United States
Department of
Agriculture

Natural
Resources
Conservation
Service

In cooperation with
Missouri Department of
Natural Resources and
Missouri Agricultural
Experiment Station

Soil Survey of Mercer County, Missouri

How To Use This Soil Survey

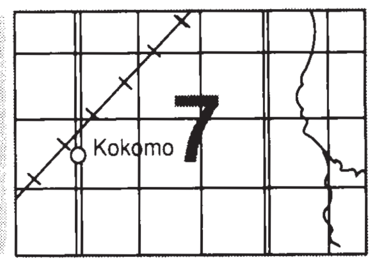
General Soil Map

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.

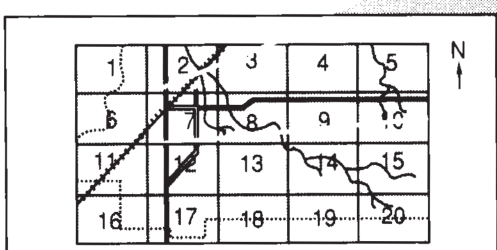
Detailed Soil Maps

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



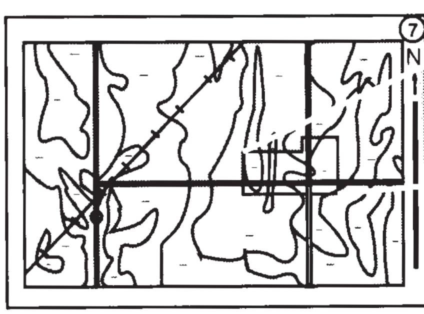
MAP SHEET

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.



INDEX TO MAP SHEETS

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.



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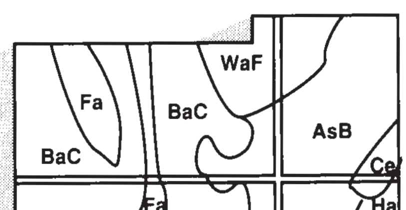

AREA OF INTEREST

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 Natural Resources Conservation Service (formerly the Soil Conservation Service) has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1992. Soil names and descriptions were approved in 1993. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1993. This survey was made cooperatively by the Natural Resources Conservation Service, the Missouri Department of Natural Resources, and the Missouri Agricultural Experiment Station. It is part of the technical assistance furnished to the Mercer County Soil and Water Conservation District.

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

All programs and services of the Natural Resources Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

Cover: Typical landscape in an area of the Adair-Armstrong-Grundy association.

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Summary of Tables

Foreword

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

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to 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 Natural Resources Conservation Service or the Cooperative Extension Service.

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Soil Survey of
Mercer County, Missouri

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Fieldwork by Buddy Festervand, Clayton Lee, and Chad Remley, Natural Resources Conservation Service, and Ronald Campbell and Anthony Dohmen, Missouri Department of Natural Resources

United States Department of Agriculture, Natural Resources Conservation Service, in cooperation with the
Missouri Department of Natural Resources and the Missouri Agricultural Experiment Station

MERCER COUNTY is in the north-central part of Missouri (fig. 1). It has an area of 291,488 acres, or about 456 square miles. Of this total, 420 acres is made up of bodies of water more than 40 acres in size. Princeton, the county seat, is located in the center of the county.

Mercer County is bounded on the north by Decatur and Wayne Counties in Iowa; on the south by Grundy County, Missouri; on the west by Harrison County, Missouri; and on the east by Putnam and Sullivan Counties in Missouri. The county is about 21 miles from east to west and 21 miles from north to south.

The major land resource area in the county is the Iowa and Missouri Heavy Till Plain (Austin, 1965). Major soils in this area include Adair, Armstrong, and Grundy soils on ridges and Gara, Shelby, and Winnegan soils on side slopes. Humeston, Nodaway, and Zook soils are on bottom land.

Farming is the main enterprise in the county. The principal crops are soybeans, corn, wheat, and hay for livestock. Beef and dairy cattle, hogs, and sheep are commonly raised in the county. The county has some forested areas on the flood plains along major creeks and rivers.

Figure 1.—Location of Mercer County in Missouri.

General Nature of the County

This section provides some general information about Mercer County. It describes climate, history and development, and relief and drainage.

Climate

Table 1 gives data on temperature and precipitation for the survey area as recorded at Princeton in the period 1963 to 1993. 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 27 degrees F and the average daily minimum temperature is 17 degrees. The lowest temperature on record, which occurred at Princeton on January 22, 1930, is -26 degrees. In summer, the average temperature is 74 degrees and the average daily maximum temperature is 86 degrees. The highest recorded temperature, which occurred at Princeton on July 15, 1936, is 114 degrees.

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

The total annual precipitation is about 35 inches. Of this, about 24 inches, or 68 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 20 inches. The heaviest 1-day rainfall during the period of record was 5.75 inches at Princeton on September 18, 1978. Thunderstorms occur on about 50 days each year, and most occur in June.

The average seasonal snowfall is about 19 inches. The greatest snow depth at any one time during the period of record was 30 inches. On the average, 17 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 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 70 percent of the time possible in summer and 55 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 13 miles per hour, in March.

History and Development

Before the first permanent settler arrived in the survey area in 1837, the land was used as hunting grounds by the Sac, Fox, and Iowa Indians. The settlers began arriving from the south and located in the timbered areas along the major streams. Mercer County was organized on February 14, 1845. It was named in honor of General Hugh Mercer, a Revolutionary War hero (Rogers and Rogers, 1911). Princeton, the county seat, was named for the battle in which General Mercer lost his life.

Most early settlers lived along streams because of the availability of water and wood. The soils in these areas were easier to cultivate than the prairie soils. Also, most big game species were more abundant in these areas.

Early settlers practiced subsistence agriculture; that is, they produced only what they needed because they had no reasonable means of transporting surplus products the long distances to established markets. Indian corn, small grain, vegetables, hay, and livestock were the most important agricultural products.

The railroad movement in the early 1870's allowed agriculture to become more profit-oriented. By 1923, Princeton was one of the biggest livestock shipping points in the Missouri Division of the Rock Island Railroad (Missouri Agricultural Statistics Service, 1992).

Agriculture has always been the dominant enterprise in the county. About 30 percent of the land in the county is used for the production of crops, such as corn, soybeans, small grain, and hay. Pastureland for livestock makes up about 35 percent of the acreage, and woodland makes up 10 percent. About 15 percent of the acreage is in the Conservation Reserve Program (Missouri Agricultural Statistics Service, 1992).

Population and farming trends in Mercer County are similar to those of other counties in northern Missouri. The population of Mercer County peaked in 1900 at approximately 14,500. Since then, in conjunction with a trend towards fewer but larger farms, the population has dropped. In 1989, for instance, the population of the county was about 4,000 (Missouri Agricultural Statistics Service, 1992).

Relief and Drainage

Relief in Mercer County ranges from 1,100 feet in the northeast corner of the county to 794 feet at the point where the Thompson River drainage system intersects the county in the southwest corner.

Most of Mercer County consists of gently rolling to hilly uplands. The wide, gently sloping ridges are oriented north to south, as are the major drainageways. Four major systems control drainage in the county. The West Medicine Creek and Muddy Creek systems enter the county at the Iowa border and drain the eastern part of the county. The Weldon Fork of the Grand River bisects and drains the middle of the county. Much of the Weldon Fork north of Princeton has been channelized for flood control. Many intermittent streams in the far western part of Mercer County drain to the southwest towards the Thompson River, which is near the border between Mercer County and Harrison County.

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 biological activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and 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 a considerable degree of 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, reaction, 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 interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are 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 are 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 predict with a fairly high degree of accuracy 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.

The descriptions, names, and delineations of the soils on the soil maps in this survey area do not fully agree with those on the maps of adjacent counties, which were published at different dates. Differences are the result of additional soils data, variations in the intensity of mapping, and correlation decisions that reflect local conditions. 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.

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 two or three 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 in 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.

Soil Descriptions

1. Adair-Armstrong-Grundy Association

Very deep, gently sloping to strongly sloping, somewhat poorly drained soils that formed in loess or loamy sediments and in the underlying glacial till; on uplands

This association consists of soils that formed in loess or loamy sediments on high ridgetops and side slopes below nearly level upland divides and soils that formed in glacial till on medium or narrow ridgetops, on side slopes, and in coves at the head of drainageways (fig. 2). Slopes range from 2 to 14 percent.

This association makes up about 40 percent of the county. It is about 40 percent Adair and similar soils, 30 percent Armstrong soils, 11 percent Grundy and similar soils, and 19 percent soils of minor extent.

Adair soils formed in loamy sediments and in the underlying glacial till. They are on moderately sloping, convex ridges and strongly sloping side slopes in the uplands.

The typical sequence, depth, and composition of the layers of the Adair soils are as follows—

Surface layer:
0 to 8 inches, very dark grayish brown, friable loam

Subsoil:
8 to 11 inches, brown, mottled, firm clay loam
11 to 22 inches, dark brown, mottled, very firm clay
22 to 60 inches, dark brown, dark yellowish brown, and yellowish brown, mottled, very firm clay loam

Armstrong soils formed in a thin mantle of loamy sediments and in the underlying glacial till. They are on moderately sloping, convex ridges and strongly sloping side slopes in the uplands.

The typical sequence, depth, and composition of the layers of the Armstrong soils are as follows—

Surface layer:
0 to 6 inches, very dark grayish brown, friable loam

Subsoil:
6 to 10 inches, dark yellowish brown, mottled, friable clay loam
10 to 40 inches, brown, strong brown, and yellowish brown, mottled, firm clay
40 to 60 inches, yellowish brown, mottled, firm clay loam

Grundy soils formed in loess. They are on gently sloping, convex ridgetops in the uplands.

The typical sequence, depth, and composition of the layers of the Grundy soils are as follows—

Surface layer:
0 to 8 inches, very dark gray, friable silty clay loam

Subsoil:
8 to 26 inches, dark grayish brown, mottled, firm silty clay
26 to 52 inches, gray, mottled, firm silty clay and silty clay loam

Substratum:
52 to 60 inches, gray, mottled, very firm silty clay loam

Of minor extent in this association are Clarinda, Edina, Gara, Humeston, Nodaway, Pering, Shelby, and

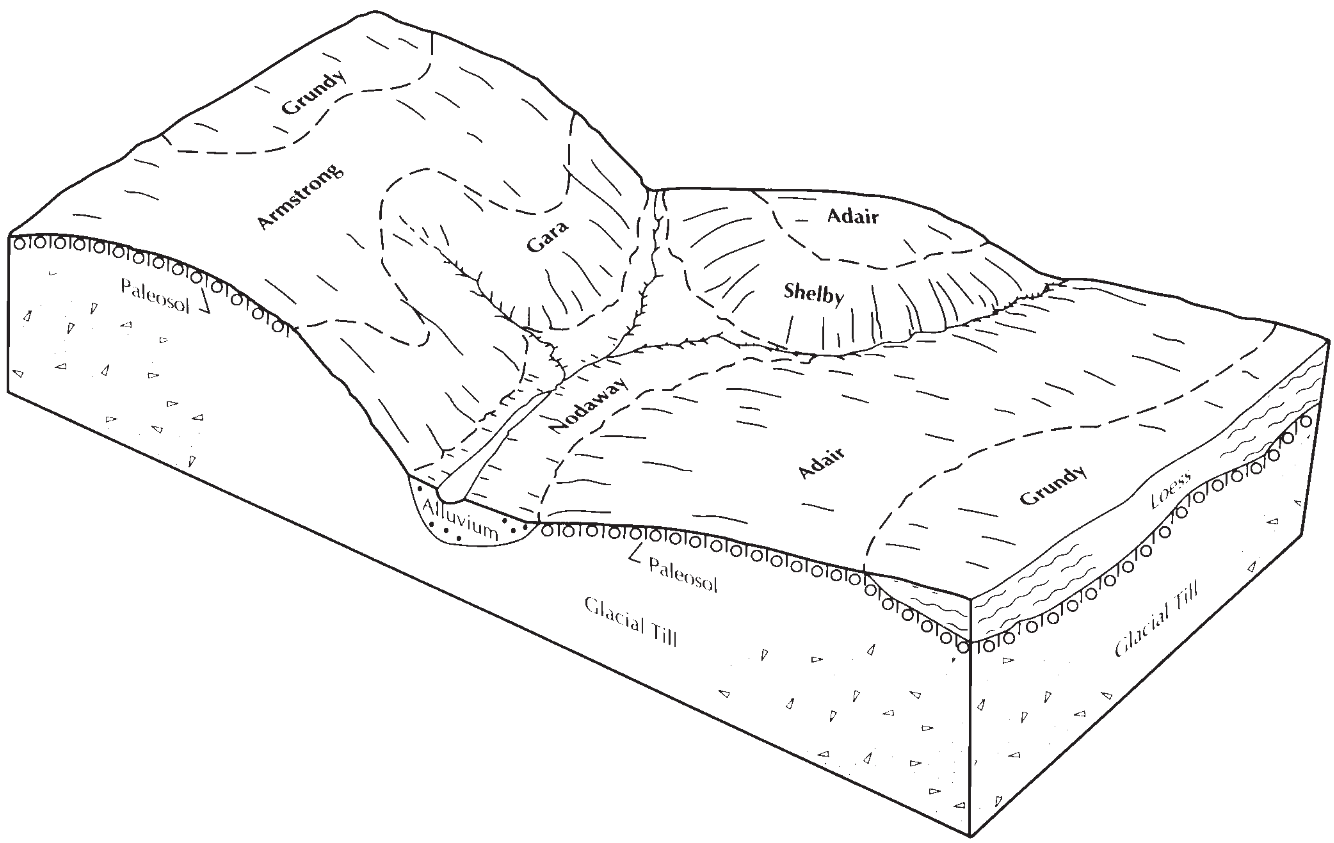

Figure 2.—Typical pattern of soils and parent material in the Adair-Armstrong-Grundy association.

Vigar soils. The poorly drained Clarinda soils are in moderately sloping, concave areas at the head of drainageways. The poorly drained Edina soils are on nearly level, wide divides and ridgetops. The moderately well drained Gara soils are on strongly sloping to moderately steep side slopes. Pering soils contain less sand than the Adair and Armstrong soils. Also, they are not as dark or as deep as the Grundy soils. They are on gently sloping, convex ridgetops and moderately sloping side slopes. The moderately well drained Shelby soils are on strongly sloping side slopes. The moderately well drained Nodaway and Vigar soils and the poorly drained Humeston soils are in narrow drainageways.

About 70 percent of this association is used as cropland. The major crops are corn, soybeans, and wheat. The rest of the acreage is used as pasture or hayland. Erosion is the main management concern. A system of conservation tillage that leaves a protective cover of crop residue on the surface throughout the year, winter cover crops, grassed waterways, terraces, and contour farming help to control erosion. Tall fescue, smooth bromegrass, orchardgrass, alfalfa, and red clover are the main pasture plants or hay crops. Overgrazing is the main management concern affecting pasture. It may cause rapid erosion and gullying.

This association is suited to onsite waste disposal systems if sewage lagoons are used. The slope is the main limitation. Wetness and the shrink-swell potential are limitations if dwellings are built. If roads or streets are built on these soils, wetness, low strength, frost action, and the shrink-swell potential are limitations.

2. Gara Association

Very deep, strongly sloping to very steep, moderately well drained soils that formed in glacial till; on uplands

This association is characterized by highly dissected side slopes, commonly adjacent to stream valleys. Slopes range from 9 to 35 percent.

This association makes up about 45 percent of the county. It is about 76 percent Gara and similar soils and 24 percent soils of minor extent (fig. 3).

Gara soils are on dissected side slopes in the uplands.

The typical sequence, depth, and composition of the

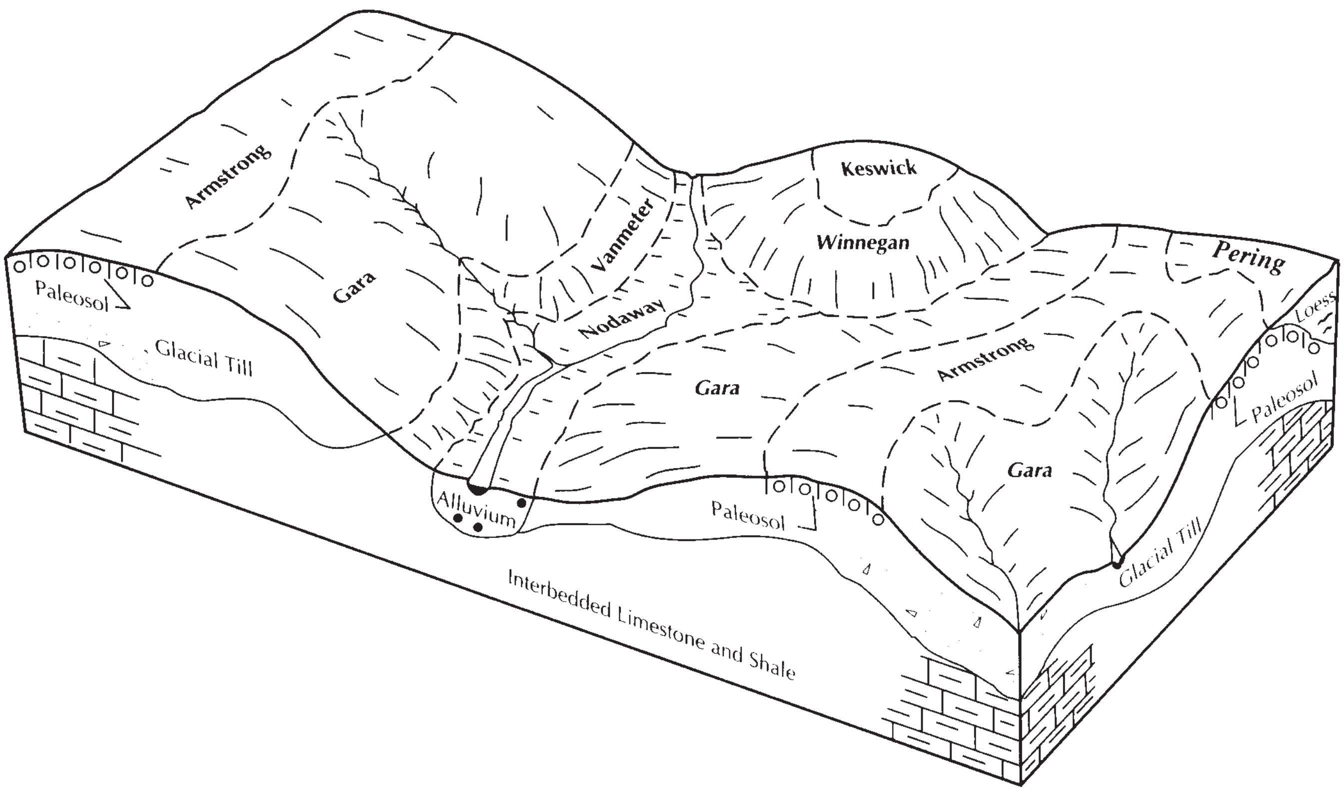

Figure 3.—Typical pattern of soils and parent material in the Gara association.

layers of the Gara soils are as follows—

Surface layer:

0 to 6 inches, very dark grayish brown, friable loam

Subsoil:

6 to 20 inches, dark yellowish brown, mottled, friable and firm clay loam

20 to 31 inches, yellowish brown, mottled, firm clay loam

31 to 60 inches, yellowish brown, mottled, very firm, calcareous clay loam and loam

Of minor extent in this association are Adair, Armstrong, Colo, Humeston, Keswick, Lamoni, Lenzburg, Nodaway, Olmitz, Pering, Putco, Schuline, Vanmeter, Vesser, Vigar, and Zook soils. The somewhat poorly drained Adair and Armstrong soils are on moderately sloping, narrow, convex ridgetops and strongly sloping side slopes. Keswick soils have more clay in the subsoil than the Gara soils. They are on moderately sloping and strongly sloping, narrow, convex ridgetops and side slopes. Putco soils and the well drained Lenzburg soils are moderately sloping to very steep. They are spoil areas associated with quarrying. The somewhat poorly drained Lamoni soils are on moderately sloping, narrow ridgetops and the upper side slopes. The somewhat poorly drained Pering soils are on high stream terraces. The well drained Schuline soils are gently sloping to strongly sloping. They have been graded and reclaimed from rock quarry spoil areas. The moderately deep Vanmeter soils are on strongly sloping to very steep upland side slopes adjacent to the larger streams and their tributaries. Nodaway, Olmitz, and Vigar soils have thicker dark upper layers than the Gara soils. The poorly drained Colo, Humeston, Vesser, and Zook soils are on small flood plains and in narrow drainageways.

Most areas of this association are used for pasture, hayland, or woodland. The equipment limitation and the hazard of erosion are the main management concerns.

These soils are used mostly for pasture and hay. Tall fescue, smooth bromegrass, orchardgrass, alfalfa, red clover, and birdsfoot trefoil are the main pasture plants and hay crops. Overgrazing is the major management concern affecting pasture because it causes rapid erosion and gullying.

This association is suited to onsite waste disposal systems if sewage lagoons are used. The slope is the main limitation. If roads or streets are built, the slope,

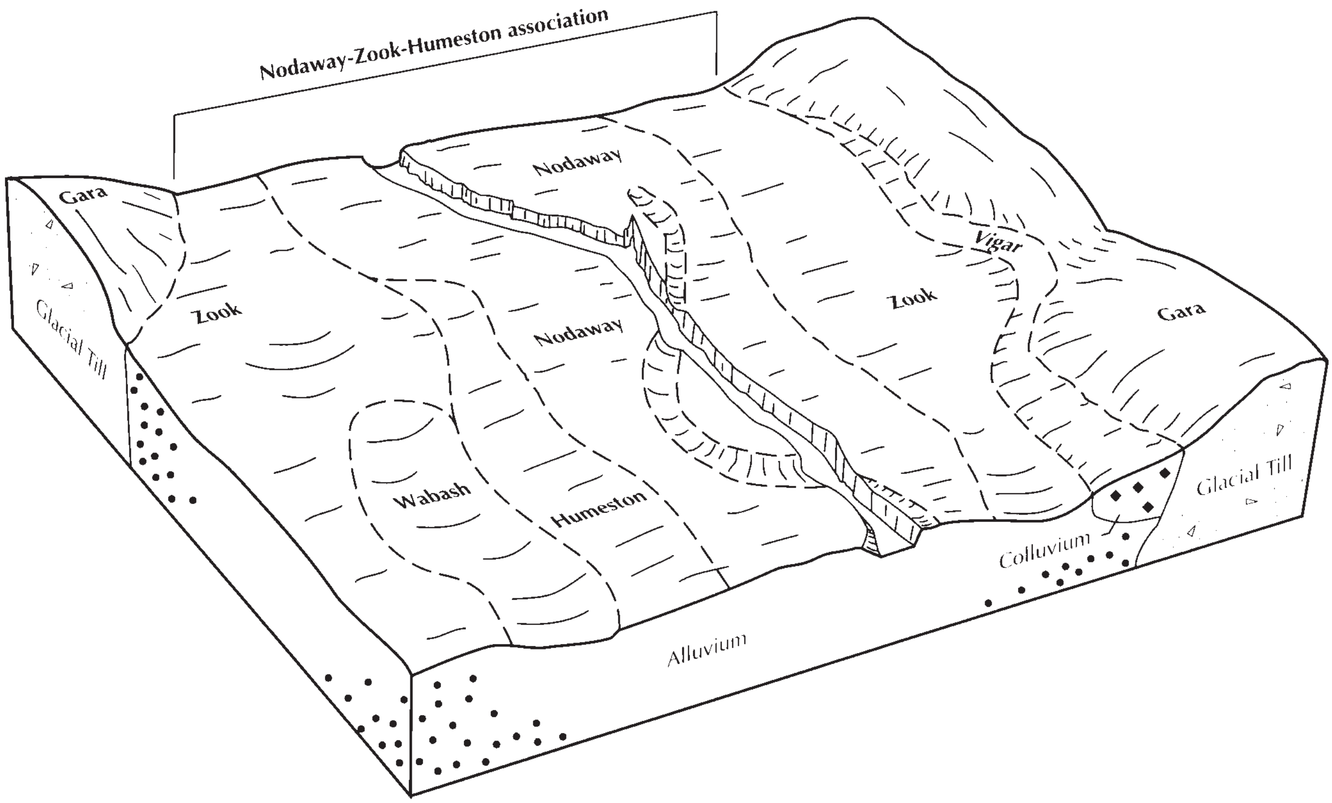

Figure 4.—Typical pattern of soils and parent material in the Nodaway-Zook-Humeston association.

low strength, the shrink-swell potential, and the potential for frost action are limitations.

3. Nodaway-Zook-Humeston Association

Very deep, nearly level, moderately well drained and poorly drained soils that formed in silty and clayey alluvium; on flood plains

This association consists of soils on large and medium sized flood plains. Many areas have old abandoned channels where streams have been straightened. Slopes range from 0 to 2 percent.

This association makes up about 15 percent of the county. It is about 45 percent Nodaway and similar soils, 28 percent Zook and similar soils, 11 percent Humeston soils, and 16 percent soils of minor extent (fig. 4).

The moderately well drained Nodaway soils are commonly on flood plains adjacent to river and stream channels.

The typical sequence, depth, and composition of the layers of the Nodaway soils are as follows—

Surface layer:
0 to 8 inches, very dark grayish brown, friable silt loam

Substratum:
8 to 48 inches, stratified very dark grayish brown, dark grayish brown, and brown, mottled, friable silt loam
48 to 60 inches, stratified dark grayish brown and brown, mottled silt loam

The poorly drained Zook soils are commonly adjacent to the uplands in slack-water areas on flood plains.

The typical sequence, depth, and composition of the layers of the Zook soils are as follows—

Surface layer:
0 to 9 inches, black, friable silty clay loam

Subsurface layer:
9 to 16 inches, black, firm silty clay loam
16 to 34 inches, black, very firm silty clay

Subsoil:
34 to 52 inches, black, very firm silty clay

52 to 60 inches, very dark gray, mottled, very firm silty clay

The poorly drained Humeston soils are commonly on the higher parts of flood plains adjacent to the uplands.

The typical sequence, depth, and composition of the layers of the Humeston soils are as follows—

Surface layer:
0 to 6 inches, very dark gray, friable silty clay loam

Subsurface layer:
6 to 14 inches, very dark gray, friable silty clay loam
14 to 26 inches, dark gray, friable silt loam

Subsoil:
26 to 30 inches, very dark gray, firm silty clay loam
30 to 48 inches, very dark gray, very firm silty clay loam
48 to 60 inches, dark gray, very firm silty clay

Of minor extent in this association are Belinda, Caleb, Mystic, Pering, Sandover, Vigar, and Wabash soils. The poorly drained Belinda soils are on nearly level and very gently sloping high stream terraces. The moderately well drained Caleb and somewhat poorly drained Mystic soils are on moderately sloping and strongly sloping side slopes of high stream terraces. The somewhat poorly drained Pering soils are on gently sloping high stream terraces. The moderately well drained Sandover soils are in nearly level areas on flood plains adjacent to stream channels. The moderately well drained Vigar soils are on gently sloping and moderately sloping foot slopes adjacent to but slightly higher than the flood plains. Wabash soils have more clay throughout than the major soils. They are commonly in concave areas on the lowest part of the flood plain.

Most areas of this association are used as cropland. The major cultivated crops are corn and soybeans. Flooding and wetness are the main management concerns.

Some areas of this association are used for pasture and hay. Wetness-tolerant plants, such as reed canarygrass, grow best on the soils in this association. Flooding and wetness are the main management concerns.

A small acreage of this association is used as woodland. Most of these areas are adjacent to river or stream channels and old meander scars and are subject to flooding.

This association is unsuitable for sanitary facilities and building sites because of flooding and wetness.

Detailed Soil Map Units

The map units on the detailed soil maps in 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 is given under the heading "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, Gara loam, 14 to 20 percent slopes, eroded, is a phase of the Gara series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Nodaway-Humeston-Vigar complex, 0 to 6 percent slopes, is an example.

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

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. The Pits component of the map unit Putco-Pits complex, 5 to 35 percent slopes, is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

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

Soil Descriptions

10—Edina silt loam. This very deep, nearly level, poorly drained soil is on ridgetops and in upland depressional areas. Individual areas are irregular in shape and range from about 10 to 400 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:

0 to 9 inches, very dark gray, friable silt loam

Subsurface layer:

9 to 16 inches, dark gray, friable silt loam

Subsoil:

16 to 38 inches, very dark gray, dark grayish brown, and grayish brown, very firm silty clay; mottled in the lower part

38 to 60 inches, grayish brown and olive gray, mottled, very firm silty clay loam

In some places the surface layer is less than 8 inches thick.

Included with this soil in mapping are small areas of the somewhat poorly drained Grundy soils. These soils are in gently sloping areas in positions on the landscape slightly lower than those of the Edina soil. They make up less than 5 percent of the map unit.

Important properties of the Edina soil—

Permeability: Very slow
Surface runoff: Very slow
Available water capacity: High
Organic matter content: Moderate
Shrink-swell potential: Very high
Seasonal high water table: Perched at a depth of 0.5 foot to 2.0 feet from late fall through early spring

Most areas are used for cultivated crops, but a few areas are used for pasture and hay. This soil is suited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Wetness is the major management concern. Land grading and shallow surface drains help to remove excess water.

Pasture and hay mixtures that contain wetness-tolerant varieties grow best on this soil. This soil is moderately well suited to birdsfoot trefoil, reed canarygrass, and switchgrass. It is moderately suited to tall fescue, big bluestem, and indiangrass. Overgrazing or grazing when the soil is too wet generally causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to some kinds of sanitary facilities and building site development if proper design and installation procedures are used. Sewage lagoons function well in areas of this soil. If dwellings are built on this soil, wetness and the shrink-swell potential are concerns. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand or gravel help to prevent the damage caused by shrinking and swelling of the soil. Installing tile drains around the foundations and footings helps to prevent the damage caused by wetness.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material helps to minimize the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage help to prevent the damage caused by shrinking and swelling, wetness, and frost action.

The land capability classification is IIw.

11C2—Clarinda silty clay loam, 5 to 9 percent slopes, eroded. This very deep, moderately sloping, poorly drained soil is on concave slopes at the head of drainageways and on the sides of ridges in the uplands. Water erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from about 10 to 220 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 8 inches, very dark gray, friable silty clay loam

Subsoil:
8 to 38 inches, dark gray and gray, mottled, very firm silty clay
38 to 60 inches, gray, mottled, firm silty clay

In some areas the surface layer is thicker.

Included with this soil in mapping are areas of the somewhat poorly drained Grundy and Lamoni soils. Grundy soils are on ridgetops above the Clarinda soil, and Lamoni soils are in landscape positions similar to but slightly lower than those of the Clarinda soil. Also included are some severely eroded areas of soils that have a surface layer of grayish brown silty clay. Included areas make up 5 to 10 percent of the map unit.

Important properties of the Clarinda soil—

Permeability: Very slow
Surface runoff: Medium
Available water capacity: Moderate
Organic matter content: Moderate
Shrink-swell potential: High
Seasonal high water table: Perched at a depth of 1 to 3 feet from late fall through spring

Most areas are used for cultivated crops or for pasture and hay. This soil is suited to corn, soybeans, and small grain on a limited basis. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves a protective cover of crop residue on the surface throughout the year, winter cover crops, grassed waterways, and a cropping sequence that includes close-growing pasture plants help to control erosion. A few small areas have slopes that are long and smooth enough to be terraced and farmed on the contour. Some type of grade-stabilization structure generally is needed if grassed waterways are used. Returning crop residue to the soil or regularly adding other organic material generally improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

Growing grasses and legumes for pasture or hay is very effective in controlling erosion. Pasture and hay mixtures that contain wetness-tolerant varieties grow best. This soil is moderately well suited to reed canarygrass and switchgrass and moderately suited to tall fescue, birdsfoot trefoil, big bluestem, and indiangrass. Controlling erosion during seedbed preparation is the main management concern. Timely tillage and the quick establishment of ground cover are necessary to prevent excessive erosion. Overgrazing and grazing when the soil is too wet generally cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to some kinds of sanitary facilities and building site development if proper design and installation procedures are used. Sewage lagoons function well in areas of this soil if sites are leveled or graded. If dwellings are built on this soil, wetness and the shrink-swell potential are concerns. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand or gravel help to prevent the damage caused by shrinking and swelling of the soil. Installing tile drains around the foundations and footings helps to prevent the damage caused by wetness.

Low strength, the shrink-swell potential, the wetness, and a high potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material helps to minimize the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage help to prevent the damage caused by shrinking and swelling, wetness, and frost action.

The land capability classification is IVe.

12B2—Grundy silty clay loam, 2 to 5 percent slopes, eroded. This very deep, gently sloping, somewhat poorly drained soil is on convex ridgetops and side slopes below nearly level upland divides. Water erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from about 10 to more than 475 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 8 inches, very dark gray, friable silty clay loam

Subsoil:
8 to 26 inches, dark grayish brown, mottled, firm silty clay
26 to 52 inches, gray, mottled, firm silty clay and silty clay loam

Substratum:
52 to 60 inches, gray, mottled, very firm silty clay loam

In some slightly eroded areas, the surface layer is silt loam. In places the lower part of the subsoil has more glacial sand.

Included with this soil in mapping are small areas of the poorly drained Edina soils. These soils have a thicker surface layer than the Grundy soil. They are slightly above the Grundy soil on nearly level to concave upland divides. Also included are soils that have steeper slopes than the Grundy soil. Included soils make up about 5 percent of the map unit.

Important properties of the Grundy soil—

Permeability: Slow
Surface runoff: Medium
Available water capacity: High
Organic matter content: Moderate
Shrink-swell potential: High
Seasonal high water table: Perched at a depth of 1.0 to 2.5 feet from late fall through spring

Most areas are used for cultivated crops or for hay and pasture. This soil is suited to corn, soybeans, grain sorghum, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves a protective cover of crop residue on the surface throughout the year (fig. 5), winter cover crops, underground tile outlets, grassed waterways, contour farming, and a cropping sequence that includes close-growing pasture plants help to control erosion. Returning crop residue to the soil or regularly adding other organic material generally improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

Growing grasses and legumes for pasture or hay is very effective in controlling erosion. Pasture and hay mixtures that contain wetness-tolerant varieties grow best. This soil is moderately well suited to tall fescue, reed canarygrass, birdsfoot trefoil, big bluestem, indiangrass, and switchgrass. It is moderately suited to smooth bromegrass, orchardgrass, red clover, and alfalfa. Controlling erosion during seedbed preparation is the main management concern. Timely tillage and the quick establishment of ground cover are necessary to prevent excessive erosion. Overgrazing and grazing when the soil is too wet generally cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to some kinds of sanitary facilities and building site development if proper design and

Figure 5.—Leaving crop residue on the surface helps to control further erosion in this area of Grundy silty clay loam, 2 to 5 percent slopes, eroded.

installation procedures are used. Sewage lagoons function well in areas of this soil if sites are leveled or graded. If dwellings are built on this soil, wetness and the shrink-swell potential are concerns. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand or gravel help to prevent the damage caused by shrinking and swelling of the soil. Installing tile drains around the foundations and footings helps to prevent the damage caused by wetness.

Low strength, the shrink-swell potential, the wetness, and a high potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material helps to minimize the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage help to prevent the damage caused by shrinking and swelling, wetness, and frost action.

The land capability classification is IIIe.

13D2—Caleb-Mystic complex, 5 to 14 percent slopes, eroded. These very deep, moderately sloping and strongly sloping, moderately well drained and somewhat poorly drained soils are on side slopes along streams and high terraces. Water erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from about 10 to 50 acres in size.

This map unit is about 50 percent Caleb soil and 40 percent Mystic soil. The two soils occur as areas too narrow and intermingled to be mapped separately.

The typical sequence, depth, and composition of the layers of the Caleb soil are as follows—

Surface layer:
0 to 7 inches, dark brown, friable loam

Subsoil:
7 to 27 inches, dark yellowish brown, friable and firm clay loam
27 to 52 inches, dark yellowish brown, mottled, firm sandy loam

Substratum:
52 to 60 inches, yellowish brown, mottled, firm sandy clay loam

Important properties of the Caleb soil—

Permeability: Moderate
Surface runoff: Medium
Available water capacity: Moderate
Organic matter content: Moderate
Shrink-swell potential: Moderate
Seasonal high water table: Perched at a depth of 3 to 5 feet from late fall through early spring

The typical sequence, depth, and composition of the layers of the Mystic soil are as follows—

Surface layer:
0 to 6 inches, very dark grayish brown, friable silt loam

Subsurface layer:
6 to 10 inches, brown, friable silt loam

Subsoil:
10 to 60 inches, brown and strong brown, mottled, friable and firm clay loam and clay

Important properties of the Mystic soil—

Permeability: Slow
Surface runoff: Medium
Available water capacity: Moderate
Organic matter content: Moderate
Shrink-swell potential: High
Seasonal high water table: Perched at a depth of 1 to 3 feet from late fall through midsummer

Included with these soils in mapping are small areas of the somewhat poorly drained Pering soils in gently sloping areas. These included soils have more sand than the Mystic soil. Also included are small sandy areas, areas that have slopes of more than 14 percent, and some areas of severely eroded soils that have a surface layer of clay loam. Included areas make up about 10 percent of the map unit.

Most areas of this unit are used for hay and pasture. Some areas are used for cultivated crops, and a few areas are wooded. These soils are suited to cultivated crops on a limited basis in rotation with small grain and close-growing pasture or hay crops. If cultivated crops are grown on a continuous basis, the hazard of erosion is severe. A system of conservation tillage that leaves a protective cover of crop residue on the surface throughout the year, stripcropping, winter cover crops, and grassed waterways help to control erosion. Some type of grade-stabilization structure generally is needed if grassed waterways are used. Returning crop residue to the soil or regularly adding other organic material generally improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

Growing grasses and legumes for pasture and hay is very effective in controlling erosion. Pasture and hay mixtures that contain wetness-tolerant varieties grow best. These soils are moderately well suited to birdsfoot trefoil, reed canarygrass, tall fescue, big bluestem, indiangrass, and switchgrass. They are moderately suited to alfalfa, red clover, orchardgrass, and smooth bromegrass. Controlling erosion during seedbed preparation and preventing overgrazing are the main management concerns. Preparing seedbeds on the contour and in a timely manner helps to ensure rapid growth for ground cover. Overgrazing or grazing when the soils are too wet generally causes surface compaction, excessive runoff, and poor tilth. Maintaining fertility and controlling brush and weeds are necessary. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

These soils are suited to trees. A few areas support stands of native hardwoods. The hazards and limitations that affect planting and harvesting are slight.

These soils are suited to some kinds of sanitary facilities and building site development if proper design and installation procedures are used. Areas used for sewage lagoons and dwellings should be graded. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand or gravel help to prevent the damage caused by shrinking and swelling of the soil.

Low strength, the shrink-swell potential, the slope, and the potential for frost action limit the use of these soils as sites for local roads and streets. Strengthening roads with crushed rock or other suitable base material helps to minimize the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage help to prevent the damage caused by shrinking and swelling and by frost action. Cutting and filling may be necessary because of the slope, or the roads and streets can be designed so that they conform to the natural landscape.

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

14C2—Adair loam, 5 to 9 percent slopes, eroded. This very deep, moderately sloping, somewhat poorly drained soil is on narrow, convex ridgetops, on side slopes, and at the head of drainageways in the uplands. Water erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from about 10 to 600 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:

0 to 8 inches, very dark grayish brown, friable loam

Subsoil:

8 to 35 inches, dark yellowish brown and brown, mottled, firm and very firm clay and clay loam

35 to 60 inches, dark yellowish brown and yellowish brown, mottled, very firm clay loam

In places the surface layer is thicker. In a few areas the subsoil has less glacial sand and pebbles. In some places the subsoil is grayer. In other places calcium carbonates are closer to the surface.

Included with this soil in mapping are small areas of the moderately well drained Shelby soils. These soils are on the steeper slopes below the Adair soil. Also included are areas that have steeper slopes than the Adair soil and a few areas of severely eroded soils that have a surface layer of brown clay loam. Included areas make up about 10 percent of the map unit.

Important properties of the Adair soil—

Permeability: Slow
Surface runoff: Medium
Available water capacity: High
Organic matter content: Moderate
Shrink-swell potential: High
Seasonal high water table: Perched at a depth of 1 to 3 feet from late fall through spring

Most areas are used for cultivated crops or for hay and pasture. This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves a protective cover of crop residue on the surface throughout the year, winter cover crops, and grassed waterways help to control erosion. A few small areas have slopes that are long and smooth enough to be terraced and farmed on the contour. Some type of grade-stabilization structure generally is needed if grassed waterways are used. Returning crop residue to the soil or regularly adding other organic material generally improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

Growing grasses and legumes for pasture or hay is very effective in controlling erosion (fig. 6). Pasture and hay mixtures that contain wetness-tolerant varieties grow best. This soil is moderately well suited to birdsfoot trefoil, tall fescue, reed canarygrass, big bluestem, indiangrass, and switchgrass. It is moderately suited to orchardgrass, smooth bromegrass, alfalfa, and red clover. Controlling erosion during seedbed preparation is the main management concern. Timely tillage and the quick establishment of ground cover are necessary to prevent excessive erosion. Overgrazing and grazing when the soil is too wet generally cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to some kinds of sanitary facilities and building site development if proper design and installation procedures are used. Sewage lagoons function adequately if sites are leveled or graded. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand or gravel help to prevent the damage caused by shrinking and swelling of the soil. Installing tile drains around the foundations and footings helps to prevent the damage caused by wetness.

Low strength, the shrink-swell potential, the wetness, and a high potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material helps to minimize the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage help to prevent the damage caused by shrinking and swelling, wetness, and frost action.

The land capability classification is IIIe.

14D2—Adair loam, 9 to 14 percent slopes, eroded. This very deep, strongly sloping, somewhat poorly drained soil is on side slopes and narrow, convex ridgetops. Water erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from about 5 to 250 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:

0 to 8 inches, very dark gray, friable loam

Figure 6.—Maintaining a cover of vegetation, such as grasses and legumes grown for pasture or hay, helps to control erosion in this area of Adair loam, 5 to 9 percent slopes, eroded.

Subsoil:

8 to 38 inches, brown, mottled, friable and firm clay loam

38 to 60 inches, strong brown and yellowish brown, mottled, firm and very firm clay loam

In some areas calcium carbonates are closer to the surface. In places the subsoil is grayer.

Included with this soil in mapping are small areas of the moderately well drained Gara and Shelby soils. These soils are on the lower parts of side slopes. Also included are a few areas of severely eroded soils that have a surface layer of brown clay loam. Included areas make up about 10 percent of the unit.

Important properties of the Adair soil—

Permeability: Slow
Surface runoff: Medium
Available water capacity: High
Organic matter content: Moderate
Shrink-swell potential: High
Seasonal high water table: Perched at a depth of 1 to 3 feet from late fall through spring

Most areas are used for hay and pasture. Some areas are used for cultivated crops. This soil is suited to cultivated crops on a limited basis and in rotation with small grain and close-growing pasture or hay crops. If cultivated crops are grown on a continuous basis, the hazard of erosion is severe. A system of conservation tillage that leaves a protective cover of crop residue on the surface throughout the year, winter cover crops, stripcropping, and grassed waterways help to control erosion. Some type of grade-stabilization structure generally is needed if grassed waterways are used. Returning crop residue to the soil or regularly adding other organic material generally improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

Growing grasses and legumes for pasture and hay is very effective in controlling erosion. Pasture and hay mixtures that include wetness-tolerant varieties grow best. This soil is moderately well suited to birdsfoot trefoil, reed canarygrass, tall fescue, big bluestem, switchgrass, and indiangrass. It is moderately suited to alfalfa, red clover, orchardgrass, and smooth bromegrass. Controlling erosion during seedbed preparation and preventing overgrazing are the main management concerns. Preparing seedbeds on the contour and in a timely manner helps to ensure rapid growth for ground cover. Overgrazing or grazing when the soil is too wet generally causes surface compaction, excessive runoff, and poor tilth. Maintaining fertility and controlling brush and weeds are necessary. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to some kinds of sanitary facilities and building site development if proper design and installation procedures are used. Areas used for sewage lagoons and dwellings should be graded. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand or gravel help to prevent the damage caused by shrinking and swelling of the soil. Installing tile drains around the foundations and footings helps to prevent the damage caused by wetness.

Low strength, the shrink-swell potential, the slope, the wetness, and a high potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material helps to minimize the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage help to prevent the damage caused by shrinking and swelling, wetness, and frost action. Cutting and filling may be necessary because of the slope, or the roads and streets can be designed so that they conform to the natural landscape.

The land capability classification is IVe.

15C2—Lamoni clay loam, 5 to 9 percent slopes, eroded. This very deep, moderately sloping, somewhat poorly drained soil is on the upper side slopes, on narrow ridgetops, and at the head of drainageways in the uplands. Water erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from about 10 to more than 150 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 7 inches, black, very friable clay loam

Subsoil:
7 to 31 inches, dark grayish brown and light olive brown, mottled, friable clay loam and clay
31 to 60 inches, yellowish brown, mottled, firm and very firm clay loam

In some slightly eroded areas, the surface layer is loam or silt loam.

Included with this soil in mapping are small areas of the moderately well drained Shelby soils. These soils are on the steeper side slopes. Also included are areas of severely eroded soils that have a surface layer of dark grayish brown clay loam. Included soils make up about 5 percent of the unit.

Important properties of the Lamoni soil—

Permeability: Slow
Surface runoff: Medium
Available water capacity: High
Organic matter content: Moderate
Shrink-swell potential: High
Seasonal high water table: Perched at a depth of 1 to 3 feet from late fall through spring

Most areas are used for cultivated crops or for hay and pasture. This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves a protective cover of crop residue on the surface throughout the year, winter cover crops, grassed waterways, and a cropping sequence that includes close-growing pasture plants help to control erosion. A few small areas have slopes that are long and smooth enough to be terraced and farmed on the contour. Some type of grade-stabilization structure generally is needed if grassed waterways are used.

Growing grasses and legumes for pasture and hay is very effective in controlling erosion. Pasture and hay mixtures that include wetness-tolerant varieties grow best. This soil is moderately well suited to birdsfoot trefoil, reed canarygrass, tall fescue, big bluestem, switchgrass, and indiangrass. It is moderately suited to alfalfa, red clover, orchardgrass, and smooth bromegrass. Controlling erosion during seedbed preparation is the main management concern. Timely tillage and the quick establishment of ground cover are necessary to prevent excessive erosion. Overgrazing or grazing when the soil is too wet generally causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to some kinds of sanitary facilities and building site development if proper design and installation procedures are used. Sewage lagoons function adequately if sites are leveled or graded. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand or gravel help to prevent the damage caused by shrinking and swelling of the soil. Installing tile drains around the foundations and footings helps to prevent the damage caused by wetness.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material helps to minimize the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage help to prevent the damage caused by shrinking and swelling, wetness, and frost action.

The land capability classification is IIIe.

16B2—Lagonda silty clay loam, 2 to 5 percent slopes, eroded. This very deep, gently sloping, somewhat poorly drained soil is on convex ridgetops. Water erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from about 10 to more than 80 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 7 inches, very dark gray, friable silty clay loam

Subsoil:
7 to 42 inches, dark grayish brown, mottled, firm silty clay and silty clay loam
42 to 60 inches, olive gray, mottled, firm and very firm clay loam and clay

In some slightly eroded areas, the surface layer is silt loam.

Included with this soil in mapping are small areas of Grundy soils on the crests of ridges. These soils contain less sand in the lower part of the solum than the Lagonda soil. They make up about 5 percent of the map unit.

Important properties of the Lagonda soil—

Permeability: Slow
Surface runoff: Medium
Available water capacity: High
Organic matter content: Moderate
Shrink-swell potential: High
Seasonal high water table: Perched at a depth of 1.5 to 2.5 feet from late fall through spring

Most areas are used for cultivated crops or for hay and pasture. This soil is suited to corn, soybeans, grain sorghum, and small grain and to grasses and legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves a protective cover of crop residue on the surface throughout the year, winter cover crops, underground tile outlets, grassed waterways, contour farming, and a cropping sequence that includes close-growing pasture plants help to control erosion. Some type of grade-stabilization structure generally is needed if grassed waterways are used. Returning crop residue to the soil or regularly adding other organic material generally improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

Growing grasses and legumes for pasture or hay is very effective in controlling erosion. Pasture and hay mixtures that include wetness-tolerant varieties grow best. This soil is moderately well suited to tall fescue, reed canarygrass, birdsfoot trefoil, big bluestem, indiangrass, and switchgrass. It is moderately suited to smooth bromegrass, orchardgrass, red clover, and alfalfa. Controlling erosion during seedbed preparation is the main management concern. Timely tillage and the quick establishment of ground cover are necessary to prevent excessive erosion. Overgrazing and grazing when the soil is too wet generally cause surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to some kinds of sanitary facilities and building site development if proper design and installation procedures are used. Sewage lagoons function well if sites are leveled or graded. If dwellings are built on this soil, wetness and the shrink-swell potential are concerns. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand or gravel help to prevent the damage caused by shrinking and swelling of the soil. Installing tile drains around the foundations and footings helps to prevent the damage caused by wetness.

Low strength, the shrink-swell potential, the wetness, and a high potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material helps to minimize the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage help to prevent the damage caused by shrinking and swelling, wetness, and frost action.

The land capability classification is IIIe.

17D2—Shelby loam, 9 to 14 percent slopes, eroded. This very deep, strongly sloping, moderately well drained soil is on convex upland side slopes. Water erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from about 10 to more than 150 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 9 inches, very dark gray, friable loam

Subsoil:
9 to 15 inches, dark yellowish brown and dark brown, friable clay loam
15 to 21 inches, dark yellowish brown, firm clay loam
21 to 60 inches, dark yellowish brown and yellowish brown, mottled, firm clay loam

In some areas the surface layer is thicker. In other areas calcium carbonates are closer to the surface.

Included with this soil in mapping are small areas of the somewhat poorly drained Adair and Lamoni soils. These soils are on the higher side slopes and at the head of drainageways. Also included are a few areas of severely eroded soils that have a surface layer of brown clay loam. Included soils make up about 10 percent of the map unit.

Important properties of the Shelby soil—

Permeability: Moderately slow
Surface runoff: Medium
Available water capacity: High
Organic matter content: Moderate
Shrink-swell potential: Moderate

Most areas are used for cultivated crops or for pasture and hay. This soil is suited to cultivated crops on a limited basis in rotation with small grain and close-growing pasture or hay crops. If cultivated crops are grown on a continuous basis, the hazard of erosion is severe. A system of conservation tillage that leaves a protective cover of crop residue on the surface throughout the year, stripcropping, winter cover crops, and grassed waterways help to control erosion. Some type of grade-stabilization structure generally is needed if grassed waterways are used. Returning crop residue to the soil or regularly adding other organic material generally improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

Growing grasses and legumes for pasture and hay is very effective in controlling erosion. This soil is well suited to timothy, red clover, tall fescue, birdsfoot trefoil, and switchgrass. It is moderately well suited to smooth bromegrass, orchardgrass, alfalfa, big bluestem, and indiangrass. Controlling erosion during seedbed preparation and preventing overgrazing are the main management concerns. Preparing seedbeds on the contour and in a timely manner helps to ensure rapid growth for ground cover. Overgrazing or grazing when the soil is too wet generally causes surface compaction, excessive runoff, and poor tilth. Maintaining fertility and controlling brush and weeds are necessary. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suitable for some kinds of sanitary facilities and building site development if proper design and installation procedures are used. Areas used for sewage lagoons and dwellings should be graded. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand or gravel help to prevent the damage caused by shrinking and swelling of the soil.

Low strength, the shrink-swell potential, the slope, and the potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material helps to minimize the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage help to prevent the damage caused by shrinking and swelling and by frost action. Cutting and filling may be necessary because of the slope, or the roads and streets can be designed so that they conform to the natural landscape.

The land capability classification is IVe.

17E2—Shelby loam, 14 to 20 percent slopes, eroded. This very deep, moderately steep, moderately well drained soil is on convex upland side slopes. Water erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from about 10 to more than 500 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 8 inches, very dark gray, friable loam

Subsoil:
8 to 14 inches, dark yellowish brown, friable clay loam
14 to 37 inches, dark yellowish brown, mottled, firm clay loam
37 to 60 inches, yellowish brown, mottled, firm clay loam

In some areas calcium carbonates are closer to the surface. In other areas the surface layer is thicker.

Included with this soil in mapping are small areas of the somewhat poorly drained Adair and Lamoni soils. These soils are on the higher side slopes and at the head of drainageways. Also included are a few areas of severely eroded soils that have a surface layer of brown clay loam. Included soils make up about 10 percent of the map unit.

Important properties of the Shelby soil—

Permeability: Moderately slow
Surface runoff: Medium
Available water capacity: High
Organic matter content: Moderate
Shrink-swell potential: Moderate

Most areas are used for pasture or hay. Because of the slope, this soil is unsuitable for cultivated crops. The soil is well suited to timothy, red clover, tall fescue, birdsfoot trefoil, and reed canarygrass. It is moderately well suited to smooth bromegrass, orchardgrass, alfalfa, big bluestem, and indiangrass. Controlling erosion during seedbed preparation and preventing overgrazing are the main management concerns. Preparing seedbeds on the contour and in a timely manner helps to ensure rapid growth for ground cover. Measures that prevent overgrazing are needed. Maintaining fertility and controlling brush and weeds also are important.

This soil is suitable for some kinds of sanitary facilities and building site development if proper design and installation procedures are used. Areas used for sewage lagoons or dwellings should be graded. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand or gravel help to prevent the damage caused by shrinking and swelling of the soil.

Low strength, the shrink-swell potential, the slope, and the potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material helps to minimize the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage help to prevent the damage caused by shrinking and swelling and by frost action. Cutting and filling may be needed because of the slope, or the roads and streets can be designed so that they conform to the natural landscape.

The land capability classification is VIe.

19D2—Keswick loam, 5 to 14 percent slopes, eroded. This very deep, moderately sloping and strongly sloping, moderately well drained soil is on narrow ridges and on convex side slopes. Water erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from about 10 to 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 3 inches, dark grayish brown, friable loam

Subsurface layer:
3 to 6 inches, brown, mottled, friable loam

Subsoil:
6 to 32 inches, brown and yellowish brown, mottled, firm clay
32 to 60 inches, yellowish brown and grayish brown, mottled, firm clay loam

In some areas the upper part of the subsoil has less glacial sand and pebbles. In some slightly eroded areas, the surface layer is silt loam.

Included with this soil in mapping are sandy areas along the east side of the Weldon River extending about 1 mile north and 1 mile south of Highway K. Also included are a few areas of severely eroded soils that have a surface layer of brown clay loam. Included areas make up about 5 percent of the map unit.

Important properties of the Keswick soil—

Permeability: Slow
Surface runoff: Medium
Available water capacity: Moderate
Organic matter content: Moderately low
Shrink-swell potential: High
Seasonal high water table: Perched at a depth of 1 to 3 feet from late fall through spring

Most areas are used for pasture, hay, or woodland. Growing grasses and legumes for pasture and hay is very effective in controlling erosion. Pasture and hay mixtures that include wetness-tolerant varieties grow best. This soil is moderately well suited to birdsfoot trefoil, reed canarygrass, tall fescue, big bluestem, switchgrass, and indiangrass. It is moderately suited to alfalfa, red clover, orchardgrass, and smooth bromegrass. Controlling erosion during seedbed preparation is the main management concern. Timely tillage and the quick establishment of ground cover are necessary to prevent excessive erosion. Overgrazing or grazing when the soil is too wet generally causes surface compaction, excessive runoff, and poor tilth. Maintaining fertility and controlling brush and weeds are necessary. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees (fig. 7). The windthrow hazard and seedling mortality are management concerns. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is not a concern. Planting container-grown stock improves the seedling survival rate.

This soil is suited to cultivated crops on a limited basis. Erosion is a severe hazard. A system of conservation tillage that leaves a protective cover of crop residue on the surface throughout the year, winter cover crops, grassed waterways, contour farming, and a cropping sequence that includes close-growing pasture plants help to control erosion. Some type of grade-stabilization structure generally is needed if grassed waterways are used.

This soil is suited to some kinds of sanitary facilities and building site development if proper design and installation procedures are used. Areas used for sewage lagoons and dwellings should be graded. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand or gravel help to prevent the damage caused by shrinking and swelling of the soil. Installing tile drains around the foundations and footings helps to prevent the damage caused by wetness.

Low strength, the shrink-swell potential, the slope, the wetness, and a high potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material helps to minimize the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage help to prevent the damage caused by shrinking and swelling, wetness, and frost action. Cutting and filling may be necessary because of the slope, or the roads and streets can be designed so that they conform to the natural landscape.

The land capability classification is IVe. The woodland ordination symbol is 3C.

22D2—Gara loam, 9 to 14 percent slopes, eroded. This very deep, strongly sloping, moderately well drained soil is on convex upland side slopes. Water erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from about 10 to more than 150 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 6 inches, very dark grayish brown, friable loam

Subsoil:
6 to 17 inches, dark yellowish brown, firm clay loam
17 to 60 inches, yellowish brown, mottled, firm clay loam and loam

In some areas calcium carbonates are closer to the surface. In other areas the surface layer is thicker. In places the surface layer has more clay.

Included with this soil in mapping are small areas of the somewhat poorly drained Armstrong soils. These soils are on moderately sloping and strongly sloping, narrow ridgetops and convex side slopes. Also included are a few areas of severely eroded soils that have a surface layer of brown clay loam. Included soils make up about 5 percent of the map unit.

Important properties of the Gara soil—

Permeability: Moderately slow
Surface runoff: Medium
Available water capacity: High
Organic matter content: Moderate
Shrink-swell potential: Moderate

Most areas are used for hay and pasture. Some areas are used for cultivated crops, and a few areas are wooded. This soil is suited to cultivated crops on a limited basis in rotation with small grain and close-growing pasture or hay crops. If cultivated crops are grown on a continuous basis, the hazard of erosion is severe. A system of conservation tillage that leaves a protective cover of crop residue on the surface throughout the year, stripcropping, winter cover crops, and grassed waterways help to control erosion. Some type of grade-stabilization structure generally is needed if grassed waterways are used. Returning crop residue to the soil or regularly adding other organic material generally improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

Growing grasses and legumes for pasture and hay is very effective in controlling erosion. This soil is well suited to timothy, red clover, tall fescue, birdsfoot trefoil, and switchgrass. It is moderately well suited to smooth bromegrass, orchardgrass, alfalfa, big bluestem, and

Figure 7.—Native stands of oak and hickory are common in areas of Keswick loam, 5 to 14 percent slopes, eroded.

indiangrass. Controlling erosion during seedbed preparation and preventing overgrazing are the main management concerns. Preparing seedbeds on the contour and in a timely manner helps to ensure rapid growth for ground cover. Overgrazing or grazing when the soil is too wet generally causes surface compaction, excessive runoff, and poor tilth. Maintaining fertility and controlling brush and weeds are necessary. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. A few areas support native hardwoods. The hazards and limitations that affect planting and harvesting are slight.

This soil is suitable for some kinds of sanitary facilities and building site development if proper design and installation procedures are used. Areas used for sewage lagoons and dwellings should be graded. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand or gravel help to prevent the damage caused by shrinking and swelling of the soil.

Low strength, the shrink-swell potential, the slope, and the potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material helps to minimize the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage help to prevent the damage caused by shrinking and swelling and by frost action. Cutting and filling may be necessary because of the slope, or the roads and streets can be designed so that they conform to the natural landscape.

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

22E2—Gara loam, 14 to 20 percent slopes, eroded. This very deep, moderately steep, moderately well drained soil is on dissected upland side slopes, commonly adjacent to stream valleys. Water erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from about 20 to more than 600 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:

0 to 6 inches, very dark grayish brown, friable loam

Subsoil:

6 to 20 inches, dark yellowish brown, mottled, friable and firm clay loam

20 to 60 inches, yellowish brown, mottled, firm and very firm clay loam and loam

In some areas calcium carbonates are closer to the surface. In other areas the surface layer is thicker. In places the surface layer has more clay.

Included with this soil in mapping are small areas of the somewhat poorly drained Armstrong soils and the moderately deep Vanmeter soils. Armstrong soils are on strongly sloping side slopes, and Vanmeter soils are on steep side slopes along the Weldon River and its tributaries. Also included are a few areas that have slopes of more than 20 percent and areas of severely eroded soils that have a surface layer of brown clay loam. Included areas make up about 5 percent of the map unit.

Important properties of the Gara soil—

Permeability: Moderately slow
Surface runoff: Rapid
Available water capacity: High
Organic matter content: Moderate
Shrink-swell potential: Moderate

Most areas are used for pasture, but a few areas are wooded (fig. 8). Because of the slope, this soil is unsuitable for cultivated crops. The soil is well suited to red clover, birdsfoot trefoil, tall fescue, and switchgrass. It is moderately well suited to alfalfa, orchardgrass, smooth bromegrass, big bluestem, and indiangrass. Controlling erosion during seedbed preparation and preventing overgrazing are the main management concerns. Preparing seedbeds on the contour and in a timely manner helps to ensure rapid growth for ground cover. Measures that prevent overgrazing, maintain fertility, and control brush and weeds are necessary.

This soil is suited to trees. A few areas support stands of native hardwoods. The erosion hazard and the equipment limitation are the main management concerns. Special erosion-control measures are needed. Careful design and construction of roads and skid trails can help to overcome the steepness and length of slopes and to minimize the concentration of water. Seeding disturbed areas may be necessary after harvesting is completed. The safe operation of equipment is hindered by the slope. Roads and skid trails should be established on the contour. In some cases it may be necessary to yard the logs uphill to logging roads or skid trails. Hand planting or direct seeding may also be necessary.

This soil is suitable for some kinds of sanitary facilities and building site development if proper design and installation procedures are used. Areas used for sewage lagoons or dwellings should be graded. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand or gravel help to prevent the damage caused by shrinking and swelling of the soil.

Low strength, the shrink-swell potential, the slope, and the potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material helps to minimize the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage help to prevent the damage caused by shrinking and swelling and by frost action. Cutting and filling may be necessary because of the slope, or the roads and streets can be designed so that they conform to the natural landscape.

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

22F2—Gara loam, 20 to 30 percent slopes, eroded. This very deep, steep, moderately well drained soil is on dissected upland side slopes, commonly adjacent to stream valleys. Water erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual

Figure 8.—A typical area of Gara loam, 14 to 20 percent slopes, eroded.

areas are irregular in shape and range from about 15 to more than 500 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:

0 to 6 inches, very dark grayish brown, very friable loam

Subsoil:

6 to 15 inches, brown, mottled, friable loam

15 to 39 inches, strong brown and light grayish brown, mottled, firm clay loam

39 to 60 inches, yellowish brown and light grayish brown, firm clay loam

In some areas calcium carbonates are closer to the surface. In other areas the surface layer is thicker. In places the surface layer has more clay.

Included with this soil in mapping are small areas of the moderately deep Vanmeter soils. These soils commonly are on steep side slopes along the Weldon River and its tributaries. Also included are a few areas that have slopes of less than 20 percent and a few areas of severely eroded soils that have a surface layer of brown clay loam. Included areas make up about 5 percent of the map unit.

Important properties of the Gara soil—

Permeability: Moderately slow
Surface runoff: Rapid
Available water capacity: High
Organic matter content: Moderate
Shrink-swell potential: Moderate

Most areas are used for pasture. A few areas are wooded. Because of the slope, this soil is unsuitable for cultivated crops. The soil is well suited to red clover, birdsfoot trefoil, tall fescue, and switchgrass. It is moderately well suited to alfalfa, orchardgrass, smooth bromegrass, big bluestem, and indiangrass. Controlling erosion during seedbed preparation and preventing overgrazing are the main management concerns. Preparing seedbeds on the contour and in a timely manner helps to ensure rapid growth for ground cover. Measures that prevent overgrazing are needed. Maintaining fertility and controlling brush and weeds are also important.

This soil is suited to trees. Some areas support stands of native hardwoods. The erosion hazard and the equipment limitation are the main management concerns. Special erosion-control measures are needed. Careful design and construction of roads and skid trails can help to overcome the steepness and length of slopes and to minimize the concentration of water. Seeding disturbed areas may be necessary after harvesting is completed. The safe operation of equipment is hindered by the slope. Roads and skid trails should be established on the contour. In extreme cases, it may be necessary to yard the logs uphill to logging roads and skid trails. Hand planting or direct seeding may also be necessary.

This soil is suitable for some kinds of sanitary facilities and building site development if proper design and installation procedures are used. Areas used for sewage lagoons or dwellings should be graded. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand or gravel help to prevent the damage caused by shrinking and swelling of the soil.

Low strength, the shrink-swell potential, the slope, and the potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material helps to minimize the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage help to prevent the damage caused by shrinking and swelling and by frost action. Cutting and filling may be necessary because of the slope, or the roads and streets can be designed so that they conform to the natural landscape.

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

24C2—Armstrong loam, 5 to 9 percent slopes, eroded. This very deep, moderately sloping, somewhat poorly drained soil is on narrow, convex ridges and side slopes. Water erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from about 10 to 500 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 6 inches, very dark grayish brown, friable loam

Subsoil:
6 to 10 inches, dark yellowish brown, mottled, friable clay loam
10 to 40 inches, brown, strong brown, and yellowish brown, mottled, firm clay
40 to 60 inches, yellowish brown, mottled, firm clay loam

In some slightly eroded areas, the surface layer is thicker. In some places the subsoil has less glacial sand and pebbles. In other places the subsoil is grayer. In some areas calcium carbonates are closer to the surface.

Included with this soil in mapping are areas of severely eroded soils that have a surface layer of brown clay loam. Also included are areas that have steeper slopes than the Armstrong soil. Included areas make up about 5 percent of the map unit.

Important properties of the Armstrong soil—

Permeability: Slow
Surface runoff: Medium
Available water capacity: Moderate
Organic matter content: Moderate
Shrink-swell potential: High
Seasonal high water table: Perched at a depth of 1 to 3 feet from late fall through spring

Most areas are used for cultivated crops or for hay and pasture. A few areas are wooded. This soil is suited to corn, soybeans, and small grain in a rotation system that includes some close-growing pasture or hay crops. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves a protective cover of crop residue on the surface throughout the year, winter cover crops, and grassed waterways help to control erosion. A few small areas have slopes that are long and smooth enough to be terraced and farmed on the contour. Some type of grade-stabilization structure generally is needed if grassed waterways are used. Returning crop residue to the soil or regularly adding other organic material generally improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

Growing grasses and legumes for pasture and hay is very effective in controlling erosion. Pasture and hay mixtures that include wetness-tolerant varieties grow best. This soil is moderately well suited to birdsfoot trefoil, reed canarygrass, tall fescue, big bluestem, indiangrass, and switchgrass. It is moderately suited to alfalfa, red clover, orchardgrass, and smooth bromegrass. Controlling erosion during seedbed preparation is the main management concern. Timely tillage and the quick establishment of ground cover are necessary to prevent excessive erosion. Overgrazing or grazing when the soil is too wet generally causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. A few areas support native hardwoods. Seedling mortality and windthrow are management concerns. Planting container-grown stock improves the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is not a concern.

This soil is suited to some kinds of sanitary facilities and building site development if proper design and installation procedures are used. Sewage lagoons function adequately if sites are leveled or graded. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand or gravel help to prevent the damage caused by shrinking and swelling of the soil. Installing tile drains around the foundations and footings helps to prevent the damage caused by wetness.

Low strength, the shrink-swell potential, the wetness, and a high potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material helps to minimize the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage help to prevent the damage caused by shrinking and swelling, wetness, and frost action.

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

24D2—Armstrong clay loam, 9 to 14 percent slopes, eroded. This very deep, strongly sloping, somewhat poorly drained soil is on side slopes and narrow, convex ridgetops. Water erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from about 10 to 350 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:

0 to 7 inches, very dark grayish brown, firm clay loam

Subsoil:

7 to 35 inches, brown, strong brown, and yellowish brown, mottled, firm and very firm clay

35 to 60 inches, yellowish brown, mottled, very firm clay loam

In some areas the subsoil is grayer. In other areas calcium carbonates are closer to the surface.

Included with this soil in mapping are small areas of the moderately well drained Gara soils on side slopes. Also included are areas of severely eroded soils that have a surface layer of brown clay loam. Included soils make up about 10 percent of the map unit.

Important properties of the Armstrong soil—

Permeability: Slow
Surface runoff: Medium
Available water capacity: Moderate
Organic matter content: Moderate
Shrink-swell potential: High
Seasonal high water table: Perched at a depth of 1 to 3 feet from late fall through spring

Most areas are used for hay and pasture. Some areas are used for cultivated crops, and a few areas are wooded. This soil is suited to cultivated crops on a limited basis in rotation with small grain and close-growing pasture or hay crops. If cultivated crops are grown on a continuous basis, the hazard of erosion is severe. A system of conservation tillage that leaves a protective cover of crop residue on the surface throughout the year, stripcropping, winter cover crops, and grassed waterways help to control erosion. Some type of grade-stabilization structure generally is needed if grassed waterways are used. Returning crop residue to the soil or regularly adding other organic material generally improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

Growing grasses and legumes for pasture and hay is very effective in controlling erosion. Pasture and hay mixtures that include wetness-tolerant varieties grow best. This soil is moderately well suited to birdsfoot trefoil, reed canarygrass, tall fescue, big bluestem, indiangrass, and switchgrass. It is moderately suited to alfalfa, red clover, orchardgrass, and smooth bromegrass. Controlling erosion during seedbed preparation and preventing overgrazing are the main management concerns. Preparing seedbeds on the contour and in a timely manner helps to ensure rapid growth for ground cover. Overgrazing or grazing when the soil is too wet generally causes surface compaction, excessive runoff, and poor tilth. Maintaining fertility and controlling brush and weeds are necessary. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. A few areas support native hardwoods. Seedling mortality and windthrow are management concerns. Planting container-grown stock improves the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is not a concern.

This soil is suited to some kinds of sanitary facilities and building site development if proper design and installation procedures are used. Areas used for sewage lagoons and dwellings should be graded. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand or gravel help to prevent the damage caused by shrinking and swelling of the soil. Installing tile drains around the foundations and footings helps to prevent the damage caused by wetness.

Low strength, the shrink-swell potential, the slope, the wetness, and a high potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material helps to minimize the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage help to prevent the damage caused by shrinking and swelling, wetness, and frost action. Cutting and filling may be necessary because of the slope, or the roads and streets can be designed so that they conform to the natural landscape.

The land capability classification is IVe. The woodland ordination symbol is 3C.

25B2—Pering silty clay loam, 2 to 5 percent slopes, eroded. This very deep, gently sloping, somewhat poorly drained soil is on convex ridgetops. Water erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from about 5 to 200 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 7 inches, very dark gray, friable silty clay loam

Subsoil:
7 to 17 inches, brown, firm silty clay that is mottled in the lower part
17 to 28 inches, grayish brown, mottled, firm silty clay
28 to 60 inches, light brownish gray, mottled, firm silty clay loam

In some slightly eroded areas, the surface layer is silt loam. In places the lower part of the subsoil has more glacial sand.

Important soil properties—

Permeability: Slow
Surface runoff: Medium
Available water capacity: High
Organic matter content: Moderate
Shrink-swell potential: High
Seasonal high water table: Perched at a depth of 2 to 4 feet from late fall through spring

Most areas are used for cultivated crops or for pasture and hay. A few areas are wooded. This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves a protective cover of crop residue on the surface throughout the year, winter cover crops, underground tile outlets, grassed waterways, contour farming, and a cropping sequence that includes close-growing pasture plants help to control erosion. Some type of grade-stabilization structure generally is needed if grassed waterways are used. Returning crop residue to the soil or regularly adding other organic material generally improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

Growing grasses and legumes for pasture or hay is very effective in controlling erosion (fig. 9). Pasture and hay mixtures that include wetness-tolerant varieties grow best. This soil is moderately well suited to tall fescue, reed canarygrass, birdsfoot trefoil, big bluestem, indiangrass, and switchgrass. It is moderately suited to smooth bromegrass, orchardgrass, red clover, and alfalfa. Controlling erosion during seedbed preparation is the main management concern. Timely tillage and the quick establishment of ground cover are necessary to prevent excessive erosion. Overgrazing or grazing when the soil is too wet generally causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. A few areas support native hardwoods. Seedling mortality and windthrow are management concerns. Planting container-grown stock improves the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is not a concern.

This soil is suited to some kinds of sanitary facilities and building site development if proper design and installation procedures are used. Sewage lagoons function well in areas of this soil if sites are leveled or graded. If dwellings are built, wetness and the shrink-swell potential are concerns. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand or gravel help to prevent the damage caused by shrinking and swelling of the soil. Installing tile drains around the

Figure 9.—Bales of grass-legume hay in an area of Pering silty clay loam, 2 to 5 percent slopes, eroded.

foundations and footings helps to prevent the damage caused by wetness.

Low strength, the shrink-swell potential, the wetness, and a high potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material helps to minimize the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage help to prevent the damage caused by shrinking and swelling, wetness, and frost action.

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

25C2—Pering silty clay loam, 5 to 9 percent slopes, eroded. This very deep, moderately sloping, somewhat poorly drained soil is on side slopes and narrow, convex ridges. Water erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from about 5 to 60 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows:

Surface layer:
0 to 7 inches, very dark gray, friable silty clay loam

Subsoil:
7 to 14 inches, brown, mottled, friable silty clay loam
14 to 30 inches, brown, mottled, firm silty clay
30 to 60 inches, grayish brown, mottled, firm silty clay loam

In some slightly eroded areas, the surface layer is silt loam. In places the lower part of the subsoil has more glacial sand.

Important soil properties—

Permeability: Slow
Surface runoff: Medium
Available water capacity: High
Organic matter content: Moderate

Shrink-swell potential: High
Seasonal high water table: Perched at a depth of 2 to 4 feet from late fall through spring

Most areas are used for cultivated crops or for pasture and hay. A few areas are wooded. This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, the hazard of erosion is severe. A system of conservation tillage that leaves a protective cover of crop residue on the surface throughout the year, winter cover crops, underground tile outlets, grassed waterways, and a cropping sequence that includes close-growing pasture plants help to control erosion. A few small areas have slopes that are long and smooth enough to be terraced and farmed on the contour. Some type of grade-stabilization structure generally is needed if grassed waterways are used. Returning crop residue to the soil or regularly adding other organic material generally improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

Growing grasses and legumes for pasture or hay is very effective in controlling erosion. Pasture and hay mixtures that include wetness-tolerant varieties grow best. This soil is moderately well suited to tall fescue, reed canarygrass, birdsfoot trefoil, big bluestem, indiangrass, and switchgrass. It is moderately suited to smooth bromegrass, orchardgrass, red clover, and alfalfa. Controlling erosion during seedbed preparation is the main management concern. Timely tillage and the quick establishment of ground cover are necessary to prevent excessive erosion. Overgrazing or grazing when the soil is too wet generally causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. A few areas support native hardwoods. Seedling mortality and windthrow are management concerns. Planting container-grown stock improves the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is not a concern.

This soil is suited to some kinds of sanitary facilities and building site development if proper design and installation procedures are used. Sewage lagoons function adequately if sites are leveled or graded. If dwellings are built on this soil, wetness and the shrink-swell potential are concerns. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand or gravel help to prevent the damage caused by shrinking and swelling of the soil. Installing tile drains around the foundations and footings helps to prevent the damage caused by wetness.

Low strength, the shrink-swell potential, the wetness, and a high potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material helps to minimize the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage help to prevent the damage caused by shrinking and swelling, wetness, and frost action.

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

29F—Winnegan loam, 14 to 35 percent slopes. This very deep, moderately steep to very steep, moderately well drained soil is on dissected upland side slopes. Individual areas are irregular in shape and range from about 20 to 300 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 2 inches, very dark grayish brown, very friable loam

Subsurface layer:
2 to 8 inches, brown, friable loam

Subsoil:
8 to 30 inches, dark yellowish brown and yellowish brown, firm clay that is mottled in the lower part
30 to 60 inches, yellowish brown, mottled, firm clay loam

In some areas calcium carbonates are closer to the surface.

Included with this soil in mapping are small areas of Keswick and Vanmeter soils. Keswick soils have grayer colors in the upper part of the subsoil than the Winnegan soil. They are on the upper part of side slopes. The moderately deep Vanmeter soils are on the lower part of the side slopes along the Weldon River and its tributaries. Also included are sandy areas along the east side of the Weldon River extending about 1 mile north and 1 mile south of Highway K and some areas of moderately eroded and severely eroded soils that have a surface layer of clay loam. Included areas make up about 10 percent of the map unit.

Important properties of the Winnegan soil—

Permeability: Slow
Surface runoff: Rapid
Available water capacity: Moderate
Organic matter content: Moderately low
Seasonal high water table: At a depth of 2.0 to 3.5 feet from late fall through spring

Shrink-swell potential: High

Most areas are used for trees or pasture. Because of the slope, this soil is unsuitable for cultivated crops. The soil is suited to red clover, birdsfoot trefoil, tall fescue, and switchgrass. It is moderately well suited to alfalfa, orchardgrass, smooth bromegrass, big bluestem, and indiangrass. Controlling erosion during seedbed preparation and preventing overgrazing are the main management concerns. Preparing seedbeds on the contour and in a timely manner helps to ensure rapid growth for ground cover. Measures that help to prevent overgrazing are needed. Maintaining fertility and controlling brush and weeds are also necessary.

This soil is suited to trees. Many areas support stands of native hardwoods. The erosion hazard and the equipment limitation are the main management concerns. Special erosion-control measures are needed. Careful design and construction of roads and skid trails can help to overcome the steepness and length of slopes and to minimize the concentration of water. Seeding disturbed areas may be necessary after harvesting is completed. The safe operation of equipment is hindered by the slope. Roads and skid trails should be established on the contour. In severe cases, it may be necessary to yard the logs uphill to logging roads and skid trails. Hand planting or direct seeding may also be needed.

This soil is generally unsuitable for sanitary facilities and building site development because of the slope.

Low strength, the shrink-swell potential, the slope, and the potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material helps to minimize the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage help to prevent the damage caused by shrinking and swelling and by frost action. Cutting and filling may be necessary because of the slope, or the roads and streets can be designed so that they conform to the natural landscape.

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

33F—Vanmeter silty clay loam, 9 to 40 percent slopes. This moderately deep, strongly sloping to very steep, moderately well drained soil is on upland side slopes adjacent to the larger streams and their tributaries. Individual areas are irregular in shape and range from about 20 to more than 200 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 3 inches, very dark grayish brown, friable silty clay loam

Subsoil:
3 to 6 inches, dark grayish brown, firm silty clay
6 to 19 inches, yellowish brown, firm silty clay
19 to 35 inches, strong brown, mottled, firm silty clay

Substratum:
35 to 45 inches, partially weathered siltstone and sandstone

In some areas the depth to bedrock is less than 20 inches, and in a few areas it is more than 40 inches. In several places the surface layer is flaggy.

Included with this soil in mapping are small areas of the very deep Keswick, Armstrong, Gara, and Winnegan soils, which formed in glacial till. Keswick soils and the somewhat poorly drained Armstrong soils are on the upper side slopes and on narrow ridges. Gara and Winnegan soils are on side slopes. Also included are a few small rocky areas, some bedrock outcrops and ledges, and sandy areas along the east side of the Weldon River extending about 1 mile north and 1 mile south of Highway K. Included areas make up about 15 percent of the map unit.

Important properties of the Vanmeter soil—

Permeability: Very slow
Surface runoff: Rapid
Available water capacity: Moderate
Organic matter content: Moderately low
Shrink-swell potential: High

Most areas are wooded or are used for pasture. This soil is moderately well suited to tall fescue, birdsfoot trefoil, reed canarygrass, big bluestem, and indiangrass. It is moderately suited to smooth bromegrass, orchardgrass, and switchgrass. The safe use of equipment is hindered by the bedrock outcrops, the rocky ledges, and stones on the surface and in the upper part of the soil. Controlling erosion during seedbed preparation and preventing overgrazing are the main management concerns. Preparing seedbeds on the contour and in a timely manner helps to ensure rapid growth for ground cover. Measures that minimize overgrazing, maintain fertility, and control brush and weeds are necessary.

This soil is suited to trees. Many areas support stands of native hardwoods. The main management concerns affecting planting and harvesting are the hazard of erosion in disturbed areas, the equipment limitations caused by the slope, the rock outcrops and ledges, seedling mortality, and windthrow. Constructing roads and skid trails on the contour helps to overcome the steepness and length of slopes and minimizes the concentration of water. Seeding may be necessary in disturbed areas after harvesting. Planting larger seedlings than normal improves survival rates. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is not a concern.

This soil generally is unsuitable for sanitary facilities and building site development because of the slope, the depth to rock, and the shrink-swell potential. Soils that are better suited to these uses generally are nearby.

Low strength, the shrink-swell potential, the slope, and the potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material helps to minimize the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage help to prevent the damage caused by shrinking and swelling and by frost action. Cutting and filling may be necessary because of the slope, or the roads and streets can be designed so that they conform to the natural landscape.

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

42—Sandover fine sand, occasionally flooded. This very deep, nearly level, moderately well drained soil is on flood plains adjacent to stream channels. Individual areas are irregular in shape and range from about 10 to 75 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 9 inches, brown, loose fine sand

Substratum:
9 to 25 inches, brown, loose fine sand
25 to 60 inches, stratified dark grayish brown, grayish brown, dark gray, and very dark grayish brown, mottled, friable silt loam

In some areas the surface layer is loamy sand or loamy fine sand.

Included with this soil in mapping are small areas of Nodaway soils, which are silt loam throughout. These soils are in the lower areas. They make up about 5 percent of the map unit.

Important properties of the Sandover soil—

Permeability: Rapid in the upper part, moderate in the lower part
Surface runoff: Slow
Available water capacity: High
Organic matter content: Very low
Shrink-swell potential: Moderate
Seasonal high water table: At a depth of 2 to 3 feet from late fall through spring

Most areas are used for cultivated crops. A few areas are wooded. This soil is suited to corn, soybeans, and small grain. It is subject to scouring and sediment deposition during periods of flooding in the spring and fall. Structures that retard floodwater minimize the crop damage or loss caused by flooding. A conservation tillage system that leaves a protective cover of crop residue on the surface helps to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material generally improves fertility.

This soil is moderately well suited to tall fescue, reed canarygrass, orchardgrass, big bluestem, indiangrass, and switchgrass. It is moderately suited to smooth bromegrass, timothy, red clover, birdsfoot trefoil, and alfalfa. Flooding is the main management concern affecting pasture. It should be considered when a grazing system is designed.

This soil is suited to trees. Equipment limitations and seedling mortality are the main management concerns. Flooding may limit the use of equipment from November through May. Trees should be harvested only when the ground is frozen or during extended dry periods. Using special planting stock that is larger than normal or planting containerized stock increases the seedling survival rate.

This soil generally is unsuited to building site development and sanitary facilities because of the flooding.

The land capability classification is IIw. The woodland ordination symbol is 6W.

45—Humeston silty clay loam, occasionally flooded. This very deep, nearly level, poorly drained soil is on flood plains. Individual areas are irregular in shape and range from about 15 to 80 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 14 inches, very dark gray, friable silty clay loam

Subsurface layer:
14 to 26 inches, dark gray, mottled, friable silt loam

Subsoil:
26 to 48 inches, very dark gray, mottled, firm silty clay loam
48 to 60 inches, dark gray, mottled, very firm silty clay

In some places, the dark gray subsurface horizon is thicker and the subsoil has less clay. In a few areas the surface layer is silt loam or sandy loam.

Included with this soil in mapping are small areas of Zook soils. These soils have a thicker dark surface layer than the Humeston soil. They are commonly in the lower areas on the flood plains. Also included are a few small depressional areas where water is ponded. Included areas make up about 5 percent of the map unit.

Important properties of the Humeston soil—

Permeability: Very slow
Surface runoff: Slow
Available water capacity: High
Organic matter content: Moderate
Shrink-swell potential: High
Seasonal high water table: Within a depth of 1 foot from late fall through spring

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, flooding and wetness are the main concerns. Structures that retard floodwater minimize the crop damage or loss caused by flooding. Surface drainage can be improved by land grading or surface ditches. Diversions help to protect the soil against runoff from the uplands. Returning crop residue to the soil or regularly adding other organic material generally improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is best suited to shallow-rooted grasses and legumes that can withstand wetness. It is moderately well suited to reed canarygrass and is moderately suited to alsike clover, birdsfoot trefoil, and ladino clover. The flooding and the wetness are the main concerns in areas used as hayland. Flooding should be considered when a grazing system is designed. Preparing a seedbed is difficult only during wet periods. The deeper rooted species grow better if a surface drainage system is installed.

This soil is generally unsuited to sanitary facilities and building site development because of the flooding and the seasonal high water table.

The land capability classification is IIIw.

49—Belinda silt loam. This very deep, nearly level, poorly drained soil is on high terraces. Individual areas are irregular in shape and range from about 10 to 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 9 inches, very dark grayish brown, friable silt loam

Subsurface layer:
9 to 16 inches, dark gray, friable silt loam

Subsoil:
16 to 34 inches, dark grayish brown, mottled, firm and very firm silty clay
34 to 60 inches, grayish brown, mottled, very firm silty clay

Important soil properties—

Permeability: Very slow
Surface runoff: Very slow
Available water capacity: High
Organic matter content: Moderate
Shrink-swell potential: High
Seasonal high water table: At a depth of 0.5 foot to 2.0 feet from late fall through spring

Most areas are used for cultivated crops or for pasture and hay. This soil is suited to corn, soybeans, and small grain. Wetness is the major management concern. Land grading and shallow surface drains help to remove excess water. Returning crop residue to the soil or regularly adding other organic material generally improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

Pasture and hay mixtures that include wetness-tolerant varieties grow best. This soil is moderately well suited to reed canarygrass and is moderately suited to birdsfoot trefoil and alsike clover. Overgrazing or grazing when the soil is too wet generally causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to some kinds of sanitary facilities and building site development if proper design and installation procedures are used. Sewage lagoons function well in areas of this soil. If dwellings are built, wetness and the shrink-swell potential are concerns. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand or gravel help to prevent the damage caused by shrinking and swelling of the soil. Installing tile drains around the foundations and footings helps to prevent the damage caused by wetness.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material helps to minimize the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage help to prevent the damage caused by shrinking and swelling, wetness, and frost action.

The land capability classification is IIIw. The woodland ordination symbol is 2W.

51B—Pering silt loam, terrace, 2 to 6 percent slopes. This very deep, gently sloping, somewhat poorly drained soil is on high structural terraces. Individual areas are irregular in shape and range from about 5 to 200 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 7 inches, very dark gray, friable silt loam

Subsurface layer:
7 to 10 inches, dark grayish brown, friable silt loam

Subsoil:
10 to 16 inches, brown, friable silty clay loam
16 to 22 inches, brown, mottled, firm silty clay loam
22 to 43 inches, grayish brown, mottled, firm silty clay
43 to 60 inches, grayish brown, mottled, firm silty clay loam

In some areas the lower part of the subsoil contains more sand.

Included with this soil in mapping are small areas of the poorly drained Belinda soils in nearly level areas on the terrace. Also included are areas of Mystic soils and the moderately well drained Caleb soils along the edges of the terrace. Mystic soils contain more sand throughout than the Pering soil. Included soils make up about 5 percent of the map unit.

Important properties of the Pering soil—

Permeability: Slow
Surface runoff: Medium
Available water capacity: High
Organic matter content: Moderate
Shrink-swell potential: High
Seasonal high water table: Perched at a depth of 2 to 4 feet from late fall through spring

Most areas are used for cultivated crops or for pasture and hay. A few areas are wooded. This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, further erosion is a hazard. A system of conservation tillage that leaves a protective cover of crop residue on the surface throughout the year, winter cover crops, underground tile outlets, grassed waterways, and a cropping sequence that includes close-growing pasture plants help to control erosion. A few small areas have slopes that are long and smooth enough to be terraced and farmed on the contour. Some type of grade-stabilization structure generally is needed if grassed waterways are used. Returning crop residue to the soil or regularly adding other organic material generally improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

Growing grasses and legumes for pasture or hay is very effective in controlling erosion. Pasture and hay mixtures that include wetness-tolerant varieties grow best. This soil is moderately well suited to tall fescue, reed canarygrass, birdsfoot trefoil, big bluestem, indiangrass, and switchgrass. It is moderately suited to smooth bromegrass, orchardgrass, red clover, and alfalfa. Controlling erosion during seedbed preparation is the main management concern. Timely tillage and the quick establishment of ground cover are necessary to prevent excessive erosion. Overgrazing or grazing when the soil is too wet generally causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suited to trees. A few areas support native hardwoods. Seedling mortality and windthrow are management concerns. Planting container-grown stock improves the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is not a concern.

This soil is suited to some kinds of sanitary facilities and building site development if proper design and installation procedures are used. Sewage lagoons function well if sites are leveled or graded. If dwellings are built, wetness and the shrink-swell potential are concerns. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand or gravel help to prevent the damage caused by shrinking and swelling of the soil. Installing tile drains around the foundations and footings helps to prevent the damage caused by wetness.

Low strength, the shrink-swell potential, the wetness, and a high potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material helps to minimize the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage help to prevent the damage caused by shrinking and swelling, wetness, and frost action.

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

52B—Vigar loam, 2 to 6 percent slopes, rarely flooded. This very deep, gently sloping and moderately sloping, moderately well drained soil is on slightly concave or plane toe slopes and alluvial fans. Individual areas are long and narrow or irregularly shaped and range from about 10 to 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 6 inches, black, friable loam

Subsurface layer:
6 to 13 inches, black, friable loam

Subsoil:
13 to 23 inches, black, friable loam
23 to 32 inches, very dark gray, mottled, firm loam
32 to 60 inches, dark grayish brown and brown, mottled, firm clay loam and loam

In some areas the soil has more clay throughout.

Included with this soil in mapping are small areas of the poorly drained Zook soils on the adjacent flood plains. Also included are small overwash areas close to drainageways and manmade ditches. Included areas make up about 5 percent of the map unit.

Important properties of the Vigar soil—

Permeability: Moderately slow
Surface runoff: Medium
Available water capacity: High
Organic matter content: Moderate
Shrink-swell potential: Moderate
Seasonal high water table: At a depth of 2 to 3 feet from late fall through spring

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, further erosion is a hazard. A system of conservation tillage that leaves a protective cover of crop residue on the surface throughout the year, winter cover crops, grassed waterways, and a cropping sequence that includes close-growing pasture plants help to control erosion. A few small areas have slopes that are long and smooth enough to be terraced and farmed on the contour. Some type of grade-stabilization structure generally is needed if grassed waterways are used. Returning crop residue to the soil or regularly adding other organic material generally helps to maintain fertility and increases the rate of water infiltration.

Growing grasses and legumes for pasture or hay is very effective in controlling erosion. Pasture and hay mixtures that include wetness-tolerant varieties grow best. This soil is moderately well suited to timothy, tall fescue, birdsfoot trefoil, reed canarygrass, big bluestem, indiangrass, and switchgrass. It is moderately suited to smooth bromegrass, orchardgrass, alfalfa, and red clover. Controlling erosion during seedbed preparation is the main management concern. Timely tillage and the quick establishment of ground cover are necessary to prevent excessive erosion. Overgrazing or grazing when the soil is too wet generally causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

This soil is suitable for some kinds of building site development and sanitary facilities if proper design and installation procedures are used. Sewage lagoons can function adequately if they are protected from flooding and the bottoms are sealed with slowly permeable material. If dwellings are built, wetness, flooding, and the shrink-swell potential are concerns. Protection from flooding is needed. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand or gravel help to prevent the damage caused by shrinking and swelling of the soil. Installing tile drains around the foundations and footings helps to prevent the damage caused by wetness.

Low strength, the shrink-swell potential, the wetness, and a high potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material helps to minimize the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage help to prevent the damage caused by shrinking and swelling, wetness, and frost action.

The land capability classification is IIe.

54—Zook silty clay loam, occasionally flooded. This very deep, nearly level, poorly drained soil is on low flood plains along rivers and large and small streams. Individual areas are irregular in shape and range from about 10 to 400 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 9 inches, black, friable silty clay loam

Subsurface layer:
9 to 16 inches, black, firm silty clay loam
16 to 34 inches, black, very firm silty clay

Subsoil:
34 to 52 inches, very dark gray, very firm silty clay
52 to 60 inches, dark gray, mottled, very firm silty clay

In some areas the soil has more clay throughout. In other areas, the surface layer is silt loam and the subsoil contains less clay.

Included with this soil in mapping are small areas of the moderately well drained Nodaway soils. These soils are adjacent to the stream channels. Also included are small overwash areas close to manmade ditches.

Included areas make up about 5 percent of the map unit.

Important properties of the Zook soil—

Permeability: Slow
Surface runoff: Slow
Available water capacity: Moderate
Organic matter content: High
Shrink-swell potential: High
Seasonal high water table: At the surface to 3 feet below the surface from late fall through spring

Most areas are used for cultivated crops or for pasture and hay. A few areas support trees. This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, flooding and wetness are the main concerns. Structures that retard floodwater minimize the crop damage or loss caused by flooding. Surface drainage can be improved by land grading or surface ditches. Diversions help to protect the soil against runoff from the uplands. Returning crop residue to the soil or regularly adding other organic material generally improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is best suited to shallow-rooted grasses and legumes that can withstand wetness. It is moderately well suited to reed canarygrass and is moderately suited to birdsfoot trefoil and alsike clover. Flooding and wetness are the main concerns in areas used as hayland. Flooding should be considered when a grazing system is designed. The deeper rooted species grow better if a surface drainage system is installed.

This soil generally is unsuitable for building site development and sanitary facilities because of the flooding.

The land capability classification is IIw.

55A—Colo silty clay loam, channeled, 0 to 3 percent slopes, frequently flooded. This very deep, nearly level and gently sloping, poorly drained soil is in narrow drainageways that dissect and branch into the uplands. Individual areas are irregular in shape and range from about 5 to 25 acres in size.

The location of the typical pedon of the Colo soil in this map unit is in Grundy County, Missouri. The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 8 inches, black, friable silty clay loam

Subsurface layer:
8 to 30 inches, black, friable silty clay loam

Subsoil:
30 to 50 inches, very dark gray, firm silty clay loam that is mottled in the lower part
50 to 60 inches, dark gray, mottled, firm silty clay loam

In some areas the soil has more clay throughout. In other areas it is dark to a depth of less than 36 inches. In some places the surface layer has less clay.

Included with this soil in mapping are areas of streambanks and channels. These areas are steeper than the Colo soil. They make up about 5 percent of the map unit.

Important properties of the Colo soil—

Permeability: Moderate
Surface runoff: Slow
Available water capacity: High
Organic matter content: High
Shrink-swell potential: Moderate
Seasonal high water table: At a depth of 1 to 3 feet from late fall through spring

Most areas are used for hay and pasture. Some areas are wooded. A few areas are used for cultivated crops. This soil is best suited to shallow-rooted grasses and legumes that can withstand wetness. It is moderately suited to reed canarygrass and alsike clover. Streambank erosion, wetness, and flooding are the main concerns. Also, inaccessibility is a problem in most areas when forage crops are harvested. Reshaping and seeding streambanks can help to control streambank erosion. Surface drainage can be improved by land grading or surface ditches. Diversions help to protect the soil against runoff from the uplands. Overgrazing reduces the production of grasses and legumes and increases weed growth. Timely mowing reduces competition from undesirable plants and encourages uniform grazing. Grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

A few areas are used for trees. Many areas that are inaccessible for farming could support a stand of hardwoods or conifers. The soil also is suitable for the development of openland, woodland, and wetland wildlife habitat. Plants that can withstand wetness are preferable for wildlife food and cover.

This soil generally is not used for cultivated crops because most areas are too narrow and too channeled to be readily accessible to large machinery. Many areas are dissected by gullies and by meandering intermittent streams. In areas that are accessible, the soil is suited to corn and soybeans and is well suited to small grain.

This soil generally is unsuited to building site development and onsite waste disposal systems because of the flooding.

The land capability classification is Vw.

56B—Nodaway-Humeston-Vigar complex, 0 to 6 percent slopes. These very deep, nearly level to moderately sloping soils are in narrow drainageways adjacent to moderately sloping to very steep soils in the uplands. The Nodaway and Vigar soils are moderately well drained, and the Humeston soil is poorly drained. The Nodaway and Humeston soils are on nearly level flood plains and are subject to occasional flooding. The Vigar soil is gently sloping or moderately sloping and is subject to rare flooding. It is on toe slopes or alluvial fans in positions on the landscape higher than those of the Nodaway and Humeston soils. The Nodaway soil is adjacent to old stream channels. The Humeston soil is between the Nodaway and Vigar soils. Individual areas of this unit are long and narrow or irregularly shaped. They range from about 200 to 1,000 feet in width and from about 1,500 feet to more than a mile in length. They are about 30 percent Nodaway soil, 20 percent Humeston soil, and 20 percent Vigar soil. The three soils occur as areas so closely intermingled that they could not be mapped separately at the scale used.

The typical sequence, depth, and composition of the layers of the Nodaway soil are as follows—

Surface layer:
0 to 8 inches, very dark gray, friable silt loam

Substratum:
8 to 28 inches, stratified dark grayish brown and very dark gray, friable silt loam
28 to 60 inches, stratified dark grayish brown and very dark gray, mottled, friable silt loam

In some areas the soil has more sand throughout.

Important properties of the Nodaway soil—

Permeability: Moderate
Surface runoff: Slow
Available water capacity: Very high
Organic matter content: Moderate
Shrink-swell potential: Moderate
Seasonal high water table: At a depth of 3 to 5 feet from late fall through spring

The typical sequence, depth, and composition of the layers of the Humeston soil are as follows—

Surface layer:
0 to 10 inches, very dark gray, friable silty clay loam

Subsurface layer:
10 to 16 inches, dark gray, friable silt loam

Subsoil:
16 to 60 inches, very dark gray and dark gray, mottled, firm silty clay loam

In some areas the subsoil has less clay.

Important properties of the Humeston soil—

Permeability: Very slow
Surface runoff: Slow
Available water capacity: High
Organic matter content: Moderate
Shrink-swell potential: High
Seasonal high water table: At the surface to 1 foot below the surface from late fall through spring

The typical sequence, depth, and composition of the layers of the Vigar soil are as follows—

Surface layer:
0 to 12 inches, black, friable loam

Subsoil:
12 to 36 inches, very dark gray, dark grayish brown, and grayish brown, mottled, firm clay loam
36 to 42 inches, dark grayish brown, mottled, firm clay loam
42 to 60 inches, grayish brown, mottled, firm clay loam

In some areas the subsoil has more clay.

Important properties of the Vigar soil—

Permeability: Moderately slow
Surface runoff: Medium
Available water capacity: High
Organic matter content: Moderate
Shrink-swell potential: Moderate
Seasonal high water table: At a depth of 2 to 3 feet from late fall through spring

Included with these soils in mapping are small areas of the poorly drained Zook soils in depressions. Zook soils have a thicker dark surface layer than the major soils. They are in lower areas on the flood plains than the Humeston soil. Also included are entrenched drainageways that carry water part of the year and sandy areas that are commonly adjacent to drainageways. Included areas make up about 30 percent of the map unit.

Most areas of this map unit are used for pasture and hay. Some areas are wooded, and a few areas are used for cultivated crops. These soils are poorly suited to cultivated crops because of the meandering drainageways and the flooding. Streambank erosion and runoff from adjacent uplands are also concerns.

These soils are suited to pasture and hay. Low areas hold water for long periods after rains, and the stands of legumes and some grasses are affected. Reed canarygrass, alsike clover, and birdsfoot trefoil grow better than other species. On the Humeston soil, deep-rooted legumes, such as alfalfa, do not grow well because of the high water table. Most of the grasses and legumes commonly grown in the area grow well on the Vigar and Nodaway soils. Overgrazing reduces the production of grasses and legumes and increases weed growth. Timely mowing reduces competition from undesirable plants and encourages uniform grazing. Grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

These soils are suitable for the development of openland, woodland, and wetland wildlife habitat. Wetness-tolerant plants are preferable for food and cover.

These soils generally are unsuitable for onsite waste disposal systems and building development. In most areas the Vigar soil occurs in small, narrow bands and is not practical for development. The Humeston and Nodaway soils are unsuitable for these purposes because of the flooding.

The land capability classification is IIw for the Nodaway soil, IIIw for the Humeston soil, and IIe for the Vigar soil. The woodland ordination symbol for the Nodaway soil is 3A. No woodland ordination symbol is assigned to the Humeston soil or the Vigar soil.

57B—Olmitz-Zook-Vesser complex, 0 to 5 percent slopes. These very deep, nearly level to gently sloping soils are in narrow drainageways and on narrow foot slopes. The Zook and Vesser soils are poorly drained and are subject to occasional flooding. The Zook soil is on the lowest part of the flood plain. The Vesser soil is on high flood plains, foot slopes, or alluvial fans. The Olmitz soil is moderately well drained and is on foot slopes or alluvial fans. Individual areas of this unit are long and narrow or irregularly shaped and range from about 10 to more than 100 acres in size. The three soils occur as areas so closely intermingled that they could not be mapped separately at the scale used.

The location of the typical pedon of the Olmitz soil in this map unit is in Decatur County, Iowa. The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 7 inches, very dark grayish brown, friable loam

Subsurface layer:
7 to 16 inches, very dark grayish brown, friable loam
16 to 24 inches, black, mottled, friable clay loam
24 to 34 inches, black and dark brown, mottled, friable and firm clay loam

Subsoil:
34 to 60 inches, brown, mottled, firm clay loam

In some areas the surface layer is clay loam.

Important properties of the Olmitz soil—

Permeability: Moderate
Surface runoff: Slow
Available water capacity: High
Organic matter content: Moderate
Shrink-swell potential: Moderate

The location of the typical pedon of the Zook soil in this map unit is in Decatur County, Iowa. The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 7 inches, black, friable silty clay loam

Subsurface layer:
7 to 11 inches, very dark gray, friable silty clay loam
11 to 34 inches, black, firm silty clay that is mottled in the lower part

Subsoil:
34 to 60 inches, very dark gray, mottled, firm silty clay

In some areas the subsoil has less clay.

Important properties of the Zook soil—

Permeability: Slow
Surface runoff: Slow
Available water capacity: Moderate
Organic matter content: High
Shrink-swell potential: High
Seasonal high water table: At the surface to 3 feet below the surface from late fall through spring

The location of the typical pedon of the Vesser soil in this map unit is in Decatur County, Iowa. The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 10 inches, very dark grayish brown, friable silt loam

Subsurface layer:
10 to 26 inches, dark grayish brown, friable silt loam that is mottled in the lower part

Subsoil:
26 to 60 inches, dark grayish brown and very dark grayish brown, mottled, firm silty clay loam

In some areas the subsoil has more clay.

Important properties of the Vesser soil—

Permeability: Moderate
Surface runoff: Slow
Available water capacity: High
Organic matter content: Moderate
Shrink-swell potential: Moderate

Seasonal high water table: At a depth of 1 to 3 feet from late fall through spring

Included with these soils in mapping are small areas of the moderately well drained Nodaway soils. Nodaway soils have a thinner dark surface soil than the Olmitz and Zook soils and are stratified. They are near stream channels. They make up about 10 percent of the map unit.

Most areas of this map unit are used for pasture and hay. Some areas are wooded, and a few areas are used for cultivated crops. This unit is poorly suited to cultivated crops because of the meandering drainageways and the flooding. Streambank erosion and runoff are also concerns.

These soils are suited to pasture and hay. Low areas hold water for long periods after rains, and the stands of legumes and some grasses are affected. Reed canarygrass, alsike clover, and birdsfoot trefoil grow better than other species. On the Vesser and Zook soils, deep-rooted legumes, such as alfalfa, do not grow well because of the high water table. Most of the grasses and legumes commonly grown in the area grow well on the Olmitz soil. Overgrazing reduces the production of grasses and legumes and increases weed growth. Timely mowing reduces competition from undesirable plants and encourages uniform grazing. Grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition.

These soils are suitable for the development of openland, woodland, and wetland wildlife habitat. Wetness-tolerant plants are preferable for food and cover.

These soils generally are unsuitable for onsite waste disposal systems and building development. In most areas the Olmitz soil occurs in small, narrow bands and thus is not practical for development. The Vesser and Zook soils are unsuitable for these purposes because of the flooding.

The land capability classification is IIe for the Olmitz soil and IIw for the Zook and Vesser soils. No woodland ordination symbol is assigned.

58—Wabash silty clay, occasionally flooded. This very deep, nearly level or depressional, poorly drained soil is on flood plains along rivers and large streams. Individual areas are irregular in shape and range from about 10 to more than 100 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 6 inches, black, firm silty clay

Subsurface layer:
6 to 27 inches, black, mottled, firm clay

Subsoil:
27 to 46 inches, very dark gray, mottled, very firm clay
46 to 60 inches, dark gray, mottled, very firm silty clay

In some areas the soil has less clay in the upper layers.

Important soil properties—

Permeability: Very slow
Surface runoff: Very slow
Available water capacity: Moderate
Organic matter content: Moderate
Shrink-swell potential: Very high
Seasonal high water table: At the surface to 1 foot below the surface from late fall through spring

Most areas are used for cultivated crops, hay, or pasture. This soil is suited to corn, soybeans, and small grain. If cultivated crops are grown, flooding and wetness are the main concerns. Structures that retard floodwater minimize the crop damage or loss caused by flooding. Surface drainage can be improved by land grading or surface ditches. Returning crop residue to the soil or regularly adding other organic material generally improves fertility, minimizes surface crusting, and increases the rate of water infiltration.

This soil is suited to pasture but is poorly suited to hay. It is best suited to shallow-rooted grasses and legumes that can withstand wetness. It is moderately well suited to reed canarygrass and is moderately suited to birdsfoot trefoil and alsike clover. Flooding and wetness are the main concerns and should be considered when a grazing system is designed. Maintaining stands of desirable species is difficult in depressional areas. The deeper rooted species grow better if a surface drainage system is installed.

This soil is suited to trees. The equipment limitation, seedling mortality, and windthrow are the main concerns. The trees should be harvested only when the ground is frozen or during extended dry periods. Ridging the soil and planting water-tolerant species on the ridges increase the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely.

This soil generally is unsuited to building site development and onsite waste disposal systems because of the flooding. Soils that are better suited to these uses generally are nearby.

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

66—Nodaway silt loam, occasionally flooded. This very deep, nearly level, moderately well drained soil is on flood plains adjacent to old stream channels. Individual areas are long and narrow and range from about 20 to more than 400 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:

0 to 8 inches, very dark grayish brown, friable silt loam

Substratum:

8 to 48 inches, stratified very dark grayish brown, dark grayish brown, and brown, mottled, friable silt loam

48 to 60 inches, stratified dark grayish brown and brown, mottled, friable silt loam

In some areas the substratum has grayer colors. In other areas the surface layer has more sand. In places the surface layer is more than 10 inches thick.

Included with this soil in mapping are small areas of the poorly drained Humeston and Zook soils and areas of Sandover soils. Sandover soils have more sand in the upper layers than the Nodaway soil. Humeston and Sandover soils are in the slightly higher positions. Zook soils are in the slightly lower positions. Also included are a few old stream channels. Included areas make up about 10 percent of the map unit.

Important properties of the Nodaway soil—

Permeability: Moderate
Surface runoff: Slow
Available water capacity: Very high
Organic matter content: Moderate
Shrink-swell potential: Moderate
Seasonal high water table: At a depth of 3 to 5 feet from late fall through spring

Most areas are used for cultivated crops. A few areas are used for pasture or are wooded. This soil is well suited to corn, soybeans (fig. 10), and small grain. It is subject to scouring and sediment deposition during periods of flooding in the spring and fall. Structures that retard floodwater minimize the crop damage or loss caused by flooding. A conservation tillage system that leaves a protective cover of crop residue on the surface helps to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material generally improves fertility and increases the rate of water infiltration.

This soil is well suited to tall fescue, reed canarygrass, orchardgrass, birdsfoot trefoil, alfalfa, red clover, and switchgrass. It is moderately well suited to smooth bromegrass, big bluestem, and indiangrass. Flooding is the main management concern. It should be considered when the grazing system is designed.

This soil is suited to trees. No major hazards or limitations affect timber management.

This soil generally is unsuited to building site development and sanitary facilities because of the flooding.

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

69—Fatima silt loam, occasionally flooded. This very deep, nearly level, moderately well drained soil is on flood plains along medium and small streams. Individual areas are irregular in shape and range from about 5 to 40 acres in size.

The location of the typical pedon of the Fatima soil in this map unit is in Grundy County, Missouri. The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface soil:

0 to 14 inches, very dark gray, friable silt loam

Subsoil:

14 to 55 inches, dark grayish brown and brown, mottled, friable silt loam

Substratum:

55 to 60 inches, dark grayish brown, mottled, friable silt loam

In some areas the dark surface soil is less than 10 inches thick and is silty clay loam. In other areas the subsoil is grayer.

Included with this soil in mapping are areas of streambanks and channels. These areas are steeper than the Fatima soil. Also included are small areas of the poorly drained Colo and Zook soils. These soils have a higher content of clay than the Fatima soil. They are in the slightly lower areas. Included areas make up about 10 percent of the map unit.

Important properties of the Fatima soil—

Permeability: Moderate
Surface runoff: Medium
Available water capacity: Very high
Organic matter content: Moderate
Shrink-swell potential: Low
Seasonal high water table: At a depth of 2.0 to 3.5 feet from late fall through spring

Most areas are used for cultivated crops. Some areas are used for hay or pasture. This soil is suited to corn, soybeans, grain sorghum, and small grain. It is subject to scouring and sediment deposition during periods of flooding in the spring and fall. Structures that

Figure 10.—Soybeans in an area of Nodaway silt loam, occasionally flooded.

retard floodwater minimize the crop damage or loss caused by flooding. A conservation tillage system that leaves a protective cover of crop residue on the surface helps to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material generally improves fertility and increases the rate of water infiltration.

This soil is suited to pasture. It is well suited to reed canarygrass. It is moderately well suited to birdsfoot trefoil, red clover, tall fescue, and switchgrass. Flooding is the main concern affecting pasture. It should be considered when the grazing system is designed.

This soil is suited to trees. No major hazards or limitations affect timber management.

This soil generally is unsuited to building site development and sanitary facilities because of the flooding.

The land capability classification is IIw. The woodland ordination symbol is 5A.

80D—Schuline clay loam, 2 to 14 percent slopes. This very deep, gently sloping to strongly sloping, well drained soil is on upland ridgetops and side slopes in areas that have been quarried for limestone. The soil was excavated during quarry operations and was later graded and reclaimed. Individual areas are generally rectangular and range from about 25 to 60 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:

0 to 3 inches, brown, firm clay loam

Substratum:

3 to 28 inches, mixed yellowish brown, strong brown, and gray, firm clay loam

28 to 38 inches, mixed dark grayish brown, strong brown, and gray, firm clay loam

38 to 60 inches, mixed yellowish brown, dark

yellowish brown, dark brown, and grayish brown, firm clay loam

In some places the surface layer is loam, silt loam, silty clay loam, or silty clay.

Included with this soil in mapping are a few areas that have slopes of more than 14 percent. These areas make up less than 5 percent of the map unit.

Important properties of the Schuline soil—

Permeability: Slow
Surface runoff: Medium
Available water capacity: High
Organic matter content: Low
Shrink-swell potential: Moderate

Most areas are used for hay or pasture. Species that are tolerant of a limited rooting depth should be selected. This soil is well suited to tall fescue, birdsfoot trefoil, reed canarygrass, red clover, and switchgrass. It is moderately well suited to smooth bromegrass, orchardgrass, alfalfa, big bluestem, and indiangrass. Erosion control during seedbed preparation is the main management concern. Timely tillage and the quick establishment of ground cover are necessary to prevent excessive erosion.

This soil is suited to some kinds of sanitary facilities and building site development if proper design and installation procedures are used. Sewage lagoons function adequately if sites are leveled or graded. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand or gravel help to prevent the damage caused by shrinking and swelling of the soil.

Low strength, the shrink-swell potential, and the potential for frost action limit the use of this soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material helps to minimize the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage help to prevent the damage caused by shrinking and swelling and by frost action.

The land capability classification is IIIe.

84F—Putco-Pits complex, 5 to 35 percent slopes. This map unit consists of a very deep, moderately sloping to very steep, well drained soil in spoil areas associated with quarry operations and areas of open pits from which limestone rock was removed. At certain times of the year, some of these pits hold water. The Putco soil is variable in texture but generally has clayey or loamy soil material. Shale, limestone, and sandstone fragments grade from boulder to gravel size on the soil surface and below. Individual areas of this unit are irregular in shape and range from about 10 to 65 acres in size.

The typical sequence, depth, and composition of the layers of the Putco soil are as follows—

Surface layer:
0 to 1 inch, very dark grayish brown, friable silty clay loam

Substratum:
1 to 60 inches, mixed dark gray, grayish brown, strong brown, yellowish brown, and very dark gray, firm silty clay

In some places the surface layer is silty clay.

Included in mapping are gravel piles that are presently being used. Also included are piles of stones and boulders that have been abandoned. Included areas make up less than 5 percent of the map unit.

Important properties of the Putco soil—

Permeability: Slow
Surface runoff: Rapid
Available water capacity: Low
Organic matter content: Low
Shrink-swell potential: High

Most areas have been left to revert back to natural vegetation but could be used for hay, pasture, or trees. Species that are tolerant of a limited rooting depth should be selected. The Putco soil is moderately well suited to tall fescue, big bluestem, switchgrass, and indiangrass. Erosion control during seedbed preparation is the main management concern. Timely tillage and the quick establishment of ground cover are necessary to prevent excessive erosion.

The Putco soil is suited to trees. Cottonwood and willow are the dominant species. The hazard of erosion and the equipment limitations are the main management concerns. Areas of this map unit are different from natural landscapes. Because of the irregular slopes, special techniques may be required for seeding and planting and for controlling erosion.

The Putco soil is generally unsuitable for sanitary facilities and building site development because of the slope and the shrink-swell potential.

Low strength, the shrink-swell potential, the slope, and the potential for frost action limit the use of the Putco soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material helps to minimize the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage help to prevent the damage caused by shrinking and swelling and by frost action. Cutting and filling may be necessary because of the slope, or the roads and streets can be designed so that they conform to the landscape.

The land capability classification of the Putco soil is VIe. The woodland ordination symbol is 2R.

88F—Lenzburg-Pits complex, 5 to 35 percent slopes. This map unit consists of a very deep, moderately sloping to very steep, well drained soil and areas of open pits. The Lenzburg soil consists of spoil areas associated with quarry operations. Some of the pits hold water at certain times of the year. The Lenzburg soil is variable in texture but generally has clayey or loamy soil material that contains glacial till pebbles or fragments of shale, sandstone, or limestone bedrock. Individual areas of this map unit are irregular in shape and range from about 45 to 75 acres in size.

The typical sequence, depth, and composition of the layers of the Lenzburg soil are as follows—

Surface layer:

0 to 2 inches, mixed very dark grayish brown, brown, and strong brown, friable gravelly clay loam

Substratum:

2 to 15 inches, grayish brown, mottled, firm gravelly clay loam

15 to 60 inches, mixed brown, dark yellowish brown, and grayish brown, mottled, firm gravelly clay loam

Included in mapping are gravel piles that are presently being used. Also included are piles of stones and boulders that have been abandoned. Included areas make up less than 5 percent of the map unit.

Important properties of the Lenzburg soil—

Permeability: Moderately slow
Surface runoff: Rapid
Available water capacity: High
Organic matter content: Very low
Shrink-swell potential: Moderate

Most areas have been left to revert back to natural vegetation but could be used for hay, pasture, or trees. Species that are tolerant of a limited rooting depth should be selected. The Lenzburg soil is moderately well suited to tall fescue, big bluestem, switchgrass, and indiangrass. Erosion control during seedbed preparation is the main management concern. Timely tillage and the quick establishment of ground cover are necessary to prevent excessive erosion.

The Lenzburg soil is suited to trees. Cottonwood and willow are the dominant species. The hazard of erosion and the equipment limitations are the main management concerns. Areas of this unit are different from natural landscapes. Because of the irregular slopes, special techniques may be required for seeding and planting and for controlling erosion.

The Lenzburg soil has a fair potential for the development of habitat for openland wildlife and a good potential for the development of habitat for woodland wildlife.

The Lenzburg soil generally is unsuitable for sanitary facilities and building site development because of the slope and the shrink-swell potential.

Low strength, the shrink-swell potential, the slope, and the potential for frost action limit the use of the Lenzburg soil as a site for local roads and streets. Strengthening roads with crushed rock or other suitable base material helps to minimize the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage help to prevent the damage caused by shrinking and swelling and by frost action. Cutting and filling may be necessary because of the slope, or the roads and streets can be designed so that they conform to the landscape.

The land capability classification of the Lenzburg soil is VIe. The woodland ordination symbol is 5R.

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 or 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 expenditure 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 Natural Resources Conservation Service.

About 39,000 acres in the survey area, or about 13 percent of the total acreage, meets the soil requirements for prime farmland. Scattered tracts of this land are throughout the county, but most are in areas of the Nodaway-Zook-Humeston association. A few tracts are in areas of the Adair-Armstrong-Grundy association. These associations are described under the heading "General Soil Map Units." Most of the prime farmland is used for crops, but a small acreage is used as pasture or hayland.

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. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Soils that have a seasonal high water table qualify as prime farmland only in areas where this limitation has been overcome by drainage measures. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not this limitation has been overcome by corrective measures.

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 to prevent 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 behavioral 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 recreational 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 Natural Resources 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 the heading "Detailed Soil Map Units." Specific information can be obtained from the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

The potential of the soils in Mercer County for the sustained production of food is good. About 13 percent of the county is prime farmland. Only a small percentage of the cropland and pasture is adequately treated to meet conservation needs. The inadequately treated cropland is mostly in upland areas that are being farmed in a manner that causes excessive water erosion. Some of the marginal cropland used for row crops should be converted to pasture and hayland.

The major management needs on the cropland and pasture in the county are measures that control water erosion, reduce wetness, control floodwater, and maintain fertility and tilth.

Water erosion is the major problem on nearly all of the sloping cropland and overgrazed pasture in the county. It is a hazard in areas where the slope is more than 2 percent. Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging on soils that have a clayey subsoil, such as Adair, Armstrong, Grundy, Lamoni, and Pering soils. Erosion also reduces the productivity of Vanmeter and other soils that tend to be droughty because bedrock is within a depth of 3 feet. Second, water erosion on farmland results in the sedimentation of roadside ditches and of streams, lakes, and ponds. Controlling erosion minimizes this pollution and thus improves the quality of water for municipal and recreational uses and for fish and wildlife.

In severely eroded areas, seedbed preparation and tillage are difficult because the original friable surface soil has been removed by erosion. Such spots occur in the eroded areas of Adair, Armstrong, Clarinda, Lamoni, and Pering soils.

Erosion-control measures provide a protective plant cover, help to control runoff, and increase the rate of water infiltration. A cropping system that maintains vegetation or crop residue on the surface minimizes erosion and does not reduce the productive capacity of the soils. Growing grasses and legumes for pasture and hay is effective in controlling erosion. Including legumes, such as clover and alfalfa, in the crop rotation improves tilth and helps to provide nitrogen for the following crop.

Contour stripcropping consists of contoured strips of meadow crops grown in short-term rotations. The grass or grass-legume strips generally are used for hay. Row crops are planted on the contour in the areas between the strips. No-till farming is increasing in the county. It is effective in controlling erosion on the more sloping soils. It can be used on many soils in the survey area, but special management is needed in severely eroded areas.

Wetness and flooding are management concerns on some of the cropland and pasture in Mercer County. Wabash soils are so wet that crop growth usually is slowed during part of the year. Wetness also is a limitation in areas of Humeston and Zook soils. Land grading or a surface drainage system generally is needed on all of these soils. Occasional flooding can be a problem on Humeston, Nodaway, Wabash, and Zook soils. The flooding usually occurs during the period from November through May.

Soil fertility is naturally lower in most of the eroded and moderately deep soils in the county than in other soils. On all of the soils, however, additional plant nutrients are needed for optimum production. Most of the soils in the county are naturally acid in the upper part of the root zone and require applications of ground limestone to raise the pH sufficiently for the optimum growth of legumes. On all soils, 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 an important factor affecting the germination of seeds and the infiltration of water into the soil. Soils that have good tilth are granular and porous.

Fall tillage is common in the survey area but is a poor conservation practice on most upland soils. Most of the cropland in the uplands consists of sloping soils that are subject to erosion if they are tilled in the fall.

Tilth is a problem in the clayey Zook and Wabash soils, which often stay wet until late in the spring. If they are wet when plowed, these soils tend to become cloddy when they dry. Because of the cloddiness, preparing a seedbed is difficult. Fall tillage generally improves tilth in areas of these soils.

Field crops suited to the soils and climate of the survey area include corn, soybeans, and wheat. According to Missouri Farm Facts, 15,900 acres of corn, 24,100 acres of soybeans, and 4,900 acres of wheat was harvested in 1990.

Pasture and hay crops suited to the soils and climate of the survey area include several legumes, cool-season grasses, and warm-season native grasses. Alfalfa and red clover are the most common legumes grown for hay. They also are included in mixtures with bromegrass, orchardgrass, fescue, or timothy grown for hay and pasture. Birdsfoot trefoil is used in mixtures that include bromegrass, orchardgrass, fescue, and bluegrass grown for pasture.

The warm-season native grasses that can be grown in the survey area are big bluestem, little bluestem, indiangrass, and switchgrass. These grasses grow well during the hot summer months. Management techniques needed for proper growth of these grasses differ from those needed in areas of cool-season grasses.

Alfalfa is best suited to deep, moderately well drained soils, such as Gara, Shelby, Nodaway, and Vigar soils. The other legumes and all grasses grow well on most of the upland soils in the survey area. Zook, Wabash, and other soils that are occasionally flooded and stay wet for long periods are not suited to some grasses. These soils are better suited to short-season summer annuals.

The major management concerns on most of the pasture in the county are overgrazing and gully erosion. Grazing should be controlled so that the plants not only survive but also yield the optimum amount of forage. Grazing management that maintains the vigor of the forage plants can help to control runoff and gullying.

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 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 Natural Resources 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 woodland or for engineering purposes.

In the capability system, soils are generally grouped at three levels—capability class, subclass, and unit (USDA, 1961). Only class and subclass are used in this survey.

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.

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

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

The capability classification of the map units in this survey area is given in the section "Detailed Soil Map Units" and in the yields table.

Woodland Management and Productivity

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; *F*, a high content of rock fragments in the soil; and *N*, snowpack. 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, F, and N.

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, and fire lanes and in 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 and season of use are 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 in 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 generally is the most common species on the soil and is the one that determines the ordination class.

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

Windbreaks and Environmental Plantings

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 Natural Resources Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Recreation

Jim Palmer, Mercer County Conservation Agent, Missouri Department of Conservation, helped prepare this section.

The gently rolling hills of Mercer County offer a wide variety of recreational opportunities. The landscape is a mixture of pasture, cropland, and wooded areas. This diversity provides needed habitat for wildlife. Hunting is popular among many county residents.

Most of the land is privately owned, but public hunting is available at the Lake Paho Wildlife Area, which is 4 miles west of Princeton. This area consists of 1,782 acres and is administered by the Missouri Department of Conservation. It includes a 277-acre lake that provides opportunities for fishing and for viewing of waterfowl. Other recreational activities available in the area include hiking, birdwatching, camping, picnicking, and wildlife photography.

Fishing is also available in the Weldon River, which flows throughout the length of the county from north to south, and in numerous farm ponds. The county has three small private lakes, which offer fishing, boating, and swimming. These are Lake Marie, Twin Lakes, and Hidden Valley Lake. The 20-acre Bagley Natural Area, which is also administered by the Missouri Department of Conservation, is in the northern part of the county. Mercer County also has a public swimming pool, a commercial campground, a private golf course, and three licensed shooting areas.

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 sewer lines. 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 recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 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 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

Dennis J. Browning, wildlife management biologist, Missouri Department of Conservation, helped prepare this section.

The soils and streams in Mercer County were formed by slow-moving glaciers that scoured long, narrow watersheds. Trees along these watersheds were protected from fires that burned across prairies, and thus the grassland vegetation was maintained. The main watersheds in Mercer County include Muddy Creek, Medicine Creek, Wild Cat Creek, Honey Creek, and Sandy Creek. These creeks flow in a southerly direction and eventually reach the Grand River.

Presettlement records indicate that the area existed in a mixed condition of woods and prairie. This mixture resulted in a rich environment for wildlife. Land clearing and agriculture radically changed the landscape of the county. Prairie sod and bottom-land hardwood forest were converted to the production of row crops because of economic pressures. More recently, areas of the county have been transformed back to grass through the Conservation Reserve Program. Cool-season grasses, such as orchardgrass, bromegrass, and fescue, predominate. Warm-season grasses, including switchgrass, big bluestem, and indiangrass, were also planted. Wildlife have responded well in areas where mixed grasses and legumes interface with fields of row crops. Although land use practices have disrupted many of the naturally occurring wildlife habitats, certain wildlife species persist despite the change.

Records from the Missouri Fish and Wildlife Information System indicate that 200 fish and wildlife species are classified as permanent residents in the county. An additional 120 species are termed migratory and pass through the county sometime during the year.

Wildlife populations fluctuate from fair to excellent throughout the county, depending on the quality of habitat and how well it matches the specific needs of the individual species. Territory size also plays a significant role in the ability of certain species to adapt to land use changes.

There are about 130 wildlife species using the oak-hickory forests in the county. These include white-tailed deer, eastern wild turkey, fox squirrel, ruffed grouse, red-sided garter snake, gray catbird, American crow, Cooper's hawk, barred owl, brown thrasher, red-eyed vireo, red bat, gray fox, least shrew, and striped skunk. Many species in this group depend on acorns as a major food source. Numerous shrubs and trees also provide berries, seeds, tender shoots, and buds for food and a dense understory for cover. Clearing of timber and grazing of woodlands have major adverse effects on forest wildlife because they eliminate essential habitat.

Wooded buffer strips along creeks and streams are known as riparian corridors (fig. 11). These areas are home to about 88 species of wildlife, including northern spring peeper, northern cardinal, wood duck, bald eagle, great blue heron, blue jay, barred owl, wild turkey, beaver, white-tailed deer, mink, and raccoon. This woody vegetation is also important in controlling erosion of streambanks caused by meandering bodies of flowing water.

About 60 wildlife species use the grasslands in the county. Individual species include the bullsnake, ornate box turtle, eastern bluebird, dickcissel, red-tailed hawk, western meadowlark, northern bobwhite, ring-necked pheasant, badger, coyote, eastern mole, and meadow vole. When grassland is being established, the selection of grass species has an impact on the kinds of wildlife that will be attracted to the area. Mixtures that include a legume are important.

Marshes once existed in many watersheds in the county. These wetlands help to filter pollutants before they reach ground-water reservoirs. About 70 species of wildlife utilize the marshes in the county. Species include the bullfrog, plains leopard frog, common snapping turtle, sandhill crane, cattle egret, mallard, orchard oriole, song sparrow, marsh wren, and muskrat. The 95-acre Cloe Lowrey Marsh Natural Area, near Princeton, is an example of this vanishing habitat. The area is managed by the Missouri Department of Conservation.

Only four species of wildlife that are considered rare or endangered are known to inhabit the survey area. These are the mooneye, peregrine falcon, Henslow's sparrow, and Indiana myotis. An additional 13 species listed as rare or endangered are likely to occur in the county. Among these are the bald eagle, American bittern, western fox snake, northern pike, pied-billed grebe, and little blue heron.

Fishing waters are fairly plentiful in the county, and many farms have stocked ponds. The Weldon River

Figure 11.—A riparian corridor in an area of the Gara association. Gara soils are in the foreground, Winnegan soils are in the background, and Humeston soils are on the flood plain in the center.

flows through the county and is inhabited by several species of fish. The Lake Paho Wildlife Area has a large impoundment that is stocked with crappie, bass, bluegill, channel catfish, and walleye.

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 flooding. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and soybeans.

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, flooding, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, lovegrass, bromegrass, clover, and alfalfa.

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

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

Coniferous plants furnish browse 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, saltgrass, cordgrass, rushes, sedges, and reeds.

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

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

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

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, 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. Ratings are given for 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 should 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 or 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 kinds 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 evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and 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, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and 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, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

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

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

Sanitary Facilities

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

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

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to 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 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 resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

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

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

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench 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 sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

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

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as the 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 to 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, a 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 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 have a water table at a depth of 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. They 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 high 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, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, and sulfur. Availability of drainage outlets is not considered in the ratings.

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

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of 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 or to a cemented pan affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances such as salts and sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

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

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

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 to characterize key soils.

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

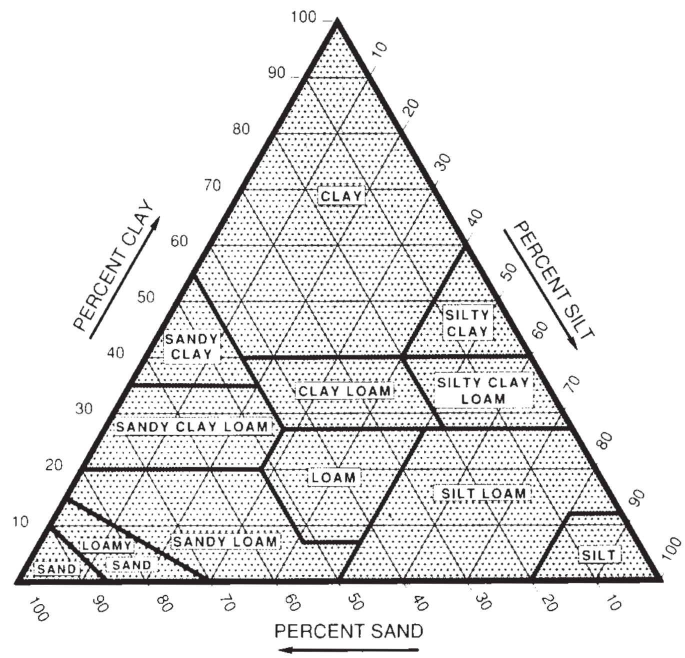

Figure 12.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

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 the heading "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. 12). "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, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (ASTM, 1993) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 1986).

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 10 inches in diameter and 3 to 10 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, 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 ⅓-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 and septic tank absorption fields.

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

3. Coarse sandy loams, 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 loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, noncalcareous 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. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

8. Soils that are not subject to soil blowing because of coarse fragments on the surface or because of surface wetness.

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 in 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 infiltration 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, by runoff from adjacent slopes, or by tides. 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 (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs often under normal weather conditions (the chance of flooding is more than 50 percent in any year). Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 days to 1 month, and *very long* if more than 1 month. Probable dates are expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

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 little or no horizon development.

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 estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are 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.

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. Only saturated zones within a depth of about 6 feet are indicated.

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.

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

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. 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 (USDA, 1975). 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. Eleven 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 Alfisol.

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 Udalf (*Ud*, meaning humid, plus *alf*, from Alfisol).

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 Hapludalfs (*Hapl*, meaning minimal horizonation, plus *udalf*, the suborder of the Alfisols 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. An example is Mollic Hapludalfs.

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-loamy, mixed, mesic Mollic Hapludalfs.

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" (USDA, 1993). Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" (USDA, 1975). 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."

Adair Series

The Adair series consists of very deep, somewhat poorly drained, slowly permeable soils on uplands. These soils formed in very thin loamy sediments and in the underlying paleosol weathered from glacial till. Slopes range from 5 to 14 percent.

The Adair soils in Mercer County have a thinner dark A horizon than is defined as the range for the series. This difference, however, does not significantly affect the use or behavior of the soils. The soils are classified as fine, montmorillonitic, mesic Aquertic Hapludalfs.

Typical pedon of Adair loam, 5 to 9 percent slopes, eroded, in a pasture, 2,500 feet west and 1,300 feet north of the southeast corner of sec. 23, T. 65 N., R. 23 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; many fine roots; moderately acid; clear smooth boundary.

2Bt1—8 to 11 inches; dark yellowish brown (10YR 4/4) clay loam; weak fine subangular blocky structure; firm; common fine roots; few faint clay films on faces of peds; common fine prominent strong brown (7.5YR 5/6) masses of iron accumulation throughout; common very dark grayish brown (10YR 3/2) coatings; 1 percent fine gravel; strongly acid; clear smooth boundary.

2Bt2—11 to 22 inches; brown (7.5YR 4/4) clay; moderate medium subangular blocky structure; very firm; few fine roots; common distinct clay films on faces of peds; few fine prominent dark grayish brown (10YR 4/2) iron depletions in the matrix; common fine prominent red (2.5YR 4/6) masses of iron accumulation throughout; 2 percent fine gravel; strongly acid; gradual smooth boundary.

2Bt3—22 to 35 inches; brown (7.5YR 4/4) clay loam; moderate medium subangular blocky structure; very firm; common distinct clay films on faces of peds; few fine prominent grayish brown (10YR 5/2) iron depletions in the matrix; common fine iron and manganese concretions; 1 percent fine gravel; moderately acid; clear smooth boundary.

2Bt4—35 to 51 inches; dark yellowish brown (10YR 4/4) clay loam; weak medium subangular blocky structure; very firm; common distinct clay films on faces of peds; common fine distinct grayish brown (10YR 5/2) iron depletions in the matrix; common medium iron and manganese concretions; 1 percent fine gravel; neutral; clear smooth boundary.

2Btk—51 to 60 inches; yellowish brown (10YR 5/6) clay loam; weak medium prismatic structure; very firm; few distinct clay films on vertical cleavage planes; common medium prominent grayish brown (10YR 5/2) iron depletions in the matrix; common medium iron and manganese concretions; common carbonate masses; 1 percent fine gravel; violent effervescence; slightly alkaline.

The thickness of the dark surface layer ranges from 6 to 9 inches. The depth to carbonates ranges from 48 to more than 60 inches.

The A horizon has chroma of 1 or 2. The 2Bt horizon has value of 3 to 5. The 2Btk horizon has chroma of 4 to 6. The 2Bt and 2Btk horizons contain 1 to 2 percent fine gravel.

Armstrong Series

The Armstrong series consists of very deep, somewhat poorly drained, slowly permeable soils on uplands. These soils formed in very thin loamy sediments and in the underlying paleosol weathered from glacial till. Slopes range from 5 to 14 percent.

These soils are classified as fine, montmorillonitic, mesic Aquertic Hapludalfs.

Typical pedon of Armstrong loam, 5 to 9 percent slopes, eroded, in a pasture, 2,450 feet west and 200 feet north of the southeast corner of sec. 29, T. 67 N., R. 23 W.

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

Bt1—6 to 10 inches; dark yellowish brown (10YR 4/4) clay loam; weak fine subangular blocky structure; friable; common fine roots; few distinct clay films on faces of peds; few fine prominent yellowish red (5YR 5/6) masses of iron accumulation throughout; common very dark grayish brown (10YR 3/2) coatings; 1 percent fine gravel; moderately acid; clear smooth boundary.

2Bt2—10 to 16 inches; brown (7.5YR 4/4) clay; moderate fine subangular blocky structure; firm; common fine roots; common distinct clay films on faces of peds; few fine prominent dark grayish brown (10YR 4/2) iron depletions in the matrix; common fine prominent yellowish red (5YR 4/6) masses of iron accumulation throughout; 1 percent fine gravel; very strongly acid; clear smooth boundary.

2Bt3—16 to 28 inches; strong brown (7.5YR 5/6) clay; moderate fine subangular blocky structure; firm; common fine roots; common distinct clay films on faces of peds; few fine prominent dark grayish brown (10YR 4/2) iron depletions in the matrix; common fine distinct yellowish red (5YR 4/6) masses of iron accumulation throughout; 2 percent fine gravel; very strongly acid; gradual smooth boundary.

2Bt4—28 to 40 inches; yellowish brown (10YR 5/4) clay; weak fine subangular blocky structure; firm; few fine roots; few distinct clay films on faces of peds; common fine distinct grayish brown (10YR 5/2) iron depletions in the matrix; common fine iron and manganese concretions; 2 percent fine gravel; strongly acid; clear smooth boundary.

2Bk—40 to 60 inches; yellowish brown (10YR 5/6) clay loam; weak fine prismatic structure parting to weak medium subangular blocky; firm; common medium prominent grayish brown (10YR 5/2) iron depletions in the matrix; few fine iron and manganese concretions; common carbonate masses; 1 percent fine gravel; strong effervescence; slightly alkaline.

The depth to carbonates ranges from 42 to more than 60 inches.

The A horizon has chroma of 1 or 2. It is commonly loam, but the range includes clay loam. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 to 6. The 2Bt horizon has hue of 10YR to 5YR, value of 4 or 5, and chroma of 3 to 6. It is clay loam or clay. The 2Bk horizon has value of 4 or 5 and chroma of 3 to 6. The Bt, 2Bt, and 2Bk horizons contain 1 to 2 percent fine gravel.

Belinda Series

The Belinda series consists of very deep, poorly drained, very slowly permeable soils on high stream terraces along major streams. These soils formed in loess underlain by alluvium. Slopes range from 0 to 2 percent.

These soils are classified as fine, montmorillonitic, mesic Vertic Albaqualfs.

Typical pedon of Belinda silt loam, in a cultivated field, 2,500 feet west and 2,950 feet south of the northeast corner of sec. 3, T. 65 N., R. 24 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; friable; few fine roots; moderately acid; abrupt smooth boundary.

E—9 to 16 inches; dark gray (10YR 4/1) silt loam, gray (10YR 6/1) dry; weak thin platy structure parting to weak fine granular; friable; few fine roots; moderately acid; abrupt smooth boundary.

Btg1—16 to 25 inches; dark grayish brown (10YR 4/2) silty clay; moderate medium subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; common fine prominent strong brown (7.5YR 5/6) masses of lime accumulation throughout; common very dark grayish brown (10YR 3/2) and very dark gray (10YR 3/1) coatings; few gray (10YR 6/1) silt coatings; strongly acid; gradual smooth boundary.

Btg2—25 to 34 inches; dark grayish brown (10YR 4/2) silty clay; moderate medium subangular blocky structure; very firm; many distinct clay films on faces of peds; common fine prominent strong brown (7.5YR 5/6) masses of iron accumulation throughout; few very dark grayish brown (10YR 3/2) coatings; few fine iron and manganese concretions; strongly acid; gradual smooth boundary.

Btg3—34 to 45 inches; grayish brown (10YR 5/2) silty clay; moderate medium subangular blocky structure; very firm; many distinct clay films on faces of peds; common fine prominent strong brown (7.5YR 5/6) and few fine prominent yellowish brown (10YR 5/6) masses of iron accumulation throughout; common fine iron and manganese concretions; moderately acid; gradual smooth boundary.

Btg4—45 to 60 inches; grayish brown (2.5Y 5/2) silty clay; weak medium subangular blocky structure; very firm; few faint clay films on faces of peds; common fine prominent strong brown (7.5YR 5/6) masses of iron accumulation throughout; few fine iron and manganese concretions; moderately acid.

The A horizon has chroma of 1 or 2. The E horizon has value of 4 to 6 and chroma of 1 or 2. The Btg horizon has hue of 10YR or 2.5Y and value of 4 or 5. It is silty clay or silty clay loam. The masses of iron accumulation have hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 8.

Caleb Series

The Caleb series consists of very deep, moderately well drained, moderately permeable soils on side slopes of high stream terraces. These soils formed in loamy alluvium derived from glaciers. Slopes range from 5 to 14 percent.

These soils are classified as fine-loamy, mixed, mesic Mollic Hapludalfs.

Typical pedon of Caleb loam, in an area of Caleb-Mystic complex, 5 to 14 percent slopes, eroded, in a hay field, 350 feet east and 2,300 feet south of the northwest corner of sec. 31, T. 67 N., R. 24 W.

Ap—0 to 7 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; weak fine granular structure; friable; many fine roots; moderately acid; clear smooth boundary.

Bt1—7 to 13 inches; dark yellowish brown (10YR 4/4) clay loam; weak fine subangular blocky structure; friable; few fine roots; common distinct clay films on faces of peds; strongly acid; gradual smooth boundary.

Bt2—13 to 20 inches; dark yellowish brown (10YR 4/4) clay loam; weak medium subangular blocky structure; firm; few fine roots; many distinct clay films on faces of peds; strongly acid; gradual smooth boundary.

Bt3—20 to 27 inches; dark yellowish brown (10YR 4/4) clay loam; weak medium subangular blocky structure; firm; common distinct clay films on faces of peds; strongly acid; clear smooth boundary.

2Bt4—27 to 42 inches; dark yellowish brown (10YR 4/4) sandy loam; weak medium subangular blocky structure; firm; few faint clay films on faces of peds; common fine prominent yellowish red (5YR 4/6) masses of iron accumulation throughout; common faint pale brown (10YR 6/3) sand lenses; very strongly acid; clear smooth boundary.

2Bt5—42 to 52 inches; dark yellowish brown (10YR 4/4) sandy loam; weak medium subangular blocky structure; firm; few faint clay films on faces of peds; common medium distinct light brownish gray (10YR 6/2) iron depletions in the matrix; common fine prominent strong brown (7.5YR 5/6) masses of iron accumulation throughout; very strongly acid; clear smooth boundary.

2C—52 to 60 inches; yellowish brown (10YR 5/6) sandy clay loam; massive; firm; many prominent light brownish gray (10YR 6/2) iron depletions in the matrix; common medium distinct strong brown (7.5YR 4/6) masses of iron accumulation throughout; common fine iron and manganese concretions; strongly acid.

The A horizon has chroma of 2 or 3. Some pedons have an E horizon. This horizon has chroma of 2 or 3. The Bt and 2Bt horizons have hue of 10YR, value of 4 or 5, and chroma of 3 to 6. They are clay loam or sandy clay loam. The 2C horizon has hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 2 to 6. The textures are quite variable.

Clarinda Series

The Clarinda series consists of very deep, poorly drained, very slowly permeable soils on uplands. These soils formed in gray, clayey paleosols that developed in glacial till. Slopes range from 5 to 9 percent.

The Clarinda soils in Mercer County have a thinner dark A horizon than is defined as the range for the series. This difference, however, does not significantly affect the use or behavior of the soils. The soils are classified as fine, montmorillonitic, mesic Vertic Epiaqualfs.

Typical pedon of Clarinda silty clay loam, 5 to 9 percent slopes, eroded, in a pasture, 700 feet east and 300 feet north of the southwest corner of sec. 9, T. 66 N., R. 22 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; many fine roots; neutral; clear smooth boundary.

2Btg1—8 to 17 inches; dark gray (10YR 4/1) silty clay; moderate fine subangular blocky structure; very firm; common fine roots; common distinct clay films on faces of peds; few fine distinct yellowish brown (10YR 5/4) and few fine prominent strong brown (7.5YR 4/6) masses of iron accumulation throughout; few white sand grains; strongly acid; clear smooth boundary.

2Btg2—17 to 30 inches; gray (10YR 5/1) silty clay; weak medium subangular blocky structure; very firm; common fine roots; common distinct clay films on faces of peds; common fine prominent strong brown (7.5YR 4/6) masses of iron accumulation throughout; few white sand grains; strongly acid; clear smooth boundary.

2Btg3—30 to 38 inches; gray (10YR 5/1) silty clay; weak medium subangular blocky structure; very firm; few fine roots; few distinct clay films on faces of peds; few fine prominent strong brown (7.5YR 4/6) masses of iron accumulation throughout; common white sand grains; moderately acid; clear smooth boundary.

2Btg4—38 to 60 inches; gray (5Y 5/1) silty clay; weak medium subangular blocky structure; firm; few fine roots; few faint clay films on faces of peds; few fine prominent strong brown (7.5YR 5/6) masses of iron accumulation throughout; common white sand grains; slightly acid.

The thickness of the mollic epipedon ranges from 7 to 9 inches.

The A horizon has value of 2 or 3. The 2Btg horizon has hue of 10YR to 5Y and chroma of 1 or 2. It contains varying amounts of iron masses of yellowish brown and strong brown. The texture is silty clay or clay. The content of white sand grains increases with increasing depth.

Colo Series

The Colo series consists of very deep, poorly drained, moderately permeable soils on flood plains and in small drainageways. These soils formed in silty alluvium. Slopes range from 0 to 3 percent.

These soils are classified as fine-silty, mixed, mesic Cumulic Endoaquolls.

Typical pedon of Colo silty clay loam, channeled, 0 to 3 percent slopes, frequently flooded, 1,650 feet west and 775 feet south of the northeast corner of sec. 20, T. 63 N., R. 25 W.; in Grundy County, Missouri:

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure parting to weak fine granular; friable; common fine roots; slightly acid; abrupt smooth boundary.

A1—8 to 14 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; common fine roots; moderately acid; gradual smooth boundary.

A2—14 to 20 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; common fine roots; moderately acid; gradual smooth boundary.

A3—20 to 30 inches; black (10YR 2/1) silty clay loam; weak medium subangular blocky structure; friable; common fine roots; slightly acid; diffuse smooth boundary.

BA—30 to 41 inches; very dark gray (10YR 3/1) silty clay loam; weak medium subangular blocky structure; firm; common fine roots; neutral; diffuse smooth boundary.

Bg—41 to 50 inches; very dark gray (10YR 3/1) silty clay loam; weak medium prismatic structure; firm; common fine roots; few fine distinct dark yellowish brown (10YR 4/4) masses of iron accumulation throughout; neutral; gradual smooth boundary.

BCg—50 to 60 inches; dark gray (10YR 4/1) silty clay loam; weak medium prismatic structure; firm; few fine roots; common fine prominent strong brown (7.5YR 4/6) masses of iron accumulation throughout; neutral.

Some pedons have stratified overwash sediments, which are as much as 18 inches thick. The A horizon has value of 2 or 3 and chroma of 0 or 1. The Cg horizon, if it occurs, has hue of 10YR to 5Y, value of 3 to 5, and chroma of 2 or less. It is silty clay loam, clay loam, or silt loam.

Edina Series

The Edina series consists of very deep, very slowly permeable, poorly drained soils on upland divides. These soils formed in loess. Slopes range from 0 to 2 percent.

These soils are classified as fine, montmorillonitic, mesic Vertic Argialbolls.

Typical pedon of Edina silt loam, in a meadow, 200 feet west and 150 feet north of the southeast corner of sec. 25, T. 67 N., R. 23 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; moderate thin platy structure parting to weak fine granular; friable; many fine roots; neutral; abrupt smooth boundary.

E—9 to 16 inches; dark gray (10YR 4/1) silt loam, gray (10YR 6/1) dry; moderate thick platy structure parting to weak fine subangular blocky; friable; common fine roots; common very dark gray (10YR 3/1) coatings; slightly acid; abrupt smooth boundary.

Bt—16 to 22 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; very firm; few fine roots; common distinct clay films on faces of peds; strongly acid; clear smooth boundary.

Btg1—22 to 28 inches; dark grayish brown (10YR 4/2) silty clay; moderate fine subangular blocky structure; very firm; few fine roots; many distinct clay films on faces of peds; common very dark gray (10YR 3/1) coatings; strongly acid; clear smooth boundary.

Btg2—28 to 38 inches; grayish brown (2.5Y 5/2) silty clay; moderate fine subangular blocky structure; very firm; common distinct clay films on faces of peds; common fine prominent dark yellowish brown (10YR 4/6) masses of iron accumulation throughout; common very dark gray (10YR 3/1) coatings; moderately acid; clear smooth boundary.

Btg3—38 to 48 inches; grayish brown (2.5Y 5/2) silty clay loam; moderate fine subangular blocky structure; very firm; common distinct clay films on faces of peds; common fine prominent dark yellowish brown (10YR 4/6) masses of iron accumulation throughout; few very dark gray (10YR 3/1) coatings; slightly acid; clear smooth boundary.

Btg4—48 to 60 inches; olive gray (5Y 5/2) silty clay loam; moderate medium prismatic structure parting to weak fine subangular blocky; very firm; few faint clay films on faces of peds; common fine prominent strong brown (7.5YR 4/6) masses of iron accumulation throughout; few fine iron and manganese concretions; slightly acid.

The mollic epipedon ranges from 10 to 22 inches in thickness and includes the upper part of the argillic horizon.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The E horizon has value of 4 or 5. The upper part of the Bt horizon has hue of 2.5Y or 10YR and value of 2 or 3. It has mottles with hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 4 to 8. The lower part of the Bt horizon has hue of 10YR to 5Y, value of 3 to 5, and chroma of 1 or 2.

Fatima Series

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

These soils are classified as fine-silty, mixed, mesic Fluvaquentic Hapludolls.

Typical pedon of Fatima silt loam, occasionally flooded, 2,000 feet east and 1,700 feet north of the southwest corner of sec. 29, T. 62 N., R. 25 W.; in Grundy County, Missouri:

Ap—0 to 7 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak fine granular structure; friable; common fine roots; slightly acid; clear smooth boundary.

A—7 to 14 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak fine granular structure; friable; common fine roots; neutral; clear smooth boundary.

Bw1—14 to 30 inches; dark grayish brown (10YR 4/2) silt loam; weak fine subangular blocky structure parting to weak fine granular; friable; common fine roots; common fine faint dark brown (10YR 3/3) masses of iron accumulation throughout; few thin grayish brown (10YR 5/2) strata; slightly acid; gradual smooth boundary.

Bw2—30 to 55 inches; brown (10YR 4/3) silt loam; weak fine subangular blocky structure; friable; common fine roots; common fine faint dark grayish brown (10YR 4/2) iron depletions in the matrix; few thin grayish brown (10YR 5/2) strata; slightly acid; gradual smooth boundary.

Cg—55 to 60 inches; dark grayish brown (10YR 4/2) silt loam; massive; friable; few very fine roots; common fine distinct dark yellowish brown (10YR 4/4) masses of iron accumulation in the matrix; weakly stratified; slightly acid.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The Bw horizon has value of 4 or 5.

Gara Series

The Gara series consists of very deep, moderately well drained, moderately slowly permeable soils on uplands. These soils formed in glacial till. Slopes range from 9 to 30 percent.

These soils are classified as fine-loamy, mixed, mesic Mollic Hapludalfs.

Typical pedon of Gara loam, 14 to 20 percent slopes, eroded, in a meadow, 1,800 feet south and 1,950 feet east of the northwest corner of sec. 24, T. 65 N., R. 23 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak thin platy structure parting to weak fine granular; friable; many fine roots; 1 percent fine gravel; moderately acid; clear smooth boundary.

Bt1—6 to 13 inches; dark yellowish brown (10YR 4/4) clay loam; weak fine subangular blocky structure; friable; common fine roots; few distinct clay films on faces of peds; common fine distinct yellowish brown (10YR 5/6) masses of iron accumulation throughout; common very dark grayish brown (10YR 3/2) coatings; 2 percent fine gravel; strongly acid; clear smooth boundary.

Bt2—13 to 20 inches; dark yellowish brown (10YR 4/4) clay loam; weak medium subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; many medium distinct yellowish brown (10YR 5/6) masses of iron accumulation throughout; 2 percent fine gravel; moderately acid; clear smooth boundary.

Bt3—20 to 31 inches; yellowish brown (10YR 5/4) clay loam; moderate medium subangular blocky structure; firm; common distinct clay films on faces of peds; common fine distinct grayish brown (10YR 5/2) iron depletions in the matrix; few fine iron and manganese concretions; 1 percent fine gravel; slightly acid; clear smooth boundary.

Btk—31 to 40 inches; yellowish brown (10YR 5/6) clay loam; weak fine prismatic structure; firm; few distinct clay films on faces of peds; common medium prominent grayish brown (2.5Y 5/2) iron depletions in the matrix; few fine iron and manganese concretions; common carbonate masses; 2 percent fine gravel; strong effervescence; moderately alkaline; gradual smooth boundary.

Bk—40 to 60 inches; yellowish brown (10YR 5/6) loam; weak medium prismatic structure; very firm; common medium prominent grayish brown (2.5Y 5/2) iron depletions in the matrix; few fine iron and manganese concretions; many carbonate masses; 1 percent fine gravel; violent effervescence; moderately alkaline.

The depth to carbonates ranges from 30 to 50 inches.

The A horizon has chroma of 1 or 2. The Bt horizon has value of 4 or 5 and chroma of 3 to 6. The Btk and Bk horizons have value of 5 or 6 and chroma of 2 to 6. The B horizons are clay loam or loam. All horizons contain 1 to 2 percent fine gravel.

Grundy Series

The Grundy series consists of very deep, somewhat poorly drained, slowly permeable soils on uplands. These soils formed in loess. Slopes range from 2 to 5 percent.

The Grundy soils in Mercer County have a thinner dark A horizon than is defined as the range for the series. This difference, however, does not significantly affect the use or behavior of the soils. The soils are classified as fine, montmorillonitic, mesic Aquertic Hapludalfs.

Typical pedon of Grundy silty clay loam, 2 to 5 percent slopes, eroded, in a cultivated field, 2,600 feet east and 100 feet north of the southwest corner of sec. 17, T. 66 N., R. 22 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silty clay loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; few fine roots; moderately acid; clear smooth boundary.

Btg1—8 to 15 inches; dark grayish brown (10YR 4/2) silty clay; moderate fine subangular blocky structure; firm; few fine roots; common faint clay films on faces of peds; common fine distinct yellowish brown (10YR 5/4) masses of iron accumulation throughout; common very dark gray (10YR 3/1) coatings; moderately acid; clear smooth boundary.

Btg2—15 to 26 inches; dark grayish brown (2.5Y 4/2) silty clay; moderate fine angular blocky structure; firm; common prominent clay films on faces of peds; common medium prominent yellowish brown (10YR 5/4) masses of iron accumulation throughout; few fine iron and manganese concretions; strongly acid; gradual smooth boundary.

Btg3—26 to 35 inches; gray (5Y 5/1) silty clay; moderate medium subangular blocky structure; firm; common prominent clay films on faces of peds; common fine prominent yellowish brown (10YR 5/6) masses of iron accumulation throughout; common fine iron and manganese concretions; moderately acid; gradual smooth boundary.

Btg4—35 to 44 inches; gray (5Y 5/1) silty clay loam; moderate medium subangular blocky structure; firm; common prominent clay films on faces of peds; common fine prominent yellowish brown (10YR 5/6) masses of iron accumulation throughout; common fine iron and manganese concretions; moderately acid; gradual smooth boundary.

Btg5—44 to 52 inches; gray (5Y 5/1) silty clay loam; weak medium subangular blocky structure; firm; few distinct clay films on faces of peds; common fine distinct dark grayish brown (2.5Y 4/2) iron depletions in the matrix; common medium prominent yellowish brown (10YR 5/8) masses of iron accumulation throughout; slightly acid; gradual smooth boundary.

Cg—52 to 60 inches; gray (5Y 5/1) silty clay loam; massive; very firm; many coarse faint olive gray (5Y 5/2) iron depletions in the matrix; common medium prominent yellowish brown (10YR 5/6) masses of iron accumulation throughout; slightly acid.

The thickness of the mollic epipedon ranges from 7 to 9 inches.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The upper part of the Bt horizon has hue of 10YR or 2.5Y, value of 3 or 4, and chroma of 1 or 2. The Btg horizon has hue of 10YR to 5Y. The Cg horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. It has iron masses with higher chroma.

Humeston Series

The Humeston series consists of very deep, poorly drained, very slowly permeable soils on flood plains. Slopes range from 0 to 2 percent.

These soils are classified as fine, montmorillonitic, mesic Argiaquic Argialbolls.

Typical pedon of Humeston silty clay loam, occasionally flooded, in a cultivated field, 1,950 feet east and 1,100 feet south of the northwest corner of sec. 30, T. 65 N., R. 22 W.

Ap—0 to 6 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; moderate fine granular structure; friable; common fine roots; slightly acid; clear smooth boundary.

A—6 to 14 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; moderate fine subangular blocky structure; friable; common fine roots; slightly acid; clear smooth boundary.

E—14 to 26 inches; dark gray (10YR 4/1) silt loam, gray (10YR 6/1) dry; moderate thin platy structure parting to weak fine granular; friable; few fine roots; common fine distinct dark yellowish brown (10YR 4/4) masses of iron accumulation throughout; strongly acid; clear smooth boundary.

Bt1—26 to 30 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; firm; few distinct clay films on faces of peds; few fine prominent brown (7.5YR 5/4) masses of iron accumulation throughout; strongly acid; clear smooth boundary.

Bt2—30 to 48 inches; very dark gray (10YR 3/1) silty clay loam; weak fine subangular blocky structure; firm; common distinct clay films on faces of peds; common fine prominent strong brown (7.5YR 5/6) masses of iron accumulation throughout; strongly acid; gradual smooth boundary.

Btg—48 to 60 inches; dark gray (10YR 4/1) silty clay; weak medium subangular blocky structure; very firm; common distinct clay films on faces of peds; common fine prominent strong brown (7.5YR 5/6) masses of iron accumulation throughout; moderately acid.

The A horizon has value of 2 or 3. The E horizon has value of 4 or 5. The Bt and Btg horizons have value of 2 to 4.

Keswick Series

The Keswick series consists of very deep, moderately sloping and strongly sloping, moderately well drained, slowly permeable soils on uplands. These soils formed in a thin mantle of loess or sediments and in the underlying paleosol weathered from glacial till. Slopes range from 5 to 14 percent.

These soils are classified as fine, montmorillonitic, mesic Aquertic Chromic Hapludalfs.

Typical pedon of Keswick loam, 5 to 14 percent slopes, eroded, in a pasture, 2,200 feet east and 200 feet south of the northwest corner of sec. 24, T. 64 N., R. 24 W.

Ap—0 to 3 inches; dark grayish brown (10YR 4/2) loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; many fine roots; moderately acid; clear smooth boundary.

E—3 to 6 inches; brown (10YR 5/3) loam, very pale brown (10YR 7/3) dry; weak thin platy structure; friable; common fine roots; common fine prominent strong brown (7.5YR 5/6) masses of iron accumulation throughout; strongly acid; clear smooth boundary.

2Bt1—6 to 14 inches; brown (7.5YR 4/4) clay; moderate fine subangular blocky structure; firm; common fine roots; few distinct clay films on faces of peds; common fine distinct reddish brown (5YR 5/4) masses of iron accumulation throughout; 1 percent fine gravel; very strongly acid; clear smooth boundary.

2Bt2—14 to 24 inches; brown (7.5YR 4/4) clay; moderate medium subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; common fine prominent grayish brown (10YR 5/2) iron depletions in the matrix; common fine distinct reddish brown (5YR 5/4) masses of iron accumulation throughout; 1 percent fine gravel; very strongly acid; clear smooth boundary.

2Bt3—24 to 32 inches; yellowish brown (10YR 5/4) clay; moderate medium subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; common fine distinct grayish brown (10YR 5/2) iron depletions in the matrix; common fine prominent strong brown (7.5YR 5/6) masses of iron accumulation throughout; 1 percent fine gravel; very strongly acid; clear smooth boundary.

2Bt4—32 to 48 inches; yellowish brown (10YR 5/4) clay loam; weak medium subangular blocky structure; firm; few faint clay films on faces of peds; common fine distinct grayish brown (10YR 5/2) iron depletions in the matrix; common fine prominent strong brown (7.5YR 5/6) masses of iron accumulation throughout; common fine iron and manganese concretions; 1 percent fine gravel; very strongly acid; clear smooth boundary.

2Bkg—48 to 60 inches; grayish brown (2.5Y 5/2) clay loam; weak medium prismatic structure; firm; common fine prominent yellowish brown (10YR 5/6) masses of iron accumulation throughout; common fine iron and manganese concretions; common carbonate nodules; 1 percent fine gravel; strong effervescence; moderately alkaline.

The depth to carbonates ranges from 42 to more than 60 inches.

The Ap horizon has value of 2 to 4. The E horizon has value of 4 or 5 and chroma of 2 or 3. The upper part of the 2Bt horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. Where the matrix has hue of 7.5YR, the upper part of the 2Bt horizon has mottles with hue of 5YR or 2.5YR. The texture is clay loam or clay. The lower part of the 2Bt horizon and the 2Bkg horizon have hue of 7.5YR to 5Y, value of 4 or 5, and chroma of 1 to 6.

Lagonda Series

The Lagonda series consists of very deep, somewhat poorly drained, slowly permeable soils on uplands. These soils formed in loess and in the underlying pedisediment and glacial till. Slopes range from 2 to 5 percent.

The Lagonda soils in Mercer County have a thinner dark A horizon than is defined as the range for the series. This difference, however, does not significantly affect the use or behavior of the soils. The soils are classified as fine, montmorillonitic, mesic Aquertic Hapludalfs.

Typical pedon of Lagonda silty clay loam, 2 to 5 percent slopes, eroded, in a hay field, 2,050 feet south and 500 feet west of the northeast corner of sec. 30, T. 64 N., R. 22 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak fine granular structure; friable; many fine roots; slightly acid; clear smooth boundary.

Btg1—7 to 14 inches; dark grayish brown (10YR 4/2) silty clay; moderate fine subangular blocky structure; firm; common fine roots; common distinct clay films on faces of peds; common fine prominent brown (7.5YR 4/4) masses of iron accumulation throughout; moderately acid; clear smooth boundary.

Btg2—14 to 21 inches; dark grayish brown (10YR 4/2) silty clay loam; moderate fine subangular blocky structure; firm; common fine roots; common distinct clay films on faces of peds; common fine prominent brown (7.5YR 4/4) masses of iron accumulation throughout; common very dark gray (10YR 3/1) coatings; moderately acid; clear smooth boundary.

Btg3—21 to 28 inches; dark grayish brown (10YR 4/2) silty clay loam; weak fine subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; common medium prominent strong brown (7.5YR 5/6) masses of iron accumulation throughout; common very dark gray (10YR 3/1) coatings; moderately acid; clear smooth boundary.

2Btg4—28 to 42 inches; dark grayish brown (10YR 4/2) silty clay loam; weak fine subangular blocky structure; firm; few fine roots; common faint clay films on faces of peds; common fine prominent strong brown (7.5YR 5/6) masses of iron accumulation throughout; few very dark gray (10YR 3/1) coatings; few coarse sand grains; neutral; clear smooth boundary.

3Btg5—42 to 56 inches; olive gray (5Y 5/2) clay loam; moderate medium subangular blocky structure; firm; few fine roots; many prominent clay films on faces of peds; common fine prominent strong brown (7.5YR 5/6) and many fine prominent dark reddish brown (2.5YR 3/4) masses of iron accumulation throughout; common fine iron and manganese concretions; 1 percent fine gravel; neutral; clear smooth boundary.

3Btg6—56 to 60 inches; olive gray (5Y 5/2) clay; moderate medium subangular blocky structure; very firm; few fine roots; many prominent clay films on faces of peds; common fine prominent strong brown (7.5YR 5/6) and many fine prominent dark reddish brown (2.5YR 3/4) masses of iron accumulation throughout; common fine iron and manganese concretions; 1 percent fine gravel; neutral.

The thickness of the mollic epipedon ranges from 6 to 9 inches.

The A horizon has value of 2 or 3. The Bt horizon has hue of 10YR or 2.5Y, value of 3 or 4, and chroma of 2 to 4. The 2Bt and 3Btg horizons have hue of 10YR to 5Y, value of 4 or 5, and chroma of 1 or 2.

Lamoni Series

The Lamoni series consists of very deep, somewhat poorly drained, slowly permeable soils on uplands. These soils formed in a paleosol weathered from glacial till. Slopes range from 5 to 9 percent.

The Lamoni soils in Mercer County have a thinner dark A horizon than is defined as the range for the series. This difference, however, does not significantly affect the use or behavior of the soils. The soils are classified as fine, montmorillonitic, mesic Aquertic Hapludalfs.

Typical pedon of Lamoni clay loam, 5 to 9 percent slopes, eroded, in a hay field, 750 feet west and 950 feet north of the southeast corner of sec. 32, T. 67 N., R. 25 W.

Ap—0 to 7 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; moderate fine granular structure; very friable; many fine roots; slightly acid; clear smooth boundary.

2Btg1—7 to 14 inches; dark grayish brown (10YR 4/2) clay loam; moderate fine subangular blocky structure; firm; common fine roots; few faint clay films on faces of peds; common fine prominent brown (7.5YR 4/4) masses of iron accumulation throughout; common black (10YR 2/1) and very dark gray (10YR 3/1) coatings; moderately acid; clear smooth boundary.

2Btg2—14 to 22 inches; dark grayish brown (10YR 4/2) clay; moderate medium subangular blocky structure; firm; common fine roots; common distinct clay films on faces of peds; few fine prominent yellowish brown (10YR 5/6) and common fine prominent brown (7.5YR 4/4) masses of iron accumulation throughout; few fine iron and manganese concretions; common very dark gray (10YR 3/1) coatings; 1 percent fine gravel; moderately acid; gradual smooth boundary.

2Bt1—22 to 31 inches; light olive brown (2.5Y 5/4) clay; moderate medium subangular blocky structure; firm; few fine roots; many distinct clay films on faces of peds; common fine prominent yellowish brown (10YR 5/6) and brown (7.5YR 4/4) masses of iron accumulation throughout; common medium iron and manganese concretions; few very dark gray (10YR 3/1) coatings; 1 percent fine gravel; slightly acid; clear smooth boundary.

2Bt2—31 to 52 inches; yellowish brown (10YR 5/4) clay loam; weak medium subangular blocky structure; firm; few fine roots; few distinct clay films on faces of peds; common fine prominent gray (5Y 6/1) iron depletions in the matrix; common fine distinct brown (7.5YR 4/4) masses of iron accumulation throughout; common fine iron and manganese concretions; 1 percent fine gravel; neutral; clear smooth boundary.

2BC—52 to 60 inches; yellowish brown (10YR 5/4) clay loam; moderate medium prismatic structure parting to weak fine subangular blocky; firm; few fine prominent light brownish gray (2.5Y 6/2) iron depletions in the matrix; many medium iron and manganese concretions; 1 percent fine gravel; neutral.

The thickness of the mollic epipedon ranges from 6 to 9 inches.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The upper part of the 2Bt horizon has hue of 10YR or 2.5Y and chroma of 2 or 3. The lower part has hue of 10YR to 5Y, value of 5 or 6, and chroma 1 to 6.

Lenzburg Series

The Lenzburg series consists of very deep, well drained, moderately slowly permeable soils in rock quarry areas. These soils formed in materials that have been excavated during rock quarrying. Slopes range from 5 to 35 percent.

These soils are classified as fine-loamy, mixed (calcareous), mesic Typic Udorthents.

Typical pedon of Lenzburg gravelly clay loam, in an area of Lenzburg-Pits complex, 5 to 35 percent slopes, in a meadow, 1,250 feet south and 1,300 feet east of the northwest corner of sec. 16, T. 65 N., R. 23 W.

A—0 to 2 inches; mixed very dark grayish brown (10YR 3/2), brown (10YR 5/3), and strong brown (7.5YR 5/6) gravelly clay loam, pale brown (10YR 6/3) dry; weak fine granular structure; friable; many fine and medium roots; 15 percent coarse fragments of till pebbles and channers and flags of limestone; slight effervescence; slightly alkaline; abrupt wavy boundary.

C1—2 to 15 inches; grayish brown (2.5Y 5/2) gravelly clay loam; common fine prominent yellowish brown (10YR 5/6), dark yellowish brown (10YR 4/4), and strong brown (7.5YR 5/6) mottles; massive; firm; common fine roots; 18 percent coarse fragments of till pebbles and channers and flags of limestone; strong effervescence; slightly alkaline; clear wavy boundary.

C2—15 to 60 inches; mixed brown (10YR 5/3), dark yellowish brown (10YR 4/4), and grayish brown (2.5Y 5/2) gravelly clay loam; common fine prominent strong brown (7.5YR 4/6) mottles; massive; firm; few fine roots; 23 percent coarse fragments of till pebbles and channers and flags of limestone; strong effervescence; slightly alkaline.

The A horizon has hue of 10YR to 5Y and value of 2 to 5. It typically has chroma of 2 to 4, but chroma ranges from 1 to 6. The C horizon has hue of 7.5YR to 2.5Y, value of 2 to 6, and chroma of 2 to 4. It is silty clay loam, silt loam, loam, silty clay, or clay loam or the channery, gravelly, or cobbly analogs of these textures.

Mystic Series

The Mystic series consists of very deep, somewhat poorly drained, slowly permeable soils on high stream terraces. These soils formed in loamy alluvium derived from glaciers. Slopes range from 5 to 14 percent.

These soils are classified as fine, montmorillonitic, mesic Aquertic Hapludalfs.

Typical pedon of Mystic silt loam, in an area of Caleb-Mystic complex, 5 to 14 percent slopes, eroded, in a hay field, 2,000 feet west and 2,450 feet north of the southeast corner of sec. 4, T. 64 N., R. 24 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; common fine roots; moderately acid; abrupt smooth boundary.

E—6 to 10 inches; brown (10YR 4/3) silt loam; weak thick platy structure parting to weak fine subangular blocky; friable; common fine roots; strongly acid; clear smooth boundary.

Btg1—10 to 15 inches; brown (7.5YR 4/2) clay loam; moderate fine subangular blocky structure; friable; common fine roots; common distinct clay films on faces of peds; common fine prominent red (2.5YR 4/6) masses of iron accumulation throughout; very strongly acid; clear smooth boundary.

Btg2—15 to 23 inches; brown (7.5YR 4/2) clay; moderate fine subangular blocky structure; firm; few fine roots; many distinct clay films on faces of peds; common fine prominent strong brown (7.5YR 5/6) and red (2.5YR 4/6) masses of iron accumulation throughout; strongly acid; clear smooth boundary.

Bt1—23 to 34 inches; brown (10YR 5/3) clay loam; weak medium subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; common fine prominent strong brown (7.5YR 5/8) masses of iron accumulation throughout; common fine iron and manganese concretions; strongly acid; clear smooth boundary.

Bt2—34 to 45 inches; brown (10YR 5/3) clay loam; weak medium subangular blocky structure; firm; few distinct clay films on faces of peds; common fine prominent strong brown (7.5YR 5/6) masses of iron accumulation throughout; common fine iron and manganese concretions; strongly acid; clear smooth boundary.

BC—45 to 60 inches; strong brown (7.5YR 5/6) clay loam; weak medium subangular blocky structure; firm; many medium prominent light brownish gray (2.5Y 6/2) iron depletions in the matrix; common fine iron and manganese concretions; slightly acid.

The E horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 or 3. The Bt horizon has hue of

2.5YR to 2.5Y, value of 3 to 5, and chroma of 2 to 4. The texture is quite variable over short distances, but it typically is clay loam or clay. The BC horizon has hue of 5YR to 10YR, value of 4 to 6, and chroma of 2 to 8.

Nodaway Series

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

These soils are classified as fine-silty, mixed, nonacid, mesic Mollic Udifluvents.

Typical pedon of Nodaway silt loam, occasionally flooded, in a cultivated field, 350 feet north and 100 feet west of the southeast corner of sec. 20, T. 65 N., R. 24 W.

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

C1—8 to 32 inches; very dark grayish brown (10YR 3/2) silt loam that has strata of dark grayish brown (10YR 4/2) and brown (10YR 5/3); massive; friable; few fine roots; common fine prominent strong brown (7.5YR 4/6) masses of iron accumulation throughout; neutral; clear smooth boundary.

C2—32 to 48 inches; dark grayish brown (10YR 4/2) silt loam that has strata of very dark grayish brown (10YR 3/2) and brown (10YR 5/3); massive; friable; common fine prominent yellowish brown (10YR 5/6) mottles; common fine prominent yellowish brown (10YR 5/6) masses of iron accumulation throughout; neutral; clear smooth boundary.

C3—48 to 60 inches; dark grayish brown (10YR 4/2) silt loam that has strata of brown (10YR 5/3); massive; friable; few fine prominent yellowish brown (10YR 5/6) masses of iron accumulation throughout; neutral.

The A horizon has chroma of 1 or 2. The C horizon has value of 3 to 5 and chroma of 1 to 3.

Olmitz Series

The Olmitz series consists of very deep, moderately well drained, moderately permeable soils on foot slopes or alluvial fans. These soils formed in loamy local alluvium. Slopes range from 2 to 5 percent.

These soils are classified as fine-loamy, mixed, mesic Cumulic Hapludolls.

Typical pedon of Olmitz loam, in an area of Olmitz-Zook-Vesser complex, 0 to 5 percent slopes, in a hay field, 700 feet south and 1,250 feet west of the northeast corner of sec. 12, T. 68 N., R. 24 W.; in Decatur County, Iowa:

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; moderate medium and fine subangular blocky structure; friable; few fine roots; neutral; abrupt smooth boundary.

A1—7 to 16 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; weak medium and fine subangular blocky structure; friable; common fine roots; common very dark gray (10YR 3/1) organic coatings on faces of peds; neutral; abrupt smooth boundary.

A2—16 to 24 inches; black (10YR 2/1) clay loam, very dark grayish brown (10YR 3/2) dry; common fine distinct dark brown (10YR 3/3) mottles; strong medium subangular blocky structure parting to moderate fine and medium angular blocky; friable; few fine roots; neutral; clear smooth boundary.

A3—24 to 28 inches; black (10YR 2/1) clay loam; common fine distinct dark brown (10YR 3/3) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; friable; few fine roots; neutral; clear smooth boundary.

A4—28 to 34 inches; dark brown (10YR 3/3) clay loam; weak medium prismatic structure parting to moderate medium and fine subangular blocky; firm; few fine roots; common fine faint dark yellowish brown (10YR 4/4) and few fine prominent strong brown (7.5YR 4/6) masses of iron accumulation throughout; many black (10YR 2/1) coatings on faces of peds; neutral; clear smooth boundary.

Bw1—34 to 43 inches; brown (10YR 4/3) clay loam; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; common fine distinct dark yellowish brown (10YR 4/6) and common fine prominent strong brown (7.5YR 5/8) masses of iron accumulation throughout; many very dark gray (10YR 3/1) coatings on faces of peds; neutral; clear smooth boundary.

Bw2—43 to 50 inches; brown (10YR 4/3) clay loam; moderate medium prismatic structure; firm; few fine roots; common faint clay films on vertical faces of peds; common fine distinct dark yellowish brown (10YR 4/6) and common fine prominent strong brown (7.5YR 4/6) masses of iron accumulation throughout; neutral; clear smooth boundary.

BC—50 to 60 inches; brown (10YR 4/3) clay loam; moderate medium prismatic structure; firm; few fine roots; common distinct clay films on vertical faces of peds; common fine prominent strong brown (7.5YR 4/6) and many medium distinct dark yellowish brown (10YR 4/6) masses of iron accumulation throughout; neutral.

The thickness of the solum ranges from 36 to 65 inches. The solum has no stones. Carbonates typically are leached to a depth of 72 inches or more.

The A horizon has value and chroma of 2 or 3. The B horizon has a clay maximum ranging from 28 to 34 percent.

Pering Series

The Pering series consists of very deep, somewhat poorly drained, slowly permeable soils on loess-covered uplands and high stream terraces. Slopes range from 2 to 9 percent.

These soils are classified as fine, montmorillonitic, mesic Aquertic Hapludalfs.

Typical pedon of Pering silty clay loam, 2 to 5 percent slopes, eroded, in a hay field, 300 feet east and 800 feet south of the northwest corner of sec. 21, T. 66 N., R. 23 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; moderate medium granular structure; friable; many fine roots; moderately acid; clear smooth boundary.

Bt1—7 to 12 inches; brown (10YR 5/3) silty clay; weak fine subangular blocky structure; firm; common fine roots; common distinct clay films on faces of peds; strongly acid; clear smooth boundary.

Bt2—12 to 17 inches; brown (10YR 5/3) silty clay; moderate medium subangular blocky structure; firm; few fine roots; many prominent clay films on faces of peds; common fine faint dark grayish brown (10YR 4/2) iron depletions; common fine prominent strong brown (7.5YR 4/4) masses of iron accumulation throughout; strongly acid; gradual smooth boundary.

Btg1—17 to 28 inches; grayish brown (2.5Y 5/2) silty clay; moderate fine subangular blocky structure; firm; few fine roots; common fine prominent brown (7.5YR 4/4) masses of iron accumulation throughout; strongly acid; gradual smooth boundary.

Btg2—28 to 38 inches; light brownish gray (2.5Y 6/2) silty clay loam; moderate fine subangular blocky structure; firm; common distinct clay films on faces of peds; common medium prominent brown (7.5YR 4/4) masses of iron accumulation throughout; few fine iron and manganese concretions; moderately acid; gradual smooth boundary.

Btg3—38 to 47 inches; light brownish gray (2.5Y 6/2) silty clay loam; weak fine subangular blocky structure; firm; few distinct clay films on faces of peds; common fine prominent brown (7.5YR 4/4) and common medium prominent dark yellowish brown (10YR 4/4) masses of iron accumulation throughout; common fine iron and manganese concretions; slightly acid; gradual smooth boundary.

BCg—47 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam; weak fine subangular blocky structure; firm; common fine prominent dark yellowish brown (10YR 4/4), brown (7.5YR 4/4), and yellowish red (5YR 4/6) masses of iron accumulation throughout; few fine iron and manganese concretions; slightly acid.

The A horizon has chroma of 1 or 2. The Bt horizon has value of 4 or 5 and chroma of 3 or 4. It is silty clay loam or silty clay. The Btg horizon has hue of 10YR or 2.5Y and value of 4 to 6. The masses of iron accumulation have different hue and higher chroma.

Putco Series

The Putco series consists of very deep, well drained, slowly permeable soils in rock quarry areas. These soils formed in materials that have been excavated during rock quarrying. Slopes range from 5 to 35 percent.

These soils are classified as fine, mixed (calcareous), mesic Typic Udorthents.

Typical pedon of Putco silty clay loam, in an area of Putco-Pits complex, 5 to 35 percent slopes, in a meadow, 1,650 feet east and 1,600 feet south of the northwest corner of sec. 11, T. 64 N., R. 24 W.

A—0 to 1 inch; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; many fine and medium roots; 8 percent shale fragments; slight effervescence; slightly alkaline; clear wavy boundary.

C—1 to 60 inches; mixed dark gray (10YR 4/1), grayish brown (2.5Y 5/2), strong brown (7.5YR 5/6), yellowish brown (10YR 5/4), and very dark gray (N 3/0) silty clay; massive; firm; few fine roots; 12 percent shale fragments; moderate effervescence; slightly alkaline.

The A horizon has hue of 10YR to 2.5Y or is neutral in hue. It has value of 2 to 5 and chroma of 0 to 6. The C horizon has hue of 10R to 2.5Y or is neutral in hue. It has value of 3 to 6 and chroma of 0 to 6. It is silty clay or clay.

Sandover Series

The Sandover series consists of very deep, moderately well drained soils on flood plains. These soils formed in stratified sandy alluvium over loamy alluvium. Permeability is rapid in the sandy material and moderate in the underlying loamy material. Slopes range from 0 to 2 percent.

These soils are classified as sandy over loamy, mixed, nonacid, mesic Aquic Udifluvents.

Typical pedon of Sandover fine sand, occasionally flooded, in a cultivated field, 1,750 feet east and 1,350 feet south of the northwest corner of sec. 9, T. 64 N., R. 24 W.

Ap—0 to 9 inches; brown (10YR 4/3) fine sand, pale brown (10YR 6/3) dry; single grain; loose; common fine roots; very strongly acid; clear smooth boundary.

C—9 to 25 inches; brown (10YR 5/3) fine sand that has strata of very dark grayish brown (10YR 3/2); single grain; loose; few fine roots; strongly acid; abrupt wavy boundary.

2Cg1—25 to 32 inches; dark grayish brown (10YR 4/2) silt loam that has strata of grayish brown (10YR 5/2) and very dark grayish brown (10YR 3/2); appears massive but has distinct bedding planes; friable; common medium prominent reddish brown (5YR 4/4) masses of iron accumulation throughout; moderately acid; gradual smooth boundary.

2Cg2—32 to 45 inches; dark grayish brown (10YR 4/2) silt loam that has strata of grayish brown (10YR 5/2) and very dark grayish brown (10YR 3/2); appears massive but has distinct bedding planes; friable; common medium prominent strong brown (7.5YR 4/6) and reddish brown (5YR 4/4) masses of iron accumulation throughout; moderately acid; gradual smooth boundary.

2Cg3—45 to 60 inches; dark gray (10YR 4/1) silt loam that has strata of dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2); appears massive but has weak bedding planes; friable; common medium prominent dark reddish brown (2.5YR 3/4) masses of iron accumulation throughout; slightly acid.

The A horizon has value of 3 or 4 and chroma of 2 to 4. The C horizon has value of 3 to 6 and chroma of 2 to 4. The 2C horizon has value of 4 or 5.

Schuline Series

The Schuline series consists of very deep, well drained, slowly permeable soils in rock quarry areas. These soils formed in materials that have been excavated and reclaimed during rock quarrying. Slopes range from 2 to 14 percent.

These soils are classified as fine-loamy, mixed (calcareous), mesic Typic Udorthents.

Typical pedon of Schuline clay loam, 2 to 14 percent slopes, in a hay field, 200 feet east and 1,000 feet south of the northwest corner of sec. 22, T. 66 N., R. 23 W.

Ap—0 to 3 inches; brown (10YR 4/3) clay loam, yellowish brown (10YR 5/4) dry; moderate medium granular structure; firm; common fine roots; strong effervescence; slightly alkaline; clear wavy boundary.

C1—3 to 28 inches; mixed yellowish brown (10YR 5/4), strong brown (7.5YR 4/6), and gray (10YR 6/1) clay loam; massive; firm; few fine roots; few carbonate threads; 4 percent fine and medium gravel; strong effervescence; moderately alkaline; abrupt wavy boundary.

C2—28 to 38 inches; mixed dark grayish brown (10YR 4/2), strong brown (7.5YR 4/6), and gray (10YR 6/1) clay loam; massive; firm; few fine roots; few carbonate threads; 4 percent fine and medium gravel; coatings of yellowish brown (10YR 5/4) sandy loam; strong effervescence; moderately alkaline; abrupt wavy boundary.

C3—38 to 60 inches; mixed yellowish brown (10YR 5/4), dark yellowish brown (10YR 4/6), dark brown (7.5YR 4/3), and grayish brown (2.5Y 5/2) clay loam; massive; firm; few carbonate threads; 3 percent fine and medium gravel; strong effervescence; moderately alkaline.

The A horizon has hue of 10YR or 7.5YR and value of 4 or 5. It typically has chroma of 3 or 4, but chroma ranges from 2 to 6. The C horizon has value of 4 to 7 and chroma of 2 to 6. It is loam, clay loam, silt loam, silty clay loam, or silty clay.

Shelby Series

The Shelby series consists of very deep, moderately well drained, moderately slowly permeable soils on uplands. These soils formed in glacial till. Slopes range from 9 to 20 percent.

The Shelby soils in Mercer County have a thinner dark A horizon than is defined as the range for the series. This difference, however, does not significantly affect the use or behavior of the soils. The soils are classified as fine-loamy, mixed, mesic Mollic Hapludalfs.

Typical pedon of Shelby loam, 14 to 20 percent slopes, eroded, in a meadow, 1,800 feet south and 300 feet west of the northeast corner of sec. 16, T. 65 N., R. 22 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; many fine roots; 1 percent fine gravel; neutral; clear smooth boundary.

Bt1—8 to 14 inches; dark yellowish brown (10YR 4/4) clay loam; weak fine subangular blocky structure; friable; many fine roots; few faint clay films on faces of peds; common very dark grayish brown (10YR 3/2) coatings in channels and on faces of peds; 1 percent fine gravel; moderately acid; clear smooth boundary.

Bt2—14 to 27 inches; dark yellowish brown (10YR 4/4) clay loam; moderate fine subangular blocky structure; firm; common fine roots; common distinct clay films on faces of peds; common fine distinct yellowish brown (10YR 5/6) masses of iron accumulation throughout; common fine iron and manganese concretions; 1 percent fine gravel; moderately acid; clear smooth boundary.

Bt3—27 to 37 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; firm; common fine roots; many distinct clay films on faces of peds; light brownish gray (2.5Y 6/2) iron depletions in the matrix; common fine prominent strong brown (7.5YR 5/6) masses of iron accumulation throughout; common fine iron and manganese concretions; 1 percent fine gravel; neutral; clear smooth boundary.

Bk1—37 to 49 inches; yellowish brown (10YR 5/4) clay loam; weak medium prismatic structure; firm; few fine roots; common distinct clay films on vertical cleavage planes; common fine prominent light brownish gray (2.5Y 6/2) iron depletions in the matrix; common carbonate masses; 1 percent fine gravel; strong effervescence; moderately alkaline; gradual smooth boundary.

Bk2—49 to 60 inches; yellowish brown (10YR 5/4) clay loam; weak medium prismatic structure; firm; few fine roots; common distinct clay films on vertical cleavage planes; common fine prominent light brownish gray (2.5Y 6/2) iron depletions in the matrix; common carbonate masses; 1 percent fine gravel; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 6 to 9 inches. The depth to carbonates ranges from 30 to more than 60 inches.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The Bt horizon has value of 3 to 5 and chroma of 3 or 4. The Bk horizon has value of 5 or 6 and chroma of 2 to 6.

Vanmeter Series

The Vanmeter series consists of moderately deep, moderately well drained, very slowly permeable soils that formed in calcareous shale residuum. Slopes range from 9 to 40 percent.

These soils are classified as fine, illitic, mesic Typic Eutrochrepts.

Typical pedon of Vanmeter silty clay loam, 9 to 40 percent slopes, in a pasture, 2,500 feet south and 2,300 feet east of the northwest corner of sec. 26, T. 64 N., R. 24 W.

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

Bw1—3 to 6 inches; dark grayish brown (10YR 4/2) silty clay; moderate medium subangular blocky structure; firm; common fine roots; slightly acid; clear smooth boundary.

Bw2—6 to 19 inches; yellowish brown (10YR 5/4) silty clay; moderate medium subangular blocky structure; firm; common fine roots; common dark grayish brown (10YR 4/2) coatings in cracks and pores; slightly acid; clear smooth boundary.

Bw3—19 to 35 inches; strong brown (7.5YR 5/6) silty clay loam; few fine distinct reddish yellow (7.5YR 6/8) mottles; moderate fine subangular blocky structure; firm; few fine roots; 1 percent limestone rock fragments; slight effervescence; slightly alkaline; clear smooth boundary.

Cr—35 to 60 inches; weathered siltstone and sandstone; strong effervescence.

The depth to weathered bedrock ranges from 20 to 40 inches.

The A horizon has value of 3 or 4 and chroma of 1 or 2. The Bw horizon has hue of 2.5Y to 5YR, value of 4 to 6, and chroma of 2 to 6. The Cr horizon has hue of 5Y to 7.5YR, value of 2 to 8, and chroma of 1 to 6.

Vesser Series

The Vesser series consists of very deep, somewhat poorly drained, moderately permeable soils on high flood plains, foot slopes, and alluvial fans. These soils formed in silty alluvium. Slopes range from 0 to 5 percent.

These soils are classified as fine-silty, mixed, mesic Argiaquic Argialbolls.

Typical pedon of Vesser silt loam, in an area of Olmitz-Zook-Vesser complex, 0 to 5 percent slopes, in a cultivated field, 2,500 feet east and 320 feet south of the center of sec. 9, T. 70 N., R. 26 W.; in Decatur County, Iowa:

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure; friable; common fine roots; neutral; abrupt smooth boundary.

A—7 to 10 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak thick platy structure parting to moderate fine subangular blocky; friable; few fine roots; neutral; clear smooth boundary.

E1—10 to 14 inches; dark grayish brown (10YR 4/2) silt loam; moderate thick platy structure parting to moderate fine subangular blocky; friable; few fine roots; moderately acid; clear smooth boundary.

E2—14 to 18 inches; dark grayish brown (10YR 4/2) silt loam; moderate thick platy structure parting to moderate fine subangular blocky; friable; few fine roots; few fine faint brown (10YR 5/3) masses of iron accumulation throughout; few very dark grayish brown (10YR 3/2) organic coatings on faces of peds; light gray (10YR 7/2) silt coatings on faces of peds; moderately acid; clear smooth boundary.

E3—18 to 26 inches; dark grayish brown (10YR 4/2) silt loam; weak thick platy structure parting to moderate fine subangular blocky; friable; few fine roots; few fine faint brown (10YR 5/3) masses of iron accumulation throughout; few distinct very dark grayish brown (10YR 3/2) organic coatings in pores and root channels; light gray (10YR 7/2) silt coatings on faces of peds; strongly acid; clear smooth boundary.

Bt1—26 to 31 inches; dark grayish brown (10YR 4/2) silty clay loam; moderate fine subangular blocky structure; firm; few fine roots; few faint clay films on faces of peds; common fine faint brown (10YR 4/3) masses of iron accumulation throughout; few very dark grayish brown (10YR 3/2) organic coatings in pores and root channels; light gray (10YR 7/2) silt coatings on faces of peds; strongly acid; clear smooth boundary.

Bt2—31 to 38 inches; very dark grayish brown (10YR 3/2) silty clay loam; moderate medium and fine prismatic structure parting to moderate medium and fine subangular blocky; firm; few fine roots; few faint clay films on faces of peds; common fine faint dark brown (10YR 3/3) masses of iron accumulation throughout; light gray (10YR 7/2) silt coatings on faces of peds; strongly acid; clear smooth boundary.

Bt3—38 to 46 inches; very dark grayish brown (10YR 3/2) silty clay loam; moderate medium and fine prismatic structure parting to moderate fine subangular blocky; firm; few fine roots; common distinct clay films on faces of peds; few fine distinct dark yellowish brown (10YR 3/4) masses of iron accumulation throughout; light gray (10YR 7/2) silt coatings on faces of peds; strongly acid; clear smooth boundary.

Bt4—46 to 60 inches; very dark grayish brown (10YR 3/2) silty clay loam; weak fine prismatic structure parting to weak fine subangular blocky; firm; common distinct clay films on faces of peds; few fine prominent dark yellowish brown (10YR 4/6) masses of iron accumulation throughout; light gray (10YR 7/2) silt coatings on faces of peds; moderately acid.

The thickness of the solum typically is more than 60 inches.

The Ap or A horizon has value of 2 or 3 and chroma of 1 or 2. The E horizon has value of 3 to 5 and chroma of 1 or 2. The Bt horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 1 or 2.

Vigar Series

The Vigar series consists of very deep, moderately well drained, moderately slowly permeable soils on alluvial fans and toe slopes. These soils formed in local colluvium. Slopes range from 2 to 6 percent.

These soils are classified as fine-loamy, mixed, mesic Aquic Argiudolls.

Typical pedon of Vigar loam, 2 to 6 percent slopes, rarely flooded, in a cultivated field, 1,250 feet east and 1,600 feet south of the northwest corner of sec. 7, T. 66 N., R. 24 W.

Ap—0 to 6 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; few fine roots; slightly acid; gradual smooth boundary.

A—6 to 13 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; few fine roots; slightly acid; gradual smooth boundary.

BA—13 to 23 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; friable; few fine roots; few faint clay films on faces of peds; neutral; gradual smooth boundary.

Bt1—23 to 32 inches; very dark gray (10YR 3/1) loam, dark grayish brown (10YR 4/2) dry; moderate medium subangular blocky structure; firm; few faint clay films on faces of peds; few fine distinct brown (10YR 4/3) masses of iron accumulation throughout; neutral; clear smooth boundary.

Bt2—32 to 40 inches; dark grayish brown (10YR 4/2) clay loam; moderate medium subangular blocky structure; firm; few faint clay films on faces of peds; common fine distinct dark yellowish brown (10YR 4/4) and few fine prominent yellowish brown (10YR 5/6) masses of iron accumulation throughout; neutral; gradual smooth boundary.

Bt3—40 to 55 inches; dark grayish brown (10YR 4/2) loam; moderate medium subangular blocky structure; firm; common distinct clay films on faces of peds; common fine prominent yellowish brown

(10YR 5/6) and common fine distinct dark yellowish brown (10YR 4/4) masses of iron accumulation throughout; few fine iron and manganese concretions; neutral; gradual smooth boundary.

Bt4—55 to 60 inches; brown (10YR 4/3) loam; weak medium subangular blocky structure; firm; few faint clay films on faces of peds; common fine distinct dark gray (10YR 4/1) iron depletions in the matrix; many fine distinct yellowish brown (10YR 5/6) masses of iron accumulation throughout; few fine iron and manganese concretions; neutral.

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

The A horizon has value of 2 or 3 and chroma of 1 or 2. The BA horizon has value of 2 to 4. The Bt horizon has hue of 7.5YR or 10YR and value of 3 to 5.

Wabash Series

The Wabash series consists of very deep, poorly drained, very slowly permeable soils on low flood plains. These soils formed in fine textured alluvium. Slopes are less than 1 percent.

These soils are classified as fine, montmorillonitic, mesic Cumulic Vertic Endoaquolls.

Typical pedon of Wabash silty clay, occasionally flooded, in a meadow, 3,200 feet east and 2,250 feet north of the southwest corner of sec. 6, T. 66 N., R. 25 W.

Ap—0 to 6 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; strong fine granular structure; firm; many fine roots; strongly acid; clear smooth boundary.

A1—6 to 14 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure; firm; many fine roots; few fine prominent strong brown (7.5YR 5/6) masses of iron accumulation throughout; strongly acid; clear smooth boundary.

A2—14 to 27 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; firm; common fine roots; few fine prominent strong brown (7.5YR 5/6) masses of iron accumulation throughout; few pressure faces; moderately acid; gradual smooth boundary.

Bg1—27 to 46 inches; very dark gray (N 3/0) clay, dark gray (N 4/0) dry; weak medium subangular blocky structure; very firm; common fine roots; common fine prominent strong brown (7.5YR 4/6) masses of iron accumulation throughout; common pressure faces; common black (10YR 2/1) organic coatings in channels; neutral; gradual smooth boundary.

Bg2—46 to 60 inches; dark gray (10YR 4/1) silty clay; weak medium subangular blocky structure; very firm; few fine roots; common fine prominent strong brown (7.5YR 4/6) masses of iron accumulation throughout; common pressure faces; neutral.

The mollic epipedon is more than 36 inches thick.

The A horizon has value of 2 or 3 and chroma of 2 or less. The part of the Bg horizon within a depth of 36 inches has the same range in color as the A horizon. Below a depth of 36 inches, the matrix commonly has value of 4 or 5.

Winnegan Series

The Winnegan series consists of very deep, moderately well drained, slowly permeable soils on uplands. These soils formed in glacial till. Slopes range from 14 to 35 percent.

These soils are classified as fine, mixed, mesic Oxyaquic Hapludalfs.

Typical pedon of Winnegan loam, 14 to 35 percent slopes, in a wooded area, 2,550 feet east and 800 feet south of the northwest corner of sec. 24, T. 64 N., R. 24 W.

A—0 to 2 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; many fine roots; moderately acid; abrupt smooth boundary.

E—2 to 8 inches; brown (10YR 5/3) loam; weak thin platy structure; friable; common fine roots; 1 percent fine gravel; very strongly acid; clear smooth boundary.

Bt1—8 to 16 inches; dark yellowish brown (10YR 4/4) clay; weak fine subangular blocky structure; firm; common fine roots; few distinct clay films on faces of peds; 1 percent fine gravel; very strongly acid; clear smooth boundary.

Bt2—16 to 20 inches; yellowish brown (10YR 5/4) clay; moderate medium subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; 1 percent fine gravel; very strongly acid; clear smooth boundary.

Bt3—20 to 24 inches; yellowish brown (10YR 5/4) clay; moderate medium subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; few fine distinct grayish brown (10YR 5/2) iron depletions in the matrix; 1 percent fine gravel; very strongly acid; clear smooth boundary.

Bt4—24 to 30 inches; yellowish brown (10YR 5/4) clay; weak fine subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; common fine distinct grayish brown (10YR 5/2) iron depletions in the matrix; 1 percent fine gravel; moderately acid; clear smooth boundary.

Bk—30 to 60 inches; yellowish brown (10YR 5/4) clay loam; weak medium prismatic structure; firm; common fine distinct grayish brown (10YR 5/2) iron depletions in the matrix; few carbonate masses; 1 percent fine gravel; strong effervescence; slightly alkaline.

The depth to carbonates ranges from 24 to 40 inches.

The A horizon has value and chroma of 2 or 3. The E horizon has value of 4 to 6 and chroma of 2 to 4. The Bt horizon has hue of 10YR or 7.5YR and chroma of 4 to 6. It is clay loam or clay. The Bk horizon has colors and textures similar to those of the Bt horizon.

Zook Series

The Zook series consists of very deep, poorly drained, slowly permeable soils on low flood plains. These soils formed in silty and clayey alluvium. Slopes range from 0 to 2 percent.

These soils are classified as fine, montmorillonitic, mesic Cumulic Vertic Endoaquolls.

Typical pedon of Zook silty clay loam, occasionally flooded, in a pasture, 1,000 feet west and 2,400 feet north of the southeast corner of sec. 19, T. 65 N., R. 22 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; many fine roots; neutral; clear smooth boundary.

A1—9 to 16 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; firm; common fine roots; neutral; gradual smooth boundary.

A2—16 to 34 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; very firm; common fine roots; slightly acid; gradual smooth boundary.

Bw—34 to 52 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; very firm; common fine roots; moderately acid; clear smooth boundary.

Bg—52 to 60 inches; dark gray (10YR 4/1) silty clay; weak medium prismatic structure; very firm; few fine roots; common fine distinct dark yellowish brown (10YR 3/4) masses of iron accumulation throughout; moderately acid.

The mollic epipedon is more than 36 inches thick.

The A horizon has value of 2 or 3. The Bg horizon has hue of 10YR to 5Y and value of 3 to 5. It is silty clay or silty clay loam.

Formation of the Soils

Soil forms through processes that act on deposited or accumulated geologic material. The characteristics of the soil are determined by the physical and mineralogical composition of the parent material, the plant and animal life on and in the soil, the climate under which the soil material has accumulated and existed since accumulation, the relief, and the length of time that the forces of soil formation have acted on the soil material.

Climate and vegetation are active forces in soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and vegetation are conditioned by relief. The parent material affects the kind of profile that forms and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil. Generally, a long time is needed for the development of distinct horizons. The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made about the effect of any one factor unless conditions are specified for the others.

Parent Material

Parent material is the unconsolidated mass in which a soil forms. The formation or deposition of this material is the first step in the development of a soil profile. The characteristics of the parent material affect the chemical and mineralogical composition of the soil. Four principal kinds of parent material, alone or in combination, have contributed to the formation of the soils in Mercer County. These are loess, or wind-deposited material; glacial till; residual material weathered from bedrock; and alluvium, or water-deposited material. Of lesser importance is colluvium, which is material that has been transported short distances downslope by the action of water and gravity.

Loess, or silty material transported by the wind, is an extensive parent material in parts of Mercer County. The principal local source of loess probably originated from the flood plains along the Grand River and Weldon Fork. Grundy, Edina, and Pering soils formed in loess on the upland flats and gently sloping ridges.

Glaciers transported clay, silt, sand, and gravel into the area that is now Missouri. The material deposited by the glaciers, which is referred to as glacial till, is the parent material in which Gara, Shelby, and Winnegan soils formed.

Residual parent material develops in place from the underlying bedrock. For example, the weathering of shale resulted in the formation of Vanmeter soils, which are on moderately steep to very steep, convex side slopes that parallel the Weldon River in the southern part of the county.

Alluvium is the parent material of soils on the flood plains. Rivers and streams deposited sand, silt, and clay on the flood plains. The material deposited depends on the velocity of the floodwaters. As the floodwater leaves the stream channel, its velocity begins to slow as it moves away from the channel. Nodaway soils formed in silty alluvium adjacent to the stream. In slack-water areas farthest from the stream channel, Wabash and Zook soils formed where the finer clay particles settled.

Some of the soils in the survey area formed in more than one kind of parent material. For example, Lagonda soils formed in loess and in the underlying glacial till.

Plants and Animals

Living organisms in and on the soil help to alter parent materials and soil properties. Plants, bacteria, fungi, burrowing animals, and human activities affect organic matter content, nutrient balance, soil structure, aeration, and other properties of the soil.

Plants greatly affect soil formation. Plant communities vary, depending on soil fertility, available water capacity, drainage, and depth. Trees were the dominant type of vegetation during the formation of Keswick soils. Grundy soils formed under native grasses. They have a thick, dark surface layer. The annual return of grass residue affects the physical, chemical, and biological nature of the surface layer. Nutrients extracted from the soil by plants are eventually returned to the soil through decomposition.

Micro-organisms are important in the decomposition of plant residue. By reducing raw material to soil humus, micro-organisms release plant nutrients, enhance soil structure, and improve the general physical condition of the surface layer. Soils favoring high biological activity normally have a high content of organic matter, are moderately acid to neutral, are well aerated, have a low bulk density, and are medium textured.

Intensive cultivation, the clearing of trees, and other human activities all affect soil formation. Cultivation can mix the surface layer and subsurface layers, thereby lowering the organic matter content, reducing biological activity in the soil, and decreasing the stability of soil structure. The combination of these factors may increase the runoff rate and the susceptibility of the soil to erosion. In some areas erosion has removed the original surface layer and thus has reduced the fertility and productivity of the soil. Introducing new crops and adding chemicals, such as fertilizer and lime, can also alter soil formation.

Climate

Climate has been an important factor in the formation of the soils in Mercer County. In the past 1 million years, variations in the climate have drastically affected the area. The county currently has a subhumid midcontinental climate.

Rainfall and temperature continue to affect soil formation. Past climates have influenced the kinds of parent material deposited by ice, wind, and water. These same climatic patterns shaped the development of soils in those parent materials. The rate of geologic erosion varies with the climate, and the shape and character of landforms are influenced accordingly. Changes in the relative abundance and species composition of plants and animals are affected by climatic changes.

The midcontinental climate encourages chemical changes in the soil and physical disintegration of the soil. Calcium carbonate and other soluble salts may be removed by leaching, thus reducing soil fertility. The physical and chemical characteristics of most soils in Mercer County reflect these climate-induced changes. Vanmeter soils are examples of soils that formed as a result of the weathering of shale.

Relief

Relief affects the formation of soils mostly through its effect on drainage, runoff, and erosion. The amount of water entering and passing through the soil depends on the slope, the permeability, and the amount and intensity of rainfall. Because runoff is rapid on steep soils, little water passes through the soil profile and the profile shows little evidence of the development of distinct horizons. Runoff is slow on gently sloping and nearly level soils, and most of the water passes through the soil material. The soils in these areas are characterized by maximum profile development. On similar slopes, soils that are rapidly permeable form more slowly than soils that are slowly permeable.

Soils on south-facing ridges are generally more droughty than soils on north-facing slopes. The droughtiness affects soil formation by influencing the amount and kind of vegetation that grows on the soil, the susceptibility of the soil to erosion, and freezing and thawing action.

Time

The degree of profile development depends partly on the length of time that the parent material has been in place and has been subjected to the soil-forming processes. Older soils show the effects of leaching and clay movement and have distinct horizons. Young soils show little evidence of profile development.

Alluvial soils are the youngest soils in Mercer County. Nodaway soils show no evidence of profile development because alluvial material is added nearly every year. Humeston soils, which are older alluvial soils on stream terraces, have more distinct horizons. The formation of an argillic (clay-enriched) horizon in the Armstrong soils has taken place over long periods of time. These glacial till soils are older than the alluvial soils.

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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:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Back slope. The geomorphic component that forms the steepest inclined surface and principal element of many hillslopes. Back slopes in profile typically range from gently sloping to very steep and linear and descend to a foot slope. In terms of gradational process, back slopes are erosional forms produced mainly by mass wasting and running water.

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Bedding system. A drainage system made by plowing, grading, or otherwise shaping the surface of a flat field. It consists of a series of low ridges separated by shallow, parallel dead furrows.

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.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

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.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

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

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

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

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

Complex slope. Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

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

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.

Corrosion. Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

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.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

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.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities 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.

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

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

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, or 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.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

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 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of the 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.

Head slope. The concave surface at the head of a drainageway where the flow of water converges downward toward the center and contour lines form concave curves.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Hillslope. The steeper part of a hill between its summit and the drainage line at the base of the hill. In descending order, geomorphic components of a simple hillslope may include shoulder, back slope, foot slope, and toe slope.

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.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

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.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

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

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

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.

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 the wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or 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 three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, 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 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, such as 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.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

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 degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Ridge. A long, narrow elevation of the land surface, generally sharp crested with steep sides forming an extended upland between valleys.

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.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

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-sized particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the 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.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

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.

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 multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey, the following slope classes are recognized:

Nearly level	0 to 2 percent
Gently sloping	2 to 5 percent
Moderately sloping	5 to 9 percent
Strongly sloping	9 to 14 percent
Moderately steep	14 to 20 percent
Steep	20 to 30 percent
Very steep	more than 30 percent

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, in millimeters, of separates recognized in the United States are as follows:

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 substratum. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

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 erosion 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 grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind erosion 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.

Subsoiling. Breaking up a compact subsoil by pulling a special chisel through the soil.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

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). A layer of otherwise suitable soil material that is too thin for the specified use.

Till plain. An extensive area of nearly level to undulating soils underlain by glacial till.

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.

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

Valley fill. In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.

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 a 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 1963-93 at Princeton, 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
	°F	°F	°F	°F	°F	Units	In	In	In	
January-----	34.3	14.0	24.1	62	-18	1	0.98	0.35	1.57	3
February----	39.5	17.9	28.7	67	-14	2	.89	.43	1.28	3
March-------	52.5	29.7	41.1	82	3	45	2.46	1.06	3.64	5
April-------	65.4	41.3	53.4	88	19	167	3.71	2.03	5.19	7
May---------	74.7	51.0	62.8	90	31	388	3.93	2.63	5.12	7
June--------	83.6	60.2	71.9	97	43	631	3.99	2.23	5.54	6
July--------	88.3	64.6	76.4	102	49	822	4.66	1.91	6.98	5
August------	85.9	61.5	73.7	101	44	739	3.77	1.73	5.51	5
September---	78.2	53.8	66.0	95	32	467	4.17	2.38	5.76	6
October-----	67.3	41.9	54.6	88	21	192	3.00	1.03	4.63	5
November----	51.2	30.1	40.7	76	3	35	2.03	.68	3.26	4
December----	37.4	18.2	27.8	65	-13	2	1.57	.78	2.37	4
Yearly:										
Average---	63.2	40.3	51.8	---	---	---	---	---	---	---
Extreme---	---	---	---	103	-21	---	---	---	---	---
Total-----	---	---	---	---	---	3,491	35.14	28.49	39.63	60

* 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 1963-93 at Princeton, Missouri)

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 17	Apr. 26	May 9
2 years in 10 later than--	Apr. 12	Apr. 21	May 4
5 years in 10 later than--	Apr. 2	Apr. 11	Apr. 24
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 10	Sept. 29	Sept. 22
2 years in 10 earlier than--	Oct. 16	Oct. 5	Sept. 27
5 years in 10 earlier than--	Oct. 27	Oct. 16	Oct. 7

TABLE 3.--GROWING SEASON

(Recorded in the period 1963-93 at Princeton, Missouri)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
9 years in 10	175	166	144
8 years in 10	181	172	150
5 years in 10	194	183	162
2 years in 10	206	193	174
1 year in 10	213	199	181

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

Map symbol	Soil name	Acres	Percent
10	Edina silt loam	850	0.3
11C2	Clarinda silty clay loam, 5 to 9 percent slopes, eroded	3,250	1.1
12B2	Grundy silty clay loam, 2 to 5 percent slopes, eroded	12,400	4.3
13D2	Caleb-Mystic complex, 5 to 14 percent slopes, eroded	2,000	0.7
14C2	Adair loam, 5 to 9 percent slopes, eroded	32,750	11.2
14D2	Adair loam, 9 to 14 percent slopes, eroded	2,100	0.7
15C2	Lamoni clay loam, 5 to 9 percent slopes, eroded	16,200	5.6
16B2	Lagonda silty clay loam, 2 to 5 percent slopes, eroded	860	0.3
17D2	Shelby loam, 9 to 14 percent slopes, eroded	8,800	3.0
17E2	Shelby loam, 14 to 20 percent slopes, eroded	6,600	2.3
19D2	Keswick loam, 5 to 14 percent slopes, eroded	1,800	0.6
22D2	Gara loam, 9 to 14 percent slopes, eroded	6,400	2.2
22E2	Gara loam, 14 to 20 percent slopes, eroded	75,490	25.9
22F2	Gara loam, 20 to 30 percent slopes, eroded	8,500	2.9
24C2	Armstrong loam, 5 to 9 percent slopes, eroded	36,000	12.3
24D2	Armstrong clay loam, 9 to 14 percent slopes, eroded	6,100	2.1
25B2	Pering silty clay loam, 2 to 5 percent slopes, eroded	880	0.3
25C2	Pering silty clay loam, 5 to 9 percent slopes, eroded	398	0.1
29F	Winnegan loam, 14 to 35 percent slopes	7,600	2.6
33F	Vanmeter silty clay loam, 9 to 40 percent slopes	4,350	1.5
42	Sandover fine sand, occasionally flooded	590	0.2
45	Humeston silty clay loam, occasionally flooded	5,500	1.9
49	Belinda silt loam	330	0.1
51B	Pering silt loam, terrace, 2 to 6 percent slopes	2,000	0.7
52B	Vigar loam, 2 to 6 percent slopes, rarely flooded	2,550	0.9
54	Zook silty clay loam, occasionally flooded	11,000	3.8
55A	Colo silty clay loam, channeled, 0 to 3 percent slopes, frequently flooded	140	*
56B	Nodaway-Humeston-Vigar complex, 0 to 6 percent slopes	12,800	4.4
57B	Olmitz-Zook-Vesser complex, 0 to 5 percent slopes	250	0.1
58	Wabash silty clay, occasionally flooded	1,450	0.5
66	Nodaway silt loam, occasionally flooded	20,500	7.0
69	Fatima silt loam, occasionally flooded	90	*
80D	Schuline clay loam, 2 to 14 percent slopes	90	*
84F	Putco-Pits complex, 5 to 35 percent slopes	180	0.1
88F	Lenzburg-Pits complex, 5 to 35 percent slopes	190	0.1
	Water	500	0.2
	Total	291,488	100.0

* 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
10	Edina silt loam (where drained)
12B2	Grundy silty clay loam, 2 to 5 percent slopes, eroded
16B2	Lagonda silty clay loam, 2 to 5 percent slopes, eroded
25B2	Pering silty clay loam, 2 to 5 percent slopes, eroded
42	Sandover fine sand, occasionally flooded
45	Humeston silty clay loam, occasionally flooded (where drained)
49	Belinda silt loam (where drained)
51B	Pering silt loam, terrace, 2 to 6 percent slopes
52B	Vigar loam, 2 to 6 percent slopes, rarely flooded
54	Zook silty clay loam, occasionally flooded (where drained)
56B	Nodaway-Humeston-Vigar complex, 0 to 6 percent slopes (where drained)
57B	Olmitz-Zook-Vesser complex, 0 to 5 percent slopes (where drained)
58	Wabash silty clay, occasionally flooded (where drained)
66	Nodaway silt loam, occasionally flooded
69	Fatima silt loam, occasionally flooded

TABLE 6.--LAND CAPABILITY 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	Winter wheat	Orchard-grass-alfalfa hay	Timothy-red clover hay	Tall fescue	Switchgrass
		Bu	Bu	Bu	Tons	Tons	AUM*	AUM*
10------------- Edina	IIw	100	36	40	3.8	3.8	7.3	10.2
11C2------------ Clarinda	IVe	84	29	35	2.2	2.7	6.0	7.2
12B2------------ Grundy	IIIe	96	35	40	3.9	3.9	7.1	8.5
13D2:								
Caleb----------	IVe	83	28	31	3.0	3.0	5.8	7.0
Mystic---------	IVe	74	24	30	2.8	2.8	5.5	6.6
14C2------------ Adair	IIIe	90	30	36	3.5	3.5	6.6	7.9
14D2------------ Adair	IVe	81	27	32	2.9	2.9	6.0	7.2
15C2------------ Lamoni	IIIe	91	31	34	3.4	3.4	6.2	7.4
16B2------------ Lagonda	IIIe	96	36	39	3.6	3.6	7.1	8.5
17D2------------ Shelby	IVe	89	33	36	3.5	3.5	6.7	8.0
17E2------------ Shelby	VIe	---	---	---	3.2	3.2	5.9	6.8
19D2------------ Keswick	IVe	72	23	28	3.0	3.0	5.8	6.6
22D2------------ Gara	IVe	80	29	32	3.0	3.0	5.8	7.0
22E2------------ Gara	VIe	---	---	---	2.9	2.9	5.0	6.0
22F2------------ Gara	VIe	---	---	---	2.5	2.5	4.6	5.5
24C2------------ Armstrong	IIIe	84	30	34	3.3	3.3	5.8	7.0
24D2------------ Armstrong	IVe	72	23	28	2.8	2.8	5.5	6.6
25B2------------ Pering	IIIe	90	34	35	3.5	3.5	6.4	7.7
25C2------------ Pering	IIIe	86	32	34	3.2	3.2	6.1	7.3

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Winter wheat	Orchard-grass-alfalfa hay	Timothy-red clover hay	Tall fescue	Switchgrass
		Bu	Bu	Bu	Tons	Tons	AUM*	AUM*
29F------------- Winnegan	VIe	---	---	---	1.6	1.6	3.3	3.7
33F------------- Vanmeter	VIIe	---	---	---	1.5	1.5	3.0	3.7
42-------------- Sandover	IIw	85	30	35	3.0	3.0	6.5	6.5
45-------------- Humeston	IIIw	102	34	40	3.5	3.5	7.2	10.1
49-------------- Belinda	IIIw	104	35	41	3.4	3.4	5.3	7.4
51B------------- Pering	IIIe	92	32	38	3.7	3.7	6.8	8.2
52B------------- Vigar	IIe	121	45	49	4.5	4.5	9.0	10.8
54-------------- Zook	IIw	85	36	39	3.2	3.2	6.4	9.0
55A------------- Colo	Vw	---	---	---	---	3.5	6.6	9.2
56B:								
Nodaway---------	IIw	100	39	45	3.9	3.9	7.9	11.1
Humeston--------	IIIw	95	32	37	3.2	3.2	6.8	9.5
Vigar-----------	IIe	112	40	45	4.3	4.3	8.9	10.8
57B:								
Olmitz----------	IIe	115	42	48	4.5	4.5	8.8	11.2
Zook------------	IIw	80	32	36	3.0	3.0	6.2	8.7
Vesser----------	IIw	97	35	42	3.5	3.5	7.0	9.8
58-------------- Wabash	IIIw	81	30	33	2.9	2.9	6.0	8.4
66-------------- Nodaway	IIw	110	41	48	4.1	4.1	8.2	11.5
69-------------- Fatima	IIw	121	45	49	4.5	4.5	9.0	11.8
80D------------- Schuline	IIIe	---	---	---	1.5	1.5	2.3	2.5
84F:								
Putco-----------	VIe	---	---	---	1.0	1.0	1.5	2.0
Pits.								

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Winter wheat	Orchard-grass-alfalfa hay	Timothy-red clover hay	Tall fescue	Switchgrass
		Bu	Bu	Bu	Tons	Tons	AUM*	AUM*
88F:								
Lenzburg-------	VIe	---	---	---	1.0	1.0	1.5	2.0
Pits.								

* 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: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
13D2:									
Caleb	3A	Slight	Slight	Slight	Slight	White oak	55	38	White oak, northern red oak, white ash.
						Northern red oak	55	38	
Mystic	3A	Slight	Slight	Slight	Slight	White oak	55	38	White oak, northern red oak, white ash.
19D2 Keswick	3C	Slight	Slight	Moderate	Severe	White oak	57	40	White oak, northern red oak, black oak.
						Northern red oak	55	38	
						Black oak	62	45	
22D2 Gara	3A	Slight	Slight	Slight	Slight	White oak	55	38	White oak, northern red oak, black oak.
						Northern red oak	55	38	
						Black oak	59	42	
22E2, 22F2 Gara	3R	Moderate	Moderate	Slight	Slight	White oak	56	39	White oak, northern red oak, black oak.
						Northern red oak	57	40	
						Black oak	59	42	
24C2, 24D2 Armstrong	3C	Slight	Slight	Moderate	Severe	White oak	54	38	White oak, northern red oak, black oak.
						Northern red oak	66	48	
						Black oak	65	48	
25B2, 25C2 Pering	3C	Slight	Slight	Severe	Severe	White oak	55	38	Post oak, black oak, pin oak.
						Post oak	---	---	
						Black oak	---	---	
29F Winnegan	3R	Moderate	Moderate	Slight	Slight	White oak	58	41	White oak, black oak, white ash, northern red oak.
						Post oak	---	---	
						Black oak	63	46	
33F Vanmeter	2R	Severe	Severe	Severe	Severe	White oak	51	35	Black oak, post oak.
						Black oak	---	---	
						Post oak	---	---	
42 Sandover	6W	Slight	Moderate	Moderate	Slight	Eastern cottonwood	85	91	Eastern cottonwood, green ash.
						Willow	---	---	
						Pin oak	75	57	
49 Belinda	2W	Slight	Severe	Moderate	Moderate	White oak	45	30	Eastern cottonwood, silver maple, American sycamore, green ash.
						Pin oak	---	---	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
51B Pering	3C	Slight	Slight	Severe	Severe	White oak	55	38	Post oak, black oak, pin oak.
						Post oak	---	---	
						Black oak	---	---	
56B:									
Nodaway	3A	Slight	Slight	Slight	Slight	White oak	65	48	Black walnut, cottonwood, green ash, white oak.
						Cottonwood	106	144	
						White ash	86	89	
Humeston.									
Vigar.									
58 Wabash	4W	Slight	Severe	Severe	Moderate	Pin oak	75	57	Pin oak, pecan, eastern cottonwood.
						Green ash	75	73	
						Silver maple	95	46	
66 Nodaway	3A	Slight	Slight	Slight	Slight	White oak	65	48	Black walnut, cottonwood, green ash, white oak.
						Cottonwood	106	144	
						White ash	88	90	
69 Fatima	5A	Slight	Slight	Slight	Slight	Pin oak	86	68	Pin oak, black walnut, pecan, eastern cottonwood, American sycamore.
						Black walnut	---	---	
						Bur oak	---	---	
80D Schuline	---	--------	--------	--------	--------	-------------------	---	---	Eastern white pine, green ash, American sycamore, cottonwood.
84F:									
Putco	2R	Moderate	Severe	Severe	Slight	Cottonwood	---	---	Eastern white pine, cottonwood, American elm, American sycamore.
						River birch	---	---	
						American elm	---	---	
Pits.									
88F:									
Lenzburg	5R	Moderate	Moderate	Slight	Slight	Eastern cottonwood	---	---	American sycamore, green ash.
						River birch	---	---	
Pits.									

* 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
10----------------- Edina	Redosier dogwood	Silky dogwood, American cranberrybush, holly.	Washington hawthorn, Austrian pine, green ash, northern whitecedar.	Baldcypress, red maple.	Pin oak.
11C2--------------- Clarinda	---	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, American cranberrybush.	Green ash, common hackberry.	Eastern white pine, pin oak, Austrian pine.	---
12B2--------------- Grundy	---	Washington hawthorn, eastern redcedar, Amur privet, American cranberrybush, arrowwood.	Austrian pine, green ash.	Pin oak, Norway spruce.	---
13D2:					
Caleb-------------	---	Amur privet, American cranberrybush, silky dogwood.	White fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce, Austrian pine.	Eastern white pine, pin oak.
Mystic------------	---	American cranberrybush, eastern redcedar, arrowwood, Amur privet, Washington hawthorn.	Green ash, Austrian pine, common hackberry.	Pin oak, Norway spruce.	---
14C2, 14D2--------- Adair	---	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, American cranberrybush.	Austrian pine, green ash, common hackberry.	Pin oak, Norway spruce.	---
15C2--------------- Lamoni	---	Eastern redcedar, Washington hawthorn, arrowwood, Amur privet, American cranberrybush.	Austrian pine, green ash, common hackberry.	Pin oak, Norway spruce.	---

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
16B2--------------- Lagonda	Fragrant sumac----	Amur maple, gray dogwood, eastern redcedar.	Norway spruce, hackberry, green ash, autumn-olive.	Pin oak, Austrian pine, honeylocust, American sycamore.	---
17D2, 17E2--------- Shelby	---	Silky dogwood, American cranberrybush, Amur privet.	Washington hawthorn, northern whitecedar, blue spruce, white fir.	Norway spruce, Austrian pine.	Pin oak, eastern white pine.
19D2--------------- Keswick	---	Eastern redcedar, American cranberrybush, Washington hawthorn, arrowwood, Amur privet.	Austrian pine, green ash, common hackberry.	Pin oak, Norway spruce.	---
22D2, 22E2, 22F2--- Gara	---	American cranberrybush, Amur privet, silky dogwood.	Northern whitecedar, white fir, Washington hawthorn, blue spruce.	Austrian pine, Norway spruce.	Eastern white pine, pin oak.
24C2, 24D2--------- Armstrong	---	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, American cranberrybush.	Austrian pine, green ash, common hackberry.	Pin oak, Norway spruce.	---
25B2, 25C2--------- Pering	---	Eastern redcedar, American cranberrybush, Washington hawthorn, Amur privet, arrowwood.	Austrian pine, green ash, common hackberry.	Pin oak, Norway spruce.	---
29F---------------- Winnegan	Fragrant sumac----	Amur maple, gray dogwood.	Hackberry, eastern redcedar, Norway spruce, Virginia pine.	Honeylocust, pin oak.	---
33F---------------- Vanmeter	Siberian peashrub	Eastern redcedar, Osage-orange, Russian-olive, Washington hawthorn.	Northern catalpa, honeylocust, green ash.	---	---

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
42 Sandover	---	American cranberrybush, Amur privet, Tatarian honeysuckle, Washington hawthorn.	Austrian pine, eastern redcedar, northern whitecedar.	Eastern white pine, Norway spruce, red pine.	---
45 Humeston	---	Amur privet, American cranberrybush, silky dogwood, gray dogwood.	Norway spruce, Austrian pine, northern whitecedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
49 Belinda	---	Amur privet, silky dogwood, American cranberrybush, gray dogwood.	Austrian pine, Norway spruce, blue spruce, northern whitecedar, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
51B Pering	---	Eastern redcedar, American cranberrybush, Washington hawthorn, Amur privet, arrowwood.	Austrian pine, green ash, common hackberry.	Pin oak, Norway spruce.	---
52B Vigar	---	Amur privet, American cranberrybush, silky dogwood, gray dogwood.	Austrian pine, white fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce	Eastern white pine, pin oak.
54 Zook	---	Silky dogwood, American cranberrybush, Amur privet, gray dogwood.	Norway spruce, northern whitecedar, Austrian pine, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
55A Colo	---	Amur privet, American cranberrybush, silky dogwood, gray dogwood.	Norway spruce, Austrian pine, blue spruce, white fir, northern whitecedar, Washington hawthorn.	Eastern white pine	Pin oak.

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
56B:					
Nodaway	---	Amur privet, American cranberrybush, silky dogwood, gray dogwood.	Austrian pine, white fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce	Eastern white pine, pin oak.
Humeston	---	Amur privet, American cranberrybush, silky dogwood, gray dogwood.	Norway spruce, Austrian pine, northern whitecedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
Vigar	---	Amur privet, American cranberrybush, silky dogwood, gray dogwood.	Austrian pine, white fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce	Eastern white pine, pin oak.
57B:					
Olmitz	---	Amur privet, silky dogwood, American cranberrybush.	White fir, blue spruce, northern whitecedar, Washington hawthorn.	Austrian pine, Norway spruce.	Pin oak, eastern white pine.
Zook	---	Silky dogwood, American cranberrybush, Amur privet, gray dogwood.	Norway spruce, northern whitecedar, Austrian pine, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
Vesser	---	Amur privet, American cranberrybush, silky dogwood, gray dogwood.	Norway spruce, Austrian pine, northern whitecedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
58 Wabash	---	Gray dogwood, silky dogwood, Amur privet, American cranberrybush.	Norway spruce, Austrian pine, northern whitecedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
66 Nodaway	---	Amur privet, American cranberrybush, silky dogwood, gray dogwood.	Austrian pine, white fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce	Eastern white pine, pin oak.

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
69----------------- Fatima	Fragrant sumac----	American plum, blackhaw, silky dogwood.	Nannyberry viburnum, white fir, Washington hawthorn.	Green ash, eastern white pine, Norway spruce.	Pin oak, eastern cottonwood.
80D---------------- Schuline	Siberian peashrub	Eastern redcedar, jack pine, silky dogwood, Washington hawthorn, Osage-orange, Russian-olive.	Honeylocust, northern catalpa.	---	---
84F:					
Putco-------------	Siberian peashrub	Russian-olive, Washington hawthorn, eastern redcedar, Osage-orange.	Black locust, bur oak, green ash, honeylocust, northern catalpa.	Siberian elm------	---
Pits.					
88F:					
Lenzburg----------	Siberian peashrub	Eastern redcedar, jack pine, Russian-olive, Washington hawthorn, Osage-orange.	Honeylocust, northern catalpa.	---	---
Pits.					

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
10-------------------- Edina	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Slight----------	Slight.
11C2------------------ Clarinda	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: slope, wetness, percs slowly.	Severe: erodes easily.	Moderate: wetness.
12B2------------------ Grundy	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Moderate: wetness.	Moderate: wetness.
13D2:					
Caleb----------------	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
Mystic---------------	Severe: wetness.	Moderate: slope, wetness, percs slowly.	Severe: slope, wetness.	Severe: erodes easily.	Moderate: wetness, slope.
14C2------------------ Adair	Severe: wetness.	Moderate: wetness.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.
14D2------------------ Adair	Severe: wetness.	Moderate: slope, wetness.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness, slope.
15C2------------------ Lamoni	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: slope, wetness, percs slowly.	Severe: erodes easily.	Moderate: wetness.
16B2------------------ Lagonda	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
17D2------------------ Shelby	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight----------	Moderate: slope.
17E2------------------ Shelby	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
19D2------------------ Keswick	Severe: wetness.	Moderate: slope, wetness, percs slowly.	Severe: slope, wetness.	Severe: erodes easily.	Moderate: wetness, slope.
22D2------------------ Gara	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight----------	Moderate: slope.
22E2------------------ Gara	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
22F2: Gara	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
24C2: Armstrong	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.
24D2: Armstrong	Severe: wetness.	Moderate: slope, wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness, slope.
25B2: Pering	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Severe: erodes easily.	Slight.
25C2: Pering	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: slope.	Severe: erodes easily.	Slight.
29F: Winnegan	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
33F: Vanmeter	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: erodes easily.	Severe: slope.
42: Sandover	Severe: flooding, too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Moderate: droughty, flooding.
45: Humeston	Severe: flooding, wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
49: Belinda	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
51B: Pering	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Severe: erodes easily.	Slight.
52B: Vigar	Severe: flooding.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Slight	Slight.
54: Zook	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
55A: Colo	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
56B:					
Nodaway	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
56B:					
Humeston	Severe: flooding, wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
Vigar	Severe: flooding.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Slight	Slight.
57B:					
Olmitz	Slight	Slight	Moderate: slope.	Slight	Slight.
Zook	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Vesser	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
58 Wabash	Severe: flooding, wetness, percs slowly.	Severe: wetness, too clayey, percs slowly.	Severe: too clayey, wetness.	Severe: wetness, too clayey.	Severe: wetness, too clayey.
66 Nodaway	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
69 Fatima	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
80D Schuline	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
84F:					
Putco	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Moderate: slope.	Severe: small stones, droughty, slope.
Pits.					
88F:					
Lenzburg	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Pits.					

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
10----------------- Edina	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
11C2--------------- Clarinda	Poor	Fair	Poor	Fair	Poor	Poor	Poor	Fair	Fair	Poor.
12B2--------------- Grundy	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
13D2:										
Caleb--------------	Fair	Good	Fair	Good	Fair	Poor	Poor	Fair	Good	Poor.
Mystic-------------	Fair	Good	Fair	Good	Fair	Very poor.	Poor	Fair	Good	Very poor.
14C2, 14D2--------- Adair	Fair	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.
15C2--------------- Lamoni	Fair	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.
16B2--------------- Lagonda	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
17D2--------------- Shelby	Fair	Good	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
17E2--------------- Shelby	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
19D2--------------- Keswick	Fair	Good	Fair	Good	Fair	Very poor.	Poor	Fair	Good	Very poor.
22D2--------------- Gara	Fair	Good	Fair	Good	Good	Very poor.	Poor	Fair	Good	Poor.
22E2--------------- Gara	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
22F2--------------- Gara	Very poor.	Very poor.	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
24C2, 24D2--------- Armstrong	Fair	Good	Fair	Good	Fair	Very poor.	Very poor.	Fair	Good	Very poor.
25B2--------------- Pering	Good	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.
25C2--------------- Pering	Fair	Fair	Fair	Fair	Fair	Very poor.	Poor	Fair	Fair	Very poor.
29F---------------- Winnegan	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
33F---------------- Vanmeter	Very poor.	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	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 herba-ceous plants	Hardwood trees	Conif-erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
42: Sandover	Poor	Fair	Good	Good	Good	Poor	Poor	Fair	Good	Poor.
45: Humeston	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
49: Belinda	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
51B: Pering	Good	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.
52B: Vigar	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
54: Zook	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
55A: Colo	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
56B:										
Nodaway	Good	Good	Good	Good	Fair	Fair	Poor	Fair	Good	Fair.
Humeston	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
Vigar	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
57B:										
Olmitz	Good	Good	Fair	Good	Good	Poor	Poor	Good	Good	Poor.
Zook	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
Vesser	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
58: Wabash	Poor	Poor	Poor	Poor	Poor	Poor	Good	Poor	Poor	Fair.
66: Nodaway	Good	Good	Good	Good	Fair	Fair	Poor	Fair	Good	Fair.
69: Fatima	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
80D: Schuline	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
84F:										
Putco	Poor	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
Pits	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
88F:										
Lenzburg	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	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
88F:										
Pits	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.

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
10----------------- Edina	Moderate: too clayey, wetness.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Slight.
11C2--------------- Clarinda	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength.	Moderate: wetness.
12B2--------------- Grundy	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, frost action.	Moderate: wetness.
13D2:						
Caleb-------------	Moderate: wetness, slope.	Moderate: shrink-swell, slope.	Moderate: wetness, slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
Mystic------------	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell, slope.	Severe: shrink-swell, low strength.	Moderate: wetness, slope.
14C2--------------- Adair	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength.	Moderate: wetness.
14D2--------------- Adair	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell, slope.	Severe: shrink-swell, low strength.	Moderate: wetness, slope.
15C2--------------- Lamoni	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength.	Moderate: wetness.
16B2--------------- Lagonda	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength, frost action.	Moderate: wetness.
17D2--------------- Shelby	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
17E2--------------- Shelby	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
19D2--------------- Keswick	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell, slope.	Severe: shrink-swell, low strength.	Moderate: wetness, 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
22D2--------------- Gara	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
22E2, 22F2--------- Gara	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
24C2--------------- Armstrong	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength.	Moderate: wetness.
24D2--------------- Armstrong	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell, slope.	Severe: shrink-swell, low strength.	Moderate: wetness, slope.
25B2, 25C2--------- Pering	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength, frost action.	Slight.
29F---------------- Winnegan	Severe: wetness, slope.	Severe: shrink-swell, slope.	Severe: wetness, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength, slope.	Severe: slope.
33F---------------- Vanmeter	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength, slope.	Severe: slope.
42----------------- Sandover	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding.	Moderate: droughty, flooding.
45----------------- Humeston	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.
49----------------- Belinda	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
51B---------------- Pering	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength, frost action.	Slight.
52B---------------- Vigar	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength, frost action.	Slight.
54----------------- Zook	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.

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
55A---------------- Colo	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
56B:						
Nodaway-----------	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding, frost action.	Moderate: flooding.
Humeston----------	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.
Vigar-------------	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength, frost action.	Slight.
57B:						
Olmitz------------	Slight----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
Zook--------------	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.
Vesser------------	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
58----------------- Wabash	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.
66----------------- Nodaway	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding, frost action.	Moderate: flooding.
69----------------- Fatima	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength, flooding, frost action.	Moderate: flooding.
80D---------------- Schuline	Moderate: too clayey, dense layer, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
84F:						
Putco-------------	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength, slope.	Severe: small stones, droughty, slope.
Pits.						

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
88F:						
Lenzburg---------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
Pits.						

TABLE 12.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "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	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
10 Edina	Severe: wetness, percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
11C2 Clarinda	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
12B2 Grundy	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
13D2:					
Caleb	Severe: wetness.	Severe: slope, wetness.	Moderate: wetness, slope, too clayey.	Moderate: slope.	Fair: too clayey, slope, wetness.
Mystic	Severe: wetness, percs slowly.	Severe: seepage, slope.	Severe: seepage, wetness.	Severe: wetness.	Poor: too clayey, hard to pack.
14C2, 14D2 Adair	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness.	Severe: wetness.	Poor: wetness.
15C2 Lamoni	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
16B2 Lagonda	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
17D2 Shelby	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
17E2 Shelby	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
19D2 Keswick	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness.	Severe: wetness.	Poor: wetness.
22D2 Gara	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
22E2, 22F2 Gara	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: 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
24C2, 24D2 Armstrong	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
25B2 Pering	Severe: wetness, percs slowly.	Moderate: slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
25C2 Pering	Severe: wetness, percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
29F Winnegan	Severe: wetness, percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
33F Vanmeter	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: depth to rock, slope.
42 Sandover	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, seepage, wetness.	Fair: wetness.
45 Humeston	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
49 Belinda	Severe: wetness, percs slowly.	Moderate: seepage.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
51B Pering	Severe: wetness, percs slowly.	Moderate: slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
52B Vigar	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
54 Zook	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
55A Colo	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
56B:					
Nodaway	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: too clayey, wetness.

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
56B:					
Humeston-----------	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
Vigar--------------	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
57B:					
Olmitz-------------	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
Zook---------------	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
Vesser-------------	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
58------------------ Wabash	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
66------------------ Nodaway	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: too clayey, wetness.
69------------------ Fatima	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: wetness.
80D----------------- Schuline	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, large stones, slope.
84F:					
Putco--------------	Severe: percs slowly, slope.	Severe: slope.	Severe: slope, too clayey.	Severe: slope.	Poor: too clayey, hard to pack, small stones.
Pits.					
88F:					
Lenzburg-----------	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Pits.					

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
10 Edina	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
11C2 Clarinda	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
12B2 Grundy	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
13D2:				
Caleb	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
Mystic	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
14C2, 14D2 Adair	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
15C2 Lamoni	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
16B2 Lagonda	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
17D2 Shelby	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
17E2 Shelby	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
19D2 Keswick	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
22D2 Gara	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
22E2 Gara	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
22F2 Gara	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
24C2, 24D2------------ Armstrong	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
25B2, 25C2------------ Pering	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
29F------------------- Winnegan	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
33F------------------- Vanmeter	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
42-------------------- Sandover	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
45-------------------- Humeston	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
49-------------------- Belinda	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
51B------------------- Pering	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
52B------------------- Vigar	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
54-------------------- Zook	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
55A------------------- Colo	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
56B:				
Nodaway--------------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Humeston-------------	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
Vigar----------------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
57B:				
Olmitz---------------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
57B:				
Zook	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Vesser	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
58 Wabash	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
66 Nodaway	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
69 Fatima	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
80D Schuline	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
84F:				
Putco	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones, area reclaim.
Pits.				
88F:				
Lenzburg	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
Pits.				

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--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
10 Edina	Slight	Severe: hard to pack.	Deep to water	Percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
11C2 Clarinda	Moderate: slope.	Severe: hard to pack.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Erodes easily, wetness.	Wetness, erodes easily.
12B2 Grundy	Moderate: slope.	Severe: hard to pack.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness.	Wetness, erodes easily.
13D2:						
Caleb	Severe: slope.	Moderate: thin layer.	Deep to water	Slope, rooting depth.	Slope	Slope, rooting depth.
Mystic	Severe: seepage, slope.	Moderate: thin layer, hard to pack, wetness.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Slope, erodes easily, wetness.	Wetness, slope, erodes easily.
14C2 Adair	Moderate: slope.	Moderate: wetness.	Percs slowly, frost action, slope.	Slope, wetness.	Wetness	Wetness, percs slowly.
14D2 Adair	Severe: slope.	Moderate: wetness.	Percs slowly, frost action, slope.	Slope, wetness.	Slope, wetness.	Wetness, slope, percs slowly.
15C2 Lamoni	Moderate: slope.	Moderate: hard to pack, wetness.	Percs slowly, slope.	Slope, wetness, percs slowly.	Erodes easily, wetness.	Wetness, erodes easily.
16B2 Lagonda	Moderate: slope.	Moderate: hard to pack, wetness.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Erodes easily, wetness.	Erodes easily, percs slowly.
17D2, 17E2 Shelby	Severe: slope.	Slight	Deep to water	Slope	Slope	Slope.
19D2 Keswick	Severe: slope.	Moderate: wetness.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Slope, erodes easily, wetness.	Wetness, slope, erodes easily.
22D2, 22E2, 22F2 Gara	Severe: slope.	Slight	Deep to water	Slope, rooting depth.	Slope	Slope, rooting depth.
24C2 Armstrong	Moderate: slope.	Severe: hard to pack.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly.
24D2 Armstrong	Severe: slope.	Severe: hard to pack.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Slope, wetness, percs slowly.	Wetness, slope, percs slowly.
25B2, 25C2 Pering	Moderate: slope.	Moderate: hard to pack, wetness.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Erodes easily, wetness.	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
29F--------------- Winnegan	Severe: slope.	Moderate: wetness.	Percs slowly, slope.	Slope, wetness, percs slowly.	Slope, wetness.	Slope, percs slowly.
33F--------------- Vanmeter	Severe: slope.	Slight---------	Deep to water	Slope, percs slowly, depth to rock.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
42---------------- Sandover	Severe: seepage.	Moderate: piping, wetness.	Flooding-------	Wetness, droughty, fast intake.	Erodes easily, wetness, soil blowing.	Erodes easily, droughty.
45---------------- Humeston	Moderate: seepage.	Severe: wetness.	Percs slowly, flooding, frost action.	Wetness, percs slowly.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
49---------------- Belinda	Slight---------	Severe: wetness.	Percs slowly---	Wetness, percs slowly, erodes easily.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
51B--------------- Pering	Moderate: slope.	Moderate: hard to pack, wetness.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Erodes easily, wetness.	Erodes easily, percs slowly.
52B--------------- Vigar	Moderate: slope.	Moderate: wetness.	Frost action, slope.	Slope, wetness.	Wetness--------	Favorable.
54---------------- Zook	Slight---------	Severe: hard to pack, wetness.	Percs slowly, flooding, frost action.	Wetness, percs slowly.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
55A--------------- Colo	Moderate: seepage.	Severe: wetness.	Flooding, frost action.	Wetness, flooding.	Wetness--------	Wetness.
56B:						
Nodaway----------	Moderate: seepage.	Severe: piping.	Deep to water	Flooding-------	Erodes easily	Erodes easily.
Humeston---------	Moderate: seepage.	Severe: wetness.	Percs slowly, flooding, frost action.	Wetness, percs slowly.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
Vigar------------	Moderate: slope.	Moderate: wetness.	Frost action, slope.	Slope, wetness.	Wetness--------	Favorable.
57B:						
Olmitz-----------	Moderate: seepage, slope.	Slight---------	Deep to water	Slope----------	Favorable------	Favorable.
Zook-------------	Slight---------	Severe: hard to pack, wetness.	Percs slowly, flooding, frost action.	Wetness, percs slowly.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
Vesser-----------	Moderate: seepage.	Severe: wetness.	Flooding, frost action.	Wetness, flooding.	Erodes easily, wetness.	Wetness, erodes easily.
58---------------- Wabash	Slight---------	Severe: hard to pack, wetness.	Percs slowly, flooding.	Wetness, droughty, slow intake.	Wetness, percs slowly.	Wetness, droughty, percs slowly.
66---------------- Nodaway	Moderate: seepage.	Severe: piping.	Deep to water	Flooding-------	Erodes easily	Erodes easily.

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
69----------------- Fatima	Moderate: seepage.	Moderate: thin layer, piping, wetness.	Deep to water	Flooding-------	Favorable------	Favorable.
80D---------------- Schuline	Severe: slope.	Moderate: thin layer, piping.	Deep to water	Slope, percs slowly, rooting depth.	Slope, erodes easily.	Slope, erodes easily, rooting depth.
84F:						
Putco------------	Severe: slope.	Moderate: hard to pack.	Deep to water	Slope, droughty.	Slope, percs slowly.	Slope, droughty, percs slowly.
Pits.						
88F:						
Lenzburg---------	Severe: slope.	Moderate: piping.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
Pits.						

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: Unified	Classification: AASHTO	Fragments > 10 inches	Fragments 3-10 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
10------------ Edina	0-9	Silt loam-----	CL-ML, CL	A-4, A-6	0	0	100	100	95-100	85-100	25-40	5-15
	9-16	Silt loam-----	CL-ML, CL	A-4, A-6	0	0	100	100	95-100	85-100	25-40	5-15
	16-38	Silty clay, clay.	CH	A-7	0	0	100	100	95-100	90-100	55-75	30-45
	38-60	Silty clay loam.	CL, CH	A-6, A-7	0	0	100	100	95-100	90-100	35-60	15-35
11C2---------- Clarinda	0-8	Silty clay loam.	CL	A-7	0	0	100	95-100	90-100	85-100	40-50	20-30
	8-38	Silty clay, clay.	CH	A-7	0	0	100	95-100	85-100	80-100	55-70	30-40
	38-60	Clay, silty clay.	CH	A-7	0	0	95-100	95-100	80-95	75-90	55-70	35-45
12B2---------- Grundy	0-8	Silty clay loam.	CH, CL	A-7	0	0	100	100	95-100	90-100	40-55	20-35
	8-15	Silty clay loam, silty clay.	CH, CL	A-7	0	0	100	100	95-100	90-100	45-55	25-35
	15-35	Silty clay----	CH	A-7	0	0	100	100	95-100	90-100	50-70	30-45
	35-60	Silty clay loam.	CH, CL	A-7	0	0	100	100	90-100	90-100	40-55	25-35
13D2:												
Caleb--------	0-7	Loam----------	CL	A-6	0	0	95-100	85-100	70-90	60-80	30-40	10-20
	7-27	Clay loam, loam, sandy clay loam.	CL	A-6, A-7	0	0	90-100	85-100	60-80	50-75	35-45	15-25
	27-60	Sandy clay loam, sandy loam, clay loam.	SC, CL, SC-SM, CL-ML	A-6, A-4	0	0	95-100	85-100	70-90	35-80	20-40	5-20
Mystic-------	0-10	Silt loam-----	CL	A-6, A-7	0	0	100	100	80-100	65-90	30-45	10-25
	10-60	Clay loam, clay, silty clay.	CL, CH	A-7	0	0	100	90-100	80-100	65-80	40-55	25-35
14C2---------- Adair	0-8	Loam----------	CL, CL-ML	A-6, A-4	0	0	90-100	80-95	75-90	55-80	20-35	5-15
	8-35	Silty clay, clay, clay loam.	CL, CH	A-7	0	0	95-100	80-95	70-90	55-80	40-55	20-30
	35-60	Clay loam-----	CL	A-6, A-7	0	0	95-100	80-95	70-90	55-80	35-50	15-25
14D2---------- Adair	0-8	Loam----------	CL, CL-ML	A-6, A-4	0	0	90-100	80-95	75-90	55-80	20-35	5-15
	8-38	Silty clay, clay, clay loam.	CL, CH	A-7	0	0	95-100	80-95	70-90	55-80	40-55	20-30
	38-60	Clay loam-----	CL	A-6, A-7	0	0	95-100	80-95	70-90	55-80	35-50	15-25
15C2---------- Lamoni	0-7	Clay loam-----	CL	A-6, A-7	0	0	95-100	95-100	80-95	70-95	35-45	15-25
	7-31	Clay loam, clay.	CH	A-7	0	0	95-100	95-100	90-100	85-100	50-60	25-35
	31-60	Clay loam-----	CL	A-6, A-7	0	0	95-100	95-100	70-90	55-85	35-50	15-30

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 10 inches	Fragments 3-10 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
16B2----------- Lagonda	0-7	Silty clay loam.	CL	A-7	0	0	100	100	95-100	90-100	40-50	15-25
	7-21	Silty clay loam, silty clay.	CH, CL	A-7	0	0	100	100	95-100	95-100	40-70	25-40
	21-42	Silty clay loam, clay loam.	CL, CH	A-7	0	0	95-100	90-100	80-95	75-90	45-60	25-40
	42-60	Clay loam, clay.	CL, CH	A-7	0	0	95-100	90-100	90-100	75-90	40-65	25-40
17D2----------- Shelby	0-9	Loam-----------	CL	A-6, A-7	0	0	90-95	85-95	75-90	55-70	35-45	15-25
	9-15	Clay loam-----	CL	A-6, A-7	0	0	90-95	85-95	75-90	55-70	35-45	15-25
	15-38	Clay loam-----	CL	A-6, A-7	0	0-5	90-95	85-95	75-90	55-70	30-45	15-25
	38-60	Clay loam-----	CL	A-6, A-7	0	0-5	90-95	85-95	75-90	55-70	30-45	15-25
17E2----------- Shelby	0-8	Loam-----------	CL	A-6, A-7	0	0	90-95	85-95	75-90	55-70	35-45	15-25
	8-14	Clay loam-----	CL	A-6, A-7	0	0	90-95	85-95	75-90	55-70	35-45	15-25
	14-37	Clay loam-----	CL	A-6, A-7	0	0-5	90-95	85-95	75-90	55-70	30-45	15-25
	37-60	Clay loam-----	CL	A-6, A-7	0	0-5	90-95	85-95	75-90	55-70	30-45	15-25
19D2----------- Keswick	0-6	Loam-----------	CL, CL-ML	A-6, A-4	0	0-5	90-100	80-100	75-90	60-80	20-30	5-15
	6-48	Clay loam, clay.	CH, CL	A-7	0	0-5	90-100	80-100	70-90	55-80	40-70	20-40
	48-60	Clay loam-----	CL	A-6	0	0-5	90-100	80-100	70-90	55-80	30-40	15-25
22D2----------- Gara	0-6	Loam-----------	CL	A-6, A-7	0	0	90-95	85-95	70-85	55-75	35-45	15-25
	6-36	Clay loam, loam.	CL	A-6	0	0-5	90-95	85-95	70-85	55-75	30-40	15-25
	36-60	Clay loam, loam.	CL	A-6	0	0-5	90-95	85-95	70-85	55-75	30-40	15-25
22E2----------- Gara	0-6	Loam-----------	CL	A-6, A-7	0	0	90-95	85-95	70-85	55-75	35-45	15-25
	6-31	Clay loam, loam.	CL	A-6	0	0-5	90-95	85-95	70-85	55-75	30-40	15-25
	31-60	Clay loam, loam.	CL	A-6	0	0-5	90-95	85-95	70-85	55-75	30-40	15-25
22F2----------- Gara	0-6	Loam-----------	CL	A-6, A-7	0	0	90-95	85-95	70-85	55-75	35-45	15-25
	6-29	Clay loam, loam.	CL	A-6	0	0-5	90-95	85-95	70-85	55-75	30-40	15-25
	29-60	Clay loam, loam.	CL	A-6	0	0-5	90-95	85-95	70-85	55-75	30-40	15-25
24C2----------- Armstrong	0-6	Loam-----------	CL, CL-ML	A-6, A-4	0	0-5	90-100	80-95	75-90	55-80	20-30	5-15
	6-40	Clay loam, clay, silty clay loam.	CL, CH, ML, MH	A-7	0	0-5	90-100	80-95	70-90	55-80	45-70	20-35
	40-60	Clay loam-----	CL	A-6	0	0-5	90-100	80-95	70-90	55-80	30-40	15-20
24D2----------- Armstrong	0-7	Clay loam-----	CL	A-6, A-7	0	0-5	90-100	80-95	75-90	55-80	35-45	15-25
	7-35	Clay loam, clay, silty clay loam.	CL, CH, ML, MH	A-7	0	0-5	90-100	80-95	70-90	55-80	45-70	20-35
	35-60	Clay loam-----	CL	A-6	0	0-5	90-100	80-95	70-90	55-80	30-40	15-20

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 10 inches	Frag- ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO			4	10	40	200		
	In				Pct	Pct					Pct	
25B2----------- Pering	0-7	Silty clay loam.	CL, CH	A-7	0	0	100	100	100	95-100	40-55	15-30
	7-28	Silty clay loam, silty clay.	CH, CL	A-7	0	0	100	100	100	95-100	40-65	20-40
	28-60	Silty clay loam, silt loam.	CH, CL	A-7, A-6	0	0	100	100	100	95-100	35-55	20-35
25C2----------- Pering	0-7	Silty clay loam.	CL, CH	A-7	0	0	100	100	100	95-100	40-55	15-30
	7-14	Silty clay loam.	CL, CH	A-7	0	0	100	100	100	95-100	40-55	15-30
	14-41	Silty clay loam, silty clay.	CH, CL	A-7	0	0	100	100	100	95-100	40-65	20-40
	41-60	Silty clay loam, silt loam.	CH, CL	A-7, A-6	0	0	100	100	100	95-100	35-55	20-35
29F------------ Winnegan	0-8	Loam-----------	CL-ML, CL	A-4, A-6	0	0	95-100	95-100	80-90	60-80	20-30	5-15
	8-30	Clay loam, clay.	CL	A-7	0	0	95-100	95-100	85-95	65-85	40-50	20-30
	30-60	Clay loam, loam.	CL	A-6	0	0	95-100	95-100	85-95	60-80	25-40	10-20
33F------------ Vanmeter	0-3	Silty clay loam.	ML, MH	A-7	0	0-5	95-100	75-100	70-100	65-100	40-55	11-25
	3-35	Silty clay, clay.	CH, CL	A-7	0	0-5	95-100	75-100	70-100	65-100	40-65	24-40
	35-45	Weathered bedrock.	---	---	---	---	---	---	---	---	---	---
42------------- Sandover	0-25	Sand, loamy sand, fine sand.	SM	A-2-4	0	0	100	100	60-90	12-45	---	NP
	25-60	Silt loam------	CL	A-4, A-6	0	0	100	100	90-100	70-90	25-35	8-15
45------------- Humeston	0-14	Silty clay loam.	CL	A-6	0	0	100	100	95-100	95-100	30-40	10-20
	14-26	Silt loam------	CL, CL-ML	A-6, A-4	0	0	100	100	95-100	95-100	25-40	5-15
	26-60	Silty clay loam, silty clay.	CH, CL	A-7	0	0	100	100	95-100	95-100	45-55	25-35
49------------- Belinda	0-9	Silt loam------	CL, ML	A-4, A-6	0	0	100	100	100	95-100	30-40	5-15
	9-16	Silt loam------	CL-ML, CL, ML	A-4	0	0	100	100	100	95-100	25-35	5-10
	16-60	Silty clay, silty clay loam.	CH	A-7	0	0	100	100	100	95-100	40-55	20-30
51B------------ Pering	0-10	Silt loam------	CL	A-6	0	0	100	100	100	95-100	30-40	10-20
	10-16	Silty clay loam.	CL, CH	A-7	0	0	100	100	100	95-100	40-55	15-30
	16-43	Silty clay loam, silty clay.	CH, CL	A-7	0	0	100	100	100	95-100	40-65	20-40
	43-60	Silty clay loam, silt loam.	CH, CL	A-7, A-6	0	0	100	100	100	95-100	35-55	20-35

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification Unified	Classification AASHTO	Fragments > 10 inches	Fragments 3-10 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
52B----------- Vigar	0-32	Loam----------	CL-ML, CL	A-4, A-6	0	0	95-100	90-100	85-95	60-75	20-30	5-15
	32-60	Clay loam, silty clay loam, loam.	CL	A-6	0	0	95-100	90-100	70-95	60-90	30-40	15-25
54------------ Zook	0-16	Silty clay loam.	CH, CL	A-7	0	0	100	100	95-100	95-100	45-65	20-35
	16-52	Silty clay, silty clay loam.	CH	A-7	0	0	100	100	95-100	95-100	60-85	35-55
	52-60	Silty clay loam, silty clay, silt loam.	CH, CL, ML, MH	A-7, A-6	0	0	100	100	95-100	95-100	35-80	10-50
55A----------- Colo	0-14	Silty clay loam.	CL, CH	A-7	0	0	100	100	90-100	90-100	40-60	15-30
	14-50	Silty clay loam.	CL, CH	A-7	0	0	100	100	90-100	90-100	40-55	20-30
	50-60	Silty clay loam, clay loam, silt loam.	CL, CH	A-7	0	0	100	100	95-100	80-100	40-55	15-30
56B:												
Nodaway------	0-8	Silt loam-----	CL, CL-ML	A-4, A-6	0	0	100	95-100	95-100	90-100	25-35	5-15
	8-60	Silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	0	100	95-100	95-100	90-100	25-40	5-15
Humeston-----	0-10	Silty clay loam.	CL	A-6	0	0	100	100	95-100	95-100	30-40	10-20
	10-16	Silt loam-----	CL, CL-ML	A-6, A-4	0	0	100	100	95-100	95-100	25-40	5-15
	16-60	Silty clay loam, silty clay.	CH, CL	A-7	0	0	100	100	95-100	95-100	45-55	25-35
Vigar--------	0-12	Loam----------	CL-ML, CL	A-4, A-6	0	0	95-100	90-100	85-95	60-75	20-30	5-15
	12-60	Clay loam, silty clay loam, loam.	CL	A-6	0	0	95-100	90-100	70-95	60-90	30-40	15-25
57B:												
Olmitz-------	0-7	Loam----------	CL	A-6	0	0	100	90-100	85-95	60-80	30-40	11-20
	7-34	Loam, clay loam.	CL	A-6	0	0	100	90-100	85-95	60-80	30-40	11-20
	34-60	Clay loam-----	CL	A-6, A-7	0	0	100	90-100	85-95	60-80	35-45	15-25
Zook---------	0-7	Silty clay loam.	CH, CL	A-7	0	0	100	100	95-100	95-100	45-65	20-35
	7-34	Silty clay, silty clay loam.	CH	A-7	0	0	100	100	95-100	95-100	60-85	35-55
	34-60	Silty clay loam, silty clay, silt loam.	CH, CL, ML, MH	A-7, A-6	0	0	100	100	95-100	95-100	35-80	10-50

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 10 inches	Frag- ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO			4	10	40	200		
	In				Pct	Pct					Pct	
57B:												
Vesser	0-10	Silt loam	CL	A-6	0	0	100	100	98-100	95-100	30-40	10-20
	10-26	Silt loam	CL	A-6	0	0	100	100	98-100	95-100	30-40	10-20
	26-60	Silty clay loam.	CL	A-7	0	0	100	100	98-100	95-100	40-50	15-25
58 Wabash	0-6	Silty clay	CH	A-7	0	0	100	100	100	95-100	50-75	30-50
	6-60	Silty clay, clay.	CH	A-7	0	0	100	100	100	95-100	52-78	30-55
66 Nodaway	0-8	Silt loam	CL, CL-ML	A-4, A-6	0	0	100	95-100	95-100	90-100	25-35	5-15
	8-60	Silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	0	100	95-100	95-100	90-100	25-40	5-15
69 Fatima	0-14	Silt loam	CL-ML, CL	A-4, A-6	0	0	100	100	90-100	65-90	25-40	5-18
	14-55	Silt loam	CL	A-6	0	0	100	100	95-100	80-90	30-40	12-18
	55-60	Silt loam, loam, silty clay loam.	CL-ML, CL	A-4, A-6	0	0	100	100	95-100	65-90	25-40	5-18
80D Schuline	0-3	Clay loam	CL, ML	A-6, A-7	0-1	0-2	90-100	85-100	80-95	70-85	35-50	10-25
	3-28	Loam, silty clay loam, clay loam.	CL	A-6, A-7	0-2	0-5	90-100	85-100	80-95	70-85	30-50	10-25
	28-38	Loam, silty clay loam, clay loam.	CL	A-4, A-6, A-7	0-5	0-15	85-95	85-90	75-85	60-80	25-50	7-25
	38-60	Loam, clay loam, silty clay.	ML, CL, CH, MH	A-6, A-7	0-5	0-15	85-95	80-90	75-85	60-80	35-55	10-30
84F:												
Putco	0-1	Silty clay loam.	CL, GC, SC	A-6, A-7	0-10	0-15	40-80	35-80	35-80	35-75	35-50	15-25
	1-60	Silty clay	CL, CH, GC	A-7, A-2-7	0-10	0-5	30-80	25-80	25-80	25-75	45-65	25-40
Pits.												
88F:												
Lenzburg	0-15	Gravelly clay loam.	CL	A-4, A-6, A-7	0-2	3-15	80-95	75-90	65-90	55-85	25-45	8-25
	15-60	Silty clay, silty clay loam, gravelly clay loam.	CL, CH	A-6, A-7	0-5	5-25	70-95	60-90	55-90	50-90	30-55	15-30
Pits.												

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
0---------------- Edina	0-9	15-27	1.35-1.45	0.6-2.0	0.22-0.24	5.1-7.3	Moderate-----	0.37	3	6	2-4
	9-16	15-27	1.35-1.45	0.6-2.0	0.20-0.22	5.1-7.3	Moderate-----	0.37			
	16-38	45-60	1.30-1.45	<0.06	0.11-0.13	5.1-7.3	Very high----	0.37			
	38-60	27-40	1.35-1.50	0.06-0.2	0.18-0.20	6.1-7.3	High---------	0.37			
1C2------------- Clarinda	0-8	27-38	1.45-1.50	0.2-0.6	0.17-0.19	5.1-7.3	Moderate-----	0.37	3	7	2-3
	8-38	40-60	1.50-1.65	0.00-0.6	0.14-0.16	5.1-6.5	High---------	0.37			
	38-60	40-60	1.50-1.65	0.00-0.06	0.14-0.16	5.6-8.4	High---------	0.37			
2B2------------- Grundy	0-8	28-35	1.35-1.45	0.2-0.6	0.18-0.20	5.6-7.3	High---------	0.37	3	7	2-4
	8-15	32-45	1.35-1.45	0.2-0.6	0.18-0.20	5.6-6.5	High---------	0.37			
	15-35	40-50	1.30-1.40	0.06-0.2	0.11-0.13	5.1-7.3	High---------	0.37			
	35-60	28-35	1.35-1.40	0.06-0.2	0.18-0.20	5.6-7.3	High---------	0.37			
3D2:											
Caleb-----------	0-7	22-27	1.45-1.50	0.6-2.0	0.14-0.18	4.5-7.3	Low----------	0.28	5	6	2-3
	7-27	20-35	1.45-1.65	0.6-2.0	0.14-0.18	4.5-6.0	Moderate-----	0.32			
	27-60	5-30	1.55-1.75	0.6-2.0	0.12-0.16	4.5-6.0	Low----------	0.32			
Mystic----------	0-10	22-29	1.40-1.45	0.6-2.0	0.22-0.24	4.5-7.3	Moderate-----	0.37	3	6	2-3
	10-60	30-48	1.55-1.65	0.06-0.2	0.15-0.19	4.5-6.5	High---------	0.37			
4C2------------- Adair	0-8	24-27	1.45-1.50	0.6-2.0	0.20-0.22	5.6-7.3	Moderate-----	0.32	3	6	2-3
	8-35	38-60	1.55-1.60	0.06-0.2	0.13-0.16	5.1-6.5	High---------	0.32			
	35-60	30-38	1.60-1.70	0.2-0.6	0.14-0.16	5.6-7.8	Moderate-----	0.32			
4D2------------- Adair	0-8	24-27	1.45-1.50	0.6-2.0	0.20-0.22	5.6-7.3	Moderate-----	0.32	3	6	2-3
	8-38	38-60	1.55-1.60	0.06-0.2	0.13-0.16	5.1-6.5	High---------	0.32			
	38-60	30-38	1.60-1.70	0.2-0.6	0.14-0.16	5.6-7.8	Moderate-----	0.32			
5C2------------- Lamoni	0-7	27-40	1.45-1.50	0.2-0.6	0.17-0.21	5.1-7.3	Moderate-----	0.37	3	7	2-3
	7-31	38-50	1.55-1.65	<0.2	0.13-0.17	5.1-6.5	High---------	0.37			
	31-60	32-40	1.60-1.70	0.06-0.2	0.14-0.18	5.6-7.3	High---------	0.37			
6B2------------- Lagonda	0-7	27-32	1.35-1.50	0.2-0.6	0.18-0.20	5.6-7.3	Moderate-----	0.37	2	7	2-3
	7-21	32-50	1.30-1.40	0.06-0.2	0.13-0.18	6.1-7.8	High---------	0.37			
	21-42	35-45	1.30-1.40	0.06-0.2	0.10-0.18	6.1-7.8	High---------	0.37			
	42-60	28-45	1.30-1.40	0.06-0.2	0.08-0.16	6.6-7.8	High---------	0.37			
7D2------------- Shelby	0-9	24-27	1.50-1.55	0.2-0.6	0.16-0.18	5.1-7.3	Moderate-----	0.32	5	6	2-3
	9-15	30-35	1.50-1.55	0.2-0.6	0.16-0.18	5.1-7.3	Moderate-----	0.28			
	15-38	30-35	1.55-1.65	0.2-0.6	0.16-0.18	5.1-7.3	Moderate-----	0.28			
	38-60	30-35	1.55-1.65	0.2-0.6	0.16-0.18	6.6-8.4	Moderate-----	0.37			
7E2------------- Shelby	0-8	24-27	1.50-1.55	0.2-0.6	0.16-0.18	5.1-7.3	Moderate-----	0.32	5	6	2-3
	8-14	30-35	1.50-1.55	0.2-0.6	0.16-0.18	5.1-7.3	Moderate-----	0.28			
	14-37	30-35	1.55-1.65	0.2-0.6	0.16-0.18	5.1-7.3	Moderate-----	0.28			
	37-60	30-35	1.55-1.65	0.2-0.6	0.16-0.18	6.6-8.4	Moderate-----	0.37			
9D2------------- Keswick	0-6	22-27	1.45-1.50	0.6-2.0	0.17-0.22	4.5-7.3	Moderate-----	0.37	3	6	1-2
	6-48	35-60	1.55-1.60	0.06-0.2	0.11-0.15	4.5-6.0	High---------	0.37			
	48-60	30-40	1.60-1.75	0.2-0.6	0.12-0.16	4.5-7.8	Moderate-----	0.37			
2D2------------- Gara	0-6	24-27	1.50-1.55	0.2-0.6	0.16-0.18	5.6-7.3	Moderate-----	0.32	5	6	2-3
	6-36	25-38	1.55-1.75	0.2-0.6	0.16-0.18	4.5-6.5	Moderate-----	0.32			
	36-60	24-38	1.65-1.75	0.2-0.6	0.16-0.18	5.6-8.4	Moderate-----	0.37			

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 K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
22E2----------- Gara	0-6	24-27	1.50-1.55	0.2-0.6	0.16-0.18	5.6-7.3	Moderate-----	0.32	5	6	2-3
	6-31	25-38	1.55-1.75	0.2-0.6	0.16-0.18	4.5-6.5	Moderate-----	0.32			
	31-60	24-38	1.65-1.75	0.2-0.6	0.16-0.18	5.6-8.4	Moderate-----	0.37			
22F2----------- Gara	0-6	24-27	1.50-1.55	0.2-0.6	0.16-0.18	5.6-7.3	Moderate-----	0.32	5	6	2-3
	6-29	25-38	1.55-1.75	0.2-0.6	0.16-0.18	4.5-6.5	Moderate-----	0.32			
	29-60	24-38	1.65-1.75	0.2-0.6	0.16-0.18	5.6-8.4	Moderate-----	0.37			
24C2----------- Armstrong	0-6	22-27	1.45-1.50	0.6-2.0	0.20-0.22	5.6-7.3	Moderate-----	0.32	3	6	2-3
	6-40	36-60	1.55-1.60	0.06-0.2	0.11-0.16	4.5-6.5	High---------	0.32			
	40-60	30-36	1.55-1.70	0.2-0.6	0.14-0.16	5.1-7.8	Moderate-----	0.32			
24D2----------- Armstrong	0-7	35-40	1.45-1.50	0.2-0.6	0.18-0.20	5.6-7.3	Moderate-----	0.32	3	4	2-3
	7-35	36-60	1.55-1.60	0.06-0.2	0.11-0.16	4.5-6.5	High---------	0.32			
	35-60	30-36	1.55-1.70	0.2-0.6	0.14-0.16	5.1-7.8	Moderate-----	0.32			
25B2----------- Pering	0-7	27-38	1.30-1.40	0.2-0.6	0.22-0.24	4.5-7.3	Moderate-----	0.37	3	7	2-3
	7-28	35-48	1.35-1.45	0.06-0.2	0.18-0.20	5.1-6.0	High---------	0.43			
	28-60	24-40	1.35-1.50	0.2-0.6	0.18-0.20	5.1-6.5	High---------	0.43			
25C2----------- Pering	0-7	27-38	1.30-1.40	0.2-0.6	0.22-0.24	4.5-7.3	Moderate-----	0.37	3	7	2-3
	7-14	27-35	1.30-1.40	0.2-0.6	0.20-0.22	5.1-6.0	Moderate-----	0.43			
	14-41	35-48	1.35-1.45	0.06-0.2	0.18-0.20	5.1-6.0	High---------	0.43			
	41-60	24-40	1.35-1.50	0.2-0.6	0.18-0.20	5.1-6.5	High---------	0.43			
29F------------ Winnegan	0-8	18-27	1.20-1.40	0.6-2.0	0.20-0.24	4.5-7.3	Low----------	0.32	3	6	.5-2
	8-30	35-45	1.35-1.55	0.06-0.2	0.09-0.15	4.5-6.5	High---------	0.32			
	30-60	20-35	1.40-1.60	0.2-0.6	0.09-0.15	7.4-8.4	Moderate-----	0.32			
33F------------ Vanmeter	0-3	27-35	1.30-1.40	0.2-0.6	0.14-0.16	6.1-8.4	Moderate-----	0.43	2	4L	1-2
	3-35	40-60	1.50-1.60	<0.06	0.12-0.14	6.1-8.4	High---------	0.32			
	35-45	---	---	<0.06	---	---	-------------	----			
42------------- Sandover	0-25	2-5	1.40-1.60	6.0-20	0.04-0.09	4.5-6.5	Low----------	0.17	---	---	<.5
	25-60	18-27	1.20-1.50	0.6-2.0	0.18-0.22	4.5-6.5	Moderate-----	0.43			
45------------- Humeston	0-14	27-30	1.35-1.40	0.2-0.6	0.21-0.23	5.1-7.3	Moderate-----	0.37	4	7	3-4
	14-26	20-26	1.30-1.35	0.2-2.0	0.20-0.22	4.5-6.0	Moderate-----	0.43			
	26-60	30-48	1.35-1.50	<0.06	0.13-0.15	4.5-6.5	High---------	0.32			
49------------- Belinda	0-9	16-22	1.35-1.40	0.6-2.0	0.22-0.24	5.6-7.3	Low----------	0.37	3	6	2-3
	9-16	18-27	1.30-1.35	0.6-2.0	0.20-0.22	4.5-6.0	Low----------	0.43			
	16-60	28-52	1.30-1.45	<0.06	0.12-0.14	4.5-6.5	High---------	0.32			
51B------------ Pering	0-10	20-27	1.30-1.40	0.6-2.0	0.22-0.24	4.5-7.3	Low----------	0.37	3	6	2-3
	10-16	27-35	1.30-1.40	0.2-0.6	0.20-0.22	5.1-6.0	Moderate-----	0.43			
	16-43	35-48	1.35-1.45	0.06-0.2	0.18-0.20	5.1-6.0	High---------	0.43			
	43-60	24-40	1.35-1.50	0.2-0.6	0.18-0.20	5.1-6.5	High---------	0.43			
52B------------ Vigar	0-32	15-27	1.25-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.24	5	5	2-4
	32-60	24-35	1.20-1.40	0.2-0.6	0.14-0.16	5.6-7.3	Moderate-----	0.32			
54------------- Zook	0-16	35-40	1.30-1.35	0.2-0.6	0.21-0.23	5.6-7.3	High---------	0.37	5	7	5-7
	16-52	36-45	1.30-1.45	0.06-0.2	0.11-0.13	5.6-7.8	High---------	0.28			
	52-60	20-45	1.30-1.45	0.06-0.6	0.11-0.22	5.6-7.8	High---------	0.28			
55A------------ Colo	0-14	27-36	1.28-1.32	0.6-2.0	0.21-0.23	5.6-7.3	Moderate-----	0.28	5	7	5-7
	14-50	30-35	1.25-1.35	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.28			
	50-60	25-35	1.35-1.45	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.32			

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 K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
56B:											
Nodaway----------	0-8	18-27	1.25-1.35	0.6-2.0	0.20-0.23	6.1-7.3	Low----------	0.32	5	6	2-3
	8-60	18-28	1.25-1.35	0.6-2.0	0.20-0.23	6.1-7.3	Moderate-----	0.43			
Humeston---------	0-10	27-30	1.35-1.40	0.2-0.6	0.21-0.23	5.1-7.3	Moderate-----	0.37	4	7	3-4
	10-16	20-26	1.30-1.35	0.2-2.0	0.20-0.22	4.5-6.0	Moderate-----	0.43			
	16-60	30-48	1.35-1.50	<0.06	0.13-0.15	4.5-6.5	High---------	0.32			
Vigar------------	0-12	15-27	1.25-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.24	5	5	2-4
	12-60	24-35	1.20-1.40	0.2-0.6	0.14-0.16	5.6-7.3	Moderate-----	0.32			
57B:											
Olmitz-----------	0-7	24-27	1.40-1.45	0.6-2.0	0.19-0.21	5.6-7.3	Moderate-----	0.24	5	6	3-4
	7-34	24-30	1.40-1.45	0.6-2.0	0.19-0.21	5.6-7.3	Moderate-----	0.28			
	34-60	27-34	1.45-1.55	0.6-2.0	0.15-0.17	5.1-7.3	Moderate-----	0.28			
Zook-------------	0-7	35-40	1.30-1.35	0.2-0.6	0.21-0.23	5.6-7.3	High---------	0.37	5	7	5-7
	7-34	36-45	1.30-1.45	0.06-0.2	0.11-0.13	5.6-7.8	High---------	0.28			
	34-60	20-45	1.30-1.45	0.06-0.6	0.11-0.22	5.6-7.8	High---------	0.28			
Vesser-----------	0-10	20-26	1.30-1.35	0.6-2.0	0.20-0.24	5.6-7.3	Moderate-----	0.28	5	6	2-3
	10-26	18-22	1.35-1.40	0.6-2.0	0.18-0.22	5.1-6.0	Moderate-----	0.43			
	26-60	30-35	1.40-1.45	0.6-2.0	0.17-0.21	5.1-6.5	Moderate-----	0.43			
58--------------- Wabash	0-6	40-46	1.25-1.45	<0.06	0.12-0.14	5.1-7.3	Very high----	0.28	5	4	2-4
	6-60	40-60	1.20-1.45	<0.06	0.08-0.12	5.1-7.8	Very high----	0.28			
66--------------- Nodaway	0-8	18-27	1.25-1.35	0.6-2.0	0.20-0.23	6.1-7.3	Low----------	0.32	5	6	2-3
	8-60	18-28	1.25-1.35	0.6-2.0	0.20-0.23	6.1-7.3	Moderate-----	0.43			
69--------------- Fatima	0-14	15-27	1.30-1.45	0.6-2.0	0.22-0.24	6.1-7.3	Low----------	0.28	5	6	2-4
	14-55	18-27	1.35-1.55	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.28			
	55-60	18-30	1.35-1.55	0.6-2.0	0.20-0.22	6.1-7.3	Low----------	0.28			
80D-------------- Schuline	0-3	27-35	1.30-1.60	0.6-2.0	0.17-0.19	5.6-8.4	Moderate-----	0.37	5	6	.5-1
	3-28	18-35	1.60-1.80	0.06-0.2	0.08-0.12	7.4-8.4	Moderate-----	0.37			
	28-38	18-35	1.40-1.70	0.2-0.6	0.15-0.21	7.4-8.4	Moderate-----	0.37			
	38-60	20-45	1.60-1.90	0.06-0.6	0.08-0.18	7.4-8.4	Moderate-----	0.37			
84F:											
Putco------------	0-1	27-40	1.10-1.30	0.06-0.2	0.08-0.16	6.6-8.4	Moderate-----	0.28	5	4	.5-1
	1-60	40-60	1.40-1.60	0.06-0.2	0.04-0.10	7.4-8.4	High---------	0.24			
Pits-------------	---	---	---	---	---	---	-------------	----	---	8	---
88F:											
Lenzburg---------	0-15	27-35	1.30-1.60	0.6-2.0	0.15-0.19	6.6-8.4	Moderate-----	0.24	5	8	<.5
	15-60	25-45	1.40-1.70	0.2-0.6	0.08-0.18	7.4-8.4	High---------	0.32			
Pits-------------	---	---	---	---	---	---	-------------	----	---	8	---

TABLE 17.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means 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	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
10 Edina	D	None	---	---	0.5-2.0	Perched	Nov-Apr	>60	---	Moderate	High	Moderate.
11C2 Clarinda	D	None	---	---	1.0-3.0	Perched	Nov-May	>60	---	High	High	Moderate.
12B2 Grundy	C	None	---	---	1.0-2.5	Perched	Nov-May	>60	---	High	High	Moderate.
13D2:												
Caleb	B	None	---	---	3.0-5.0	Perched	Nov-Mar	>60	---	Moderate	Moderate	Moderate.
Mystic	C	None	---	---	1.0-3.0	Perched	Nov-May	>60	---	High	Moderate	Moderate.
14C2, 14D2 Adair	C	None	---	---	1.0-3.0	Perched	Nov-May	>60	---	High	High	Moderate.
15C2 Lamoni	C	None	---	---	1.0-3.0	Perched	Nov-May	>60	---	Moderate	High	Moderate.
16B2 Lagonda	C	None	---	---	1.5-2.5	Perched	Nov-May	>60	---	High	High	Low.
17D2, 17E2 Shelby	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
19D2 Keswick	C	None	---	---	1.0-3.0	Perched	Nov-May	>60	---	High	High	Moderate.
22D2, 22E2, 22F2 Gara	C	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
24C2, 24D2 Armstrong	C	None	---	---	1.0-3.0	Perched	Nov-May	>60	---	High	High	Moderate.
25B2, 25C2 Pering	C	None	---	---	2.0-4.0	Perched	Nov-May	>60	---	High	High	Moderate.
29F Winnegan	C	None	---	---	2.0-3.5	Perched	Nov-May	>60	---	Moderate	High	High.
33F Vanmeter	C	None	---	---	>6.0	---	---	20-40	Soft	Moderate	High	Low.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
42---------------- Sandover	A	Occasional	Brief-----	Nov-May	2.0-3.0	Apparent	Mar-May	>60	---	Low------	Moderate	Moderate.
45---------------- Humeston	C/D	Occasional	Very brief	Nov-May	0-1.0	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.
49---------------- Belinda	D	None--------	---	---	0.5-2.0	Apparent	Nov-May	>60	---	Moderate	High-----	Moderate.
51B--------------- Pering	C	None--------	---	---	2.0-4.0	Perched	Nov-May	>60	---	High-----	High-----	Moderate.
52B--------------- Vigar	C	Rare--------	---	---	2.0-3.0	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.
54---------------- Zook	C/D	Occasional	Brief-----	Nov-May	0-3.0	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.
55A--------------- Colo	B/D	Frequent----	Brief-----	Nov-May	1.0-3.0	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.
56B:												
Nodaway----------	B	Occasional	Brief-----	Nov-May	3.0-5.0	Apparent	Apr-May	>60	---	High-----	Moderate	Low.
Humeston---------	C/D	Occasional	Brief-----	Nov-May	0-1.0	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.
Vigar------------	C	Rare--------	---	---	2.0-3.0	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.
57B:												
Olmitz-----------	B	Rare--------	Very brief	Nov-May	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
Zook-------------	C/D	Occasional	Brief-----	Nov-May	0-3.0	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.
Vesser-----------	C	Occasional	Brief-----	Nov-May	1.0-3.0	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.
58---------------- Wabash	D	Occasional	Brief-----	Nov-May	0-1.0	Apparent	Nov-May	>60	---	Moderate	High-----	Moderate.
66---------------- Nodaway	B	Occasional	Brief-----	Nov-May	3.0-5.0	Apparent	Apr-May	>60	---	High-----	Moderate	Low.
69---------------- Fatima	B	Occasional	Brief-----	Nov-May	2.0-3.5	Apparent	Nov-May	>60	---	High-----	Moderate	Low.
80D--------------- Schuline	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
84F:												
Putco------------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
Pits-------------	---	None---------	---	---	>6.0	---	---	>60	---	---	---	---
88F:												
Lenzburg---------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
Pits-------------	---	None---------	---	---	>6.0	---	---	>60	---	---	---	---

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
*Adair	Fine, montmorillonitic, mesic Aquertic Argiudolls
Armstrong	Fine, montmorillonitic, mesic Aquertic Hapludalfs
Belinda	Fine, montmorillonitic, mesic Vertic Albaqualfs
Caleb	Fine-loamy, mixed, mesic Mollic Hapludalfs
*Clarinda	Fine, montmorillonitic, mesic, sloping Vertic Argiaquolls
Colo	Fine-silty, mixed, mesic Cumulic Endoaquolls
Edina	Fine, montmorillonitic, mesic Vertic Argialbolls
Fatima	Fine-silty, mixed, mesic Fluvaquentic Hapludolls
Gara	Fine-loamy, mixed, mesic Mollic Hapludalfs
*Grundy	Fine, montmorillonitic, mesic Aquertic Argiudolls
Humeston	Fine, montmorillonitic, mesic Argiaquic Argialbolls
Keswick	Fine, montmorillonitic, mesic Aquertic Hapludalfs
*Lagonda	Fine, montmorillonitic, mesic Aquertic Argiudolls
*Lamoni	Fine, montmorillonitic, mesic Aquertic Argiudolls
Lenzburg	Fine-loamy, mixed (calcareous), mesic Typic Udorthents
Mystic	Fine, montmorillonitic, mesic Aquertic Hapludalfs
Nodaway	Fine-silty, mixed, nonacid, mesic Mollic Udifluvents
Olmitz	Fine-loamy, mixed, mesic Cumulic Hapludolls
Pering	Fine, montmorillonitic, mesic Aquertic Hapludalfs
Putco	Fine, mixed (calcareous), mesic Typic Udorthents
Sandover	Sandy over loamy, mixed, nonacid, mesic Aquic Udifluvents
Schuline	Fine-loamy, mixed (calcareous), mesic Typic Udorthents
*Shelby	Fine-loamy, mixed, mesic Typic Argiudolls
Vanmeter	Fine, illitic, mesic Typic Eutrochrepts
Vesser	Fine-silty, mixed, mesic Argiaquic Argialbolls
Vigar	Fine-loamy, mixed, mesic Aquic Argiudolls
Wabash	Fine, montmorillonitic, mesic Cumulic Vertic Endoaquolls
Winnegan	Fine, mixed, mesic Oxyaquic Hapludalfs
Zook	Fine, montmorillonitic, mesic Cumulic Vertic Endoaquolls

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