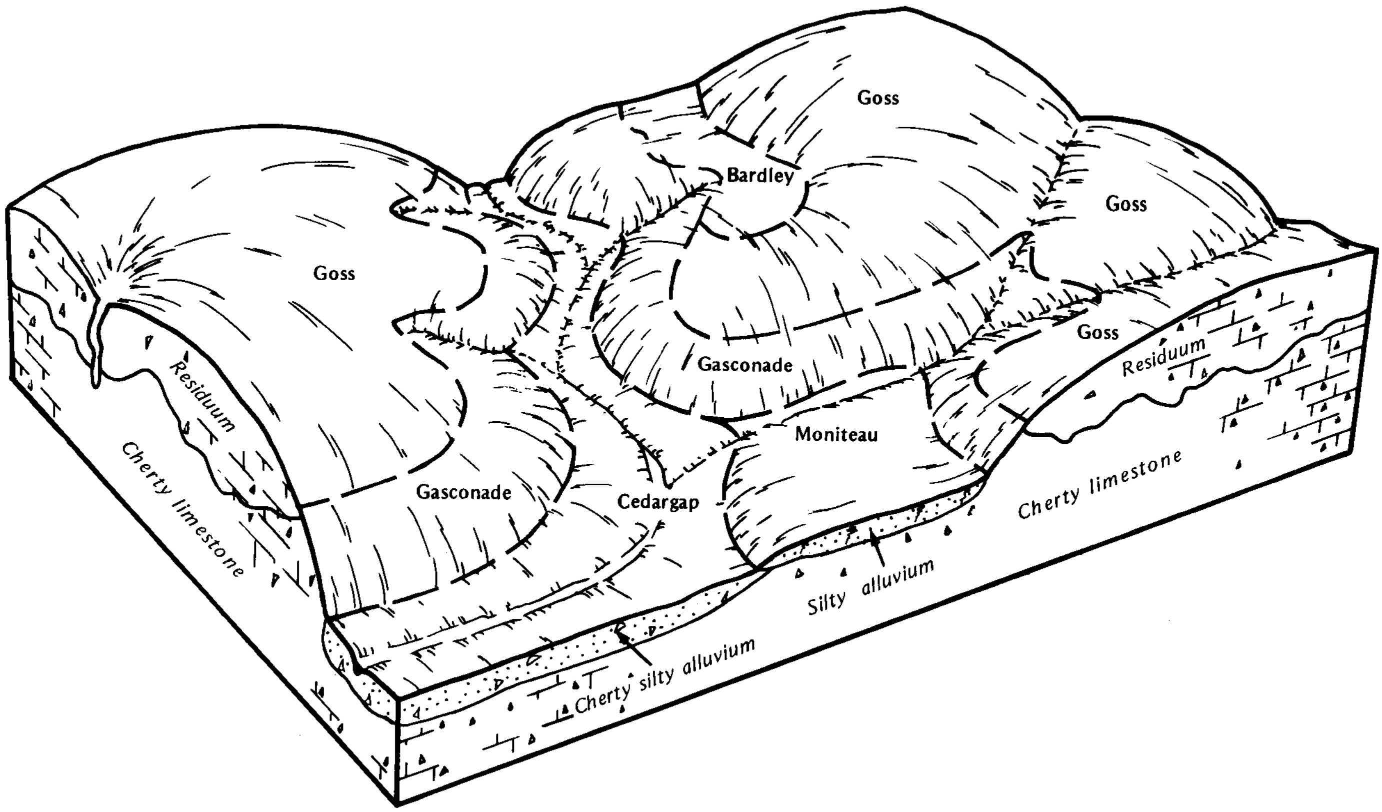

Figure 5.—Typical pattern of soils and parent material in the Goss-Gasconade association.

as pasture. The slope, droughtiness, and the hazard of erosion are the main concerns in managing pasture.

The Goss soils generally are suitable as sites for buildings and sanitary facilities. The slope and the content of chert are the main limitations. The Gasconade soils are generally unsuited to building site development and onsite waste disposal because they are shallow over bedrock.

6. Eldorado-Newtonia Association

Deep, gently sloping to strongly sloping, well drained soils formed in material weathered from cherty limestone or in silty sediments; on uplands

This association is on broad ridgetops and long side slopes adjacent to narrow flood plains and terraces. It makes up about 6 percent of the county. It is about 65 percent Eldorado soils, 10 percent Newtonia soils, and 25 percent minor soils.

Eldorado soils are gently sloping to strongly sloping. They are on ridgetops and side slopes below the Newtonia soils. Typically, the surface layer is dark brown cherty silt loam. The subsoil is dark reddish brown and reddish brown extremely cherty silty clay loam in the upper part, yellowish red extremely cherty silty clay loam in the next part, and red very cherty silty clay in the lower part.

Newtonia soils are gently sloping. They are on broad divides. Typically, the surface layer is dark brown silt loam. The subsoil is dark brown silt loam and dark reddish brown silty clay loam in the upper part, dark red silty clay loam in the next part, and red silty clay loam in the lower part.

The minor soils in this association are the Bucklick, Cedargap, Hartville, and Moniteau soils. The moderately deep Bucklick soils, the somewhat poorly drained Hartville soils, and the poorly drained Moniteau soils are on terraces. Cedargap soils are cherty and have less clay than the Eldorado soils. They are on flood plains.

About 75 percent of this association is used for pasture and hay. About 10 percent is second growth woodland. The rest is mainly gently sloping areas on the ridgetops. These areas are used for small grain or row crops. The forage crops and most of the grain crops are fed to beef and dairy cattle. Wheat, soybeans, and grain sorghum are sold as cash crops. Controlling water erosion and improving and maintaining fertility and tilth are the main concerns in managing most of the cultivated areas. Some areas have long, smooth slopes that can be terraced and farmed on the contour. These soils generally are suited to pasture and hay. Controlling water erosion during periods when the pasture is seeded and overgrazing are the main management concerns.

The major soils are suited to building site development and sanitary facilities. The major limitations are the moderate permeability and moderate shrink-swell potential of both soils and the content of chert and slope in areas of the Eldorado soils.

Detailed Soil Map Units

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

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

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

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

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Barco fine sandy loam, 2 to 5 percent slopes, is a phase in the Barco series.

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.

The descriptions, names, and delineations of soils identified on the detailed soil maps in this survey do not fully agree or join with those of the soils identified on the maps of adjacent counties published at a different date. Differences are the result of additional soil data, variations in the intensity of mapping, and correlation decisions that reflect local variations. In some areas combining small acreages of similar soils that respond to use and management in much the same way is more practical than mapping these soils separately.

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

Soil Descriptions

11—Verdigris silt loam. This nearly level, well drained soil is on flood plains adjacent to stream channels. It is occasionally flooded. Individual areas generally are narrow and elongated. They range from 20 to 100 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 8 inches thick. The subsurface layer also is very dark grayish brown, friable silt loam. It is about 13 inches thick. Below this is a transition layer of dark brown, friable silt loam about 19 inches thick. The substratum to a depth of 72 inches or more is brown, friable silt loam. In some areas the soil is dark to a depth of less than 24 inches. In other areas the surface layer is fine sandy loam.

Included with this soil in mapping are small areas of Cedargap and Cleora soils. Cedargap soils have chert fragments throughout. Cleora soils contain less clay in the subsoil than the Verdigris soil. Both soils are in landscape positions similar to those of the Verdigris soil. They make up less than 10 percent of the unit.

Permeability is moderate in the Verdigris soil, and surface runoff is slow or medium. Available water capacity is very high. Reaction is medium acid or slightly acid in the subsoil and varies widely in the surface layer as a result of local liming practices. Natural fertility is high, and the organic matter content is moderate. The surface layer is friable and can be easily tilled.

Most areas are used for cultivated crops or for pasture and hay. This soil generally is suited to corn, soybeans, and small grain. It is not well suited to cultivated crops, however, in areas cut by meandering stream channels. These areas are well suited to legumes and grasses for hay and pasture.

This soil is well suited to cool-season grasses, such as tall fescue and orchardgrass; legumes, such as alfalfa and red clover; and warm-season grasses, such as switchgrass, indiangrass, and big bluestem. The occasional flooding is the main problem. It should be considered when a grazing system is designed. The species that can withstand the flooding grow best.

A few areas support native hardwoods. This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

Because of the flooding, this soil generally is unsuited to building site development and onsite waste disposal.

The land capability classification is IIw. The woodland ordination symbol is 7A.

15—Cleora fine sandy loam. This deep, nearly level, well drained soil is on flood plains adjacent to stream channels. It is occasionally flooded. Individual areas generally are narrow and elongated and range from 5 to 50 acres in size.

Typically, the surface layer is dark brown, very friable fine sandy loam about 8 inches thick. The subsurface layer also is dark brown, very friable fine sandy loam. It is about 11 inches thick. The substratum to a depth of 72 inches or more is dark yellowish brown, friable fine sandy loam. In some areas the dark surface soil is less than 10 inches thick.

Included with this soil in mapping are small areas of soils that have a silt loam surface layer. These soils make up about 5 percent of the unit.

Permeability is moderately rapid in the Cleora soil, and surface runoff is slow. Available water capacity is moderate. Reaction is medium acid or slightly acid in the subsoil and varies widely in the surface layer as a result of local liming practices. Natural fertility is high, and the organic matter content is moderate. The surface layer is friable and can be easily tilled.

Many areas are used for cultivated crops or for pasture and hay. This soil generally is suited to corn, soybeans, and small grain. In areas cut by meandering stream channels, however, it is not well suited to cultivated crops. The only management concern is the occasional flooding, which delays planting in some years.

This soil is well suited to cool-season grasses, such as tall fescue, orchardgrass, and smooth bromegrass, and to legumes, such as red clover and lespedeza. It also is well suited to switchgrass, big bluestem, and indiangrass. Flooding and an insufficient supply of soil moisture during hot summer months are the main problems. Planting the more flood tolerant species improves the stands.

A few areas support native hardwoods. This soil is well suited to trees. No major hazards or limitations affect planting or harvesting.

Because of occasional flooding, this soil generally is unsuited to building site development and onsite waste disposal.

The land capability classification is IIw. The woodland ordination symbol is 9A.

16—Cedargap silt loam. This deep, nearly level, well drained soil is on narrow flood plains adjacent to small stream channels. It is frequently flooded for very brief periods. Individual areas generally are narrow and elongated and range from 10 to 25 acres in size.

Typically, the surface layer is very dark brown, very friable silt loam about 7 inches thick. The subsurface layer is very dark brown, very friable cherty loam about 17 inches thick. The upper part of the substratum is very dark grayish brown, friable extremely cherty loam. The lower part to a depth of 72 inches or more is very dark gray, friable very cherty silty clay loam. In places the surface layer is cherty loam or cherty silt loam.

Included with this soil in mapping are small areas of Cleora and Verdigris soils. These soils do not have chert. They are in landscape positions similar to those of the Verdigris soil. They make up less than 10 percent of the unit.

Permeability is moderately rapid in the Cedargap soil, and surface runoff is slow. Available water capacity is moderate. The subsoil is medium acid. Natural fertility is medium, and the organic matter content is moderate.

Most of the acreage is pasture or idle land. The areas of this soil are narrow and generally are not very accessible. As a result, row crops generally cannot be grown.

This soil is well suited to cool-season grasses, such as tall fescue, orchardgrass, and smooth bromegrass, and to legumes, such as red clover and lespedeza. It also is well suited to switchgrass, big bluestem, and indiangrass. Flooding and an insufficient supply of soil moisture during hot summer months are the main problems. Planting the more flood tolerant species improves the stands.

This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

Because of the flooding, this soil generally is unsuited to building site development and onsite waste disposal.

The land capability classification is IIs. The woodland ordination symbol is 3A.

21—Osage silty clay. This deep, nearly level, poorly drained soil typically is on wide flood plains along the major streams adjacent to upland foot slopes and side slopes. In a few relatively small areas, it is on narrow flood plains along intermittent streams. It is occasionally flooded. Individual areas range from about 10 to several hundred acres in size.

Typically, the surface layer is black, firm silty clay about 8 inches thick. The subsurface layer is very dark gray silty clay about 17 inches thick. The next 5 inches is dark gray, mottled silty clay loam. The subsoil to a depth of 72 inches or more is dark grayish brown, mottled, firm and very firm silty clay. In places, the surface layer is silty clay loam and the dark surface soil is less than 24 inches thick. In some areas the lower part of the subsoil is gravelly.

Included with this soil in mapping are areas of Moniteau and Verdigris soils. These soils have less clay than the Osage soil. Moniteau soils are in landscape positions similar to those of the Osage soil. The well drained Verdigris soils are adjacent to meandering stream channels. Included soils make up as much as 15 percent of the unit.

Permeability is very slow in the Osage soil, and surface runoff is slow or very slow. Available water capacity is moderate. A seasonal high water table is within a depth of 1 foot from November through May in most years. The shrink-swell potential is very high. The organic matter content is moderate, and natural fertility is medium.

Many areas are cultivated. A small acreage is pasture or hayland. This soil is suited to row crops. In the areas used as cropland, the wetness and the occasional flooding are the major management concerns. Land smoothing and properly designed and constructed surface ditches improve surface drainage. Properly managing crop residue, tilling the soil only under optimum moisture conditions, and deep plowing in the fall improve tilth and the likelihood of early planting in spring. The shorter season crops that grow in summer should be selected for planting.

This soil is best suited to water-tolerant, shallow-rooted legumes and cool-season grasses, such as lespedeza, orchardgrass, and tall fescue, and to warm-season grasses, such as big bluestem and indiangrass. It is poorly suited to hay. The wetness and the flooding are the main management concerns. The flooding should be considered when a grazing system is designed. Maintaining stands of desirable species is difficult in depressional areas. A surface drainage system is beneficial if the deeper rooted species are grown.

This soil is suited to trees. The equipment limitation, the seedling mortality rate, and the windthrow hazard are management concerns. Equipment should be used only during periods when the soil is dry or frozen. Ridging the soil and then planting on the ridges increase the seedling survival rate. Stands should be thinned less intensively and more frequently than the stands in areas where the windthrow hazard is less severe.

Because of the wetness, the shrink-swell potential, and the occasional flooding, this soil generally is unsuited to building site development and sanitary facilities.

The land capability classification is IIIw. The woodland ordination symbol is 4W.

50—Cotter silt loam. This deep, nearly level, well drained soil is on broad stream terraces adjacent to the major streams. It is subject to rare flooding. Individual areas generally are elongated and wide. They range from about 15 to more than 60 acres in size.

Typically, the surface layer is very dark brown, friable silt loam about 9 inches thick. The subsoil to a depth of 60 inches or more is friable silty clay loam. It is very dark brown and very dark grayish brown in the upper part and dark brown in the lower part. In places the subsoil is silt loam.

Included with this soil in mapping are the poorly drained Moniteau soils in the more nearly level or concave areas. These soils make up 10 to 15 percent of the unit.

Permeability is moderate in the Cotter soil, and surface runoff is slow. Available water capacity is high. Natural fertility is also high, and the organic matter content is moderate. The surface layer is friable and can be easily tilled. The shrink-swell potential is moderate.

Most areas are used for cultivated crops or pasture. A few are wooded. This soil is suited to corn and soybeans. No major management problems affect cropping. Proper management of crop residue helps to maintain the organic matter content and good tilth and increases the rate of water infiltration. Some small, irregularly shaped areas, especially along narrow drainageways, are better suited to grasses and legumes for pasture or hay than to row crops.

This soil is well suited to all of the legumes, cool-season grasses, and warm-season grasses commonly grown in the county. No major problems affect pasture or hayland.

This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

Because of the rare flooding, this soil generally is unsuited to building site development and onsite waste disposal. It is suitable only for dwellings constructed on raised, well compacted fill material.

The land capability classification is I. The woodland ordination symbol is 9A.

51B—Deepwater silt loam, 2 to 5 percent slopes. This deep, gently sloping, moderately well drained soil is on convex ridgetops and side slopes. Individual areas are irregular in shape. They range from 10 to 100 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 12 inches thick. The subsurface layer is dark brown, friable silt loam about 5 inches thick. The subsoil extends to a depth of 72 inches or more. The upper part is dark yellowish brown and yellowish brown, mottled, firm silty clay loam; the next part is strong brown, mottled, firm silty clay; and the lower part is mottled light brownish gray, brown, and strong brown, firm silty clay loam. In some areas the depth to shale bedrock is less than 48 inches. In other areas the dark surface soil is less than 10 inches thick.

Included with this soil in mapping are some small areas of the well drained Barco soils and the slowly permeable Barden soils. Barco soils are moderately deep over sandstone bedrock. They are in positions on the landscape similar to those of the Deepwater soil. Barden soils have more clay than the Deepwater soil.

They are on some of the broader, higher parts of the ridgetops. Included soils make up about 10 percent of the unit.

Permeability is moderate in the Deepwater soil, and surface runoff is medium. Available water capacity is high. Reaction is medium acid in the upper part of the subsoil and strongly acid in the lower part. It varies widely in the surface layer as a result of local liming practices. Natural fertility is high, and the organic matter content is moderate. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. A perched seasonal high water table is at a depth of 3.0 to 4.5 feet during most of the winter and spring. The shrink-swell potential is high.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, grain sorghum, and small grain. The measures commonly used to control erosion on this soil are a system of conservation tillage that leaves a protective cover of crop residue on the surface, a conservation cropping system that includes close-growing pasture and hay crops, contour farming, and in some areas terraces and grassed waterways. These measures also help to maintain the organic matter content and fertility, improve tilth, and increase the rate of water infiltration.

A cover of grasses and legumes for pasture and hay is effective in controlling erosion. This soil is well suited to all of the legumes, warm-season grasses, and cool-season grasses commonly grown in the county (fig. 6). No serious problems affect pasture or hayland. Erosion is a problem when new seedlings are becoming established. Timely seedbed preparation helps to ensure a good ground cover.

This soil is suitable for building site development if proper design and installation procedures are used. Adequately reinforcing the concrete in foundations and footings and backfilling with sand or gravel help to prevent the structural damage caused by shrinking and swelling. Installing tile drains around the footings helps to prevent the damage caused by excessive wetness.

Because of the wetness, this soil generally is unsuitable as a site for septic tank absorption fields. In

Figure 6.—Cool-season grasses in a pastured area of Deepwater silt loam, 2 to 5 percent slopes.

some areas, however, it is suitable if perimeter drains are installed to lower the water table and if the laterals are long enough to overcome the restricted permeability. The wetness and the slope are limitations on sites for sewage lagoons. The slope can be overcome by leveling the site. Sealing the bottom of the lagoon helps to prevent contamination of ground water.

This soil is suitable as a site for local roads and streets. Low strength, the shrink-swell potential, and frost action are limitations. Strengthening the subgrade with crushed rock or other suitable material helps to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing adequate side ditches, and installing culverts improve drainage and thus minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is IIe. No woodland ordination symbol is assigned.

51C2—Deepwater silt loam, 5 to 9 percent slopes, eroded. This deep, moderately sloping, moderately well drained soil is on convex side slopes and the steeper ridgetops. Individual areas are irregular in shape. They range from 5 to more than 50 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 6 inches thick. The subsurface layer is brown, friable silt loam about 3 inches thick. The subsoil to a depth of 72 inches or more is firm silty clay loam. The upper part is dark yellowish brown, the next part is yellowish brown and strong brown and is mottled, and the lower part is brown and mottled. In some areas the surface layer is dark brown silty clay loam because the upper part of the subsoil has been mixed with the surface soil by plowing.

Included with this soil in mapping are some small areas of the well drained Barco soils and the slowly permeable Barden soils. Barco soils are moderately deep. They are on knobs, the higher slopes, and broken side slopes. Barden soils have more clay than the Deepwater soil. They are on wide ridges. Included soils make up about 10 percent of the unit.

Permeability is moderate in the Deepwater soil, and surface runoff is medium. Available water capacity is high. Reaction is medium acid in the upper part of the subsoil and strongly acid in the lower part. It varies widely in the surface layer as a result of local liming practices. Natural fertility is high, and the organic matter content is moderate. The surface layer is friable and can be easily tilled throughout a wide range in moisture content. In areas where it is mixed with part of the subsoil, however, it tends to crust or puddle after hard rains. A perched seasonal high water table is at a depth of 3.0 to 4.5 feet during most of the winter and spring. The shrink-swell potential is high.

Most areas are used for cultivated crops or pasture. This soil is suited to corn, soybeans, grain sorghum, and small grain. The erosion hazard is severe if cultivated crops are grown. Terraces and grassed waterways, a system of conservation tillage that leaves a protective cover of crop residue on the surface, a conservation cropping system that includes close-grown pasture or hay crops, and contour farming help to control erosion, maintain the organic matter content and fertility, improve tilth, and increase the rate of water infiltration.

A cover of grasses and legumes for pasture and hay is effective in controlling erosion. This soil is well suited to all of the legumes, warm-season grasses, and cool-season grasses commonly grown in the county. No serious problems affect pasture or hayland. Erosion is a problem when new seedlings are becoming established. Timely seedbed preparation helps to ensure a good ground cover.

This soil is suitable for building site development if proper design and installation procedures are used. Adequately reinforcing the concrete in foundations and footings and backfilling with sand or gravel help to prevent the structural damage caused by shrinking and swelling. Installing tile drains around the footings helps to prevent the damage caused by excessive wetness.

Because of the wetness, this soil generally is unsuitable as a site for septic tank absorption fields. In some areas, however, it is suitable if perimeter drains are installed to lower the water table and if the laterals are long enough to overcome the restricted permeability. A properly constructed mound system also can overcome the wetness. The wetness and the slope are limitations on sites for sewage lagoons. The slope can be overcome by leveling the site. Sealing the bottom of the lagoon helps to prevent contamination of ground water.

This soil is suitable as a site for local roads and streets. Low strength, the shrink-swell potential, and frost action are limitations. Strengthening the subgrade with crushed rock or other suitable material helps to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing adequate side ditches, and installing culverts improve drainage and thus minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is IIIe. No woodland ordination symbol is assigned.

52—Moniteau silt loam. This deep, nearly level, poorly drained soil is on broad, low stream terraces and along some narrow upland drainageways. It is subject to rare flooding. Individual areas generally are elongated and wide. They range from about 15 to more than 100 acres in size.

Typically, the surface layer is dark grayish brown, very friable silt loam about 13 inches thick. The subsurface layer is grayish brown, mottled, friable silt loam about 16 inches thick. The subsoil to a depth of about 72 inches is dark grayish brown, mottled, firm silty clay loam. In some areas the surface soil is very dark grayish brown to a depth of more than 10 inches.

Included with this soil in mapping are areas of Hartville, Quarles, and Verdigris soils and areas of the occasionally flooded Moniteau soils. Hartville and Quarles soils have more clay in the subsoil than the Moniteau soil. They are in positions on the landscape similar to those of the Moniteau soil. The occasionally flooded Moniteau soils are adjacent to Truman Lake. The well drained Verdigris soils are on flood plains. Included soils make up 10 to 15 percent of the unit.

Permeability is moderately slow in the Moniteau soil, and surface runoff is slow. Available water capacity is high. A perched seasonal high water table is within a depth of 1 foot from November through May in most years. The organic matter content is moderately low. The shrink-swell potential is moderate in the subsoil.

Most areas are used for cultivated crops or pasture. A few are wooded. This soil is suited to corn and soybeans. The wetness is the major concern in managing cropland. Land smoothing and shallow surface ditches improve surface drainage. Proper management of crop residue helps to maintain the organic matter content and good tilth and increases the rate of water infiltration.

In some small, irregularly shaped areas, especially those along small, narrow drainageways, this soil is better suited to grasses for pasture or hay than to row crops. It is well suited to the legumes and cool-season grasses commonly grown in the county. Examples are red clover, ladino clover, lespedeza, tall fescue, and timothy. The soil is moderately suited to warm-season grasses, such as indiangrass, big bluestem, and switchgrass. The seasonal high water table is the main problem. The species that can withstand the wetness should be selected for planting. A seedbed can be easily prepared. A drainage system is beneficial if deep-rooted species are grown.

This soil is suited to the trees that can withstand wetness. The equipment limitation, the seedling mortality rate, and the windthrow hazard are management concerns. Equipment should be used only during periods when the soil is dry or frozen. Ridging the soil and then planting container-grown stock on the ridges increase the seedling survival rate. Stands should be thinned less intensively and more frequently than the stands in areas where the windthrow hazard is less severe.

Because of the wetness and the flooding, this soil generally is not suited to building site development or onsite waste disposal.

The land capability classification is IIIw. The woodland ordination symbol is 4W.

53—Quarles silt loam. This deep, nearly level, poorly drained soil is on stream terraces. It is subject to rare flooding. Individual areas are irregular in shape. They range from 5 to 50 acres in size.

Typically, the surface layer is very dark grayish brown, very friable silt loam about 9 inches thick. The subsurface layer is silt loam about 20 inches thick. The upper part is dark grayish brown, and the lower part is gray, mottled, and friable. The subsoil extends to a depth of 72 inches or more. It is mottled and firm. The upper part is dark grayish brown silty clay, and the lower part is gray silty clay loam. In some areas the dark surface layer is more than 10 inches thick.

Included with this soil in mapping are small areas of the well drained Verdigris soils on flood plains. Also included, in the slightly higher positions on terraces, are soils that are not so gray in the subsurface layer as the Quarles soil. Included soils make up less than 15 percent of the unit.

Permeability is slow in the Quarles soil. Surface runoff also is slow. Available water capacity is high. Reaction is very strongly acid to medium acid in the subsoil and varies widely in the surface layer because of local liming practices. The surface layer is friable and can be easily tilled. The organic matter content is moderate, and natural fertility is medium. A perched seasonal high water table is within a depth of 1.5 feet during winter and spring in most years. The shrink-swell potential is high.

Most areas are used for row crops. This soil is suited to corn, soybeans, and small grain. The wetness is the main management concern. Land smoothing and shallow surface ditches improve surface drainage. Proper management of crop residue helps to maintain the organic matter content, improves tilth, and increases the rate of water infiltration.

This soil is best suited to water-tolerant, shallow-rooted legumes and cool-season grasses, such as ladino clover and reed canarygrass. Switchgrass is the best suited warm-season grass. The soil is poorly suited to hay. The wetness and the flooding are the main management problems. The flooding should be considered when a grazing system is designed. Maintaining stands of desirable species is difficult in depressional areas. A surface drainage system is beneficial if the deeper rooted species are grown.

This soil is suited to trees. The equipment limitation, the seedling mortality rate, and the windthrow hazard are management concerns. The trees should be planted and harvested when the soil is firm. Ridging the soil and then planting container-grown stock on the ridges increase the seedling survival rate. Stands should be thinned less intensively and more frequently than the stands in areas where the windthrow hazard is less severe.

This soil is suitable as a site for buildings and sanitary facilities that are properly designed and are constructed on raised, well compacted fill material above flood levels. Adequately reinforcing the concrete in footings, foundations, and basement walls and backfilling with sand or gravel help to prevent the structural damage caused by shrinking and swelling. The restricted permeability and the wetness are limitations on sites for septic tank absorption fields. Overcoming these limitations is difficult. Properly designed sewage lagoons function adequately.

This soil is suitable as a site for local roads and streets. Low strength, the shrink-swell potential, frost action, and the wetness are limitations. Strengthening the subgrade with crushed rock or other suitable material helps to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing adequate side ditches, and installing culverts improve drainage and thus minimize the damage caused by shrinking and swelling, by frost action, and by wetness. The roads should be constructed on raised, well compacted fill material.

The land capability classification is IIw. The woodland ordination symbol is 4W.

54B—Bucklick silt loam, 2 to 5 percent slopes. This deep, gently sloping, well drained soil is on foot slopes in the uplands. Individual areas range from about 5 to 100 acres in size.

Typically, the surface layer is dark brown, very friable silt loam about 7 inches thick. The subsoil extends to a depth of 70 inches or more. In sequence downward, it is brown, very friable silt loam; yellowish red, friable silty clay loam; red, firm clay; and yellowish red, mottled, firm silty clay loam. In some eroded areas the surface layer is brown and reddish brown silty clay loam. In some places the subsoil is silty clay in the upper part. In other places it is cherty below a depth of 30 to 40 inches. On some short, steep slopes adjacent to flood plains and on other slope breaks, the slope is more than 5 percent.

Included with this soil in mapping are areas of Goss and Moniteau soils. Goss soils are on the tops and sides of low ridges. Their content of coarse fragments is higher than that of the Bucklick soil. Moniteau soils are grayer in the upper part of the subsoil than the Bucklick soil. They are poorly drained and are on the lower terraces. Included soils make up about 10 to 15 percent of the unit

Permeability is moderate in the Bucklick soil, and surface runoff is medium. Available water capacity is moderate. The organic matter content also is moderate, and natural fertility is medium. The shrink-swell potential is moderate. The surface layer can be easily tilled.

Most areas are used for cultivated crops or pasture. A few are wooded. This soil is suited to corn and soybeans, but erosion is a moderate hazard. The measures commonly used to control erosion on this soil are a system of conservation tillage that leaves a protective cover of crop residue on the surface, terraces and grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture and hay crops. Grass strips help to control erosion on short, steep slopes, on escarpments, and in eroded areas. Proper management of crop residue helps to maintain the organic matter content and good tilth and increases the rate of water infiltration.

A cover of grasses and legumes for pasture and hay is effective in controlling erosion. This soil is well suited to most of the legumes, warm-season grasses, and cool-season grasses commonly grown in the county. No serious problems affect pasture or hayland. Erosion is a problem when new seedlings are becoming established. Timely seedbed preparation helps to ensure a good ground cover.

A few areas support hardwoods. This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is suitable for building site development and onsite waste disposal if proper design and installation procedures are used. Adequately reinforcing the concrete in foundations and basement walls and backfilling with sand or gravel help to prevent the structural damage caused by shrinking and swelling. The moderate permeability should be considered when septic tank absorption fields or sewage lagoons are designed. Lengthening the laterals in absorption fields helps to overcome this limitation. Properly designed lagoons function adequately if enough soil material is available for the site to be leveled and if the berms and bottom of the lagoon are sealed.

This soil is suitable as a site for local roads and streets. Low strength, the shrink-swell potential, and frost action are limitations. Strengthening the subgrade with crushed rock or other suitable material helps to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing adequate side ditches, and installing culverts improve drainage and thus minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is IIe. The woodland ordination symbol is 3A.

55B—Bolivar fine sandy loam, 2 to 5 percent slopes. This moderately deep, gently sloping, well drained soil is on convex ridgetops and side slopes in the uplands. Individual areas are irregular in shape. They range from about 20 to more than 250 acres in size.

Typically, the surface layer is dark brown, very friable fine sandy loam about 4 inches thick. The subsurface layer is yellowish brown, very friable fine sandy loam about 4 inches thick. The subsoil is friable sandy clay loam about 18 inches thick. The upper part is strong brown, the next part is yellowish brown and mottled, and the lower part is strong brown, grayish brown, and dark red and is mottled. Soft, weathered sandstone bedrock is at a depth of about 26 inches. It is underlain by hard sandstone bedrock at a depth of about 44 inches. In some small eroded areas, the surface layer is fine sandy loam less than 4 inches thick and the slope is more than 5 percent. In some areas the dark surface soil is more than 10 inches thick.

Included with this soil in mapping are the cherty Goss soils in the steeper areas and the stony Hector soils on the lower side slopes. Included soils make up about 10 percent of the unit.

Permeability is moderate in the Bolivar soil, and surface runoff is medium. Available water capacity is low. The subsoil is very strongly acid, and the surface layer is strongly acid or medium acid, depending on past liming practices. Natural fertility is low, and the organic matter content is moderately low. The shrink-swell potential is moderate. The root zone is restricted by the weathered sandstone bedrock at a depth of 20 to 40 inches. The surface layer is very friable and can be easily tilled.

Most areas are used for hay, pasture, or woodland. A few are used for cultivated crops. A cover of grasses and legumes is effective in controlling erosion. This soil is well suited to cool-season grasses, such as tall fescue and orchardgrass; warm-season grasses, such as big bluestem and indiangrass; and legumes, such as lespedeza. The rooting depth is only moderate, and droughtiness is a problem during much of the year. When the soil is tilled before seeding, erosion is a hazard. It can be controlled by timely tillage and by establishment of a ground cover as soon as possible.

This soil is moderately well suited to grain sorghum, soybeans, and small grain and is poorly suited to corn. If cultivated crops are grown, erosion is a severe hazard. It can be controlled by a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, terraces and grassed waterways, a conservation cropping system that includes close-growing pasture and hay crops, and contour farming in areas where the slopes are smooth enough. Returning crop residue to the soil or regularly adding other organic material improves fertility.

Many areas support native hardwoods. This soil is suited to trees. No major limitations or hazards affect planting or harvesting.

This soil is suitable for building site development and onsite waste disposal if proper design and installation procedures are used. Adequately reinforcing the concrete in footings, foundations, and basement walls and backfilling with sand or gravel help to prevent the structural damage caused by shrinking and swelling. Provisions should be made to excavate the bedrock, or the design of the dwelling should accommodate the depth to bedrock. Special design and extra excavation are needed on sites for dwellings with basements.

An adequate amount of soil material can be added to septic tank absorption fields to increase the depth of the soil over bedrock and thus prevent seepage. Lengthening the laterals helps to overcome the restricted permeability. Land shaping can modify the slope. The berms of sewage lagoons should be built up with extra soil material, which increases the depth to bedrock and modifies the slope. Sealing the bottom of the lagoon with slowly permeable material helps to prevent seepage.

This soil is suitable as a site for local roads and streets. Low strength, the shrink-swell potential, and frost action are limitations. Strengthening the subgrade with crushed rock or other suitable base material helps to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing adequate side ditches, and installing culverts improve drainage and thus minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 3A.

55C—Bolivar fine sandy loam, 5 to 9 percent slopes. This moderately deep, moderately sloping, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape. They range from about 20 to more than 200 acres in size.

Typically, the surface layer is dark brown, very friable fine sandy loam about 11 inches thick. The subsurface layer is brown, very friable fine sandy loam about 5 inches thick. The subsoil is friable sandy clay loam about 21 inches thick. The upper part is strong brown, and the lower part is strong brown and red and is mottled. Dark red, yellowish red, and light brownish gray, soft sandstone bedrock that has thin, discontinuous lenses of shale is at a depth of about 37 inches. In some small eroded areas on the breaks along some side slopes, the fine sandy loam in the upper part of the soil is less than 4 inches thick.

Included with this soil in mapping are the stony Hector soils on the steeper, lower side slopes. These soils make up about 10 percent of the unit.

Permeability is moderate in the Bolivar soil, and surface runoff is medium. Available water capacity is low. The subsoil is very strongly acid, and the surface layer is strongly acid or medium acid, depending on past liming practices. Natural fertility is low, and the organic matter content is moderately low. The shrink-swell potential is moderate. The root zone is restricted by the weathered sandstone bedrock at a depth of 20 to 40 inches. The surface layer is very friable and can be easily tilled.

Most areas are used for hay, pasture, or woodland. A few are used for cultivated crops. A cover of grasses and legumes is effective in controlling erosion. This soil is well suited to cool-season grasses, such as tall fescue and orchardgrass; warm-season grasses, such as big bluestem and indiangrass; and legumes, such as lespedeza. The rooting depth is only moderate, and droughtiness is a problem during much of the year. When the soil is tilled before seeding, erosion is a hazard. It can be controlled by timely tillage and by establishment of a ground cover as soon as possible.

This soil is moderately well suited to grain sorghum, soybeans, and small grain and is poorly suited to corn. If cultivated crops are grown, erosion is a severe hazard. It can be controlled by a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, terraces and grassed waterways, a conservation cropping system that includes close-growing pasture and hay crops, and contour farming in areas where the slopes are smooth enough. Returning crop residue to the soil or regularly adding other organic material improves fertility.

Many areas support native hardwoods. This soil is suited to trees. No major limitations or hazards affect planting or harvesting.

This soil is suitable for building site development and onsite waste disposal if proper design and installation procedures are used. Adequately reinforcing the concrete in footings, foundations, and basement walls and backfilling with sand or gravel help to prevent the structural damage caused by shrinking and swelling. Provisions should be made to excavate the bedrock, or the design of the dwelling should accommodate the depth to bedrock. Special design and extra excavation are needed on sites for dwellings with basements.

An adequate amount of soil material can be added to septic tank absorption fields to increase the depth of the soil over bedrock and thus prevent seepage. Lengthening the laterals helps to overcome the restricted permeability. Land shaping can modify the slope. The berms of sewage lagoons should be built up with extra soil material, which increases the depth to bedrock and modifies the slope. Sealing the bottom of the lagoon with slowly permeable material helps to prevent seepage.

This soil is suitable as a site for local roads and streets. Low strength, the shrink-swell potential, and frost action are limitations. Strengthening the subgrade with crushed rock or other suitable base material helps to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing adequate side ditches, and installing culverts improve drainage and thus minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is IIIe. The woodland ordination symbol is 3A.

56B—Barco fine sandy loam, 2 to 5 percent slopes. This moderately deep, gently sloping, well drained soil is on ridgetops. Individual areas are irregular in shape. They range from 5 to 50 acres in size.

Typically, the surface layer is dark brown, friable fine sandy loam about 10 inches thick. The subsoil is about 20 inches thick. The upper part is brown, friable fine sandy loam; the next part is dark yellowish brown, mottled, friable sandy clay loam; and the lower part is strong brown, mottled, firm sandy clay loam. Light brownish gray, strong brown, and red, soft sandstone bedrock is at a depth of about 30 inches. It is underlain by hard sandstone bedrock at a depth of about 44 inches. In some areas the dark surface layer is less than 7 inches thick.

Included in this soil in mapping are small areas of Collinsville and Deepwater soils. Collinsville soils are less than 20 inches deep over bedrock. They are on ridgetops and steep side slopes. Deepwater soils are more than 60 inches deep over bedrock. They are in landscape positions similar to those of the Barco soil. Included soils make up 10 to 15 percent of the unit.

Permeability is moderate in the Barco soil, and surface runoff is medium. Natural fertility also is medium, and the organic matter content is moderate. The surface layer is friable and can be easily tilled. Available water capacity is low. The root zone is restricted by the weathered bedrock at a depth of 20 to 40 inches. The shrink-swell potential is moderate.

Most areas are used for cultivated crops or for pasture and hay (fig. 7). This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, erosion is a hazard. It can be controlled by a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, a conservation cropping system that includes close-growing pasture and hay crops, contour farming, terraces, and grassed waterways. Returning crop residue to the soil improves fertility and increases the rate of water infiltration.

A cover of hay or pasture plants is effective in controlling erosion. This soil is well suited to cool-season grasses, such as tall fescue and orchardgrass; warm-season grasses, such as big bluestem and indiangrass; and legumes, such as lespedeza. The rooting depth is only moderate, and droughtiness is a problem during much of the year. When the soil is tilled before seeding, erosion is a hazard. It can be controlled by timely tillage and by establishment of a ground cover as soon as possible.

This soil is suitable for building site development and onsite waste disposal if proper design and installation procedures are used. Adequately reinforcing the concrete in footings, foundations, and basement walls and backfilling with sand or gravel help to prevent the structural damage caused by shrinking and swelling. Provisions should be made to excavate the bedrock, or the design of the dwelling should accommodate the depth to bedrock. Special design and extra excavation are needed on sites for dwellings with basements.

An adequate amount of soil material can be added to septic tank absorption fields to increase the depth of the soil over bedrock and thus prevent seepage. Lengthening the laterals helps to overcome the restricted permeability. Land shaping can modify the slope. The berms of sewage lagoons should be built up with extra soil material, which increases the depth to bedrock and modifies the slope. Sealing the bottom of the lagoon with slowly permeable material helps to prevent seepage.

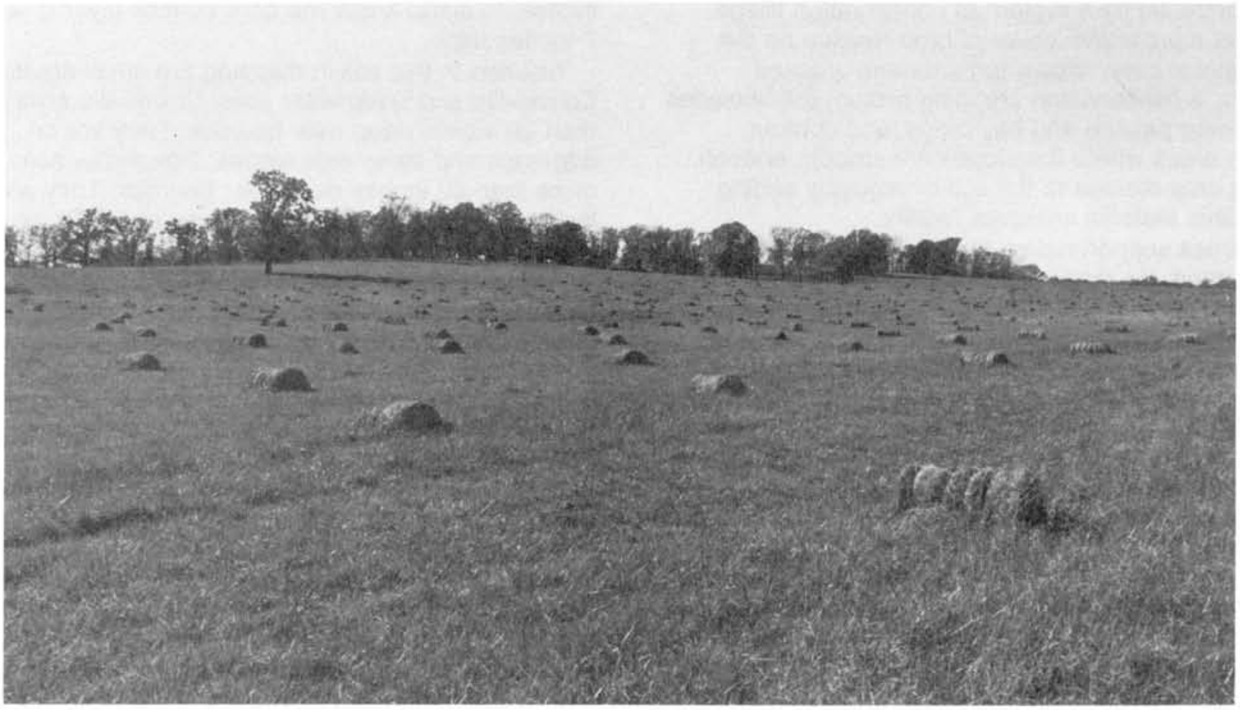

Figure 7.—An area of Barco fine sandy loam, 2 to 5 percent slopes, used for hay.

This soil is suitable as a site for local roads and streets. Low strength, the shrink-swell potential, and frost action are limitations. Strengthening the subgrade with crushed rock or other suitable material helps to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing adequate side ditches, and installing culverts improve drainage and thus minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is IIe. No woodland ordination symbol is assigned.

56C—Barco fine sandy loam, 5 to 9 percent slopes. This moderately deep, moderately sloping, well drained soil is on side slopes. Individual areas are irregular in shape. They range from 10 to 50 acres in size.

Typically, the surface layer is very dark grayish brown, friable fine sandy loam about 12 inches thick. The subsoil is about 12 inches thick. It is dark yellowish brown. The upper part is friable loam, and the lower part is firm clay loam. Red, soft sandstone bedrock is at a depth of about 24 inches. It is underlain by hard sandstone bedrock at a depth of about 28 inches. In some areas the dark surface layer is less than 7 inches thick.

Included in this soil in mapping are small areas of Collinsville and Deepwater soils. Collinsville soils are less than 20 inches deep over bedrock. They are on ridgetops and steep side slopes. Deepwater soils are more than 60 inches deep over bedrock. They are in landscape positions similar to those of the Barco soil. Included soils make up about 10 to 15 percent of the unit.

Permeability is moderate in the Barco soil, and surface runoff is medium. The organic matter content is moderate, and natural fertility is medium. The surface layer is friable and can be easily tilled. Available water capacity is low. The shrink-swell potential is moderate.

Most areas are pastured. A cover of grasses and legumes is effective in controlling erosion. This soil is well suited to cool-season grasses, such as tall fescue and orchardgrass; warm-season grasses, such as big bluestem and indiangrass; and legumes, such as lespedeza. The rooting depth is only moderate, and droughtiness is a problem during much of the year. When the soil is tilled before seeding, erosion is a hazard. It can be controlled by timely tillage and by establishment of a ground cover as soon as possible.

This soil is moderately well suited to grain sorghum, soybeans, and small grain and is poorly suited to corn. If cultivated crops are grown, erosion is a severe hazard. It can be controlled by a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, terraces and grassed waterways, a conservation cropping system that includes close-growing pasture and hay crops, and contour farming in areas where the slopes are smooth enough. Returning crop residue to the soil or regularly adding other organic material improves fertility.

This soil is suitable for building site development and onsite waste disposal if proper design and installation procedures are used. Adequately reinforcing the concrete in footings, foundations, and basement walls and backfilling with sand or gravel help to prevent the structural damage caused by shrinking and swelling. Provisions should be made to excavate the bedrock, or the design of the dwelling should accommodate the depth to bedrock. Special design and extra excavation are needed on sites for dwellings with basements.

An adequate amount of soil material can be added to septic tank absorption fields to increase the depth of the soil over bedrock and thus prevent seepage. Lengthening the laterals helps to overcome the restricted permeability. Land shaping can modify the slope. The berms of sewage lagoons should be built up with extra soil material, which increases the depth to bedrock and modifies the slope. Sealing the bottom of the lagoon with slowly permeable material helps to prevent seepage.

This soil is suitable as a site for local roads and streets. Low strength, the shrink-swell potential, and frost action are limitations. Strengthening the subgrade with crushed rock or other suitable material helps to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing adequate side ditches, and installing culverts improve drainage and thus minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is IIIe. No woodland ordination symbol is assigned.

57B—Liberal silt loam, 2 to 5 percent slopes. This moderately deep, gently sloping, moderately well drained soil is on convex ridgetops and side slopes. Individual areas are irregular in shape. They range from 10 to 75 acres in size.

Typically, the surface layer is dark brown, friable silt loam about 6 inches thick. The subsoil is about 18 inches thick. The upper part is dark brown, friable silty clay loam; the next part is dark brown, firm silty clay; and the lower part is dark brown and dark grayish brown, mottled silty clay. The substratum is grayish brown, mottled clay loam about 22 inches thick. Soft sandstone bedrock interbedded with lenses of shale is at a depth of about 46 inches. In some areas the surface layer is silty clay loam. In other areas the depth to bedrock is more than 60 inches. In places the dark surface soil is more than 10 inches thick.

Included with this soil in mapping are small areas of Deepwater soils. These soils are more than 60 inches deep over bedrock and have less clay than the Liberal soil. Also, they are lower on the side slopes. They make up less than 5 percent of the unit.

Permeability is slow in the Liberal soil, and surface runoff is medium. The organic matter content is moderately low, and natural fertility is medium. A perched seasonal high water table is at a depth of 2 to 3 feet during winter and spring in most years. The surface layer is friable and can be easily tilled. Available water capacity is moderate. The shrink-swell potential is high.

Most areas are used for cultivated crops or for pasture and hay. This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, erosion is a hazard. It can be controlled by a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, grassed waterways, and a conservation cropping system that includes close-growing pasture and hay crops. In a few areas slopes are long enough and smooth enough to be terraced and farmed on the contour. Returning crop residue to the soil improves fertility and increases the rate of water infiltration. Cultivation is sometimes delayed by wetness.

A cover of pasture plants or hay is effective in controlling erosion. This soil is well suited to cool-season grasses, such as tall fescue and timothy; legumes, such as ladino clover and lespedeza; and warm-season grasses, such as big bluestem, indiangrass, and switchgrass. Erosion during seedbed preparation is the main problem. It can be controlled by timely tillage and by establishment of a ground cover as soon as possible.

This soil is suitable for building site development if proper design and installation procedures are used. Adequately reinforcing the concrete in foundations and footings and backfilling with sand or gravel help to prevent the structural damage caused by shrinking and swelling. Installing tile drains around the footings helps to prevent the damage caused by excessive wetness.

Because of the wetness and the restricted permeability, this soil generally is unsuitable as a site for septic tank absorption fields. The wetness and the slope are limitations on sites for sewage lagoons. The slope can be overcome by leveling the site. Sealing the bottom of the lagoon helps to prevent contamination of ground water.

This soil is suitable as a site for local roads and streets. Low strength, the shrink-swell potential, and frost action are limitations. Strengthening the subgrade with crushed rock or other suitable material helps to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing adequate side ditches, and installing culverts improve drainage and thus minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is IIe. No woodland ordination symbol is assigned.

58—Hartwell silt loam. This deep, nearly level, somewhat poorly drained soil is on broad upland divides.

Individual areas are irregular in shape. They range from 20 to 200 acres in size.

Typically, the surface layer is very dark grayish brown, very friable silt loam about 9 inches thick. The subsurface layer is grayish brown, mottled, very friable silt loam about 9 inches thick. The subsoil extends to a depth of about 60 inches or more. It is firm and mottled. The upper part is very dark grayish brown and dark grayish brown silty clay, the next part is dark brown silty clay, and the lower part is strong brown silty clay loam.

Included with this soil in mapping are areas of Barden and Deepwater soils. Barden soils are moderately well drained. Deepwater soils have less clay in the subsoil than the Hartwell soil. Both soils are lower on the landscape than the Hartwell soil. They make up about 5 to 10 percent of the unit.

Permeability is slow in the Hartwell soil, and surface runoff is slow or medium. A perched seasonal high water table is at a depth of 0.5 foot to 1.5 feet during winter and spring in most years. Natural fertility is medium, and the organic matter is moderate. Available water capacity also is moderate. The shrink-swell potential is high.

Most areas are used for row crops. This soil is suited to corn, soybeans, small grain, and grain sorghum. Wetness during spring and fall is the major problem in cultivated areas. Erosion is a problem on long slopes. Also, the supply of soil moisture is often insufficient during summer. Land smoothing, shallow surface ditches, and timely tillage help to overcome the wetness. In areas where slopes are long and surface drainage is good, a system of conservation tillage that leaves protective amounts of crop residue on the surface and grassed waterways help to prevent excessive soil loss. Returning crop residue to the soil improves fertility, helps to prevent excessive crusting, and increases the rate of water infiltration.

This soil is well suited to reed canarygrass and switchgrass and is moderately suited to ladino clover, tall fescue, big bluestem, and indiangrass. It is not suited to deep-rooted pasture plants. The wetness is the main problem. Grazing should be deferred when the soil is wet.

This soil is suitable for building site development if proper design and installation procedures are used. Adequately reinforcing the concrete in footings, foundations, and basement walls helps to prevent the structural damage caused by shrinking and swelling. Installing tile drains around the footings and foundations helps to prevent the damage caused by excessive wetness.

Because of the wetness and the restricted permeability, this soil generally is unsuitable as a site for septic tank absorption fields. Properly designed sewage lagoons function adequately.

This soil is suitable as a site for local roads and streets. Low strength, the shrink-swell potential, frost action, and the wetness are limitations. Strengthening the subgrade with crushed rock or other suitable material helps to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing adequate side ditches, and installing culverts improve drainage and thus minimize the damage caused by shrinking and swelling, by frost action, and by wetness.

The land capability classification is IIe. No woodland ordination symbol is assigned.

59B—Hartville silt loam, 2 to 5 percent slopes. This deep, gently sloping, somewhat poorly drained soil is on terraces along the major streams in the county. Individual areas generally are irregular in shape and range from 5 to 50 acres in size.

Typically, the surface layer is brown, very friable silt loam about 7 inches thick. The subsurface layer is yellowish brown, very friable silt loam about 6 inches thick. The subsoil is about 47 inches thick. It is yellowish brown, mottled, friable silty clay loam in the upper part; yellowish brown, mottled, firm silty clay in the next part; and grayish brown, mottled, firm silty clay loam in the lower part. The substratum to a depth of 72 inches or more is mottled yellowish brown, strong brown, and grayish brown, firm cherty silty clay loam.

Included with this soil in mapping are areas of the well drained Cotter and poorly drained Moniteau soils. These soils are in low lying areas. They make up about 10 percent of the unit.

Permeability is slow in the Hartville soil, and surface runoff is medium. A perched seasonal high water table is at a depth of 1.5 to 3.0 feet during winter and spring in most years. The shrink-swell potential is high. Natural fertility is medium, and the organic matter content is moderate. The surface layer is very friable and can be easily tilled throughout a wide range in moisture content. Available water capacity is high.

Most areas are pastured (fig. 8). A cover of pasture plants or hay is effective in controlling erosion. This soil is well suited to reed canarygrass and switchgrass and is moderately suited to ladino clover, tall fescue, big bluestem, and indiangrass. It is not suited to deep-rooted forage species. The wetness is a problem. Grazing should be deferred when the soil is wet. Erosion is a hazard during seedbed preparation. It can be controlled by timely tillage and by establishment of a ground cover as soon as possible.

This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, erosion and the wetness caused by runoff from the upslope adjacent soils are problems. The runoff can be controlled by diversion terraces. A system of conservation tillage that leaves a protective cover of crop residue on the surface, contour farming, and a conservation cropping system that includes close-growing pasture and hay crops help to control erosion. Returning crop residue to the soil or regularly adding other organic material improves tilth and helps to prevent excessive crusting.

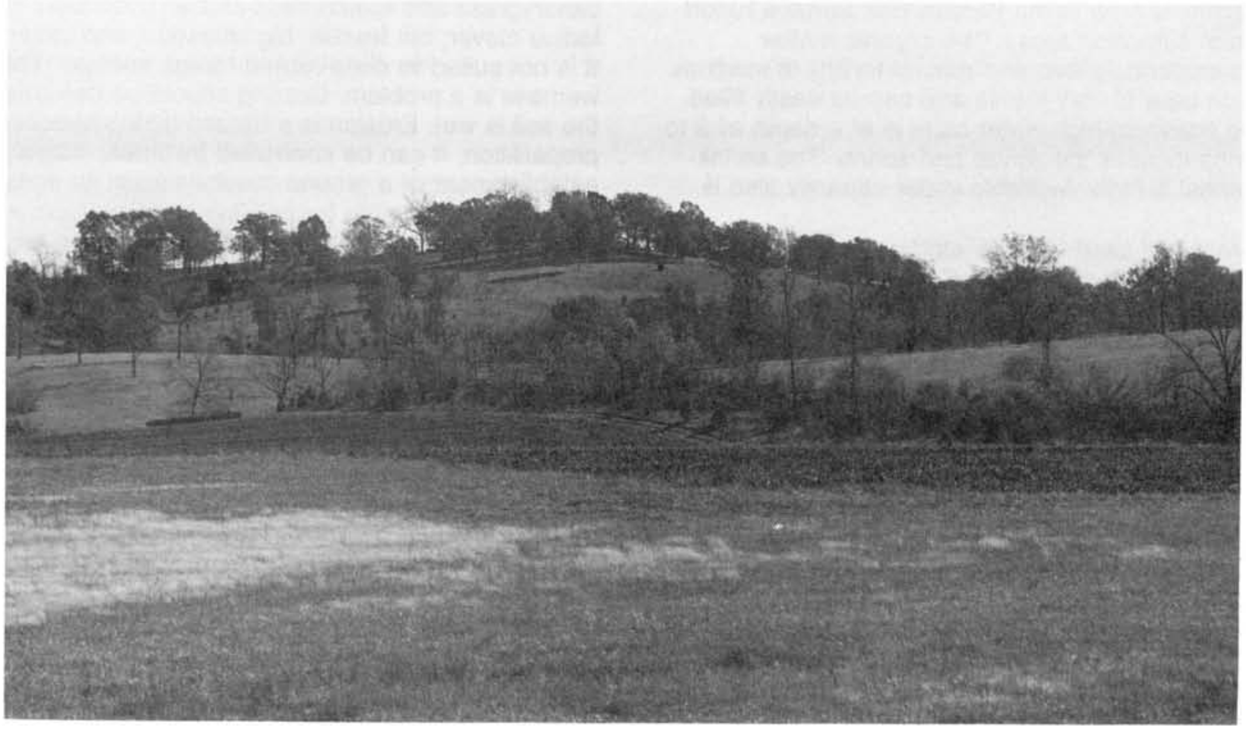

Figure 8.—Cool-season grasses in a pastured area of Hartville silt loam, 2 to 5 percent slopes. Goss soils are in the background.

A few areas support native hardwoods. This soil is suited to trees. The windthrow hazard and the seedling mortality rate are management concerns. The stands should be thinned less intensively and more frequently than the stands in areas where the windthrow hazard is less severe. Planting container-grown stock increases the survival rate.

This soil is suitable for building site development if proper design and installation procedures are used. Adequately reinforcing the concrete in footings, foundations, and basement walls and backfilling with sand or gravel help to prevent the structural damage caused by shrinking and swelling. Installing tile drains around the footings helps to prevent the damage caused by excessive wetness.

Because of the wetness and the restricted permeability, this soil generally is unsuitable as a site for septic tank absorption fields. It is suitable as a site for sewage lagoons. The slope is a limitation, but it can be overcome by leveling the site.

This soil is suitable as a site for local roads and streets. Low strength, the shrink-swell potential, frost action, and the wetness are limitations. Strengthening the subgrade with crushed rock or other suitable material helps to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing adequate side ditches, and installing culverts improve drainage and thus minimize the damage caused by shrinking and swelling, by frost action, and by wetness.

The land capability classification is IIe. The woodland ordination symbol is 2C.

60B—Barden silt loam, 1 to 5 percent slopes. This deep, gently sloping, moderately well drained soil is on convex ridgetops and side slopes. Individual areas are irregular in shape. They range from 10 to 300 acres in size.

Typically, the surface layer is dark brown, very friable silt loam about 10 inches thick. The subsoil is about 41 inches thick. The upper part is dark brown, friable silty clay loam; the next part is dark brown and dark grayish brown, mottled, firm silty clay; and the lower part is grayish brown, mottled, friable silty clay loam. The substratum to a depth of 72 inches or more is mottled light brownish gray, yellowish brown, and strong brown, friable silty clay loam. In some areas the dark surface layer is less than 7 inches thick.

Included with this soil in mapping are small areas of Deepwater and Hartwell soils. Deepwater soils have less clay in the subsoil than the Barden soil. They are in the more sloping areas. The somewhat poorly drained Hartwell soils are in the more nearly level areas. Included soils make up 10 to 15 percent of the unit.

Permeability is slow in the Barden soil. Surface runoff is medium in cultivated areas. The organic matter content is moderately low, and natural fertility is medium. The surface layer is very friable and can be easily tilled. A perched seasonal high water table is at a depth of 2 to 3 feet during most of the winter and spring. The shrink-swell potential is high. Available water capacity also is high.

Most areas are used for cultivated crops or for pasture and hay (fig. 9). This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, erosion is a hazard. It can be controlled by a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, and a conservation cropping system that includes close-growing pasture and hay crops. In a few areas slopes are long enough and smooth enough to be terraced and farmed on the contour. Returning crop residue to the soil improves fertility and increases the rate of water infiltration. Cultivation is sometimes restricted by wetness.

A cover of pasture plants or hay is effective in controlling erosion. This soil is well suited to reed canarygrass and switchgrass and is moderately suited to ladino clover, tall fescue, big bluestem, and indiangrass. It is not suited to deep-rooted forage species. The wetness is a problem. Grazing should be deferred when the soil is wet. Erosion is a hazard during seedbed preparation. It can be controlled by timely tillage and by establishment of a ground cover as soon as possible.

This soil is suitable for building site development if proper design and installation procedures are used. Adequately reinforcing the concrete in footings, foundations, and basement walls and backfilling with sand or gravel help to prevent the structural damage caused by shrinking and swelling. Installing tile drains around the footings helps to prevent the damage caused by excessive wetness.

Because of the wetness and the restricted permeability, this soil generally is unsuitable as a site for septic tank absorption fields. It is suitable as a site for sewage lagoons. The slope is a limitation, but it can be overcome by leveling the site.

This soil is suitable as a site for local roads and streets. Low strength, the shrink-swell potential, frost

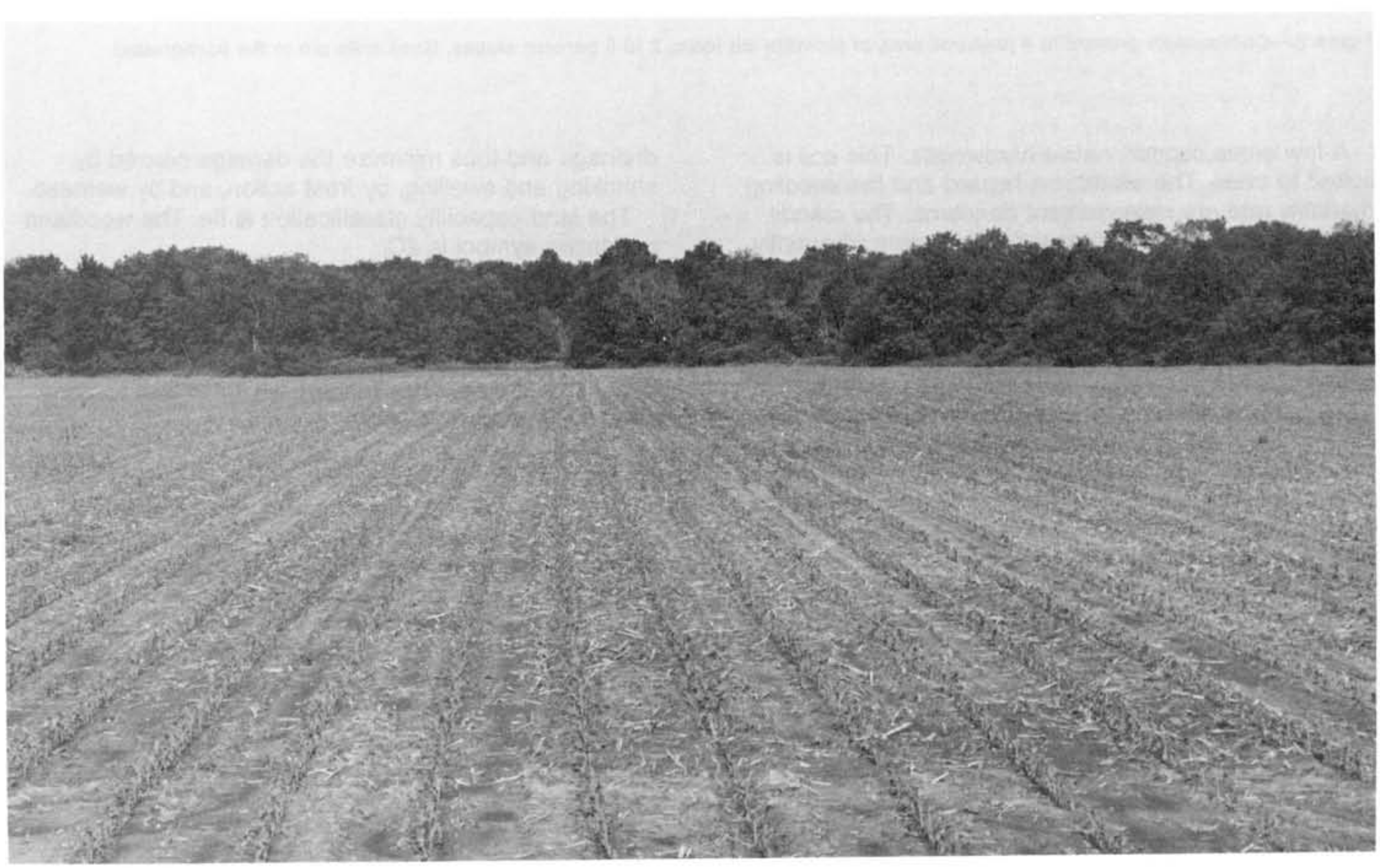

Figure 9.—Corn on Barden silt loam, 1 to 5 percent slopes.

action, and the wetness are limitations. Strengthening the subgrade with crushed rock or other suitable material helps to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing adequate side ditches, and installing culverts minimize the damage caused by shrinking and swelling, by frost action, and by wetness.

The land capability classification is IIe. No woodland ordination symbol is assigned.

61B—Summit silty clay loam, 2 to 5 percent slopes. This deep, gently sloping, moderately well drained soil is on foot slopes, side slopes, and some narrow ridgetops. Individual areas are irregular in shape. They range from 10 to 70 acres in size.

Typically, the surface layer is black, firm silty clay loam about 12 inches thick. The subsoil to a depth of 72 inches or more is very firm silty clay. It is dark grayish brown, olive brown, and very dark gray in the upper part and mottled yellowish brown, strong brown, and gray in the lower part.

Included with this soil in mapping are some areas of the moderately well drained Barden and Liberal soils. These soils have less clay in the surface layer than the Summit soil. They make up about 15 percent of the unit. Barden soils are on ridgetops and side slopes above the Summit soil. Liberal soils are moderately deep. They are on slope breaks.

Permeability is slow in the Summit soil, and surface runoff is medium. The organic matter content is moderate, and natural fertility is medium. The shrink-swell potential is high. A perched seasonal high water table is at a depth of 2 to 3 feet during most of the winter and spring. The soil cannot be easily tilled during wet periods and becomes hard and cracks during dry periods. Available water capacity is moderate or high.

Most areas are used as cropland or pasture. This soil is suited to corn, soybeans, sorghum, and small grain. If cultivated crops are grown, erosion is a hazard. Terraces and grassed waterways, contour farming, a system of conservation tillage that leaves protective amounts of crop residue on the surface, and a conservation cropping system that includes pasture or hay crops help to control erosion, maintain the organic matter content, and improve tilth.

This soil is well suited to most of the legumes, warm-season grasses, and cool-season grasses commonly grown in the county. No serious problems affect pasture or hayland. Erosion is a problem when new seedlings are becoming established. Timely seedbed preparation helps to ensure a good ground cover.

This soil is suitable for building site development if proper design and installation procedures are used. Adequately reinforcing the concrete in footings, foundations, and basement walls and backfilling with sand or gravel help to prevent the structural damage caused by shrinking and swelling. Installing tile drains around the footings helps to prevent the damage caused by excessive wetness.

Because of the wetness and the restricted permeability, this soil generally is unsuitable as a site for septic tank absorption fields. It is suitable as a site for sewage lagoons. The slope is a limitation, but it can be overcome by leveling the site.

This soil is suitable as a site for local roads and streets. Low strength, the shrink-swell potential, frost action, and the wetness are limitations. Strengthening the subgrade with crushed rock or other suitable material helps to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing adequate side ditches, and installing culverts improve drainage and thus minimize the damage caused by shrinking and swelling, by frost action, and by wetness.

The land capability classification is IIe. No woodland ordination symbol is assigned.

66C—Eldorado cherty silt loam, 3 to 9 percent slopes. This deep, gently sloping and moderately sloping, well drained soil is on the convex sides and tops of ridges in the uplands. In many places a few stones are on the surface. Individual areas range from about 10 to more than 100 acres in size.

Typically, the surface layer is dark brown, very friable cherty silt loam about 8 inches thick. The subsoil extends to a depth of 72 inches or more. It is dark reddish brown and reddish brown, friable extremely cherty silty clay loam in the upper part; yellowish red, friable extremely cherty silty clay loam in the next part; and red, firm very cherty silty clay in the lower part. In some places the soil is dark to a depth of less than 10 inches. In other places the upper part of the soil is brown. In some areas the content of clay in the upper part of the subsoil is more than 35 percent. In other areas the depth to bedrock is 40 to 60 inches.

Included with this soil in mapping are areas of Bucklick, Goss, and Newtonia soils. Bucklick soils do not have chert or a dark surface layer. They are on toe slopes. Goss soils do not have a dark surface layer. They are in landscape positions similar to those of the Eldorado soil. Newtonia soils do not contain chert and have less clay in the subsoil than the Eldorado soil. They are in the slightly higher landscape positions. Included soils make up about 5 percent of the unit.

Permeability is moderate in the Eldorado soil, and surface runoff is medium. The organic matter content is moderately low, and natural fertility is medium. Available water capacity is low. The shrink-swell potential is moderate.

Most areas are used for pasture and hay. This soil is well suited to legumes, such as alfalfa and lespedeza; cool-season grasses, such as tall fescue and orchardgrass; and warm-season grasses, such as big bluestem, indiangrass, and switchgrass. Drought is a hazard, and the chert interferes with tillage. Timely seedbed preparation and seeding can help to control erosion.

This soil is suitable for soybeans, grain sorghum, and corn grown in a rotation that includes several years of pasture or hay crops. Properly managing crop residue and including cover crops in the cropping sequence help to maintain the organic matter content and good tilth and increase the supply of available water. Terraces, grassed waterways, a system of conservation tillage that leaves a protective cover of crop residue on the surface, and contour farming help to control erosion and runoff.

This soil is suitable for building site development and some onsite waste disposal systems if proper design and installation procedures are used. Adequately reinforcing the concrete in footings, foundations, and basement walls helps to prevent the structural damage caused by shrinking and swelling. Enlarging septic tank absorption fields helps to overcome the restricted permeability of this soil. Sewage lagoons function properly if the slope can be modified by grading and leveling and the bottom and berms of the lagoon are sealed with slowly permeable material, which helps to prevent seepage. Adequate side ditches and culverts help to prevent the damage to local roads and streets caused by frost action.

Sealing embankments for farm ponds and sewage lagoons is very difficult. Because the limestone residuum under the soil occurs as a thin, porous layer that transmits water freely, proper construction is needed to ensure that the ponds can retain water.

The land capability classification is IVs. No woodland ordination symbol is assigned.

66D—Eldorado cherty silt loam, 9 to 14 percent slopes. This deep, strongly sloping, well drained soil is on side slopes. In many places a few stones are on the surface. Individual areas range from about 10 to more than 100 acres in size.

Typically, the surface layer is dark brown, friable cherty silt loam about 7 inches thick. The subsoil extends to a depth of 72 inches or more. It is reddish brown and yellowish red, friable very cherty and extremely cherty silty clay loam in the upper part; yellowish red, friable extremely cherty and very cherty silty clay in the next part; and red, firm cherty silty clay in the lower part. In some places the soil is dark to a depth of less than 10 inches. In other places the upper part of the soil is brown. In some areas the content of clay in the upper part of the subsoil is more than 35 percent. In other areas the depth to bedrock is 40 to 60 inches.

Included with this soil in mapping are areas of Bucklick, Goss, and Newtonia soils. Bucklick soils do not have chert or a dark surface layer. They are on toe slopes. Goss soils do not have a dark surface layer. They are in landscape positions similar to those of the Eldorado soil. Newtonia soils do not have chert and contain less clay in the subsoil than the Eldorado soil. They are in the slightly higher landscape positions. Included soils make up about 10 percent of the unit.

Permeability is moderate in the Eldorado soil, and surface runoff is medium. The organic matter content is moderately low, and natural fertility is medium. Available water capacity is low. The shrink-swell potential is moderate.

Most areas are used as woodland or pasture. Because of the slope and the hazard of erosion, this soil is unsuited to row crops and small grain. It is well suited to lespedeza and tall fescue and to warm-season grasses, such as big bluestem, indiangrass, and switchgrass. It is moderately suited to alfalfa, ladino clover, and red clover. Drought is a hazard, and the chert interferes with tillage. The hazard of erosion is a major concern when the pasture is seeded. No-till planting should be considered. Rotation grazing improves the stands.

This soil is suitable for building site development and some onsite waste disposal systems if proper design and installation procedures are used. Adequately reinforcing the concrete in footings, foundations, and basement walls and backfilling with sand or gravel help to prevent the structural damage caused by shrinking and swelling. The dwellings can be designed so that they conform to the natural slope of the land. Some land shaping may be necessary. Enlarging septic tank absorption fields and constructing them across the slope help to compensate for the restricted permeability and slope of this soil. Sewage lagoons function properly if the slope can be modified by grading or leveling and the bottom and berms of the lagoon are sealed with slowly permeable material, which helps to prevent seepage.

Adequate side ditches and culverts help to prevent the damage to local roads and streets caused by frost action in this soil. Some cutting and filling may be necessary because of the slope.

Sealing embankments for farm ponds and sewage lagoons is very difficult. Because the limestone residuum under the soil occurs as a thin, porous layer that transmits water freely, proper construction is needed to ensure that the ponds can retain water.

The land capability classification is VIs. No woodland ordination symbol is assigned.

67C—Bardley cherty silt loam, 3 to 9 percent slopes. This moderately deep, gently sloping and moderately sloping, well drained soil is on ridgetops and side slopes. Individual areas are irregular in shape. They range from 10 to 60 acres in size.

Typically, the surface layer is very dark grayish brown, friable cherty silt loam about 3 inches thick. The subsurface layer is brown, friable extremely cherty loam about 10 inches thick. The subsoil is yellowish red, brown, and strong brown, very firm clay about 16 inches thick. Hard limestone bedrock is at a depth of about 29 inches. In some areas the subsoil is browner.

Included with this soil in mapping are small areas of the deep, well drained Goss and shallow, somewhat excessively drained Gasconade soils. These soils are at the outer edge of the mapped areas. They make up about 10 percent of the unit.

Permeability is moderate in the Bardley soil, and surface runoff is medium or rapid. Natural fertility is low, and the organic matter content is moderately low. The surface layer is friable and can be easily tilled throughout a wide range in moisture content. Root penetration is restricted by the limestone bedrock at a depth of about 29 inches. The shrink-swell potential is moderate. Available water capacity is low.

Most areas are used for timber or pasture. This soil is well suited to legumes, such as lespedeza and crownvetch; cool-season grasses, such as tall fescue, red fescue, and orchardgrass; and warm-season grasses, such as big bluestem and indiangrass. The rooting depth is only moderate, and droughtiness is a problem during much of the year. When the soil is tilled before seeding, erosion is a hazard. It can be controlled by timely tillage and by establishment of a ground cover as soon as possible.

This soil is suited to small grain grown on a limited basis. Timely seeding and an adequate ground cover are needed to control erosion.

A few areas support native species of oak and cedar. This soil is suited to trees. No major limitations or hazards affect planting or harvesting.

This soil is suitable for building site development and onsite waste disposal if proper design and installation procedures are used. Adequately reinforcing the concrete in the footings and foundations of dwellings without basements and backfilling with sand or gravel help to prevent the structural damage caused by shrinking and swelling. Provisions should be made to excavate the bedrock, or the design of the dwelling should accommodate the depth to bedrock. Special design and extra excavation are needed on sites for dwellings with basements.

An adequate amount of soil material can be added to septic tank absorption fields to increase the depth of the soil over bedrock and thus prevent seepage. Lengthening the laterals helps to overcome the restricted permeability. Land shaping can modify the slope. The berms of sewage lagoons should be built up with extra soil material, which increases the depth to bedrock. Sealing the bottom of the lagoon with slowly permeable material helps to prevent seepage.

This soil is suitable as a site for local roads and streets. Low strength, the shrink-swell potential, and frost action are limitations. Strengthening the subgrade with crushed rock or other suitable material helps to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing adequate side ditches, and installing culverts improve drainage in low areas and thus minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is IVs. The woodland ordination symbol is 2A.

67D—Bardley cherty silt loam, 9 to 14 percent slopes. This moderately deep, well drained soil is on side slopes. Individual areas are irregular in shape. They range from 10 to 50 acres in size.

Typically, the surface layer is dark brown, friable cherty silt loam about 4 inches thick. The subsurface layer is brown, friable extremely cherty silt loam about 5 inches thick. The subsoil is yellowish red, brown, and strong brown, firm clay about 18 inches thick. Hard limestone bedrock is at a depth of about 27 inches. In some areas the subsoil is yellower.

Included with this soil in mapping are small areas of the deep, well drained Goss and shallow, somewhat excessively drained Gasconade soils. These soils are at the outer edge of the mapped area. They make up 10 percent of the unit.

Permeability is moderate in the Bardley soil, and surface runoff is medium or rapid. Natural fertility is low, and the organic matter content is moderately low. The surface layer is friable. Root penetration is restricted by the limestone bedrock at a depth of about 27 inches. Available water capacity is low.

Most areas are used for timber or pasture. Because of the cherty surface soil and the slope, this soil generally is unsuitable for cultivated crops. It is well suited to legumes, such as lespedeza and crownvetch, and to cool-season grasses, such as tall fescue, red fescue, and orchardgrass. It also is well suited to warm-season grasses, such as big bluestem and indiangrass. The rooting depth is only moderate, and droughtiness is a problem during much of the year. When the soil is tilled before seeding, erosion is a hazard. It can be controlled by timely tillage and by establishment of a ground cover as soon as possible.

A few areas support native species of oak and cedar. This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is suitable for building site development and onsite waste disposal if proper design and installation procedures are used. Adequately reinforcing the concrete in footings, foundations, and basement walls and backfilling with sand or gravel help to prevent the structural damage caused by shrinking and swelling. Provisions should be made to excavate the bedrock, or the design of the dwelling should accommodate the natural slope of the land and the depth to bedrock. Special design and extra excavation are needed on sites for dwellings with basements.

An adequate amount of soil material can be added to septic tank absorption fields to increase the depth of the soil over bedrock and thus prevent seepage. Lengthening the laterals helps to overcome the restricted permeability. Land shaping can modify the slope. Sewage lagoons function properly if the site can be leveled and the berms of the lagoon are built up with extra soil material, which increases the depth to bedrock. Sealing the bottom of the lagoon with slowly permeable material helps to prevent seepage. An alternative site in areas of the adjacent soils that are better suited to lagoons may be needed.

This soil is suitable as a site for local roads and streets. Low strength, the shrink-swell potential, and frost action are limitations. Strengthening the subgrade with crushed rock or other suitable material helps to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing adequate side ditches, and installing culverts improve drainage in low areas and thus minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is VIs. The woodland ordination symbol is 2A.

68D—Collinsville fine sandy loam, 2 to 20 percent slopes. This shallow, gently sloping to moderately steep, somewhat excessively drained soil is on ridgetops and side slopes. Individual areas are irregular in shape. They range from 5 to 50 acres in size.

Typically, the surface layer is very dark brown, very friable fine sandy loam about 9 inches thick. The subsoil is dark brown, friable loam about 6 inches thick. Hard sandstone bedrock is at a depth of about 15 inches.

Included with this soil in mapping are small areas of Barco soils. These soils are moderately deep over bedrock. They are on the lower side slopes. Also included are scattered areas where the sandstone bedrock crops out. Included areas make up about 10 to 15 percent of the unit.

Permeability is moderately rapid in the Collinsville soil, and surface runoff is medium or rapid. Natural fertility is medium, and the organic matter content is moderately low. Root penetration is restricted by the sandstone bedrock at a depth of about 15 inches. Available water capacity is very low.

Most areas are used as native pasture. Because of the shallow depth to bedrock, this soil is unsuited to row crops and to hay. It is moderately suited to big bluestem, indiangrass, and switchgrass. It is best suited to shallow-rooted plants. Tillage is nearly impossible in some areas. Broadcasting is needed in these areas. Because of the slope and the included rock outcrop, mowing for hay is difficult.

Because of the shallow depth to bedrock, this soil generally is unsuited to buildings and onsite waste disposal.

The land capability classification is VIs. No woodland ordination symbol is assigned.

69C—Goss cherty silt loam, 3 to 9 percent slopes. This deep, gently sloping and moderately sloping, well drained soil is on the convex sides and tops of upland ridges. Coarse chert covers 5 to 10 percent of the surface. Individual areas range from about 10 to more than 500 acres in size.

Typically, the surface layer is very dark grayish brown, friable cherty silt loam about 6 inches thick. The subsurface layer is yellowish brown, friable very cherty silt loam about 9 inches thick. The subsoil extends to a depth of 72 inches or more. It is yellowish red, firm very cherty silty clay loam in the upper part; dark red and red, firm very cherty silty clay in the next part; and red, mottled, firm silty clay in the lower part. In a few places the soil has a dark surface layer more than 6 inches thick. In some areas it is shallower over limestone bedrock. In other areas it is strongly sloping.

Included with this soil in mapping are soils that have no chert in the subsoil. These soils make up about 10 percent of the unit.

Permeability is moderate in the Goss soil, and surface runoff is medium. Natural fertility is low, and the organic matter content is moderately low. The shrink-swell potential is moderate. Available water capacity is low.

Most areas are cleared and are used for hay and pasture (fig. 10). A few are used for cultivated crops, and a few are wooded. This soil is well suited to legumes, such as alfalfa and lespedeza; cool-season grasses, such as tall fescue and orchardgrass; and warm-season grasses, such as big bluestem, indiangrass, and switchgrass. Drought is a hazard, and the chert interferes with tillage. Timely seedbed preparation and seeding can help to control erosion.

This soil is suited to grain sorghum and soybeans grown on a limited basis in rotation with small grain and pasture and hay crops. If cultivated crops are grown, erosion is a severe hazard. It can be controlled by a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, terraces and contour farming in areas where slopes are long enough and smooth enough, and grassed waterways. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration.

Some areas support native hardwoods. This soil is suited to trees. No major limitations or hazards affect planting or harvesting.

This soil is suitable for building site development and onsite waste disposal if proper design and installation procedures are used. Adequately reinforcing the concrete in footings, foundations, and basement walls and backfilling with sand or gravel help to prevent the structural damage caused by shrinking and swelling. Large stones should be removed from the building site. Lengthening the laterals in septic tank absorption fields helps to overcome the restricted permeability of this soil. Sealing sewage lagoons with slowly permeable material helps to prevent seepage. The slope is a limitation, but the site for the lagoon generally can be leveled.

Figure 10.—Cool-season grasses in a pastured area of Goss cherty silt loam, 3 to 9 percent slopes. Steeper Goss soils are in the background.

This soil is suitable as a site for local roads and streets. Low strength, the shrink-swell potential, and frost action are limitations. Strengthening the subgrade with crushed rock or other suitable material helps to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing adequate side ditches, and installing culverts improve drainage and thus minimize the damage caused by shrinking and swelling and by frost action.

The land capability classification is IVs. The woodland ordination symbol is 3A.

69D—Goss cherty silt loam, 9 to 14 percent slopes. This deep, strongly sloping, well drained soil is on convex side slopes. Individual areas range from about 10 to more than 200 acres in size.

Typically, the surface layer is brown, friable cherty silt loam about 5 inches thick. The subsurface layer is brown, friable very cherty silt loam about 11 inches thick. The subsoil extends to a depth of 65 inches or more. It is strong brown and yellowish red, firm very cherty silty clay in the upper part; red, mottled, firm very cherty silty clay in the next part; and strong brown, firm silty clay in the lower part. In a few places the soil has a dark surface layer more than 6 inches thick. In some areas it is shallower over limestone bedrock. In other areas it is moderately steep.

Included with this soil in mapping are areas of the moderately deep Bardley soils and the somewhat excessively drained, shallow Gasconade soils. Both of these soils are lower on the side slopes than the Goss soil. They make up about 10 percent of the unit. Also included are areas of rock outcrop and stony soils. These areas make up about 5 percent of the unit. The rock outcrop is on breaks, and the stony soils are in scattered areas throughout the unit.

Permeability is moderate in the Goss soil, and surface runoff is rapid. Natural fertility is low, and the organic matter content is moderately low. The shrink-swell potential is moderate. Available water capacity is low.

Many areas have been cleared and are used as pasture. Some are used for hay, and the rest are wooded. Because of the slope and the content of chert, this soil is unsuited to cultivated crops. It is well suited to lespedeza and tall fescue and to warm-season grasses, such as big bluestem, indiangrass, and switchgrass. It is moderately suited to alfalfa, ladino clover, and red clover. Drought is a hazard, and the chert interferes with tillage. The hazard of erosion is a major management concern when the pasture is seeded. No-till planting should be considered. Rotation grazing improves the stands.

Some areas support native hardwoods. This soil is suited to trees. No major limitations or hazards affect planting or harvesting.

This soil is suitable for building site development and onsite waste disposal if proper design and installation procedures are used. Adequately reinforcing the concrete in footings, foundations, and basement walls and backfilling with sand and gravel help to prevent the structural damage caused by shrinking and swelling. Land shaping can modify the slope, or the dwelling can be designed so that it conforms to the natural slope of the land. Large stones should be removed from the building site. Lengthening the laterals in septic tank absorption fields helps to overcome the restricted permeability of this soil. Land shaping can modify the slope, or the laterals can be installed across the slope. Sites for sewage lagoons should be leveled, and the lagoon should be sealed with slowly permeable material, which helps to prevent seepage.

This soil is suitable as a site for local roads and streets. Low strength, the shrink-swell potential, and frost action are limitations. Strengthening the subgrade with crushed rock or other suitable material helps to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing adequate side ditches, and installing culverts improve drainage and thus minimize the damage caused by shrinking and swelling and by frost action. Because of the slope, some cutting and filling generally is necessary. The roads can be designed so that they conform to the natural slope of the land.

The land capability classification is VIs. The woodland ordination symbol is 3A.

69E—Goss cherty silt loam, 14 to 30 percent slopes. This deep, moderately steep and steep, well drained soil is on side slopes along drainageways and the major streams. Individual areas are irregular in shape. They range from about 10 to more than 100 acres in size.

Typically, the surface layer is very dark grayish brown, friable cherty silt loam about 4 inches thick. The subsurface layer is brown, friable very cherty silt loam about 9 inches thick. The subsoil extends to a depth of 72 inches or more. The upper part is reddish brown, firm very cherty silty clay, and the lower part is yellowish red, mottled, firm very cherty silty clay and silty clay.

Included with this soil in mapping are areas of the moderately deep Bardley soils and the somewhat excessively drained, shallow Gasconade soils. Both of these soils are lower on the side slopes than the Goss soil. They make up about 10 percent of the unit. Also included are areas of rock outcrops and stony soils. These areas make up about 5 percent of the unit. The rock outcrop is on breaks, and the stony soils are in scattered areas throughout the unit.

Permeability is moderate in the Goss soil, and surface runoff is rapid. Natural fertility is low, and the organic matter content is moderately low. The shrink-swell potential is moderate. Available water capacity is low.

Most areas support native hardwoods. Because of the slope and droughtiness, this soil is unsuited to row crops. It is suited to trees. The erosion hazard, the equipment limitation, and the seedling mortality rate are the main management concerns. Planting container-grown stock improves the stands. The slope and the content of chert restrict equipment use. Hand planting or direct seeding may be needed. Logging roads and skid trails should be built on the contour. In most stands thinning and selective cutting are needed to remove undesirable trees.

Because of the slope and the content of chert, this soil generally is unsuited to building site development and onsite waste disposal. It is suitable for low-density building sites that are extensively prepared. The cost of preparing the site for construction is high.

The land capability classification is VIIs. The woodland ordination symbol is 3R.

70E—Hector fine sandy loam, 5 to 25 percent slopes, stony. This shallow, moderately sloping to steep, well drained soil is on ridgetops and side slopes. Scattered sandstone rocks 15 inches to more than 4 feet in size cover about 1 percent of the surface. Individual areas are irregular in shape. They range from 5 to 200 acres in size.

Typically, the surface layer is dark brown, very friable fine sandy loam about 5 inches thick. The subsoil is yellowish brown, friable gravelly fine sandy loam about 12 inches thick. Hard sandstone bedrock is at a depth of about 17 inches.

Included with this soil in mapping are small areas of Bolivar soils. These soils are moderately deep over hard bedrock. Also included are scattered areas where the sandstone bedrock crops out. Included areas make up 10 to 15 percent of the unit.

Permeability is moderately rapid in the Hector soil. Surface runoff is medium or rapid, depending on the slope. Natural fertility and the organic matter content are low. The surface layer is friable. Root penetration is restricted by the sandstone bedrock at a depth of about 17 inches. Available water capacity is very low.

Most areas support native hardwoods. Because of the slope and droughtiness, this soil is unsuited to row crops. It generally is suited to trees, but production is low and generally does not warrant intensive timber management.

This soil is poorly suited to grasses and legumes. Big bluestem, indiangrass, lespedeza, and tall fescue grow best. Maintaining a cover of grasses in cleared areas helps to prevent excessive erosion. The use of conventional equipment is feasible only in a few small areas. Seeds can be planted by broadcasting.

Because of the shallow depth to bedrock, this soil generally is unsuited to building site development and onsite waste disposal.

The land capability classification is VIIs. The woodland ordination symbol is 2D.

72E—Gasconade flaggy silty clay loam, 2 to 40 percent slopes. This shallow, gently sloping to very steep, somewhat excessively drained soil is on side slopes and ridgetops and along narrow drainageways. Individual areas are irregular in shape. They range from 10 to 200 acres in size.

Typically, the surface layer is very dark brown, friable flaggy silty clay loam about 4 inches thick. The subsoil is dark brown, firm very flaggy silty clay about 6 inches thick. Hard limestone bedrock is at a depth of about 10 inches.

Included with this soil in mapping are areas of the well drained, moderately deep Bardley soils. These soils generally are on the edge of the mapped areas, but they also are in scattered areas throughout the unit. Also included are seepy spots and scattered areas where limestone crops out. Included areas make up about 10 to 15 percent of the unit.

Permeability is moderately slow in the Gasconade soil, and surface runoff is rapid. Natural fertility is low, and the organic matter content is moderate. Available water capacity is very low. Root development is restricted by the bedrock below a depth of about 10 inches.

Most areas support native grasses and eastern redcedar. Because of the slope and droughtiness, this soil is unsuited to row crops. It is best suited to shallow-rooted pasture plants. Lespedeza, tall fescue, big bluestem, and indiangrass grow best. The included rock outcrop limits equipment use. Tillage is nearly impossible in some areas. Seeds can be planted by broadcasting in these areas.

This soil generally is suited to trees. Because of the shallow depth to bedrock, however, production is low and does not warrant intensive timber management.

This soil is fairly well suited to habitat for most kinds of upland wildlife. Native grasses and eastern redcedar provide most of the food. Because of this mixture of plants, an edge type of habitat is available.

Because of the shallow depth to bedrock, this soil generally is unsuited to building site development and onsite sewage disposal.

The land capability classification is VIIs. The woodland ordination symbol is 2R.

75B—Newtonia silt loam, 1 to 5 percent slopes. This deep, gently sloping, well drained soil is on uplands. It is on the tops and sides of ridges and in slight depressions on the ridges. Individual areas range from about 10 to more than 60 acres in size.

Typically, the surface layer is dark brown, friable silt loam about 12 inches thick. The subsoil extends to a depth of 72 inches or more. It is dark brown, friable silt loam in the upper part and reddish brown, dark red, and red, firm silty clay loam in the lower part. In some places the surface layer is brown or reddish brown. In other places the dark surface layer is less than 10 inches thick.

Permeability is moderate in the Newtonia soil, and surface runoff is slow or medium. Available water capacity is high. The shrink-swell potential is moderate. Natural fertility is high, and the organic matter content is moderate.

Most areas are used for cultivated crops or pasture. This soil is suited to corn, grain sorghum, soybeans, and winter wheat, but the hazard of erosion is moderate. Because of the erosion hazard, the choice of crops is restricted or moderate conservation practices are needed. Grassed waterways and field terraces, a system of conservation tillage that leaves a protective cover of crop residue on the surface, a conservation cropping system that includes close-growing pasture or hay crops help to control erosion. Proper management of crop residue helps to maintain the organic matter content and good tilth and increases the rate of water infiltration.

A cover of grasses and legumes for pasture and hay is effective in controlling erosion. This soil is well suited to most of the legumes, warm-season grasses, and cool-season grasses commonly grown in the county. No serious problems affect pasture or hayland. Erosion is a problem when new seedlings are becoming established. Timely seedbed preparation helps ensure a good ground cover.

This soil is suitable for building site development and most onsite waste disposal systems if proper design and installation procedures are used. Adequately reinforcing the concrete in foundations, footings, and basement walls helps to prevent the structural damage caused by shrinking and swelling. Enlarging septic tank absorption fields helps to overcome the restricted permeability of this soil.

This soil is suitable as a site for local roads and streets. Low strength, the shrink-swell potential, and frost action are limitations. Strengthening the subgrade with crushed rock or other suitable material helps to prevent the damage caused by low strength. Grading the roads so that they shed water, constructing adequate side ditches, and installing culverts improve drainage and thus help to prevent the damage caused by shrinking and swelling and by frost action.

Sealing embankments for farm ponds or lakes is difficult. Ponds commonly fail to hold water, partly because of seepage.

The land capability classification is IIe. No woodland ordination symbol is assigned.

94—Kanima shaly silty clay, 10 to 50 percent slopes. This moderately sloping to very steep, well drained soil occurs as spoil banks in upland areas that formerly were strip mined. Individual areas are irregular in shape. They range from 10 to 200 acres in size.

Typically, the surface layer is dark grayish brown, friable shaly silty clay about 8 inches thick. The substratum to a depth of 72 inches or more is grayish brown, friable very shaly silty clay loam. In some areas the slope is less than 10 percent.

Permeability is moderate in the Kanima soil, and surface runoff is rapid. Available water capacity is low. The organic matter content and natural fertility also are low.

Most areas are used for wildlife habitat or recreational development. This soil is suitable for pasture if the site is shaped and a cover of less acid soil material is provided. Erosion is a severe hazard because of the lack of a protective plant cover and the slope. A good plant cover is needed. The soil is moderately suited to legumes, such as crownvetch and lespedeza, and to warm-season grasses, such as big bluestem, indiangrass, and switchgrass.

Because of the slope, this soil generally is unsuited to building site development and onsite waste disposal.

The land capability classification is VIIs. No woodland ordination symbol is assigned.

95—Aquents, nearly level. These moderately well drained to poorly drained soils are in areas on narrow terraces and flood plains where soil material has been excavated and used as fill on sites for roads and bridges. The soils are frequently flooded. The flooding is more frequent and is of long duration when the Harry S. Truman Reservoir is above the multipurpose pool level and during the rainy periods. Individual areas are generally rectangular and range from 10 to more than 40 acres in size.

These soils vary greatly within short distances. In most areas, however, the surface layer is brown, gray, and yellowish brown, mottled silty clay and is underlain by gray, yellowish brown, and yellowish red, firm silty clay, clay, or clay loam. In many areas limestone, sandstone, or shale is exposed.

Included with these soils in mapping are many small areas and a few large areas that are flooded more than half the year.

Permeability commonly is moderate or slow but ranges to very slow. Surface runoff is medium in most areas but it ranges from slow to rapid. Available water capacity generally ranges from low to high.

These soils support a mixture of grasses, weeds, and underbrush. Establishing a good stand of grass is difficult because of the standing water on the surface at different times of the year. The soils are poorly suited to woodland. In most areas they are best suited to wetland wildlife habitat. They are unsuitable for building site development.

The land capability classification is VIIw. No woodland ordination symbol is assigned.

Prime Farmland

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

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban and built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. 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 has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

About 164,020 acres in St. Clair County, or nearly 37 percent of the total acreage, meets the requirements for prime farmland. An additional 33,905 acres meets the requirements only if the soil is drained or protected against flooding. The prime farmland is mainly in the northern, western, and central parts of the county. It is used chiefly for cultivated crops, pasture, or hay.

A recent trend in land use in some parts of the county has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4.

The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Soils that have limitations, such as a seasonal high water table or frequent flooding during the growing season, qualify for prime farmland only in areas where these limitations have been overcome by drainage measures or flood control. The need for corrective measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not a specific area of the soil is adequately drained or is frequently flooded during the growing season. Most areas of the naturally wet soils in the county are adequately drained because of the application of drainage measures or the incidental drainage that results from farming, road building, or other kinds of land development.

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 woodland; 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

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 277,000 acres in St. Clair County was used for crops and pasture in 1981. Of this total, 13,700 acres was used for corn and sorghum; 16,200 acres for soybeans; 27,100 acres for close-grown crops, dominantly wheat; and 41,800 acres for rotation hay and pasture (*3*). The rest was mainly permanent pasture, was used for conservation purposes, or was temporarily idle cropland.

The potential of the soils in St. Clair County for sustained production of food is good. About 37 percent of the county is prime farmland. An additional 8 percent can be considered prime farmland if it is drained or protected against flooding. Only about 50 percent of the cropland and pasture in the county is adequately treated for conservation purposes. The inadequately treated cropland is mainly on uplands that are farmed in a manner that causes excessive erosion, which prevents sustained production over a long period. Some of the marginal cropland used for row crops should be converted to pasture and hayland.

The main management concerns on the cropland and pasture in the county are water erosion, drainage and flooding, fertility and tilth, and the need for irrigation.

Water erosion is the major problem on nearly all of the sloping cropland and overgrazed pasture in St. Clair County. All soils that have a slope of more than 2 percent are susceptible to erosion.

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 Barden and Liberal soils. Erosion also reduces the productivity of soils that tend to be droughty because they are shallow over bedrock. Examples are Gasconade and Collinsville soils. Second, soil erosion on farmland results in sedimentation in streams, lakes, and ponds. Control of erosion minimizes this pollution and improves the quality of water for municipal use, for recreation, and for fish and other wildlife.

Erosion-control measures provide a protective cover, reduce the runoff rate, and increase the rate of water infiltration. A cropping system that keeps vegetation or crop residue on the surface can hold soil losses to an amount that will not reduce the productive capacity of the soils. Growing grasses and legumes for pasture and hay is very effective in controlling erosion. When used in crop rotations, legumes, such as clover and alfalfa, also improve tilth and provide nitrogen for the following crop.

Terraces reduce the length of slopes and thus the hazards of runoff and erosion. Conventional terraces are most practical on uneroded upland soils that have long, smooth slopes of less than 8 percent. Minimizing tillage on sloping soils and leaving large quantities of crop residue on the surface increase the rate of water infiltration and reduce the hazards of runoff and erosion. These practices can be adapted to many of the soils in the county, but they are less successful on eroded soils that have a clayey surface layer. On Barden and Liberal soils, special management techniques may be needed if terracing exposes the clayey subsoil.

If the soil is not suitable for terracing or if the farmer does not prefer terraces, other alternatives can be used. Contour stripcropping, for example, helps to control erosion by alternating contoured strips of close-growing crops with clean-tilled crops. Strips of grasses or grasses and legumes are usually used for hay. The areas between the strips are cultivated and planted to row crops, which are grown on the contour. Conservation tillage is effective in controlling erosion on sloping land. It is becoming more common in the county. It can be used on many of the soils. Special management techniques are needed, however, in eroded areas where a system of conservation tillage is applied.

Soil drainage and *flood control* are management concerns on about 6 percent of the acreage used for crops and pasture in the county. Moniteau, Osage, and Quarles soils are naturally so wet that crop production is reduced during some part of the year. Frequent flooding can prevent crop production on Cedargap soils, and occasional flooding can hinder crop production on Cleora, Osage, and Verdigris soils. The flooding on these soils commonly occurs during the period November through May.

Soil fertility is naturally lower in most of the eroded or shallow soils than in other soils. On all soils, however, additional plant nutrients are needed before maximum production can be achieved. Most of the soils in the county are naturally acid in the upper part of the root zone. As a result, applications of ground limestone are needed to raise the pH and calcium levels sufficiently for optimum growth of legumes. Additions of lime and fertilizer should be based on the results of soil tests, on the needs of the crop, and on the desired level of yields. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer and lime to be applied.

Soil tilth is affected by the texture and organic matter content of the surface layer. Most of the uneroded upland soils used for crops in the county have a silt loam surface layer that is dark and is moderate in content of organic matter. Generally, the structure of these silt loams is weakened by tillage and compaction. Under these conditions, intense rainfall causes the formation of a crust on the surface. Because it is hard when dry, the crust reduces the rate of water infiltration and increases the rate of runoff. Regular additions of crop residue, manure, or other organic material improve soil structure and tilth.

In all of the eroded upland soils in the county, the content of clay in the surface layer is higher than that in the surface layer of corresponding uneroded soils. As a result, tilth is poorer, the infiltration rate is slower, and the runoff rate is more rapid. Conservation practices are needed to control further erosion.

Several *irrigation* systems are used in the county. These systems increase yields by supplying supplemental water during critical periods of crop growth. They also make double cropping an attractive alternative. Soybeans can be planted directly into wheat stubble in irrigated areas. The irrigation system supplies enough water to ensure germination and crop growth. The large amount of crop residue on the surface is helpful in protecting the soil against erosion.

If an irrigation system is used, soil and water conservation practices are needed. Immediately after irrigation, the saturated topsoil is extremely vulnerable to erosion if intense rainfall occurs. Such accelerated erosion can drastically reduce natural fertility and can cause rapid sedimentation of any downstream bodies of water. Since most systems are supplied by reservoirs in the irrigated watershed, this sedimentation reduces the irrigation capacity. Therefore, protection of the topsoil against erosion is especially crucial. Another management concern is careful maintenance of terraces. If ruts are allowed to form where the wheels of the irrigation equipment pass over the saturated terrace berm, the effectiveness of the terrace is reduced.

Pasture and hay crops suited to the soils and climate in the county include several legumes, cool-season grasses, and warm-season native grasses. Alfalfa and red clover are the most common legumes grown for hay. They are also included in mixtures with bromegrass, orchardgrass, or timothy grown for hay or pasture.

The warm-season native grasses adapted to the county are big bluestem, little bluestem, indiangrass, and switchgrass. These grasses grow well during the hot summer months and can provide good-quality forage when cool-season plants are dormant. Prescribed burning may be needed to control undesirable vegetation and improve forage quality and quantity in areas of warm-season grasses. Burning generally is not needed more than once every 3 to 5 years. Before proper grazing management can be applied, fields of warm-season grasses should be separated from fields of cool-season grasses.

The major management concerns in most of the pastured areas in the county are overgrazing and gully erosion. Droughtiness in the cherty soils and in the moderately deep or shallow soils also is a problem. Controlled grazing is needed. Also, keeping the grasses at a desirable height reduces the hazards of runoff and gully erosion.

Specialty crops, such as apples, peaches, sunflowers, and watermelons, are grown on a small acreage in the county. Special equipment, management, and propagation techniques are needed where these crops are grown.

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 land capability classification of each map unit also is shown in the table.

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

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures 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 office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

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

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey (*8*).

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

Class I soils have few limitations that restrict their use.

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

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

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

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

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

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

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

There are no class V or class VIII soils in St. Clair County.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w,* or *s,* 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); and *s* shows that the soil is limited mainly because it is shallow, droughty, or stony.

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* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

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

Woodland Management and Productivity

James L. Robinson, forester, Soil Conservation Service, helped prepare this section.

About 33 percent of the acreage in St. Clair County is commercial forest. The forest is dominantly in areas of the Hector-Bolivar, Goss-Gasconade, and Verdigris-Moniteau-Osage soil associations, which are described under the heading "General Soil Map Units." The other associations in the county are wooded only in small areas along drainageways and on bottom land. The timber species in these small areas are those that are typical of both the upland and the bottom land forests in the county.

The oak-hickory forest type is dominant in areas of the Hector-Bolivar and Goss-Gasconade associations. The major tree species are black oak, white oak, post oak, northern red oak, blackjack oak, and hickory. The forest cover in areas of the Verdigris-Moniteau-Osage association is white oak, northern red oak, and pin oak on the terraces and ash, sycamore, cottonwood, silver maple, hackberry, boxelder, and elm on the bottom land. Many sites support both upland and bottom land species.

Soil serves as a reservoir for moisture, provides an anchor for roots, and supplies most of the available plant nutrients. Reaction, natural fertility, drainage, texture, structure, depth, and position on the landscape directly or indirectly affect these growth requirements.

Available water capacity is primarily influenced by texture, rooting depth, and content of stones and chert. Verdigris and other deep soils can have a high or very high available water capacity. The content of chert or stones affects the amount of available water in Goss soils. Also affecting the available water capacity are features that restrict root development, such as bedrock. Gasconade and other soils that are shallow over bedrock have a low potential for forest production. The trees that grow on these soils can withstand extreme moisture stress. The common species are eastern redcedar, chinkapin oak, blackjack oak, winged elm, and hackberry. The growth rate is slow, and tree form generally is poor.

Other site characteristics that affect tree growth include aspect and position on the landscape. These characteristics influence the amount of available sunlight, air drainage, soil temperature, and moisture content. North- and east-facing slopes are the best upland sites for tree growth because they are generally cooler and more moist than south- and west-facing slopes.

Following the early logging period in St. Clair County, some of the forests frequently were burned and grazed. As a result, the leaf layer on the surface was destroyed. This layer is important because it helps to control erosion and provides plant nutrients. Grazing also compacted the soil. This compaction decreased the rate of water infiltration, resulted in a deterioration of many sites, and hindered the regeneration of many desirable timber species. A combination of fire and grazing also damaged existing stands. It commonly resulted in stands of undesirable species, such as blackjack and post oak, or in poor-quality, fire-scarred stands of good species. Because of this history, forest management should be based on soil suitability and site characteristics rather than the species growing on the site.

Table 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for an indicator tree species. The number indicates the volume, in cubic meters per hectare per year, which the indicator species can produce. The number 1 indicates low potential productivity; 2 and 3, moderate; 4 and 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *R* indicates steep slopes; *X*, stoniness or rockiness; *W*, excess water in or on the soil; *T*, toxic substances in the soil; *D*, restricted rooting depth; *C*, clay in the upper part of the soil; *S*, sandy texture; and *F*, a high content of rock fragments in the soil. The letter *A* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: R, X, W, T, D, C, S, and F.

In table 7, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Erosion hazard is the probability that damage will occur as a result of site preparation and cutting where the soil is exposed along roads, skid trails, fire lanes, and log-handling areas. Forests that have been burned or overgrazed are also subject to erosion. Ratings of the erosion hazard are based on the percent of the slope. A rating of *slight* indicates that no particular prevention measures are needed under ordinary conditions. A rating of *moderate* indicates that erosion-control measures are needed in certain silvicultural activities. A rating of *severe* indicates that special precautions are needed to control erosion in most silvicultural activities.

Equipment limitation reflects the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. The chief characteristics and conditions considered in the ratings are slope, stones on the surface, rock outcrops, soil wetness, and texture of the surface layer. A rating of *slight* indicates that under normal conditions the kind of equipment or season of use is not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month. A rating of *moderate* indicates that equipment use is moderately restricted because of one or more soil factors. If the soil is wet, the wetness restricts equipment use for a period of 1 to 3 months. A rating of *severe* indicates that equipment use is severely restricted either as to the kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

Seedling mortality refers to the death of naturally occurring or planted tree seedlings, as influenced by the kinds of soil, soil wetness, or topographic conditions. The factors used in rating the soils for seedling mortality are texture of the surface layer, depth to a seasonal high water table and the length of the period when the water table is high, rock fragments in the surface layer, effective rooting depth, and slope aspect. A rating of *slight* indicates that seedling mortality is not likely to be a problem under normal conditions. Expected mortality is less than 25 percent. A rating of *moderate* indicates that some problems from seedling mortality can be expected. Extra precautions are advisable. Expected mortality is 25 to 50 percent. A rating of *severe* indicates that seedling mortality is a serious problem. Extra precautions are important. Replanting may be necessary. Expected mortality is more than 50 percent.

Windthrow hazard is the likelihood that trees will be uprooted by the wind because the soil is not deep enough for adequate root anchorage. The main restrictions that affect rooting are a seasonal high water table and the depth to bedrock, a fragipan, or other limiting layers. A rating of *slight* indicates that under normal conditions no trees are blown down by the wind. Strong winds may damage trees, but they do not uproot them. A rating of *moderate* indicates that some trees can be blown down during periods when the soil is wet and winds are moderate or strong. A rating of *severe* indicates that many trees can be blown down during these periods.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index* and as a *volume* number. The site index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

The *volume*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic feet per acre per year, indicates the amount of fiber produced on a fully stocked, even-aged, unmanaged stand.

The first species listed under *common trees* for a soil is the indicator species for that soil. It is the dominant species on the soil and the one that determines the ordination class.

Trees to plant are those that are suitable for commercial wood production.

Windbreaks and Environmental Plantings

James L. Robinson, forester, Soil Conservation Service, helped prepare this section.

Well designed farmstead and feedlot windbreaks are needed in areas of the Barden-Deepwater-Hartwell, Barden-Barco-Collinsville, and Eldorado-Newtonia soil associations, which are described under the heading "General Soil Map Units." Windbreaks can significantly reduce the energy required to heat a home and can moderate the effect of cold winter winds. Animals protected by a windbreak are healthier than those not protected from the winter winds.

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

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

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure 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 commercial nursery.

Recreation

Edward A. Gaskins, biologist, Soil Conservation Service, helped prepare this section.

In 1980, a total of 9,278 acres was developed for recreational uses in St. Clair County (*6*). Ownership of these areas is 60 percent state and 40 percent private, municipal, county, and school. The facilities include swimming areas, hunting and fishing areas, camping areas, trails, game courts, ball fields, picnic areas, play areas, historical sites, and wildlife-viewing areas. The demand for these facilities is likely to increase because the population of the county is expected to increase by 15.8 percent by 1990 (*4*).

The Harry S. Truman Reservoir provides many opportunities for water sports. The initial annual visitation is estimated at 4 million people. When completed, the project will provide St. Clair County with more than 27,000 acres of federal land and more than 12,000 acres of recreation water. It will provide public parks, campgrounds, swimming beaches, boat-launching sites, nature centers, picnicking facilities, and ball fields. Various aquatic habitat developments will improve the fish population in the lake. Hunting will be allowed on most government land.

Other county recreation areas include the state-owned Schell-Osage Wildlife Area, which makes up 8,633 acres, and the Taberville, Kings, and Wah-Kon-Tah Prairies, which make up 2,580 acres. A city park, two natural areas, and several access sites for fishermen are also available for use by the general public.

The county has a number of private and semiprivate commercial recreation enterprises. These include a golf course, a scout camp, a hunting area, campgrounds, and pay fishing lakes. The priority recreation needs in the county are campgrounds and areas for water sports. The Harry S. Truman Reservoir will meet these and other recreation needs.

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 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

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

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

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

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

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

Edward A. Gaskins, biologist, Soil Conservation Service, helped prepare this section.

St. Clair County is among the 13 counties that make up the West Prairie Zoogeographic Region in Missouri (*5*). Prior to settlement, about 43 percent of the county was prairie and the rest was woodland. Currently, only a small percentage of the original prairie remains. About 21 percent of the county is classified as cropland, 32 percent as grassland, and 47 percent as woodland, which includes areas of small shrubs and brush. This distribution favors both openland and woodland wildlife.

Deer, rabbit, turkey, and quail are the most popular game species in the county. The population of nongame wildlife species, such as songbirds, is good to excellent in each of the soil associations described under the heading "General Soil Map Units." A predicted increase of 15.8 percent in urban development is not expected to have an effect on wildlife (*4*). The traditional practice of burning woodland in the spring and a serious poaching problem, however, adversely affect wildlife populations. The commercial cutting of firewood could become a problem in areas that provide habitat for woodland wildlife.

The Goss-Gasconade, Hector-Bolivar, and Verdigris-Moniteau-Osage associations provide the primary habitat for the woodland wildlife in the county. The deer population is excellent (fig. 11), and the carrying capacity for this big game animal has been reached. The turkey population is good and is increasing. This species was first stocked in the late 1960's. The squirrel population is usually good. It is affected by the supply of mast. A small resident population of woodcock inhabits special areas, but this species makes no migratory flights into the county.

The overall furbearer population is good throughout much of the county. Because of a decline in fur prices, trapping pressure is somewhat reduced, but it is still considered strong. The most frequently harvested fur species are raccoon, opossum, coyote, muskrat, fox, striped skunk, beaver, and mink. A good population of bobcat inhabits the county. An experimental stocking of ruffed grouse in the more extensive wooded areas is planned for the near future.

Figure 11.—An area of Bucklick silt loam, 2 to 5 percent slopes, used as habitat by deer. Bardley cherty silt loam, 9 to 14 percent slopes, is in the background.

Limited numbers of prairie species inhabit the grassland areas that meet the strict habitat requirements of these species. The county has one of the best prairie chicken populations in the state. Other species include the upland plover, Henslow's sparrow, marsh hawk, and short-eared owl. The state controls several of the remaining native prairie areas.

The Barden-Deepwater-Hartwell, Barden-Barco-Collinsville, and Eldorado-Newtonia associations provide the primary habitat for the openland wildlife in the county. The chief crops are grain sorghum, wheat, and soybeans. Fall plowing, a practice harmful to wildlife, is on the decrease. It is being replaced by chisel plowing and conservation tillage systems, both of which leave more grain and crop residue on the surface after harvest and thus provide additional winter food and a limited amount of cover for wildlife.

The population of bobwhite quail is poor or fair. The breeding population has not yet recovered from the severe winters of 1976 through 1979, which killed many of the birds in this age class. Because the county has some good habitat for quail, the carrying capacity should eventually be achieved. The rabbit population is excellent. Hunting pressure is heavy on this popular game animal. A fair population of mourning doves is in the western half of the county. A lack of migratory flights helps to keep hunting pressure very light on this game bird.

The only permanent wetland habitat in the county is in old oxbow cutoffs along the Osage River. The Verdigris-Moniteau-Osage association is the only association that could provide wetland habitat. The Schell-Osage Wildlife Area and the Harry S. Truman Reservoir provide some wetland areas. Ducks and geese use the Osage and Sac Rivers as well as the Schell-Osage Wildlife Area. The population of wood duck is very good on several streams. The Schell-Osage Wildlife Area is the temporary habitat for about 25 bald eagles.

Fishing opportunities are provided by rivers, streams, lakes, and farm ponds. The county has 139 miles of permanently flowing streams (*4*). The most important public fishing areas are the Osage and Sac Rivers and Weaubleau, Brush, Bear, Muddy, Gallinipper, and Clear Creeks. These waters are inhabited by largemouth bass, smallmouth bass, channel catfish, bullheads, paddlefish, crappie, drum, carp, suckers, walleye, and sunfish.

Several lakes in the county provide the general public opportunities for impoundment fishing. The Harry S. Truman Reservoir is by far the largest of these lakes. It has more than 12,000 acres of surface water in St. Clair County alone (fig. 12). The most popular species in the reservoir include striped bass, walleye, largemouth bass, paddlefish, and sunfish. The Schell-Osage Wildlife Area includes three lakes, which are open to the public. Abandoned strip pits in the northwestern part of the county also are popular fishing areas. Bass, bluegill, channel catfish, crappie, bullheads, carp, and carpsuckers are the popular fish species in these pits.

According to recent estimates, about 1,000 farm ponds and small lakes in the county have been stocked with largemouth bass, channel catfish, and bluegill. These ponds and lakes provide opportunities for limited public fishing if permission is obtained from the landowner.

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, soybeans, and milo.

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

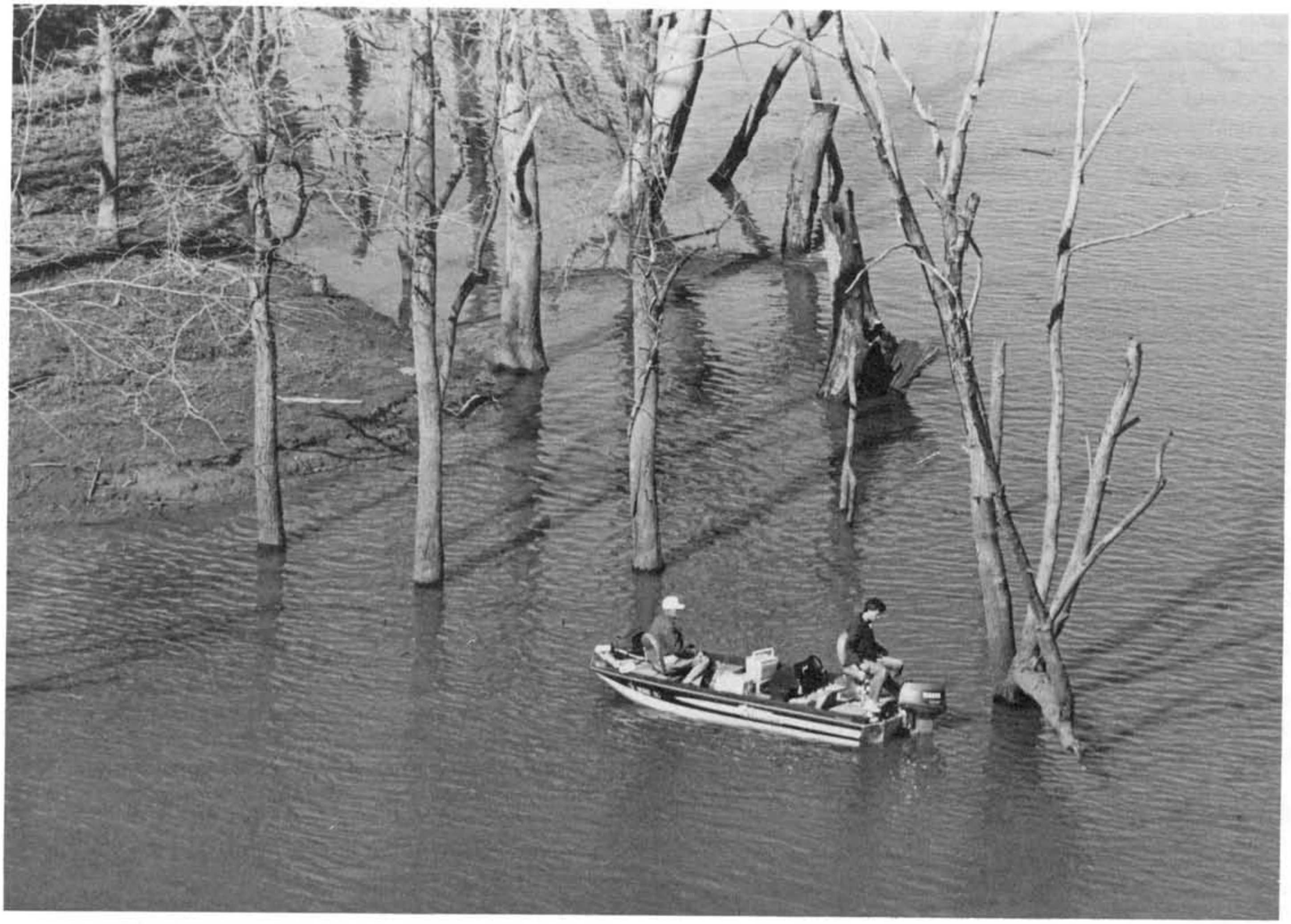

Figure 12.—A flooded area of timber in the Harry S. Truman Reservoir.

bluegrass, switchgrass, orchardgrass, clover, alfalfa, indiangrass, trefoil, and crownvetch.

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, ragweed, beggarweed, foxtail, croton, and partridge pea.

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

Coniferous plants furnish winter cover, browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, 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, wildrice, cutgrass, cattail, rushes, sedges, and reeds.

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

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

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

Engineering

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

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

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

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

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

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

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

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

Building Site Development

Table 11 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 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, and shrink-swell potential can cause the movement of footings. A high water table, depth to bedrock, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

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

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 salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 12 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

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

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

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

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 foot 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. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

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

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

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

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

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

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

Construction Materials

Table 13 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 a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 foot 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 13, 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 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

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

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

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

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

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

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

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

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

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, 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.

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.

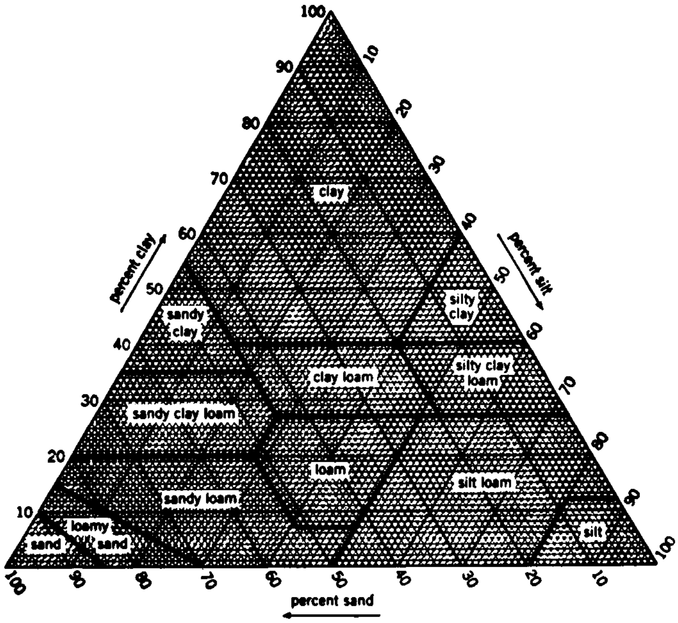

Figure 13.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Engineering Index Properties

Table 15 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 (fig. 13). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "cherty." Textural terms are defined in the Glossary.

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

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

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

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

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

The estimates of grain-size distribution, liquid limit, and plasticity index are generally 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 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

5. Loamy soils that are less than 20 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 20 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

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

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

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 16, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

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

Soil and Water Features

Table 17 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.

If a soil is assigned to two hydrologic groups in table 17, the first letter is for drained areas and the second is for undrained areas.

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

Table 17 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, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

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

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

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 17. Only saturated zones within a depth of about 6 feet are indicated.

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

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 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.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*9*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

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

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

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

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

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. 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* (*7*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*9*). 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."

Barco Series

The Barco series consists of moderately deep, well drained, moderately permeable soils on uplands. These soils formed in material weathered from acid sandstone. Slopes range from 2 to 9 percent.

Typical pedon of Barco fine sandy loam, 2 to 5 percent slopes; 100 feet west and 1,500 feet north of the southeast corner of sec. 29, T. 39 N., R. 26 W.

A—0 to 10 inches; dark brown (10YR 3/3) fine sandy loam, dark brown (10YR 4/3) dry; weak fine granular structure; friable; medium acid; clear smooth boundary.

BA—10 to 15 inches; brown (10YR 4/3) fine sandy loam; weak fine subangular blocky structure; friable; strongly acid; clear smooth boundary.

Bt—15 to 26 inches; dark yellowish brown (10YR 4/4) sandy clay loam; common fine distinct strong brown (7.5YR 5/6) and few fine prominent yellowish red (5YR 5/6) mottles; moderate medium subangular blocky structure; friable; few faint clay films on faces of peds; very strongly acid; clear smooth boundary.

BC—26 to 30 inches; strong brown (7.5YR 5/6) sandy clay loam; many coarse prominent red (2.5YR 4/6) and common fine distinct yellowish brown (10YR 5/4) mottles; weak fine subangular blocky structure; firm; very strongly acid; clear smooth boundary.

Cr1—30 to 36 inches; mottled light brownish gray (10YR 6/2), strong brown (7.5YR 5/6), and red (2.5YR 4/6) soft sandstone; very strongly acid; clear smooth boundary.

Cr2—36 to 44 inches; strong brown (7.5YR 5/6) soft sandstone; many medium faint brown (7.5YR 5/2) mottles; very strongly acid; abrupt smooth boundary.

R—44 inches; hard sandstone bedrock.

The thickness of the solum and the depth to soft sandstone bedrock range from 20 to 40 inches. The A horizon has hue of 10YR or 7.5YR and value and chroma of 2 or 3. It commonly is fine sandy loam but in some pedons is loam. It is 7 to 15 inches thick. If this horizon is more than 10 inches thick, the base saturation is less than 50 percent. The B horizon has hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 3 to 8. It is loam, sandy clay loam, or clay loam. It has a base saturation of more than 60 percent.

Barden Series

The Barden series consists of deep, moderately well drained, slowly permeable soils on uplands. These soils formed in a thin mantle of loess or silty sediments and in shale residuum. Slopes range from 1 to 5 percent.

Typical pedon of Barden silt loam, 1 to 5 percent slopes; 200 feet west and 5,900 feet south of the northeast corner of sec. 6, T. 39 N., R. 27 W.

Ap—0 to 10 inches; dark brown (10YR 3/3) silt loam, dark brown (10YR 4/3) dry; weak fine granular structure; very friable; medium acid; clear smooth boundary.

BA—10 to 13 inches; dark brown (10YR 4/3) silty clay loam; weak fine subangular blocky structure; friable; very strongly acid; clear smooth boundary.

Bt1—13 to 21 inches; dark brown (10YR 4/3) silty clay; common fine prominent yellowish red (5YR 4/6) mottles; moderate medium subangular blocky structure; firm; few faint clay films on faces of peds; strongly acid; clear smooth boundary.

Bt2—21 to 26 inches; dark grayish brown (10YR 4/2) silty clay; few fine distinct strong brown (7.5YR 4/6) mottles; moderate medium subangular blocky structure; firm; few faint clay films on faces of peds; strongly acid; clear smooth boundary.

Bt3—26 to 51 inches; grayish brown (10YR 5/2) silty clay loam; common medium prominent strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; friable; few faint clay films on faces of peds; medium acid; gradual smooth boundary.

C—51 to 72 inches; mottled light brownish gray (10YR 6/2), yellowish brown (10YR 5/4), and strong brown (7.5YR 5/6) silty clay loam; massive; friable; medium acid.

The thickness of the solum ranges from 40 to 60 inches. The A horizon is 7 to 15 inches thick. If it is more than 10 inches thick, it has a base saturation of less than 50 percent. It has hue of 10YR, value of 2 or 3, and chroma of 1 to 3. The Bt horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 5. It is silty clay, silty clay loam, or clay loam. It is medium acid or strongly acid. The C horizon is mottled silty clay loam, clay loam, or silty clay.

Bardley Series

The Bardley series consists of moderately deep, well drained, moderately permeable soils on uplands. These soils formed in cherty sediments and in limestone residuum. Slopes range from 3 to 14 percent.

Typical pedon of Bardley cherty silt loam, 3 to 9 percent slopes; 1,850 feet north and 2,350 feet west of the southeast corner of sec. 1, T. 39 N., R. 24 W.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) cherty silt loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; friable; about 30 percent chert fragments; very strongly acid; clear smooth boundary.

E—3 to 13 inches; brown (10YR 5/3) extremely cherty loam; weak fine granular structure; friable; about 70 percent chert fragments; strongly acid; clear smooth boundary.

2Bt1—13 to 22 inches; yellowish red (5YR 5/6) and brown (10YR 5/3) clay; moderate medium subangular blocky structure; very firm; common distinct clay films on faces of peds; very strongly acid; clear smooth boundary.

2Bt2—22 to 29 inches; yellowish red (5YR 5/6) and strong brown (7.5YR 5/6) clay; common medium distinct red (2.5YR 4/6) mottles; moderate medium subangular blocky structure; very firm; few faint clay films on faces of peds; about 10 percent chert fragments; strongly acid; abrupt smooth boundary.

2R—29 inches; limestone bedrock.

The thickness of the solum and the depth to bedrock range from 20 to 40 inches. The chert content in the surface soil ranges from 15 to 70 percent, and that of the B horizon is less than 35 percent.

The A horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3, and the E horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 to 4. These horizons are the cherty, very cherty, or extremely cherty analogs of loam, silt loam, or silty clay loam. The 2Bt horizon has hue of 2.5YR or 5YR, value of 3 to 5, and chroma of 4 to 6. It is silty clay, clay, or the cherty analogs of these textures.

Bolivar Series

The Bolivar series consists of moderately deep, well drained, moderately permeable soils on uplands. These soils formed in material weathered from acid sandstone. Slopes range from 2 to 9 percent.

These soils have a slightly lower base saturation than is definitive for the Bolivar series. This difference, however, does not alter the usefulness or behavior of the soils.

Typical pedon of Bolivar fine sandy loam, 2 to 5 percent slopes; 2,450 feet west and 1,350 feet north of the southeast corner of sec. 31, T. 38 N., R. 25 W.

Ap—0 to 4 inches; dark brown (10YR 3/3) fine sandy loam, brown (10YR 5/3) dry; weak fine granular structure; very friable; strongly acid; clear smooth boundary.

E—4 to 8 inches; yellowish brown (10YR 5/4) fine sandy loam, pale brown (10YR 6/3) dry; weak fine granular structure; very friable; strongly acid; clear smooth boundary.

Bt1—8 to 13 inches; strong brown (7.5YR 4/6) sandy clay loam; moderate medium subangular blocky structure; friable; few faint clay films on faces of peds; very strongly acid; gradual wavy boundary.

Bt2—13 to 20 inches; yellowish brown (10YR 5/4) sandy clay loam; common medium prominent red (2.5YR 4/6) and many medium distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; friable; common distinct clay films on faces of peds; very strongly acid; gradual wavy boundary.

BC—20 to 26 inches; mottled grayish brown (10YR 5/2), strong brown (7.5YR 5/6), and dark red (2.5YR 3/6) sandy clay loam; weak fine subangular blocky structure; friable; very strongly acid; clear wavy boundary.

Cr—26 to 44 inches; weathered soft sandstone bedrock; clear smooth boundary.

R—44 inches; unweathered hard sandstone bedrock.

The thickness of the solum and the depth to bedrock range from 20 to 40 inches. Sandstone fragments make up less than 35 percent of any horizon.

The Ap horizon has hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 2 or 3. The E horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 or 4. The Bt horizon has hue of 5YR to 10YR, value of 4 or 5, and chroma of 4 to 8. It is clay loam or sandy clay loam.

Bucklick Series

The Bucklick series consists of deep, well drained, moderately permeable soils on upland foot slopes and stream terraces. These soils formed in material weathered from limestone interbedded with siltstone or shale. Slopes range from 2 to 5 percent.

Typical pedon of Bucklick silt loam, 2 to 5 percent slopes; 350 feet east and 2,640 feet north of the southwest corner of sec. 31, T. 37 N., R. 28 W.

Ap—0 to 7 inches; dark brown (10YR 4/3) silt loam, brown (10YR 5/3) dry; moderate fine granular structure; very friable; medium acid; clear smooth boundary.

BA—7 to 12 inches; brown (7.5YR 4/4) silt loam; weak fine subangular blocky structure; very friable; strongly acid; clear smooth boundary.

Bt1—12 to 18 inches; yellowish red (5YR 4/6) silty clay loam; weak fine subangular blocky structure; friable; few distinct clay films on faces of peds; very strongly acid; gradual smooth boundary.

Bt2—18 to 47 inches; red (2.5YR 4/6) clay; moderate fine angular blocky structure; firm; many prominent clay films on faces of peds; very strongly acid; gradual smooth boundary.

Bt3—47 to 70 inches; yellowish red (5YR 4/6) silty clay loam; common fine prominent yellowish brown (10YR 5/4) and common fine prominent red (2.5YR 4/6) mottles; moderate medium angular blocky structure; firm; common distinct clay films on faces of peds; about 5 percent chert fragments; common iron and manganese stains; very strongly acid.

The solum is 60 or more inches thick. The Ap horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It typically is silt loam, but loam is within the range. The BA horizon has hue of 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is silt loam or silty clay loam. The upper part of the Bt horizon has hue of 5YR or 2.5YR, value of 4 or 5, and chroma of 6 to 8. The lower part has hue of 7.5YR to 2.5YR, value of 3 to 5, and chroma of 6 to 8. This horizon is clay, silty clay, or silty clay loam. Below a depth of 40 inches, the content of chert fragments ranges from 0 to 25 percent.

Cedargap Series

The Cedargap series consists of deep, well drained soils on flood plains. These soils formed in silty alluvium that has a high content of chert fragments. Permeability is moderately rapid. Slopes range from 0 to 2 percent.

Typical pedon of Cedargap silt loam, 250 feet east and 100 feet north of the southwest corner of sec. 4, T. 37 N., R. 28 W.

A1—0 to 7 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; about 5 percent chert fragments; medium acid; clear smooth boundary.
A2—7 to 12 inches; very dark brown (10YR 2/2) cherty loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; very friable; about 20 percent chert fragments; medium acid; clear smooth boundary.
A3—12 to 24 inches; very dark brown (10YR 2/2) cherty loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure; very friable; about 15 percent chert fragments; medium acid; gradual wavy boundary.
C1—24 to 35 inches; very dark grayish brown (10YR 3/2) extremely cherty loam; weak fine granular structure; friable; about 75 percent chert fragments; medium acid; gradual wavy boundary.
C2—35 to 72 inches; very dark gray (10YR 3/1) very cherty silty clay loam; weak fine subangular blocky structure; friable; about 40 percent chert fragments; medium acid.

The thickness of the solum and of the mollic epipedon ranges from 24 to 36 inches. The dark colors extend to a depth of 60 inches or more.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 to 3. It is loam, silt loam, or the cherty or very cherty analogs of these textures. The C horizon has hue of 7.5YR or 10YR, value of 2 to 5, and chroma of 1 to 4. It is the very cherty or extremely cherty analogs of silt loam, loam, or silty clay loam.

Cleora Series

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

Typical pedon of Cleora fine sandy loam, 1,900 feet east and 2,500 feet north of the southwest corner of sec. 22, T. 37 N., R. 27 W.

Ap—0 to 8 inches; dark brown (10YR 3/3) fine sandy loam, dark brown (10YR 4/3) dry; weak fine granular structure; very friable; medium acid; clear smooth boundary.
A—8 to 19 inches; dark brown (10YR 3/3) fine sandy loam, dark brown (10YR 4/3) dry; weak fine granular structure; friable; medium acid; clear smooth boundary.
C1—19 to 33 inches; dark yellowish brown (10YR 4/4) fine sandy loam; massive; friable; thin strata of yellowish brown (10YR 5/4) fine sandy loam; medium acid; gradual smooth boundary.
C2—33 to 72 inches; dark yellowish brown (10YR 4/4) fine sandy loam; massive; friable; thin strata of brown (10YR 5/3) fine sandy loam; medium acid.

The thickness of the solum ranges from 15 to 24 inches. The thickness of the mollic epipedon ranges from 12 to 24 inches.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3 (4 dry), and chroma of 2 or 3. It dominantly is fine sandy loam, but the range includes loam. The C horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 or 4. It is dominantly fine sandy loam but in some pedons has thin strata that range from fine sand to clay loam.

Collinsville Series

The Collinsville series consists of shallow, somewhat excessively drained soils on uplands. These soils formed in material weathered from acid sandstone. Permeability is moderately rapid. Slopes range from 2 to 20 percent.

Typical pedon of Collinsville fine sandy loam, 2 to 20 percent slopes; 2,800 feet east and 1,450 feet north of the southwest corner of sec. 22, T. 39 N., R. 28 W.

A—0 to 9 inches; very dark brown (10YR 2/2) fine sandy loam, very dark grayish brown (10YR 3/2) dry; moderate fine granular structure; very friable; about 5 percent sandstone fragments 0.5 to 1.0 inch in size; very strongly acid; clear smooth boundary.
Bw—9 to 15 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; weak fine subangular blocky structure; friable; about 5 percent sandstone fragments 0.25 to 1.0 inch in size; strongly acid; abrupt smooth boundary.
R—15 inches; hard sandstone bedrock.

The depth to hard sandstone bedrock ranges from 4 to 20 inches. The A and B horizons are fine sandy loam or loam. The content of sandstone fragments in these horizons is as much as 20 percent. The A horizon has hue of 10YR and value and chroma of 2 or 3. The B horizon has hue of 10YR or 7.5YR and value and chroma of 3 or 4. Some pedons have a C horizon. This horizon has colors and textures similar to those of the B horizon.

Cotter Series

The Cotter series consists of deep, well drained, moderately permeable soils on low terraces along the major streams. These soils formed in silty alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Cotter silt loam, 150 feet north and 1,750 feet east of the southwest corner of sec. 12, T. 36 N., R. 26 W.

Ap—0 to 5 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; friable; medium acid; clear smooth boundary.

A—5 to 9 inches; very dark brown (10YR 2/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; friable; medium acid; clear smooth boundary.

Bt1—9 to 19 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure; friable; few faint clay films on faces of peds; medium acid; gradual smooth boundary.

Bt2—19 to 27 inches; very dark grayish brown (10YR 3/2) silty clay loam; moderate fine subangular blocky structure; friable; few faint clay films on faces of peds; strongly acid; gradual smooth boundary.

Bt3—27 to 60 inches; dark brown (10YR 4/3) silty clay loam; weak fine subangular blocky structure; friable; few faint clay films on faces of peds; strongly acid.

The thickness of the solum ranges from 40 to more than 60 inches. The thickness of the mollic epipedon ranges from 24 to 36 inches.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The B horizon is silt loam or silty clay loam. The upper part of this horizon has hue of 10YR, value of 2 or 3, and chroma of 1 to 3. The lower part has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. Some pedons have a C horizon. This horizon is silt loam or loam. It has colors similar to those in the lower part of the B horizon.

Deepwater Series

The Deepwater series consists of deep, moderately well drained, moderately permeable soils on uplands. These soils formed in a thin mantle of loess or silty sediments and in shale residuum. Slopes range from 2 to 9 percent.

Typical pedon of Deepwater silt loam, 2 to 5 percent slopes; 150 feet south and 200 feet west of the northeast corner of sec. 3, T. 39 N., R. 28 W.

Ap—0 to 12 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate medium granular structure; friable; medium acid; clear smooth boundary.

AB—12 to 17 inches; dark brown (10YR 4/3) silt loam; weak fine granular structure; friable; strongly acid; clear smooth boundary.

Bt1—17 to 25 inches; dark yellowish brown (10YR 4/4) silty clay loam; common fine prominent strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; few faint clay films on faces of peds; few fine concretions of iron and manganese oxides; medium acid; clear smooth boundary.

Bt2—25 to 33 inches; yellowish brown (10YR 5/6) silty clay loam; common fine distinct brown (10YR 5/3) mottles; moderate medium subangular blocky structure; firm; common distinct clay films on faces of peds; few fine concretions of iron and manganese oxides; medium acid; clear smooth boundary.

Bt3—33 to 48 inches; strong brown (7.5YR 5/6) silty clay; common medium prominent light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; firm; common distinct clay films on faces of peds; many medium concretions of iron and manganese oxides; strongly acid; gradual smooth boundary.

BC—48 to 72 inches; mottled light brownish gray (10YR 6/2), brown (10YR 5/3), and strong brown (7.5YR 5/8) silty clay loam; weak medium subangular blocky structure; firm; strongly acid.

The thickness of the solum ranges from 48 to more than 72 inches. The mollic epipedon ranges from 11 to 24 inches in thickness.

The A horizon has hue of 10YR, value of 2 or 3 (4 dry), and chroma of 1 to 3. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. The upper part of the B horizon is silty clay loam or clay loam. The lower part is silty clay loam or silty clay.

Eldorado Series

The Eldorado series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in cherty limestone residuum. Slopes range from 3 to 14 percent.

Typical pedon of Eldorado cherty silt loam, 3 to 9 percent slopes; 1,750 feet east and 200 feet north of the southwest corner of sec. 17, T. 37 N., R. 28 W.

A—0 to 8 inches; dark brown (7.5YR 3/2) cherty silt loam, brown (7.5YR 4/2) dry; moderate medium granular structure; very friable; common fine and medium roots; about 25 percent chert fragments; strongly acid; clear smooth boundary.

Bt1—8 to 18 inches; dark reddish brown (5YR 3/3) extremely cherty silty clay loam; weak fine subangular blocky structure; friable; many fine roots; few faint clay films on faces of peds; about 60 percent chert fragments; strongly acid; clear smooth boundary.

Bt2—18 to 32 inches; reddish brown (5YR 4/4) extremely cherty silty clay loam; moderate fine subangular blocky structure; friable; common medium roots; common distinct clay films on faces of peds; about 70 percent chert fragments; strongly acid; gradual smooth boundary.

Bt3—32 to 46 inches; yellowish red (5YR 4/6) extremely cherty silty clay loam; moderate medium subangular blocky structure; friable; few medium roots; many prominent clay films on faces of peds; about 60 percent chert fragments; strongly acid; gradual smooth boundary.

Bt4—46 to 72 inches; red (2.5YR 4/6) very cherty silty clay; moderate medium subangular blocky structure; firm; many prominent clay films on faces of peds; about 40 percent chert fragments; strongly acid.

The thickness of the solum ranges from 60 to more than 72 inches. The A horizon has hue of 10YR or 7.5YR and value and chroma of 2 or 3. It is 6 to 10 inches thick. The Bt horizon has hue of 2.5YR or 5YR, value of 3 or 4, and chroma of 3 to 6. It is the cherty, very cherty, or extremely cherty analogs of silty clay loam, silty clay, or clay.

Gasconade Series

The Gasconade series consists of shallow, somewhat excessively drained soils on uplands. These soils formed in limestone residuum. Permeability is moderately slow. Slopes range from 2 to 40 percent.

Typical pedon of Gasconade flaggy silty clay loam, 2 to 40 percent slopes; 200 feet west and 950 feet north of the southeast corner of sec. 1, T. 39 N., R. 24 W.

A—0 to 4 inches; very dark brown (10YR 2/2) flaggy silty clay loam, very dark grayish brown (10YR 3/2) dry; moderate fine granular structure; friable; about 30 percent limestone fragments; neutral; clear smooth boundary.

Bw—4 to 10 inches; dark brown (7.5YR 3/2) very flaggy silty clay; moderate fine subangular blocky structure; firm; about 55 percent limestone fragments; neutral; clear irregular boundary.

R—10 inches; hard limestone bedrock.

The thickness of the solum and the depth to bedrock range from 4 to 20 inches. The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It typically is flaggy silty clay loam, but flaggy silty clay and flaggy clay loam are within the range. The B horizon has hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 2 to 4. It is the channery, flaggy, or very flaggy analogs of silty clay, clay, clay loam, or silty clay loam.

Goss Series

The Goss series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in cherty limestone residuum. Slopes range from 3 to 30 percent.

Typical pedon of Goss cherty silt loam, 3 to 9 percent slopes; 30 feet east and 250 feet south of the northwest corner of sec. 20, T. 38 N., R. 24 W.

A—0 to 6 inches; very dark grayish brown (10YR 3/2) cherty silt loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; friable; about 30 percent chert fragments; strongly acid; clear smooth boundary.

E—6 to 15 inches; yellowish brown (10YR 5/4) very cherty silt loam; weak fine granular structure; friable; about 60 percent chert fragments; strongly acid; clear smooth boundary.

Bt1—15 to 26 inches; yellowish red (5YR 5/8) very cherty silty clay loam; moderate medium subangular blocky structure; friable; few faint clay films on faces of peds; about 45 percent chert fragments; strongly acid; gradual smooth boundary.

Bt2—26 to 46 inches; red (2.5YR 4/6) very cherty silty clay; moderate medium subangular blocky structure; firm; common distinct clay films on faces of peds; about 35 percent chert fragments; strongly acid; gradual smooth boundary.

Bt3—46 to 60 inches; dark red (2.5YR 3/6) very cherty silty clay; moderate fine subangular blocky structure; firm; many prominent clay films on faces of peds; about 35 percent chert fragments; strongly acid; gradual smooth boundary.

Bt4—60 to 72 inches; red (2.5YR 4/6) silty clay; moderate medium prominent brown (10YR 5/3) mottles; moderate medium angular blocky structure; firm; many prominent clay films on faces of peds; about 5 percent chert fragments; strongly acid.

The thickness of the solum ranges from 60 to more than 72 inches. The A horizon has hue of 10YR and value and chroma of 2 to 4. It typically is cherty silt loam, but silt loam and very cherty silt loam are within the range. The E horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. It is the cherty, very cherty, or extremely cherty analogs of silt loam. The Bt horizon has hue of 2.5YR to 7.5YR, value of 3 to 5, and chroma of 4 to 8. It is dominantly the cherty or very cherty analogs of silty clay loam, silty clay, or clay, but the lower part is the noncherty analogs of these textures in many pedons.

Hartville Series

The Hartville series consists of deep, somewhat poorly drained, slowly permeable soils on terraces along the major streams. These soils formed in silty and clayey alluvium. Slopes range from 2 to 5 percent.

Typical pedon of Hartville silt loam, 2 to 5 percent slopes; 850 feet south and 1,600 feet west of the northeast corner of sec. 13, T. 37 N., R. 26 W.

Ap—0 to 7 inches; brown (10YR 4/3) silt loam, brown (10YR 5/3) dry; moderate fine granular structure; very friable; strongly acid; clear smooth boundary.

E—7 to 13 inches; yellowish brown (10YR 5/4) silt loam; moderate fine granular structure; very friable; very strongly acid; clear smooth boundary.

BA—13 to 17 inches; yellowish brown (10YR 5/4) silty clay loam; few fine prominent strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; friable; very strongly acid; clear smooth boundary.

Bt1—17 to 33 inches; yellowish brown (10YR 5/4) silty clay; many coarse distinct grayish brown (10YR 5/2) and common medium distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; few faint clay films on faces of peds; few concretions of iron and manganese oxides; very strongly acid; gradual smooth boundary.

Bt2—33 to 60 inches; grayish brown (10YR 5/2) silty clay loam; many coarse prominent strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; firm; few concretions of iron and manganese oxides; very strongly acid; gradual smooth boundary.

C—60 to 72 inches; mottled yellowish brown (10YR 5/4), strong brown (7.5YR 5/6), and grayish brown (10YR 5/2) cherty silty clay loam; weak fine subangular blocky structure; firm; about 20 percent chert fragments; few concretions of iron and manganese oxides; very strongly acid.

The thickness of the solum ranges from 48 to 72 inches. The content of coarse fragments ranges from 0 to 10 percent in the solum and from 15 to 50 percent in the C horizon.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. The E horizon has hue of 10YR, value of 5 or 6, and chroma of 2 to 4. The BA horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 3 to 6. It is silt loam or silty clay loam. The Bt horizon is silty clay or silty clay loam. The upper part of this horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. The upper 10 inches of the argillic horizon has mottles with chroma of 2 or less. The lower part of the Bt horizon has hue of 10YR to 2.5YR, value of 5 to 7, and chroma of 1 to 8. In some pedons chroma of 2 or less is dominant below a depth of 30 inches. The C horizon has colors similar to those in the Bt horizon. It is the cherty or very cherty analogs of silty clay, clay, or silty clay loam.

Hartwell Series

The Hartwell series consists of deep, somewhat poorly drained, slowly permeable soils on broad upland divides. These soils formed in a thin mantle of loess and in shale residuum. Slopes range from 0 to 2 percent.

Typical pedon of Hartwell silt loam, 1,584 feet north and 144 feet west of the southeast corner of sec. 9, T. 39 N., R. 27 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate medium granular structure; very friable; neutral; clear smooth boundary.

E—9 to 18 inches; grayish brown (10YR 5/2) silt loam; many fine distinct dark yellowish brown (10YR 4/4) mottles; moderate medium granular structure; very friable; medium acid; abrupt smooth boundary.

Bt1—18 to 26 inches; very dark grayish brown (10YR 3/2) silty clay; common fine prominent reddish brown (5YR 4/4) mottles; moderate medium subangular blocky structure; firm; few faint clay films on faces of peds; strongly acid; gradual wavy boundary.

Bt2—26 to 34 inches; dark grayish brown (10YR 4/2) silty clay; many medium prominent reddish brown (5YR 4/4) mottles; moderate medium subangular blocky structure; firm; common distinct clay films on faces of peds; strongly acid; gradual wavy boundary.

Bt3—34 to 46 inches; dark brown (10YR 4/3) silty clay; common medium distinct very dark grayish brown (10YR 3/2) mottles; weak fine and medium subangular blocky structure; firm; few distinct clay films on faces of peds; strongly acid; gradual smooth boundary.

BC—46 to 60 inches; strong brown (7.5YR 5/6) silty clay loam; many medium or coarse prominent light gray or gray (10YR 6/1) and few medium prominent dark grayish brown (10YR 4/2) mottles; weak medium subangular blocky structure; firm; strongly acid.

The thickness of the solum ranges from 48 to 72 inches. The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The E horizon has hue of 10YR, value of 5 or 6, and chroma of 1 or 2. The Bt horizon is clay or silty clay. The upper part of this horizon has hue of 10YR, value of 2 or 3, and chroma of 1 to 3. The lower part has hue of 10YR, value of 4 to 7, and chroma of 2 to 8. The color of the mottles varies widely. The BC horizon is silty clay or silty clay loam.

Hector Series

The Hector series consists of shallow, well drained soils on uplands. These soils formed in material weathered from acid sandstone. Permeability is moderately rapid. Slopes range from 5 to 25 percent.

Typical pedon of Hector fine sandy loam, 5 to 25 percent slopes, stony; 2,250 feet west and 200 feet south of the northeast corner of sec. 28, T. 38 N., R. 27 W.

A—0 to 5 inches; dark brown (10YR 4/3) fine sandy loam, brown (10YR 5/3) dry; moderate fine granular structure; very friable; about 10 percent sandstone fragments; strongly acid; clear smooth boundary.

Bw—5 to 17 inches; yellowish brown (10YR 5/4) gravelly fine sandy loam; weak medium subangular blocky structure; friable; about 20 percent sandstone fragments; very strongly acid; abrupt smooth boundary.

R—17 inches; hard sandstone bedrock.

The depth to hard sandstone bedrock ranges from 10 to 20 inches. Sandstone rocks 15 inches to 4 feet or more in size cover about 1 percent of the surface.

The A horizon has hue of 10YR, value of 3 to 5, and chroma of 2 or 3. It typically is fine sandy loam, but the range includes loam. This horizon is slightly acid to strongly acid. The B horizon has hue of 10YR or 7.5YR, value of 5, and chroma of 3 to 6, or it has hue of 5YR, value of 4, and chroma of 4 to 6. It is fine sandy loam, loam, or the gravelly analogs of these textures. It is strongly acid or very strongly acid.

Kanima Series

The Kanima series consists of deep, well drained, moderately permeable soils on uplands. These soils occur as spoil banks in areas that formerly were strip mined. Slopes range from 10 to 50 percent.

These soils are more acid than is definitive for the Kanima series. This difference, however, does not alter the usefulness or behavior of the soils.

Typical pedon of Kanima shaly silty clay, 10 to 50 percent slopes, on the west side of a mine dump; 1,450 feet east and 4,850 feet south of the northwest corner of sec. 2, T. 39 N., R. 28 W.

A—0 to 8 inches; dark grayish brown (2.5Y 4/2) shaly silty clay; massive; friable; about 30 percent shale fragments; extremely acid; diffuse wavy boundary.

C—8 to 80 inches; grayish brown (2.5Y 5/2) very shaly silty clay loam; massive; friable; about 55 percent shale fragments; extremely acid.

Reaction ranges from extremely acid to neutral throughout the profile. The content of shale or sandstone fragments less than 3 inches in diameter ranges from 15 to 60 percent in the A horizon and from 35 to 90 percent in the C horizon. The content of fragments more than 3 inches in diameter is less than 5 percent in the A horizon and ranges from 5 to 30 percent in the C horizon.

The A horizon has hue of 10YR or 2.5YR, value of 3 or 4, and chroma of 2 or 3. It typically is shaly silty clay, but very shaly silty clay and the shaly or very shaly analogs of clay loam, loam, or silty clay loam are within the range. The C horizon has hue of 10YR to 5Y, value of 3 to 5, and chroma of 2 to 4. It has the same range in texture as the A horizon. It has pockets of an undisturbed B horizon, which is similar to that of the adjacent Alfisols.

Liberal Series

The Liberal series consists of deep, moderately well drained, slowly permeable soils on uplands. These soils formed in material weathered from shale and sandstone. Slopes range from 2 to 5 percent.

Typical pedon of Liberal silt loam, 2 to 5 percent slopes; 1,100 feet west and 150 feet north of the southeast corner of sec. 14, T. 37 N., R. 27 W.

A—0 to 6 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate fine granular structure; friable; strongly acid; clear smooth boundary.

BA—6 to 8 inches; dark brown (10YR 4/3) silty clay loam; weak fine subangular blocky structure; friable; very strongly acid; clear smooth boundary.

Bt1—8 to 14 inches; dark brown (7.5YR 4/4) silty clay; moderate fine subangular blocky structure; firm; few faint clay films on faces of peds; very strongly acid; clear smooth boundary.

Bt2—14 to 17 inches; dark brown (10YR 4/3) silty clay; common fine faint dark grayish brown (10YR 4/2) mottles; moderate fine subangular blocky structure; firm; common distinct clay films on faces of peds; strongly acid; clear smooth boundary.

BC—17 to 24 inches; dark grayish brown (10YR 4/2) silty clay loam; common medium distinct strong brown (7.5YR 5/6) and common fine faint grayish brown (10YR 5/2) mottles; weak medium angular blocky structure; very firm; strongly acid; gradual smooth boundary.

C—24 to 46 inches; grayish brown (10YR 5/2) clay loam; common fine prominent yellowish brown (10YR 5/6) and many medium distinct strong brown (7.5YR 5/6) mottles; massive; very firm; strongly acid; abrupt smooth boundary.

Cr—46 to 60 inches; soft sandstone bedrock interbedded with lenses of shale.

The thickness of the solum ranges from 20 to 40 inches. The depth to bedrock ranges from 40 to 60 inches. The A horizon has hue of 7.5YR or 10YR and value and chroma of 2 or 3. It is 6 to 10 inches thick. The B horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 or 4. It is silty clay loam, silty clay, or clay.

Moniteau Series

The Moniteau series consists of deep, poorly drained soils on low stream terraces. These soils formed in silty alluvium. Permeability is moderately slow. Slopes range from 0 to 2 percent.

Typical pedon of Moniteau silt loam, 1,365 feet west and 1,560 feet south of the northeast corner of sec. 13, T. 37 N., R. 26 W.

Ap—0 to 13 inches; dark grayish brown (10YR 4/2) silt loam, pale brown (10YR 6/3) dry; moderate medium granular structure; very friable; common fine roots; medium acid; abrupt wavy boundary.

E1—13 to 20 inches; grayish brown (10YR 5/2) silt loam; many medium distinct yellowish brown (10YR 5/4) mottles; moderate medium granular structure; friable; few fine roots; many fine tubular pores; few fine concretions of iron and manganese oxides; strongly acid; clear smooth boundary.

E2—20 to 29 inches; grayish brown (10YR 5/2) silt loam; many medium distinct yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; friable; few fine roots; many fine tubular pores; strongly acid; gradual smooth boundary.

Bt1—29 to 37 inches; dark grayish brown (10YR 4/2) silty clay loam; common fine or medium prominent dark brown (7.5YR 4/4) mottles; moderate medium subangular blocky structure; firm; few faint clay films and common thin silt coatings on faces of peds; few fine roots; very strongly acid; gradual smooth boundary.

Bt2—37 to 48 inches; dark grayish brown (10YR 4/2) silty clay loam; many fine prominent dark brown (7.5YR 4/4) mottles; moderate medium subangular blocky structure; firm; few faint clay films and common thin silt coatings on faces of peds; few fine roots; very strongly acid; gradual smooth boundary.

Bt3—48 to 72 inches; dark grayish brown (10YR 4/2) silty clay loam; many fine prominent dark brown (7.5YR 4/4) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few faint clay films and common thin silt coatings on faces of peds; few fine roots; very strongly acid.

The thickness of the solum ranges from 48 to more than 72 inches. The Ap horizon has hue of 10YR, value of 4, and chroma of 1 or 2. The E and Bt horizons have hue of 10YR, value of 4 or 5, and chroma of 1 or 2. The Bt horizon is silty clay loam or silty clay.

Newtonia Series

The Newtonia series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in silty sediments. Slopes range from 1 to 5 percent.

Typical pedon of Newtonia silt loam, 1 to 5 percent slopes; 750 feet south and 100 feet west of the northeast corner of sec. 11, T. 37 N., R. 28 W.

Ap—0 to 12 inches; dark brown (10YR 3/3) silt loam, dark brown (10YR 4/3) dry; moderate fine granular structure; friable; strongly acid; clear smooth boundary.

BA—12 to 15 inches; dark brown (7.5YR 3/4) silt loam; weak fine subangular blocky structure; friable; strongly acid; clear smooth boundary.

Bt1—15 to 26 inches; dark reddish brown (5YR 3/4) silty clay loam; moderate medium subangular blocky structure; firm; few faint clay films on faces of peds; strongly acid; gradual smooth boundary.

Bt2—26 to 38 inches; dark red (2.5YR 3/6) silty clay loam; moderate medium subangular blocky structure; firm; common distinct clay films on faces of peds; strongly acid; gradual smooth boundary.

Bt3—38 to 48 inches; dark red (2.5YR 3/6) silty clay loam; moderate medium subangular blocky structure; firm; common prominent clay films on faces of peds; common iron and manganese stains; strongly acid; clear smooth boundary.

Bt4—48 to 72 inches; red (2.5YR 4/6) silty clay loam; weak medium subangular blocky structure; firm; common distinct clay films on faces of peds; common iron and manganese stains; about 10 percent chert fragments; strongly acid.

The solum is more than 60 inches thick. The mollic epipedon ranges from 10 to 24 inches in thickness.

The Ap horizon has hue of 5YR to 10YR and value and chroma of 2 or 3. It typically is silt loam, but the range includes silty clay loam. The Bt horizon has hue of 2.5YR or 5YR, value of 3 or 4, and chroma of 4 to 8. It is dominantly silty clay loam, but in some pedons the lower part is silty clay. In some pedons the content of coarse fragments less than 3 inches in diameter is as much as 15 percent in the lower part of the solum.

Osage Series

The Osage series consists of deep, poorly drained soils on flood plains along the major streams. These soils formed in clayey alluvium. Permeability is very slow. Slopes range from 0 to 2 percent.

Typical pedon of Osage silty clay, 825 feet north and 100 feet east of the southwest corner of sec. 31, T. 38 N., R. 28 W.

A1—0 to 8 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate fine angular blocky structure; firm; strongly acid; clear smooth boundary.

A2—8 to 14 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate fine angular blocky structure; firm; medium acid; clear smooth boundary.

A3—14 to 25 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate fine angular blocky structure; firm; medium acid; clear smooth boundary.

Ab—25 to 30 inches; dark gray (10YR 4/1) silty clay loam; common medium prominent dark yellowish brown (10YR 4/4) mottles; moderate fine angular blocky structure; firm; medium acid; gradual smooth boundary.

Bgb—30 to 51 inches; dark grayish brown (10YR 4/2) silty clay; many medium prominent dark yellowish brown (10YR 4/6) and common medium distinct yellowish brown (10YR 5/4) mottles; moderate fine angular blocky structure; firm; medium acid; gradual smooth boundary.

BCgb—51 to 72 inches; dark grayish brown (10YR 4/2) silty clay; common medium prominent dark yellowish brown (10YR 4/6) and red (2.5YR 4/8) mottles; weak fine angular blocky structure; very firm; slightly acid.

The thickness of the solum ranges from 40 to more than 60 inches. The mollic epipedon is more than 24 inches thick.

The A and B horizons are silty clay loam, silty clay, or clay. The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The B horizon has hue of 10YR or 2.5YR or is neutral in hue. It has value of 3 or 4 and chroma of 2 or less.

Quarles Series

The Quarles series consists of deep, poorly drained, slowly permeable soils on stream terraces. These soils formed in alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Quarles silt loam, 750 feet west and 2,250 feet south of the northeast corner of sec. 29, T. 39 N., R. 26 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; strongly acid; clear smooth boundary.

A—9 to 17 inches; dark grayish brown (10YR 4/2) silt loam; few fine faint dark yellowish brown (10YR 3/6) mottles; weak fine granular structure; very friable; few fine concretions of iron and manganese oxides; strongly acid; clear smooth boundary.

Eg—17 to 29 inches; gray (10YR 6/1) silt loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; friable; very strongly acid; abrupt smooth boundary.

Btg1—29 to 37 inches; dark grayish brown (10YR 4/2) silty clay; common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few faint clay films on faces of peds; strongly acid; clear smooth boundary.

Btg2—37 to 72 inches; gray (10YR 5/1) silty clay loam; common medium distinct yellowish brown (10YR 5/6) and strong brown (7.5YR 4/6) mottles; moderate medium subangular blocky structure; firm; common fine concretions of iron and manganese oxides; strongly acid.

The thickness of the solum ranges from 36 to more than 60 inches. The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 to 3. The E horizon has hue of 10YR, value of 4 to 6, and chroma of 1 or 2. The Btg horizon has hue of 10YR, value of 3 to 6, and chroma of 1 or 2. It is silty clay loam or silty clay. It is strongly acid or medium acid.

Summit Series

The Summit series consists of deep, moderately well drained, slowly permeable soils in convex areas on uplands and foot slopes. These soils formed in shale residuum. Slopes range from 2 to 5 percent.

Typical pedon of Summit silty clay loam, 2 to 5 percent slopes; 130 feet north and 1,320 feet east of the southwest corner of sec. 18, T. 36 N., R. 24 W.

Ap—0 to 6 inches; black (10YR 2/1) silty clay loam; moderate fine granular structure; firm; medium acid; clear smooth boundary.

A—6 to 12 inches; black (10YR 2/1) silty clay loam; moderate fine granular structure; firm; medium acid; clear smooth boundary.

BA—12 to 16 inches; very dark gray (10YR 3/1) silty clay; moderate fine subangular blocky structure; very firm; few fine concretions of iron and manganese oxides; medium acid; clear smooth boundary.

Bt1—16 to 23 inches; dark grayish brown (10YR 4/2) silty clay; moderate medium subangular blocky structure; very firm; common distinct clay films on faces of peds; medium acid; gradual smooth boundary.

Bt2—23 to 29 inches; olive brown (2.5Y 4/4) silty clay; common medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; very firm; common distinct clay films on faces of peds; medium acid; gradual smooth boundary.

Bt3—29 to 43 inches; mottled yellowish brown (10YR 5/6), strong brown (7.5YR 5/6), and gray (10YR 5/1) silty clay; moderate medium subangular blocky structure; very firm; common distinct clay films on faces of peds; about 5 percent coarse fragments; slightly acid; gradual smooth boundary.

Bt4—43 to 72 inches; gray (10YR 5/1) silty clay; common medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; very firm; few faint clay films on faces of peds; about 1 percent coarse fragments; medium acid.

The solum ranges from 50 to more than 60 inches in thickness. These soils commonly have deep cracks during the summer months.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It typically is silty clay loam, but silty clay is within the range. The Bt horizon is silty clay or clay. The upper part of this horizon has hue of 10YR or 2.5Y and value of 2 to 4. The lower part has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 1 to 6.

Verdigris Series

The Verdigris series consists of deep, well drained, moderately permeable soils on flood plains. These soils formed in silty alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Verdigris silt loam, 50 feet east and 3,200 feet south of the northwest corner of sec. 5, T. 39 N., R. 26 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; slightly acid; clear smooth boundary.

A—8 to 21 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate medium granular structure; friable; medium acid; gradual smooth boundary.

AC—21 to 40 inches; dark brown (10YR 3/3) silt loam, brown (10YR 4/3) dry; weak medium subangular blocky structure; friable; common fine and medium pores; medium acid; gradual smooth boundary.

C—40 to 72 inches; brown (10YR 4/3) silt loam; weak medium subangular blocky structure; friable; few fine pores and worm casts; medium acid.

The thickness of the solum ranges from 24 to 60 inches. The thickness of the mollic epipedon ranges from 24 to 40 inches.

The A horizon has hue of 7.5YR or 10YR, value of 2 or 3, and chroma of 1 to 3. The C horizon has hue of 7.5YR or 10YR, value of 3 to 6, and chroma of 2 to 4. It is silt loam, silty clay loam, or clay loam.

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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.

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

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

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.

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.

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 channer.

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

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

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

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

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

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

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

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

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

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

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

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

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

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

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

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

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

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

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

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

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

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

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

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

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 38 centimeters) long.

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

Foot slope. The inclined surface at the base of a hill.

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

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

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

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.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

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

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

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

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

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

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

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

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

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

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

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

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

Large stones (in tables). Rock fragments 3 inches (7.6 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.

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

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

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

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

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

Moderately coarse textured soil. Coarse sandy loam, sandy loam, and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

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

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

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

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

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

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

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

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

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

Percolation. The downward movement of water through the soil.

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

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

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

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

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

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

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

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

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

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

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.

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

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

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

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

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.

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 groundwater runoff or seepage flow from ground water.

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.

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.

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

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 surface runoff.

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.

Silica-sesquioxide ratio. The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.

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.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Sinkhole. A depression in the landscape where limestone has been dissolved.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multipled 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 ensure 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 (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

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

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

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

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

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 soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

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

Substratum. The part of the soil below the solum.

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

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

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

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

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

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

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.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

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

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

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

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

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

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

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

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1951-80 at Appleton City, Missouri]

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*	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----	40.8	19.5	30.2	69	-8	10	1.46	0.50	2.24	4	5.6
February---	46.9	24.7	35.8	73	-3	18	1.49	.58	2.24	4	3.6
March------	56.8	32.8	44.8	83	6	83	2.98	1.39	4.34	6	3.4
April------	69.8	44.6	57.2	89	23	236	3.47	1.71	4.99	6	.2
May--------	78.4	54.0	66.2	92	33	502	4.69	2.94	6.26	7	.0
June-------	86.6	62.6	74.6	99	47	738	4.73	2.02	7.01	7	.0
July-------	91.9	66.6	79.3	104	51	908	3.75	.98	5.95	6	.0
August-----	91.3	64.7	78.0	104	50	868	3.63	1.61	5.34	5	.0
September--	83.5	57.3	70.4	100	38	612	4.58	1.72	6.96	6	.0
October----	72.5	45.9	59.2	93	26	304	3.53	1.08	5.52	5	.0
November---	56.9	34.0	45.5	79	10	48	2.20	.56	3.53	4	1.4
December---	45.5	25.0	35.3	70	-3	7	1.78	.76	2.64	4	3.7
Yearly:											
Average--	68.4	44.3	56.4	---	---	---	---	---	---	---	---
Extreme--	---	---	---	106	-9	---	---	---	---	---	---
Total----	---	---	---	---	---	4,334	38.29	29.50	46.51	64	17.9

* 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 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1951-80 at Appleton City, Missouri]

Probability	Temperature		
	24^{o} F or lower	28^{o} F or lower	32^{o} F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 9	Apr. 21	May 1
2 years in 10 later than--	Apr. 4	Apr. 17	Apr. 26
5 years in 10 later than--	Mar. 25	Apr. 9	Apr. 16
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 27	Oct. 19	Oct. 11
2 years in 10 earlier than--	Oct. 31	Oct. 24	Oct. 15
5 years in 10 earlier than--	Nov. 8	Nov. 1	Oct. 22

TABLE 3.--GROWING SEASON

[Recorded in the period 1951-80 at Appleton City, Missouri]

Probability	Daily minimum temperature during growing season		
	Higher than 24^{o} F	Higher than 28^{o} F	Higher than 32^{o} F
	Days	Days	Days
9 years in 10	207	186	172
8 years in 10	214	193	177
5 years in 10	227	206	188
2 years in 10	241	219	199
1 year in 10	248	225	205

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

Map symbol	Soil name	Acres	Percent
11	Verdigris silt loam	14,600	3.4
15	Cleora fine sandy loam	5,320	1.2
16	Cedargap silt loam	7,020	1.6
21	Osage silty clay	3,000	0.7
50	Cotter silt loam	2,295	0.5
51B	Deepwater silt loam, 2 to 5 percent slopes	17,885	4.1
51C2	Deepwater silt loam, 5 to 9 percent slopes, eroded	2,075	0.5
52	Moniteau silt loam	6,005	1.4
53	Quarles silt loam	7,300	1.7
54B	Bucklick silt loam, 2 to 5 percent slopes	7,920	1.8
55B	Bolivar fine sandy loam, 2 to 5 percent slopes	19,745	4.5
55C	Bolivar fine sandy loam, 5 to 9 percent slopes	12,835	2.9
56B	Barco fine sandy loam, 2 to 5 percent slopes	34,190	7.9
56C	Barco fine sandy loam, 5 to 9 percent slopes	13,020	3.0
57B	Liberal silt loam, 2 to 5 percent slopes	6,105	1.4
58	Hartwell silt loam	10,580	2.4
59B	Hartville silt loam, 2 to 5 percent slopes	5,060	1.2
60B	Barden silt loam, 1 to 5 percent slopes	65,190	15.0
61B	Summit silty clay loam, 2 to 5 percent slopes	2,575	0.6
66C	Eldorado cherty silt loam, 3 to 9 percent slopes	12,890	3.0
66D	Eldorado cherty silt loam, 9 to 14 percent slopes	6,000	1.4
67C	Bardley cherty silt loam, 3 to 9 percent slopes	1,620	0.4
67D	Bardley cherty silt loam, 9 to 14 percent slopes	7,170	1.6
68D	Collinsville fine sandy loam, 2 to 20 percent slopes	16,420	3.8
69C	Goss cherty silt loam, 3 to 9 percent slopes	25,590	5.9
69D	Goss cherty silt loam, 9 to 14 percent slopes	25,230	5.8
69E	Goss cherty silt loam, 14 to 30 percent slopes	13,200	3.0
70E	Hector fine sandy loam, 5 to 25 percent slopes, stony	50,690	11.7
72E	Gasconade flaggy silty clay loam, 2 to 40 percent slopes	27,490	6.3
75B	Newtonia silt loam, 1 to 5 percent slopes	2,880	0.7
94	Kanima shaly silty clay, 10 to 50 percent slopes	2,815	0.6
95	Aquents, nearly level	196	*
	Total land area	434,911	100.0
	Water areas more than 40 acres in size	13,927	
	Total area	448,838	

* Less than 0.1 percent.

TABLE 5.--PRIME FARMLAND

[Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name]

Map symbol	Soil name
11	Verdigris silt loam
15	Cleora fine sandy loam
16	Cedargap silt loam (where protected from flooding or not frequently flooded during the growing season)
21	Osage silty clay (where drained)
50	Cotter silt loam
51B	Deepwater silt loam, 2 to 5 percent slopes
52	Moniteau silt loam (where drained)
53	Quarles silt loam (where drained)
54B	Bucklick silt loam, 2 to 5 percent slopes
56B	Barco fine sandy loam, 2 to 5 percent slopes
57B	Liberal silt loam, 2 to 5 percent slopes
58	Hartwell silt loam (where drained)
59B	Hartville silt loam, 2 to 5 percent slopes
60B	Barden silt loam, 1 to 5 percent slopes
61B	Summit silty clay loam, 2 to 5 percent slopes
75B	Newtonia silt loam, 1 to 5 percent slopes

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Land capability	Corn	Soybeans	Grain sorghum	Winter wheat	Tall fescue-red clover hay	Tall fescue
		Bu	Bu	Bu	Bu	Tons	AUM*
11: Verdigris	IIw	90	35	85	42	3.3	6.6
15: Cleora	IIw	---	26	65	30	2.5	5.0
16: Cedargap	IIs	---	21	55	30	2.5	5.0
21: Osage	IIIw	60	30	65	30	3.0	6.0
50: Cotter	I	110	40	100	48	3.5	7.0
51B: Deepwater	IIe	85	35	80	40	3.5	7.0
51C2: Deepwater	IIIe	70	30	65	35	3.0	6.0
52: Moniteau	IIIw	80	30	75	35	3.0	6.0
53: Quarles	IIw	72	30	65	30	3.0	6.0
54B: Bucklick	IIe	75	25	65	30	2.7	5.4
55B: Bolivar	IIIe	60	24	61	32	3.0	5.6
55C: Bolivar	IIIe	55	20	50	25	2.7	5.4
56B: Barco	IIe	65	31	66	40	3.3	6.6
56C: Barco	IIIe	60	28	55	32	3.0	6.0
57B: Liberal	IIe	60	25	60	35	3.3	6.6
58: Hartwell	IIe	80	32	74	37	3.7	7.4
59B: Hartville	IIe	65	28	60	30	2.7	5.4
60B: Barden	IIe	80	30	68	40	3.9	7.4
61B: Summit	IIe	70	30	65	35	3.0	6.0

See footnote at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Grain sorghum	Winter wheat	Tall fescue-red clover hay	Tall fescue
		Bu	Bu	Bu	Bu	Tons	AUM*
66C------------- Eldorado	IVs	---	---	---	20	2.0	4.0
66D------------- Eldorado	VIs	---	---	---	---	1.5	3.0
67C------------- Bardley	IVs	---	---	---	---	2.0	4.0
67D------------- Bardley	VIs	---	---	---	---	1.7	3.4
68D------------- Collinsville	VIs	---	---	---	---	---	2.8
69C------------- Goss	IVs	---	25	30	25	2.2	4.4
69D------------- Goss	VIs	---	---	---	---	---	3.7
69E------------- Goss	VIIs	---	---	---	---	---	3.0
70E------------- Hector	VIIs	---	---	---	---	---	2.5
72E------------- Gasconade	VIIs	---	---	---	---	---	2.0
75B------------- Newtonia	IIe	70	30	75	40	3.0	6.0
94-------------- Kanima	VIIs	---	---	---	---	---	2.6
95-------------- Aquents	VIIw	---	---	---	---	---	---

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available]

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
11---------------- Verdigris	7A	Slight	Slight	Slight	Slight	Eastern cottonwood-- Pin oak------------- Shagbark hickory---- Hackberry----------- Black walnut-------- Silver maple-------- Green ash----------- White oak-----------	87 75 --- 69 69 --- 69 56	95 57 --- --- --- --- 73 51	Eastern cottonwood, American sycamore, pin oak, black walnut, green ash.
15---------------- Cleora	9A	Slight	Slight	Slight	Slight	Eastern cottonwood-- Northern red oak---- Black walnut-------- Black cherry--------	100 80 --- ---	128 62 --- ---	Eastern cottonwood, black walnut, black cherry, American sycamore, white ash.
16---------------- Cedargap	3A	Slight	Slight	Slight	Slight	Black oak-----------	66	48	Black oak, shortleaf pine.
21---------------- Osage	4W	Slight	Moderate	Severe	Moderate	Pin oak------------- Pecan--------------- Eastern cottonwood-- Bur oak-------------	75 50 80 ---	57 --- 78 ---	Pin oak, pecan.
50---------------- Cotter	9A	Slight	Slight	Slight	Slight	Eastern cottonwood-- Silver maple--------	100 ---	128 ---	Eastern cottonwood, black walnut.
52---------------- Moniteau	4W	Slight	Severe	Moderate	Moderate	Pin oak-------------	70	52	White oak, pin oak, green ash, eastern cottonwood, silver maple.
53---------------- Quarles	4W	Slight	Severe	Moderate	Moderate	Pin oak------------- Pecan--------------- Eastern cottonwood--	80 55 ---	62 --- ---	Pin oak, pecan.
54B--------------- Bucklick	3A	Slight	Slight	Slight	Slight	White oak----------- Northern red oak---- Post oak------------ Black oak-----------	64 --- --- ---	47 --- --- ---	White oak, northern red oak.
55B, 55C---------- Bolivar	3A	Slight	Slight	Slight	Slight	White oak----------- Black oak----------- Northern red oak---- Black walnut--------	57 --- --- ---	40 --- --- ---	White oak, white ash, shortleaf pine.

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
59B------------- Hartville	2C	Slight	Slight	Severe	Severe	White oak-----------	50	34	Eastern cottonwood, white oak, pin oak.
67C, 67D-------- Bardley	2A	Slight	Slight	Slight	Slight	Post oak------------	45	30	Shortleaf pine, eastern redcedar, white oak, black oak.
69C, 69D-------- Goss	3A	Slight	Slight	Slight	Slight	White oak----------- Post oak------------ Blackjack oak------- Black oak-----------	60 --- --- ---	43 --- --- ---	Shortleaf pine, northern red oak, white ash, white oak.
69E------------- Goss	3R	Slight	Moderate	Moderate	Slight	White oak----------- Shortleaf pine------ Post oak------------ Blackjack oak------- Black oak-----------	60 --- --- --- ---	43 --- --- --- ---	Shortleaf pine, northern red oak, white ash, white oak.
70E------------- Hector	2D	Moderate	Moderate	Moderate	Moderate	Northern red oak---- Eastern redcedar---- Black oak-----------	54 30 ---	38 --- ---	Shortleaf pine, eastern redcedar.
72E------------- Gasconade	2R	Moderate	Severe	Moderate	Moderate	Chinkapin oak------- Eastern redcedar---- White ash----------- Sugar maple--------- Mockernut hickory--- Post oak------------ Blackjack oak-------	40 30 --- --- --- --- ---	26 --- --- --- --- --- ---	Eastern redcedar.

* Volume is the yield in cubic feet per acre per year calculated at the age of culmination of mean annual increment for fully stocked natural stands.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

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

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
11----------------- Verdigris	---	Lilac, Amur honeysuckle, Amur maple, autumn-olive.	Eastern redcedar	Austrian pine, green ash, hackberry, pin oak, honeylocust, eastern white pine.	Eastern cottonwood.
15----------------- Cleora	---	Amur honeysuckle, Amur maple, autumn-olive, lilac.	Eastern redcedar	Austrian pine, eastern white pine, hackberry, green ash, honeylocust, pin oak.	Eastern cottonwood.
16----------------- Cedargap	---	Amur maple, Amur honeysuckle, autumn-olive, lilac.	Eastern redcedar	Hackberry, Austrian pine, eastern white pine, green ash, honeylocust, pin oak.	Eastern cottonwood.
21----------------- Osage	Redosier dogwood	American plum, common chokecherry.	Eastern redcedar, hackberry.	Norway spruce, honeylocust, green ash, silver maple, golden willow, northern red oak.	Eastern cottonwood.
50----------------- Cotter	---	Autumn-olive, Amur maple, lilac, Amur honeysuckle.	Green ash, hackberry, bur oak, eastern redcedar, Russian-olive.	Eastern white pine, Austrian pine, honeylocust.	---
51B, 51C2--------- Deepwater	---	Amur honeysuckle, autumn-olive, Amur maple, lilac.	Hackberry, Russian-olive, eastern redcedar.	Norway spruce, pin oak, honeylocust, green ash, eastern white pine.	---
52----------------- Moniteau	Redosier dogwood	American plum, common chokecherry.	Eastern redcedar, hackberry.	Norway spruce, green ash, golden willow, honeylocust, northern red oak, silver maple.	Eastern cottonwood.
53----------------- Quarles	Redosier dogwood	American plum, common chokecherry.	Eastern redcedar, hackberry.	Norway spruce, honeylocust, green ash, silver maple, golden willow, northern red oak.	Eastern cottonwood.
54B---------------- Bucklick	---	Amur honeysuckle, lilac, autumn-olive, Amur maple.	Eastern redcedar, Russian-olive, hackberry.	Norway spruce, honeylocust, green ash, pin oak, eastern white pine.	---

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
55B, 55C----------- Bolivar	Amur honeysuckle, lilac, fragrant sumac.	Autumn-olive------	Green ash, hackberry, bur oak, Russian-olive, Austrian pine, eastern redcedar.	Siberian elm, honeylocust.	---
56B, 56C----------- Barco	Amur honeysuckle, lilac, fragrant sumac.	Autumn-olive------	Green ash, eastern redcedar, bur oak, Russian-olive, Austrian pine, hackberry.	Siberian elm, honeylocust.	---
57B---------------- Liberal	Lilac--------------	Amur honeysuckle, autumn-olive, Manchurian crabapple, Amur maple.	Austrian pine, eastern redcedar, jack pine, green ash, hackberry, Russian-olive.	Honeylocust-------	---
58----------------- Hartwell	Lilac--------------	Amur maple, Amur honeysuckle, autumn-olive, Manchurian crabapple.	Eastern redcedar, hackberry, jack pine, Austrian pine, green ash, Russian-olive.	Honeylocust-------	---
59B---------------- Hartville	Lilac--------------	Amur honeysuckle, Amur maple, autumn-olive, Manchurian crabapple.	Austrian pine, hackberry, green ash, jack pine, Russian-olive, eastern redcedar.	Honeylocust-------	---
60B---------------- Barden	Lilac--------------	Amur honeysuckle, autumn-olive, Manchurian crabapple, Amur maple.	Eastern redcedar, Austrian pine, Russian-olive, green ash, hackberry, jack pine.	Honeylocust-------	---
61B---------------- Summit	Lilac--------------	Amur honeysuckle, autumn-olive, Amur maple, Manchurian crabapple.	Eastern redcedar, Russian-olive, hackberry, green ash, Austrian pine, jack pine.	Honeylocust-------	---
66C, 66D----------- Eldorado	Amur honeysuckle, lilac.	Fragrant sumac----	Eastern redcedar, green ash, Russian-olive, bur oak, honeylocust, Austrian pine, hackberry.	Siberian elm------	---
67C, 67D----------- Bardley	Lilac, fragrant sumac, Amur honeysuckle.	Autumn-olive------	Russian-olive, hackberry, eastern redcedar, bur oak, green ash, Austrian pine, honeylocust.	Siberian elm------	---
68D. Collinsville					

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
69C, 69D, 69E----- Goss	Amur honeysuckle, lilac, fragrant sumac.	Autumn-olive------	Eastern redcedar, Austrian pine, honeylocust, hackberry, green ash, bur oak, Russian-olive.	Siberian elm------	---
70E. Hector					
72E. Gasconade					
75B--------------- Newtonia	---	Lilac, Amur honeysuckle.	Eastern redcedar, ponderosa pine, Austrian pine.	Bur oak, honeylocust, hackberry, Russian-olive, autumn-olive, green ash, silver maple.	---
94. Kanima					
95. Aquents					

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." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
11: Verdigris	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
15: Cleora	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
16: Cedargap	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
21: Osage	Severe: flooding, wetness, percs slowly.	Severe: wetness, too clayey, percs slowly.	Severe: too clayey, wetness.	Severe: wetness, too clayey.	Severe: wetness, too clayey.
50: Cotter	Severe: flooding.	Slight	Slight	Slight	Slight.
51B: Deepwater	Slight	Slight	Moderate: slope.	Slight	Slight.
51C2: Deepwater	Slight	Slight	Severe: slope.	Slight	Slight.
52: Moniteau	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
53: Quarles	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
54B: Bucklick	Slight	Slight	Moderate: slope.	Slight	Slight.
55B: Bolivar	Slight	Slight	Moderate: slope, depth to rock.	Slight	Moderate: depth to rock.
55C: Bolivar	Slight	Slight	Severe: slope.	Slight	Moderate: depth to rock.
56B: Barco	Slight	Slight	Moderate: slope, depth to rock.	Slight	Moderate: depth to rock.
56C: Barco	Slight	Slight	Severe: slope.	Slight	Moderate: depth to rock.
57B: Liberal	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Slight	Slight.
58: Hartwell	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
59B Hartville	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness, percs slowly.	Severe: erodes easily.	Moderate: wetness.
60B Barden	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Slight	Slight.
61B Summit	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness.	Slight	Slight.
66C Eldorado	Moderate: small stones.	Moderate: small stones.	Severe: slope, small stones.	Slight	Moderate: small stones, droughty.
66D Eldorado	Moderate: small stones, slope.	Moderate: small stones, slope.	Severe: slope, small stones.	Slight	Moderate: small stones, droughty, slope.
67C Bardley	Slight	Slight	Severe: slope, small stones.	Slight	Moderate: small stones, depth to rock.
67D Bardley	Moderate: slope.	Moderate: slope.	Severe: slope, small stones.	Slight	Moderate: small stones, depth to rock.
68D Collinsville	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight	Severe: depth to rock.
69C Goss	Moderate: small stones.	Moderate: small stones.	Severe: slope, small stones.	Slight	Severe: droughty.
69D Goss	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Slight	Severe: droughty.
69E Goss	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope.	Severe: droughty.
70E Hector	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope, small stones, depth to rock.	Moderate: large stones, slope.	Severe: small stones, large stones, slope.
72E Gasconade	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: large stones, slope, small stones.	Moderate: large stones, slope.	Severe: large stones, slope, depth to rock.
75B Newtonia	Slight	Slight	Moderate: slope.	Slight	Slight.
94 Kanima	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.	Severe: droughty, slope.
95. Aquents					

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]

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
11----------------- Verdigris	Good	Good	Good	Good	Good	Poor	Fair	Good	Good	Poor.
15----------------- Cleora	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
16----------------- Cedargap	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
21----------------- Osage	Fair	Fair	Fair	Fair	Fair	Poor	Good	Fair	Fair	Fair.
50----------------- Cotter	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
51B---------------- Deepwater	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
51C2--------------- Deepwater	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
52----------------- Moniteau	Fair	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
53----------------- Quarles	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
54B---------------- Bucklick	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
55B, 55C----------- Bolivar	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
56B, 56C----------- Barco	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
57B---------------- Liberal	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
58----------------- Hartwell	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
59B---------------- Hartville	Fair	Good	Good	Good	Good	Poor	Fair	Good	Good	Poor.
60B---------------- Barden	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
61B---------------- Summit	Fair	Good	Fair	Good	Good	Poor	Very poor.	Fair	Good	Very poor.
66C, 66D----------- Eldorado	Fair	Good	Good	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.
67C, 67D----------- Bardley	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
68D: Collinsville	Very poor.	Poor	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Poor	Very poor.	Very poor.
69C, 69D, 69E: Goss	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
70E: Hector	Very poor.	Very poor.	Poor	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Poor	Very poor.
72E: Gasconade	Very poor.	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
75B: Newtonia	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
94: Kanima	Very poor.	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
95. Aquents										

TABLE 11.--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. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
11 Verdigris	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
15 Cleora	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
16 Cedargap	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
21 Osage	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness, too clayey.
50 Cotter	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, frost action.	Slight.
51B Deepwater	Moderate: too clayey, wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
51C2 Deepwater	Moderate: too clayey, wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
52 Moniteau	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.
53 Quarles	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: low strength, wetness.	Severe: wetness.
54B Bucklick	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
55B Bolivar	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: depth to rock.
55C Bolivar	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Moderate: low strength, shrink-swell.	Moderate: depth to rock.
56B Barco	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: depth to rock.
56C Barco	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Moderate: low strength, shrink-swell.	Moderate: depth to rock.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
57B Liberal	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
58 Hartwell	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: low strength, wetness, shrink-swell.	Severe: wetness.
59B Hartville	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Moderate: wetness.
60B Barden	Severe: wetness.	Severe: shrink-swell.	Severe: wetness.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
61B Summit	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
66C Eldorado	Moderate: too clayey.	Slight	Moderate: shrink-swell.	Moderate: slope.	Slight	Moderate: small stones, droughty.
66D Eldorado	Moderate: too clayey, slope.	Moderate: slope.	Moderate: shrink-swell, slope.	Severe: slope.	Moderate: slope.	Moderate: small stones, droughty, slope.
67C Bardley	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: low strength.	Moderate: small stones, depth to rock.
67D Bardley	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Severe: low strength.	Moderate: small stones, depth to rock.
68D Collinsville	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: depth to rock.
69C Goss	Moderate: too clayey, large stones.	Moderate: shrink-swell, large stones.	Moderate: shrink-swell, large stones.	Moderate: shrink-swell, slope, large stones.	Moderate: low strength, frost action.	Severe: droughty.
69D Goss	Moderate: too clayey, large stones, slope.	Moderate: shrink-swell, slope, large stones.	Moderate: slope, shrink-swell, large stones.	Severe: slope.	Moderate: low strength, slope, frost action.	Severe: droughty.
69E Goss	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty.
70E 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.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
72E---------------- Gasconade	Severe: depth to rock, large stones, slope.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: large stones, slope, depth to rock.
75B---------------- Newtonia	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
94----------------- Kanima	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
95. Aquents						

TABLE 12.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
11-----Verdigris	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
15-----Cleora	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding, seepage.	Good.
16-----Cedargap	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding, seepage.	Poor: small stones.
21-----Osage	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
50-----Cotter	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
51B-----Deepwater	Severe: wetness.	Severe: wetness.	Moderate: wetness, too clayey.	Slight	Poor: thin layer.
51C2-----Deepwater	Severe: wetness.	Severe: slope, wetness.	Moderate: wetness, too clayey.	Slight	Poor: thin layer.
52-----Moniteau	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
53-----Quarles	Severe: wetness, percs slowly.	Slight	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
54B-----Bucklick	Moderate: percs slowly.	Moderate: seepage, slope.	Severe: too clayey.	Slight	Poor: too clayey.
55B-----Bolivar	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
55C-----Bolivar	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
56B-----Barco	Severe: depth to rock.	Severe: seepage, depth to rock.	Severe: depth to rock.	Severe: depth to rock, seepage.	Poor: depth to rock.
56C-----Barco	Severe: depth to rock.	Severe: seepage, depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock, seepage.	Poor: depth to rock.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
57B----------------- Liberal	Severe: wetness, percs slowly.	Moderate: depth to rock, slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock, wetness.	Poor: too clayey, hard to pack.
58------------------ Hartwell	Severe: wetness, percs slowly.	Slight-----------	Severe: wetness.	Severe: wetness.	Poor: wetness.
59B----------------- Hartville	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
60B----------------- Barden	Severe: wetness, percs slowly.	Moderate: slope.	Moderate: wetness, too clayey.	Moderate: wetness.	Fair: too clayey, wetness.
61B----------------- Summit	Severe: wetness, percs slowly.	Severe: wetness.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
66C----------------- Eldorado	Moderate: percs slowly.	Moderate: seepage, slope.	Severe: too clayey.	Slight-----------	Poor: too clayey, small stones.
66D----------------- Eldorado	Moderate: percs slowly, slope.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, small stones.
67C----------------- Bardley	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
67D----------------- Bardley	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
68D----------------- Collinsville	Severe: depth to rock.	Severe: depth to rock, slope, seepage.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: depth to rock.
69C----------------- Goss	Moderate: percs slowly, large stones.	Severe: seepage.	Severe: too clayey, large stones.	Severe: seepage.	Poor: too clayey, small stones.
69D----------------- Goss	Moderate: percs slowly, slope, large stones.	Severe: seepage, slope.	Severe: too clayey, large stones.	Severe: seepage.	Poor: too clayey, small stones.
69E----------------- Goss	Severe: slope.	Severe: seepage, slope.	Severe: slope, too clayey, large stones.	Severe: seepage, slope.	Poor: too clayey, small stones, slope.
70E----------------- 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.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
72E----------------- Gasconade	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: depth to rock, too clayey, large stones.
75B----------------- Newtonia	Moderate: percs slowly.	Moderate: seepage, slope.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
94------------------ Kanima	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: small stones, slope.
95. Aquents					

TABLE 13.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
11-------------------- Verdigris	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
15-------------------- Cleora	Good-----------------	Improbable: excess fines.	Improbable: excess fines.	Good.
16-------------------- Cedargap	Good-----------------	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
21-------------------- Osage	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
50-------------------- Cotter	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
51B, 51C2------------- Deepwater	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, thin layer.
52-------------------- Moniteau	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
53-------------------- Quarles	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
54B------------------- Bucklick	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
55B, 55C-------------- Bolivar	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, small stones.
56B, 56C-------------- Barco	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, small stones.
57B------------------- Liberal	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
58-------------------- Hartwell	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
59B------------------- Hartville	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
60B------------------- Barden	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
61B-------------------- Summit	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
66C, 66D-------------- Eldorado	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones, area reclaim.
67C, 67D-------------- Bardley	Poor: depth to rock, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones.
68D-------------------- Collinsville	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones, depth to rock.
69C, 69D-------------- Goss	Fair: low strength, large stones.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
69E-------------------- Goss	Fair: low strength, large stones, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
70E-------------------- Hector	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
72E-------------------- Gasconade	Poor: depth to rock, large stones.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: depth to rock, large stones.
75B-------------------- Newtonia	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
94--------------------- Kanima	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
95. Aquents				

TABLE 14.--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. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation]

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
11 Verdigris	Moderate: seepage.	Moderate: piping.	Deep to water	Flooding	Favorable	Favorable.
15 Cleora	Severe: seepage.	Severe: piping.	Deep to water	Flooding	Favorable	Favorable.
16 Cedargap	Severe: seepage.	Severe: seepage.	Deep to water	Flooding	Large stones	Favorable.
21 Osage	Slight	Severe: hard to pack, wetness.	Percs slowly, flooding.	Wetness, droughty, slow intake.	Wetness, percs slowly.	Wetness, droughty, percs slowly.
50 Cotter	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
51B, 51C2 Deepwater	Moderate: seepage, slope.	Slight	Deep to water	Slope	Erodes easily	Erodes easily.
52 Moniteau	Slight	Severe: wetness.	Frost action	Wetness, erodes easily.	Erodes easily, wetness.	Wetness, erodes easily.
53 Quarles	Slight	Severe: wetness.	Percs slowly	Wetness, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly.
54B Bucklick	Moderate: seepage, slope.	Slight	Deep to water	Slope	Favorable	Favorable.
55B, 55C Bolivar	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Deep to water	Soil blowing, depth to rock, slope.	Depth to rock, soil blowing.	Depth to rock.
56B, 56C Barco	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Deep to water	Soil blowing, depth to rock, slope.	Depth to rock, soil blowing.	Depth to rock.
57B Liberal	Moderate: depth to rock, slope.	Moderate: thin layer, hard to pack, wetness.	Percs slowly, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness.	Erodes easily, percs slowly.
58 Hartwell	Slight	Severe: wetness.	Percs slowly	Wetness, percs slowly.	Erodes easily, wetness.	Wetness, erodes easily, percs slowly.
59B Hartville	Moderate: slope.	Moderate: hard to pack, wetness.	Percs slowly, frost action.	Slope, wetness, percs slowly.	Erodes easily, wetness.	Erodes easily, percs slowly.
60B Barden	Moderate: slope.	Moderate: wetness.	Percs slowly, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness, percs slowly.	Erodes easily, percs slowly.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
61B: Summit	Moderate: slope.	Moderate: hard to pack, wetness.	Percs slowly, slope.	Percs slowly, slope.	Wetness, percs slowly, erodes easily.	Erodes easily, percs slowly.
66C: Eldorado	Moderate: large stones.	Slight	Deep to water	Droughty, slope.	Large stones	Droughty, large stones.
66D: Eldorado	Moderate: large stones.	Slight	Deep to water	Droughty, slope.	Slope, large stones.	Droughty, slope, large stones.
67C: Bardley	Moderate: seepage, depth to rock, slope.	Severe: piping, hard to pack.	Deep to water	Droughty, slope.	Depth to rock	Droughty, depth to rock.
67D: Bardley	Severe: slope.	Severe: piping, hard to pack.	Deep to water	Droughty, slope.	Slope, depth to rock.	Droughty, depth to rock, slope.
68D: Collinsville	Severe: depth to rock, slope, seepage.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Slope, depth to rock, large stones.	Slope, depth to rock, large stones.
69C: Goss	Moderate: seepage, slope.	Severe: large stones.	Deep to water	Large stones, droughty, slope.	Large stones	Large stones, droughty.
69D, 69E: Goss	Severe: slope.	Severe: large stones.	Deep to water	Large stones, droughty, slope.	Slope, large stones.	Large stones, slope, droughty.
70E: Hector	Severe: depth to rock, seepage.	Severe: thin layer, piping.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
72E: Gasconade	Severe: depth to rock, slope.	Severe: large stones.	Deep to water	Slope, large stones, droughty.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
75B: Newtonia	Moderate: seepage.	Moderate: hard to pack.	Deep to water	Erodes easily	Erodes easily	Erodes easily.
94: Kanima	Severe: slope.	Slight	Deep to water	Droughty, slope.	Slope	Slope, droughty.
95. Aquents						

TABLE 15.--ENGINEERING INDEX PROPERTIES

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

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
11 Verdigris	0-40	Silt loam	CL, CL-ML, ML	A-4, A-6	0	100	100	95-100	65-100	22-38	2-13
	40-72	Silt loam, silty clay loam.	CL	A-4, A-6, A-7	0	100	100	95-100	80-100	30-45	8-23
15 Cleora	0-19	Fine sandy loam	SM, ML, CL-ML, SM-SC	A-4	0	100	98-100	94-100	36-60	<26	NP-7
	19-72	Loam, fine sandy loam.	SM, SC, ML, CL	A-4	0	100	98-100	94-100	36-85	<31	NP-10
16 Cedargap	0-7	Silt loam	ML	A-4	0-5	90-100	85-95	75-95	70-95	25-35	3-9
	7-24	Cherty silt loam, cherty loam, very cherty silt loam.	SM, GM	A-1, A-2, A-4	2-15	40-85	20-65	15-45	15-40	25-35	3-9
	24-72	Very cherty silty clay loam, extremely cherty clay loam, extremely cherty loam.	GC	A-2-6, A-6	5-20	25-50	20-50	15-45	15-40	30-40	15-25
21 Osage	0-25	Silty clay	CH	A-7	0	100	100	100	95-100	50-75	30-55
	25-72	Silty clay, clay, silty clay loam.	CH, CL	A-7	0	100	100	100	95-100	40-80	20-50
50 Cotter	0-9	Silt loam	CL	A-6	0	100	100	90-100	80-95	30-40	13-20
	9-60	Silty clay loam, silt loam.	CL	A-6	0	100	100	95-100	80-90	30-40	14-22
51B, 51C2 Deepwater	0-17	Silt loam	CL	A-4, A-6	0	100	100	90-100	70-95	25-40	7-15
	17-33	Silty clay loam, clay loam.	CL	A-6, A-7	0	100	85-100	80-100	75-95	35-50	15-26
	33-48	Silty clay	CH	A-7	0	100	100	90-100	90-100	50-60	30-40
	48-72	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	80-100	35-45	15-25
52 Moniteau	0-29	Silt loam	CL-ML, CL	A-4, A-6	0	100	100	90-100	85-100	25-35	5-15
	29-72	Silty clay loam	CL	A-6, A-7	0	100	100	85-100	80-95	30-45	15-25
53 Quarles	0-17	Silt loam	CL	A-4, A-6	0	100	100	95-100	85-100	30-40	8-18
	17-29	Silt loam	CL	A-4, A-6	0	100	100	95-100	85-100	30-40	8-18
	29-72	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	95-100	90-100	40-60	20-35
54B Bucklick	0-7	Silt loam	CL-ML, CL	A-4, A-6	0	100	100	95-100	80-95	25-40	5-15
	7-18	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	95-100	90-98	30-45	15-30
	18-47	Clay, silty clay	CL	A-7	0	95-100	95-100	90-100	80-95	40-50	20-30
	47-70	Silty clay loam	CL	A-6, A-7	0-5	95-100	90-100	80-90	75-85	30-45	15-30
55B, 55C Bolivar	0-8	Fine sandy loam	ML, SM	A-4	0	100	90-100	70-95	40-55	20-30	NP-5
	8-26	Loam, sandy clay loam, clay loam.	CL, SC	A-6	0-10	85-100	85-100	70-95	45-80	25-40	10-25
	26-44	Weathered bedrock	---	---	---	---	---	---	---	---	---
	44	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
56B, 56C--------- Barco	0-15	Fine sandy loam	ML, SM, SM-SC, CL-ML	A-4	0	100	100	70-85	40-55	15-25	2-7
	15-30	Loam, sandy clay loam, clay loam.	CL, SC	A-6	0-5	85-100	75-100	75-100	45-80	25-40	11-22
	30-44	Weathered bedrock	---	---	---	---	---	---	---	---	---
	44	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
57B-------------- Liberal	0-6	Silt loam--------	CL	A-6	0	100	100	90-100	75-95	25-35	10-15
	6-46	Silty clay loam, silty clay, clay loam.	CL, CH	A-7	0	100	100	95-100	90-95	40-60	25-40
	46-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
58--------------- Hartwell	0-18	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	95-100	80-100	20-35	5-15
	18-46	Clay, silty clay	CH	A-7	0	100	100	95-100	90-100	50-65	30-40
	46-60	Silt loam, silty clay loam, silty clay.	CL	A-6, A-7	0	100	100	95-100	90-100	35-45	20-25
59B-------------- Hartville	0-7	Silt loam--------	ML, CL	A-4, A-6	0-5	95-100	95-100	80-95	70-90	30-40	7-15
	7-17	Silt loam, silty clay loam.	CL	A-6, A-7	0-10	95-100	95-100	90-98	85-95	35-45	20-25
	17-60	Silty clay, clay, silty clay loam.	CH	A-7	0-10	95-100	95-100	90-98	85-95	50-60	30-40
	60-72	Very cherty silty clay, cherty silty clay loam, very cherty clay.	CH, GC, SC	A-7	5-35	60-85	50-80	45-75	35-65	50-60	30-40
60B-------------- Barden	0-10	Silt loam--------	CL	A-4, A-6	0	100	100	90-100	75-85	25-35	8-15
	10-13	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	80-90	30-45	15-25
	13-26	Silty clay, silty clay loam, clay loam.	CL, CH	A-7	0	100	100	90-100	80-95	40-60	25-40
	26-72	Silty clay loam, clay loam.	CL	A-6, A-7	0	100	100	90-100	75-95	30-45	15-25
61B-------------- Summit	0-12	Silty clay loam	CL, CH	A-6, A-7	0	90-100	90-100	85-100	80-99	35-60	11-30
	12-16	Silty clay, silty clay loam, clay.	CL, CH	A-7, A-6	0	85-100	85-100	80-100	80-99	37-65	15-35
	16-72	Clay, silty clay	CH, CL	A-7	0	85-100	85-100	80-100	80-98	41-70	18-40
66C, 66D--------- Eldorado	0-8	Cherty silt loam	SM, SC, CL, ML	A-2, A-4	0-10	55-80	50-75	45-75	30-70	22-31	2-10
	8-46	Very cherty silt loam, extremely cherty silty clay loam.	GC	A-2, A-4, A-6	0-40	25-55	20-50	15-50	13-48	30-40	10-17
	46-72	Very cherty silty clay, extremely cherty silty clay loam.	GC	A-2, A-6, A-7	0-40	25-55	20-50	20-50	17-48	37-55	15-28
67C, 67D--------- Bardley	0-13	Cherty silt loam, extremely cherty loam.	GC, CL, SC, CL-ML	A-6, A-4	0-15	60-90	50-75	50-70	45-65	25-35	5-15
	13-29	Silty clay, clay, cherty clay.	MH, GM, SM	A-7	0-10	70-95	50-95	50-90	40-85	50-70	20-35
	29	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
68D-------------- Collinsville	0-9	Fine sandy loam	SM, ML, CL-ML, SM-SC	A-4, A-2	0-15	85-100	85-100	75-95	30-60	<26	NP-7
	9-15	Fine sandy loam, loam, stony fine sandy loam.	SM, SC, ML, CL	A-4, A-2	0-45	55-100	55-100	50-95	20-85	<30	NP-10
	15	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
69C-------------- Goss	0-6	Cherty silt loam	ML, CL, CL-ML	A-4	0-10	65-90	65-90	65-90	65-85	20-30	2-8
	6-26	Very cherty silty clay loam, very cherty silt loam.	GM, GC, GM-GC	A-2	10-40	40-60	35-55	30-50	25-35	20-30	2-8
	26-60	Cherty silty clay loam, very cherty silty clay, very cherty clay.	GC	A-7	10-45	45-70	40-65	40-50	35-45	50-70	30-40
	60-72	Silty clay, clay, cherty clay.	CL, CH	A-7	0-10	70-100	70-100	70-95	70-95	45-65	20-35
69D, 69E--------- Goss	0-6	Cherty silt loam	ML, CL, CL-ML	A-4	0-10	65-90	65-90	65-90	65-85	20-30	2-8
	6-15	Very cherty silty clay loam, very cherty silt loam.	GM, GC, GM-GC	A-2	10-40	40-60	35-55	30-50	25-35	20-30	2-8
	15-60	Cherty silty clay loam, very cherty silty clay, very cherty clay.	GC	A-7	10-45	45-70	40-65	40-50	35-45	50-70	30-40
	60-72	Silty clay, clay, cherty clay.	CL, CH	A-7	0-10	70-100	70-100	70-95	70-95	45-65	20-35
70E-------------- Hector	0-5	Fine sandy loam	SM, ML, GM, GM-GC	A-4, A-2	15-35	60-85	50-75	40-65	30-55	<30	NP-7
	5-17	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
	17	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
72E-------------- Gasconade	0-4	Flaggy silty clay loam.	CL	A-6	20-50	75-90	70-85	60-75	55-65	30-40	15-25
	4-10	Flaggy silty clay, flaggy clay, very flaggy silty clay.	GC	A-2-7	20-70	45-55	40-50	30-40	20-35	55-65	35-45
	10	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
75B-------------- Newtonia	0-12	Silt loam--------	CL	A-4, A-6	0	100	100	96-100	65-97	30-37	9-14
	12-15	Silt loam, silty clay loam.	CL	A-4, A-6	0	100	100	96-100	80-98	30-40	9-16
	15-72	Silty clay loam, silty clay, clay.	CL, CH	A-6, A-7	0	100	100	96-100	90-98	37-60	15-34

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
94--------------- Kanima	0-8	Shaly silty clay	CH, SC	A-7	0-10	50-75	50-75	50-75	40-75	40-50	18-30
	8-72	Very shaly clay loam, very shaly silty clay loam, very shaly loam.	GC, GP-GC	A-2, A-4, A-6	0-10	5-50	5-50	5-50	5-49	30-40	8-18
95. Aquents											

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

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

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
11--------------- Verdigris	0-40 40-72	15-27 18-35	1.30-1.40 1.40-1.45	0.6-2.0 0.6-2.0	0.20-0.24 0.17-0.22	5.6-7.3 5.6-7.3	Low----------- Moderate-----	0.32 0.32	5	6	2-4
15--------------- Cleora	0-19 19-72	10-18 10-18	1.30-1.60 1.40-1.70	2.0-6.0 2.0-6.0	0.11-0.15 0.11-0.20	5.6-7.3 5.6-7.3	Low----------- Low-----------	0.20 0.32	5	3	1-3
16--------------- Cedargap	0-7 7-24 24-72	15-27 12-27 25-35	1.20-1.40 1.30-1.50 1.40-1.55	0.6-2.0 2.0-6.0 2.0-6.0	0.22-0.24 0.10-0.15 0.04-0.10	5.6-7.3 5.6-7.3 5.6-7.3	Low----------- Low----------- Low-----------	0.32 0.24 0.10	5	6	1-4
21--------------- Osage	0-25 25-72	40-50 35-60	1.40-1.60 1.50-1.70	<0.06 <0.06	0.12-0.14 0.08-0.12	5.1-7.8 5.6-7.8	Very high---- Very high----	0.28 0.28	5	4	1-4
50--------------- Cotter	0-9 9-60	18-32 25-35	1.35-1.45 1.25-1.40	0.6-2.0 0.6-2.0	0.23-0.26 0.21-0.23	5.6-7.8 5.1-7.3	Moderate----- Moderate-----	0.32 0.43	5	7	3-4
51B, 51C2-------- Deepwater	0-17 17-33 33-48 48-72	15-27 27-35 40-45 30-40	1.20-1.40 1.40-1.60 1.40-1.60 1.40-1.60	0.6-2.0 0.6-2.0 0.6-2.0 0.6-2.0	0.21-0.24 0.18-0.20 0.16-0.18 0.18-0.20	5.1-7.3 5.1-6.5 5.1-6.5 5.1-6.5	Low----------- Moderate----- High---------- Moderate-----	0.32 0.43 0.32 0.32	5	7	2-4
52--------------- Moniteau	0-29 29-72	18-27 27-35	1.20-1.40 1.30-1.50	0.6-2.0 0.2-0.6	0.21-0.23 0.18-0.20	5.1-6.5 4.5-6.0	Low----------- Moderate-----	0.43 0.43	3	6	1-2
53--------------- Quarles	0-17 17-29 29-72	20-27 20-27 35-50	1.20-1.40 1.20-1.40 1.40-1.60	0.2-0.6 0.2-0.6 0.06-0.2	0.22-0.24 0.22-0.24 0.12-0.20	5.1-7.3 4.5-6.0 4.5-6.5	Low----------- Low----------- High----------	0.32 0.32 0.32	3	6	1-3
54B-------------- Bucklick	0-7 7-18 18-47 47-70	20-25 25-40 40-45 35-40	1.35-1.45 1.30-1.40 1.25-1.35 1.25-1.55	2.0-6.0 0.6-2.0 0.6-2.0 0.6-2.0	0.20-0.24 0.18-0.20 0.10-0.14 0.16-0.20	5.1-7.3 4.5-6.0 4.5-6.0 4.5-6.0	Low----------- Moderate----- Moderate----- Moderate-----	0.32 0.32 0.32 0.32	5	6	2-4
55B, 55C--------- Bolivar	0-8 8-26 26-44 44	12-18 20-35 --- ---	1.20-1.45 1.30-1.50 --- ---	2.0-6.0 0.6-2.0 --- ---	0.16-0.18 0.12-0.16 --- ---	5.1-6.0 4.5-6.0 --- ---	Low----------- Moderate----- -------------- --------------	0.24 0.32 ---- ----	4	3	.5-2
56B, 56C--------- Barco	0-15 15-30 30-44 44	10-20 18-35 --- ---	1.40-1.55 1.40-1.60 --- ---	2.0-6.0 0.6-2.0 --- ---	0.16-0.18 0.12-0.16 --- ---	5.1-6.0 4.5-6.5 --- ---	Low----------- Moderate----- -------------- --------------	0.24 0.32 ---- ----	4	3	1-3
57B-------------- Liberal	0-6 6-46 46-60	20-30 35-50 ---	1.35-1.50 1.25-1.40 ---	0.6-2.0 0.06-0.2 ---	0.20-0.24 0.11-0.20 ---	4.5-6.0 4.5-6.5 ---	Low----------- High---------- --------------	0.37 0.37 ----	3	6	1-2
58--------------- Hartwell	0-18 18-46 46-60	15-32 40-55 25-45	1.30-1.40 1.30-1.40 1.30-1.40	0.2-0.6 0.06-0.2 0.06-0.2	0.22-0.24 0.09-0.13 0.18-0.20	5.1-7.3 5.1-6.5 5.1-7.3	Low----------- High---------- Moderate-----	0.43 0.32 0.43	3	6	2-4
59B-------------- Hartville	0-7 7-17 17-60 60-72	20-27 24-40 35-60 35-60	1.10-1.30 1.20-1.40 1.20-1.50 1.20-1.50	0.6-2.0 0.06-0.2 0.06-0.2 0.06-0.2	0.22-0.24 0.18-0.21 0.10-0.12 0.05-0.09	4.5-5.5 4.5-5.5 4.5-6.5 6.6-7.3	Low----------- Moderate----- High---------- High----------	0.43 0.43 0.32 0.32	3	6	1-3

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
60B----------------- Barden	0-10	15-27	1.40-1.50	0.6-2.0	0.21-0.24	5.1-7.3	Low----------	0.37	4	6	1-2
	10-13	28-35	1.35-1.45	0.2-0.6	0.18-0.20	4.5-6.5	Moderate-----	0.37			
	13-26	36-55	1.25-1.40	0.06-0.2	0.11-0.19	4.5-6.5	High---------	0.37			
	26-72	28-40	1.30-1.45	0.2-0.6	0.10-0.14	4.5-6.5	Moderate-----	0.37			
61B----------------- Summit	0-12	27-45	1.25-1.50	0.2-0.6	0.16-0.20	5.6-7.3	Moderate-----	0.37	5	7	1-3
	12-16	32-45	1.35-1.65	0.2-0.6	0.10-0.18	5.6-7.3	High---------	0.37			
	16-72	40-60	1.35-1.60	0.06-0.2	0.10-0.18	5.6-8.4	High---------	0.32			
66C, 66D----------- Eldorado	0-8	18-26	1.30-1.50	0.6-2.0	0.04-0.20	5.1-6.5	Low----------	0.28	3	8	1-3
	8-46	18-35	1.30-1.50	0.6-2.0	0.06-0.10	5.1-6.5	Low----------	0.24			
	46-72	35-45	1.35-1.65	0.6-2.0	0.05-0.09	5.1-6.0	Moderate-----	0.20			
67C, 67D----------- Bardley	0-13	18-27	1.40-1.55	0.6-2.0	0.12-0.17	4.5-6.5	Low----------	0.28	3	8	.5-2
	13-29	60-85	1.20-1.40	0.6-2.0	0.08-0.12	4.5-6.5	Moderate-----	0.28			
	29	---	---	---	---	---	-------------	----			
68D----------------- Collinsville	0-9	5-20	1.30-1.60	2.0-6.0	0.09-0.15	4.5-6.5	Low----------	0.20	1	5	1-3
	9-15	5-20	1.40-1.70	2.0-6.0	0.07-0.20	4.5-6.5	Low----------	0.20			
	15	---	---	---	---	---	-------------	----			
69C----------------- Goss	0-6	7-27	1.10-1.30	2.0-6.0	0.06-0.17	4.5-6.0	Low----------	0.24	2	6	1-2
	6-26	20-30	1.10-1.30	2.0-6.0	0.06-0.10	4.5-6.0	Low----------	0.10			
	26-60	35-60	1.30-1.50	0.6-2.0	0.04-0.09	4.5-6.0	Moderate-----	0.10			
	60-72	50-90	1.40-1.60	0.6-2.0	0.06-0.10	4.5-7.3	Moderate-----	0.24			
69D, 69E----------- Goss	0-6	7-27	1.10-1.30	2.0-6.0	0.06-0.17	4.5-6.0	Low----------	0.24	2	6	1-2
	6-15	20-30	1.10-1.30	2.0-6.0	0.06-0.10	4.5-6.0	Low----------	0.10			
	15-60	35-60	1.30-1.50	0.6-2.0	0.04-0.09	4.5-6.0	Moderate-----	0.10			
	60-72	50-90	1.40-1.60	0.6-2.0	0.06-0.10	4.5-7.3	Moderate-----	0.24			
70E----------------- Hector	0-5	5-20	1.30-1.60	2.0-6.0	0.08-0.12	5.1-6.5	Low----------	0.17	1	8	---
	5-17	10-25	1.30-1.60	2.0-6.0	0.08-0.15	4.5-5.5	Low----------	0.17			
	17	---	---	---	---	---	-------------	----			
72E----------------- Gasconade	0-4	35-50	1.35-1.50	0.6-2.0	0.10-0.12	6.1-7.8	Moderate-----	0.20	2	8	2-4
	4-10	35-60	1.45-1.70	0.2-0.6	0.05-0.07	6.1-7.8	Moderate-----	0.20			
	10	---	---	---	---	---	-------------	----			
75B----------------- Newtonia	0-12	10-24	1.30-1.55	0.6-2.0	0.15-0.24	5.6-6.5	Low----------	0.37	5	5	1-3
	12-15	20-35	1.40-1.70	0.6-2.0	0.16-0.22	5.1-6.5	Moderate-----	0.37			
	15-72	32-45	1.35-1.65	0.6-2.0	0.12-0.20	5.1-6.0	Moderate-----	0.32			
94------------------ Kanima	0-8	40-50	1.30-1.55	0.2-0.6	0.10-0.14	3.6-8.4	Moderate-----	0.28	4	8	.5-2
	8-72	18-35	1.40-1.70	0.6-2.0	0.02-0.12	3.6-8.4	Low----------	0.28			
95. Aquents											

TABLE 17.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "long," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Soil name and map symbol	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			
11-----Verdigris	B	Occasional	Very brief	Nov-May	>6.0	---	---	>60	---	Low------	Low.
15-----Cleora	B	Occasional	Very brief	Nov-May	>6.0	---	---	>60	---	Low------	Moderate.
16-----Cedargap	B	Frequent----	Very brief	Nov-May	>6.0	---	---	>60	---	Low------	Low.
21-----Osage	D	Occasional	Very brief to long.	Nov-May	0-1.0	Apparent	Nov-May	>60	---	High-----	Moderate.
50-----Cotter	B	Rare--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate.
51B, 51C2-----Deepwater	B	None--------	---	---	3.0-4.5	Perched	Nov-Mar	>60	---	High-----	Moderate.
52-----Moniteau	C/D	Rare--------	---	---	0-1.0	Perched	Nov-May	>60	---	High-----	High.
53-----Quarles	D	Rare--------	---	---	0-1.5	Perched	Nov-May	>60	---	High-----	Moderate.
54B-----Bucklick	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate.
55B, 55C-----Bolivar	B	None--------	---	---	>6.0	---	---	20-40	Soft	Low------	Moderate.
56B, 56C-----Barco	B	None--------	---	---	>6.0	---	---	20-40	Soft	Low------	Moderate.
57B-----Liberal	D	None--------	---	---	2.0-3.0	Perched	Nov-Mar	40-60	Soft	High-----	High.
58-----Hartwell	D	None--------	---	---	0.5-1.5	Perched	Nov-Apr	>60	---	High-----	Moderate.
59B-----Hartville	C	None--------	---	---	1.5-3.0	Perched	Nov-Apr	>60	---	Moderate	Moderate.
60B-----Barden	C	None--------	---	---	2.0-3.0	Perched	Nov-Apr	>60	---	High-----	Moderate.
61B-----Summit	C	None--------	---	---	2.0-3.0	Perched	Nov-Apr	>60	---	High-----	Low.
66C, 66D-----Eldorado	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Moderate.
67C, 67D-----Bardley	C	None--------	---	---	>6.0	---	---	20-40	Hard	Moderate	Moderate.
68D-----Collinsville	D	None--------	---	---	>6.0	---	---	4-20	Hard	Low------	Moderate.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard-ness	Uncoated steel	Concrete
					Ft			In			
69C, 69D, 69E----- Goss	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate.
70E--------------- Hector	D	None--------	---	---	>6.0	---	---	10-20	Hard	Low------	Moderate.
72E--------------- Gasconade	D	None--------	---	---	>6.0	---	---	4-20	Hard	High-----	Low.
75B--------------- Newtonia	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate.
94---------------- Kanima	C	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low.
95. Aquents											

TABLE 18.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series]

Soil name	Family or higher taxonomic class
Aquents	Clayey, mixed, mesic Typic Fluvaquents
Barco	Fine-loamy, mixed, thermic Mollic Hapludalfs
Barden	Fine, mixed, thermic Aquollic Hapludalfs
Bardley	Very fine, mixed, mesic Typic Hapludalfs
*Bolivar	Fine-loamy, mixed, thermic Ultic Hapludalfs
Bucklick	Fine, mixed, mesic Typic Hapludalfs
Cedargap	Loamy-skeletal, mixed, mesic Cumulic Hapludolls
Cleora	Coarse-loamy, mixed, thermic Fluventic Hapludolls
Collinsville	Loamy, siliceous, thermic Lithic Hapludolls
Cotter	Fine-silty, mixed, mesic Typic Argiudolls
Deepwater	Fine-silty, mixed, thermic Typic Argiudolls
Eldorado	Loamy-skeletal, mixed, thermic Typic Paleudolls
Gasconade	Clayey-skeletal, mixed, mesic Lithic Hapludolls
Goss	Clayey-skeletal, mixed, mesic Typic Paleudalfs
Hartville	Fine, mixed, mesic Aquic Hapludalfs
Hartwell	Fine, mixed, thermic Typic Argialbolls
Hector	Loamy, siliceous, thermic Lithic Dystrochrepts
*Kanima	Loamy-skeletal, mixed, nonacid, thermic Udalfic Arents
Liberal	Fine, mixed, thermic Aquollic Hapludalfs
Moniteau	Fine-silty, mixed, mesic Typic Ochraqualfs
Newtonia	Fine-silty, mixed, thermic Typic Paleudolls
Osage	Fine, montmorillonitic, thermic Vertic Haplaquolls
Quarles	Fine, mixed, thermic Mollic Ochraqualfs
Summit	Fine, montmorillonitic, thermic Vertic Argiudolls
Verdigris	Fine-silty, mixed, thermic Cumulic Hapludolls

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