USDA 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 Schuyler County, Missouri

How To Use This Soil Survey

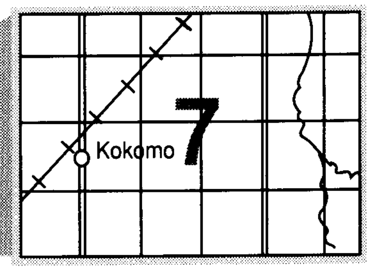
General Soil Map

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.

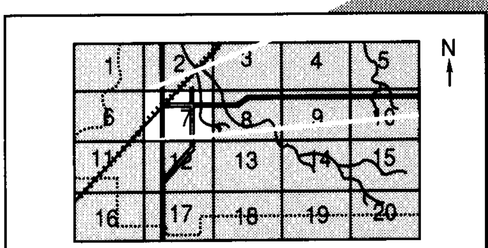
Detailed Soil Maps

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



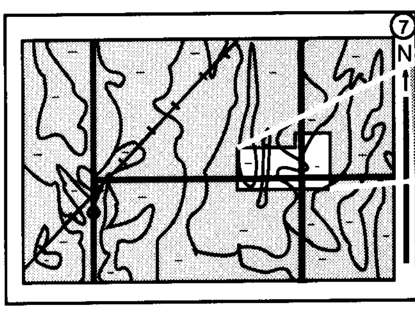
MAP SHEET

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.

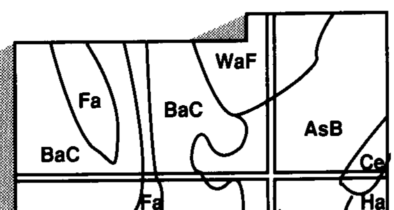


INDEX TO MAP SHEETS

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.



MAP SHEET



AREA OF INTEREST

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

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

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resouces Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in the period 1988 to 1992. Soil names and descriptions were approved in 1992. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1992. This survey was made cooperatively by the Natural Resources Conservation Service and the Missouri Agricultural Experiment Station. It is part of the technical assistance furnished to the Schuyler County Soil and Water Conservation District. The Missouri Department of Natural Resources provided soil scientists to assist with the fieldwork.

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

Cover: A typical landscape in the Gara-Armstrong association.

Additional information about the Nation's natural resources is available on the Natural Resources Conservation Service home page on the World Wide Web. The address is http://www.nrcs.usda.gov (click on "Technical Resources").

Contents

Issued 1999

Foreword

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

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

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

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

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State Conservationist
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Soil Survey of
Schuyler County, Missouri

By Henry J. Ferguson, Natural Resources Conservation Service

Fieldwork by Henry J. Ferguson, Kenneth L. Gregg, and James C. Remley, Natural Resources Conservation Service, and Rodney R. Taylor, Missouri Department of Natural Resources

United States Department of Agriculture, Natural Resources Conservation Service, in cooperation with
the Missouri Department of Natural Resources, the Missouri Agricultural Experiment Station, and the Schuyler County Soil and Water Conservation District

SCHUYLER COUNTY is in the rolling hills of northeastern Missouri (fig. 1). It has an area of about 197,548 acres, or 308 square miles. It is bordered on the north by Appanoose and Davis Counties, Iowa; on the east by Scotland County; on the south by Adair County; and on the west by Putnam County. Lancaster, the county seat, is in the north-central part of the county. In 1990, the population of the county was 4,236 and the population of Lancaster was 785. Other towns in the county with a population of 500 or more are Queen City and Greentop (U.S. Department of Commerce, 1991).

Schuyler County is in the Iowa and Missouri Heavy Till Plain and the Central Mississippi Valley Wooded Slopes major land resource areas of the Central Feed Grains and Livestock region. Crop and livestock production are the major sources of income in the county. Corn, soybeans, and wheat are the main crops, and beef cattle and hogs are the chief livestock enterprises.

Figure 1.—Location of Schuyler County in Missouri.

General Nature of the County

This section provides general information concerning the county. It describes climate; history and development; farming; and physiography, relief, and drainage.

Climate

The consistent pattern of climate in Schuyler County is one of cold winters and long, hot summers. Heavy rains occur mainly in spring and early summer, when moist air from the Gulf of Mexico interacts with drier continental air. Snow falls nearly every winter and often stays on the ground for a few weeks. The annual precipitation is normally adequate for corn, soybeans, and all grain crops.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Kirksville, Missouri, in the period 1961 to 1990. 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 about 27 degrees F and the average daily minimum temperature is about 18 degrees. The lowest temperature on record, which occurred at Kirksville on January 10, 1982, is -23 degrees. In summer, the average temperature is about 74 degrees and the average daily maximum temperature is about 85 degrees. The highest recorded temperature, which occurred on July 14, 1954, is 109 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 (40 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 69 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 19 inches. The heaviest 1-day rainfall on record was 8.07 inches at Kirksville on July 22, 1951. Thunderstorms occur on about 53 days each year.

The average seasonal snowfall is 23.2 inches. The greatest snow depth at any one time during the period of record was 27 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 about 70 percent of the time possible in summer and 55 percent in winter. The prevailing wind is from the south-southeast. Average windspeed is highest, 13 miles per hour, in spring.

Tornadoes and severe thunderstorms occur occasionally but are local in extent and of short duration. Damage varies and is spotty. Hailstorms occur at times during the warmer part of the year, but they generally occur in an irregular pattern and in only small areas.

History and Development

Schuyler County was long used as a hunting ground by the Sauk, Fox, and Iowa Indians, but no evidence remains of any permanent settlement within the boundaries of the county (Wild, 1943). The Indians set fires to suppress the growth of young timber and undergrowth and to encourage buffalo herds to use the area (Swanson and Ford).

In 1812, Governor Clark issued a proclamation dividing the part of the Louisiana Purchase known as the Territory of Missouri into five counties. In 1816, Howard County was formed from the territories of St. Louis and St. Charles. It made up nearly one-third of Missouri at that time. As the population of the State increased, counties were subdivided. Schuyler County became a part of Randolph County, then of Macon County, and later of Adair County. It was organized as a separate county in 1845 (Swanson and Ford).

P.C. Berry, an early settler, described the area as a vast wilderness with stretches of prairie on the ridges between the streams. An early attraction of the first settlers was the number of bee trees in the area. Beeswax was one of the principal exports at that time. Settlers followed streams and located in timbered areas because the material for building log cabins was readily available and game and bee trees were abundant. Also, the crude plows they possessed could not break through the tough sod of the prairie, and the early settlers did not have the well-digging skills needed to provide water to the prairie (Swanson and Ford).

The introduction of the moldboard plow and improved technology opened the rich prairie land to cultivation, and the county prospered until the Civil War. Because Schuyler County residents were divided in their sentiments, friction in the county slowed progress for several years. The completion of the railroad through Schuyler County in 1873 brought more goods, services, and people to the area; by 1890, the population had reached 11,249 (Swanson and Ford). The population of the county has steadily declined since then.

Farming is the largest industry in the county. In 1909, the chief exports were cattle, horses, mules, hogs, and sheep. That year Schuyler County ranked third in Missouri in the value of horse and mule exports, third in production of timothy seed, and third in production of tobacco. In the late 1870's, a few coal mines opened up in the western part of the county. Other mines in different parts of the county opened later for brief periods, but none of them had a large economic impact on the county (Swanson and Ford).

The production of crops and livestock enterprises are still the main sources of income in the county. Corn, wheat, and tobacco were the main cash crops in the late 1800's and early 1900's. As tobacco production decreased, the acreage used for wheat increased. In the 1950's and 1960's, soybeans and grain sorghum came into production in the county, and by 1978 more acres were being planted to soybeans than to corn (Missouri Department of Agriculture, 1988). In recent years, wheat production has dropped off dramatically and participation in conservation programs has reduced the acreage of corn and soybeans grown on highly erodible land.

Farming

Schuyler County is a rural area. Farming is the main enterprise. The main crops grown are corn, soybeans, winter wheat, legumes, and grasses. Livestock production consists of raising beef cattle, sheep, and hogs.

In 1987, the number of farms in Schuyler County was 498. The average farm size was about 314 acres. In 1987, 54,797 acres of cropland was harvested and an additional 56,279 acres of cropland was pastured or left idle. The county had 9,193 acres of woodland pasture and 24,289 acres of other pasture (U.S. Department of Commerce, 1989).

At the time of the first settlement in 1836, much of the county was covered with hardwood forests. These forest lands were steadily cleared and converted to agricultural uses. At present, only about 11 percent of the original forest land is still wooded (Missouri Department of Conservation, 1984).

Crop acreages and yields have fluctuated rather drastically during the past 120 years. In 1879, 33,063 acres of corn was harvested. This harvest yielded 32.9 bushels per acre. In 1990, about 8,400 acres of corn harvested yielded about 105 bushels per acre. The average corn yield per acre harvested from 1980 to 1990 was 83.7 bushels. The high was 124.5 bushels per acre in 1985, and the low was 39 bushels per acre in 1988 (Missouri Department of Agriculture, 1988).

In 1950, 5,400 acres of soybeans was harvested, yielding an average of 24.6 bushels per acre. In 1986, 25,200 acres of soybeans was harvested, yielding an average of 31.3 bushels per acre. The average soybean yield per acre harvested from 1980 to 1990 was 26.1 bushels. The high was 34.7 bushels per acre in 1987, and the low was 20 bushels per acre in 1981 (Missouri Department of Agriculture, 1988).

Hay production is also important in Schuyler County. In 1990, 33,100 acres was harvested. This harvest yielded an average of 1.95 tons per acre. From 1980 to 1990, hay production averaged 1.65 tons per acre harvested. The high was 2 tons per acre in 1982, and the low was 0.9 ton per acre in 1988 (Missouri Department of Agriculture, 1988).

Livestock numbers have fluctuated greatly since 1850. In that year, there were 2,953 cattle, 12,399 hogs, and 4,954 sheep in the county. The highest numbers recorded were 37,000 cattle in 1981, 32,319 hogs in 1880, and 52,575 sheep in 1910. In 1990, there were 25,100 head of cattle and 8,100 hogs in Schuyler County. In 1983, there were 11,864 sheep (fig. 2) (Missouri Department of Agriculture, 1988).

Physiography, Relief, and Drainage

The landscape in Schuyler County consists mainly of gently sloping to strongly sloping uplands. The surface was created by postglacial erosion. At least two glacial advances crossed the survey area. These advances transported glacial till material that buried previous landforms. When the glacial ice retreated, it left a wide plain that gradually sloped to the south. This original plain surface was modified by geological erosion and by deposition. In some areas drainage patterns are entrenched down through the glacial till overburden to the underlying bedrock formations. In nearly level areas that have not been dissected, thick layers of loess have accumulated. The present topography is a product of these earlier processes. The only remnants of the once-extensive plain are on the summits of current drainage divides.

Schuyler County is divided by a ridge that runs north to south through the west-central part of the county. Areas of nearly level soils are as much as one-half mile wide near Queen City. The area west of the divide is characterized by highly dissected, moderately sloping to steep hills. East of the divide is a more rolling, gently sloping to steep landscape. Loess deposits are more than 6 feet thick in places on the interstream divides. They are thinner as they extend downslope, and less weathered glacial till is exposed on moderately steep and steep slopes.

The headwaters for the North Fork Salt River, North Fork South Fabius River, and Middle Fabius River are in Schuyler County. The old channel of the Chariton River is the western boundary of the county. The Chariton River drains the western one-fourth of the county. Its flood plain is as much as 2 miles wide. The North Fabius River, which has a flood plain more than one-half mile wide, runs through the northeast corner of the county and drains much of northern Schuyler County. The rest of the county is drained to the southeast by the Middle Fabius River system and

Figure 2.—Improved pasture in an area of Armstrong clay loam, 9 to 14 percent slopes, eroded. Schuyler County ranks first in Missouri in the production of sheep.

the North Fork South Fabius River and to the south by the North Fork Salt River. The Middle Fabius River system in Schuyler County includes the North Fork Middle Fabius River, the South Fork Middle Fabius River, Brush Creek, and Brushy Creek. The other large streams in the county are the South Fork North Fabius River and Elm Creek.

The highest point in the county is 1,003 feet at Queen City, but many areas along the main divide are at an elevation of about 1,000 feet. The lowest point in the county is about 740 feet where the South Fork Middle Fabius River leaves the county. Local relief is as little as 60 feet in prairie areas and as much as 150 feet in the forested hills along the Chariton River. Relief on the flood plains is about 20 feet.

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 soil maps using aerial photographs as a base for reference. 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 for this survey do not fully agree with those on the maps for the surveys of adjacent counties, which were published at a different date. Differences are the result of additional soil data, variations in the intensity of mapping, and correlation decisions that reflect local 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.

1. Lamoni-Seymour-Leonard Association

Very deep, gently sloping and moderately sloping, somewhat poorly drained and poorly drained soils that formed in loess, pedisediments, and glacial till; on uplands

This association consists of soils on upland ridges that have long backslopes and small, branching drainageways. These ridges generally are uniform in elevation. They are in the upper reaches of watershed basins. Slopes range from 2 to 9 percent.

This association makes up about 19 percent of the county. It is about 43 percent Lamoni and similar soils, 43 percent Seymour and similar soils, 11 percent Leonard and similar soils, and 3 percent soils of minor extent (fig. 3).

The somewhat poorly drained Lamoni soils are moderately sloping. They are on convex ridgetops, head slopes, shoulders, and backslopes in the uplands. Typically, the surface layer is very dark grayish brown loam. The upper part of the subsoil is dark yellowish brown and dark grayish brown, mottled clay. The next part is grayish brown, mottled clay loam. The lower part is gray and strong brown, mottled clay loam.

The somewhat poorly drained Seymour soils are gently sloping. They are on ridgetops and shoulders in the uplands above the Leonard soils. Typically, the surface layer is very dark gray silty clay loam. The upper part of the subsoil is dark grayish brown and grayish brown, mottled silty clay. The next part is olive gray, mottled silty clay loam. The lower part is light olive gray, mottled silty clay loam.

The poorly drained Leonard soils are gently sloping. They are on the concave head slopes of drainageways and on shoulders in the uplands. Typically, the surface layer is very dark grayish brown and dark grayish brown, mottled silty clay loam. The upper part of the subsoil is dark grayish brown, mottled silty clay loam. The next part is grayish brown and gray, mottled silty clay. The lower part is gray, mottled silty clay.

Of minor extent in this association are the strongly sloping Armstrong soils. These soils are on the lower backslopes below the Lamoni soils.

This association is used mainly for cultivated crops. Some small acreages are used for pasture and hay. Other areas are used for urban or rural development. The soils are suited to corn, soybeans, grain sorghum, and winter wheat and to water-tolerant grasses and legumes. The hazard of erosion and surface wetness during spring and winter are the main management concerns in cultivated areas. Overgrazing and grazing when the soils are wet are the major concerns affecting pasture.

These soils are suited to building site development, local roads and streets, and some kinds of onsite waste disposal systems. The shrink-swell potential, the potential for frost action, wetness, and low strength are the major limitations.

2. Gara-Armstrong Association

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

This association consists of soils on upland convex ridges and backslopes adjacent to minor

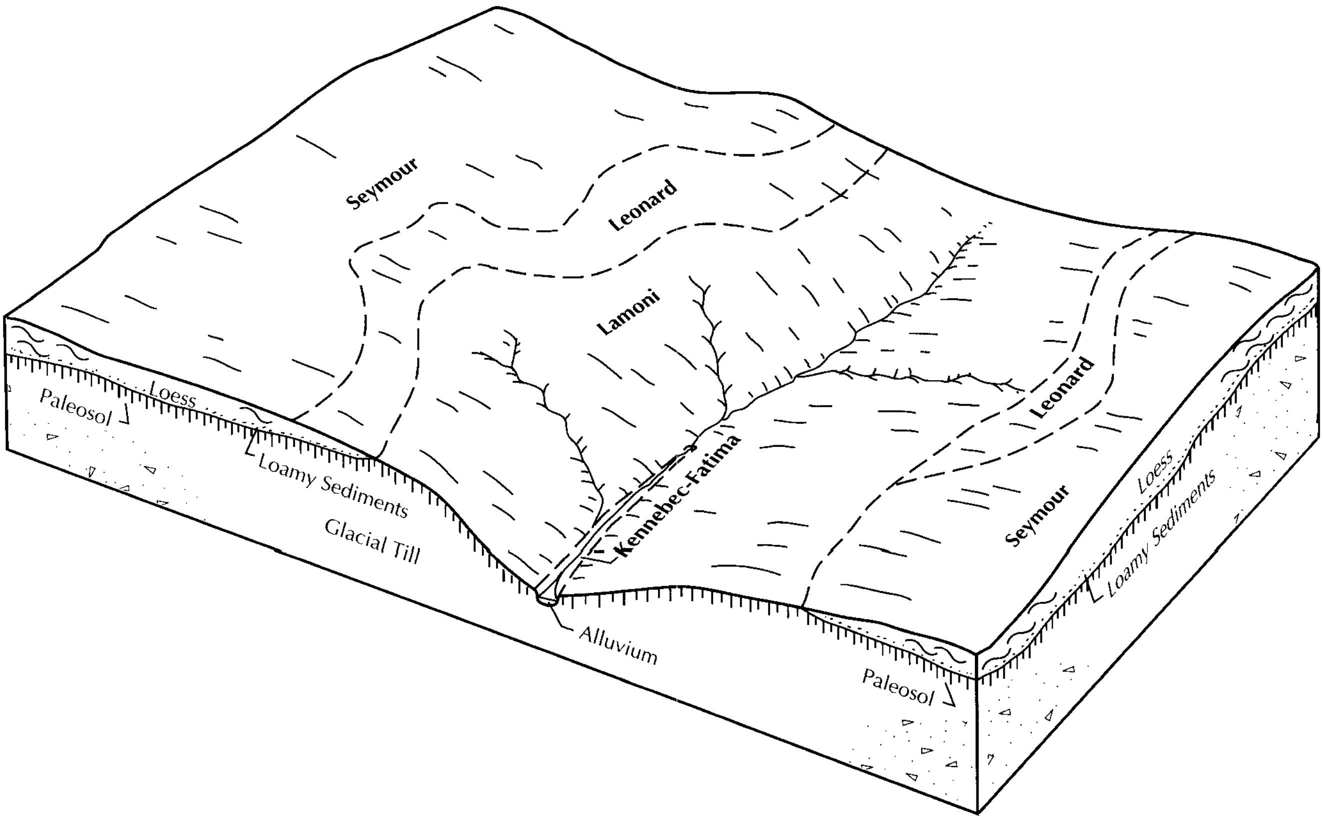

Figure 3.—Typical pattern of soils and parent material in the Lamoni-Seymour-Leonard association.

drainageways. Slopes range from 5 to 20 percent.

This association makes up about 50 percent of the county. It is about 45 percent Gara soils, 35 percent Armstrong and similar soils, and 20 percent soils of minor extent (fig. 4).

The well drained Gara soils are strongly sloping and moderately steep. They are on highly dissected backslopes in the uplands. Typically, the surface layer is very dark grayish brown loam. The upper part of the subsoil is brown clay loam. The next part is dark yellowish brown, mottled clay loam. The lower part is dark yellowish brown, mottled loam.

The moderately well drained Armstrong soils are moderately sloping and strongly sloping. They are on summits of low ridges, head slopes, and backslopes in the uplands. Typically, the surface layer is very dark grayish brown clay loam. The upper part of the subsoil is strong brown, mottled clay loam. The next part is yellowish brown, mottled clay and clay loam. The lower part is strong brown, mottled clay loam.

Of minor extent in this association are Kennebec, Vesser, Excello, and Zook soils. The moderately well drained Kennebec and poorly drained Zook soils are on flood plains along streams and drainageways. The poorly drained Vesser soils are on alluvial fans and high flood plains at the base of the sloping uplands. The somewhat poorly drained and poorly drained Excello soils are on toeslopes at the base of the sloping uplands and on narrow flood plains.

This association is used mainly for pasture or hayland. Some areas have been used as cropland, and a few areas are used for the production of timber. The native vegetation consisted of prairie grasses in the less sloping areas and hardwood forests in the steeper, more dissected areas. The soils generally are unsuited to cultivated crops because of the slope and the severe hazard of erosion. The major soils are suited to pasture and hay. The main management concerns affecting pasture are overgrazing, grazing when the soils are wet, and the hazard of erosion.

The major soils are suited to building site development, but they are generally unsuited to conventional septic tank absorption fields. The slope, wetness, the shrink-swell potential, and the potential for frost action are limitations.

3. Winnegan-Keswick Association

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

This association consists of soils on long, narrow, convex ridgetops and steep valley backslopes adjacent to major drainageways. Slopes range from 5 to 35 percent.

This association makes up about 19 percent of the county. It is about 80 percent Winnegan and similar soils, 12 percent Keswick soils, and 8 percent soils of minor extent (fig. 5).

The moderately sloping to steep Winnegan soils are on backslopes in the uplands. Typically, the surface layer is very dark grayish brown loam. The subsurface layer is brown loam. The upper part of the subsoil is yellowish brown clay. The next part is yellowish brown, mottled clay. The lower part is yellowish brown, mottled clay loam.

The moderately sloping Keswick soils are on convex ridgetops and backslopes. Typically, the surface layer is dark grayish brown clay loam. The upper part of the subsoil is strong brown and yellowish brown, mottled clay. The lower part is yellowish brown, mottled clay loam.

Of minor extent in this association are the somewhat poorly drained Gorin soils, the moderately well drained Fatima and Kennebec soils, and the poorly drained Zook soils. Gorin soils are on narrow ridgetops. Fatima, Kennebec, and Zook soils are on narrow flood plains and are frequently flooded.

This association is used mainly for the production of timber. Some areas are used for pasture and hay. The steeply sloping Winnegan soils are unsuited to cultivated crops because of the severe hazard of erosion and the equipment limitation.

Most areas of these soils are poorly suited to pasture because of the very dissected, steep slopes. Some of the less sloping areas are suitable for pasture management. The hazard of erosion, the equipment limitation, overgrazing, and grazing when the soils are wet are the main management concerns.

These soils are suited to timber production. The native vegetation consisted of hardwood forests, and large areas still support timber. The equipment

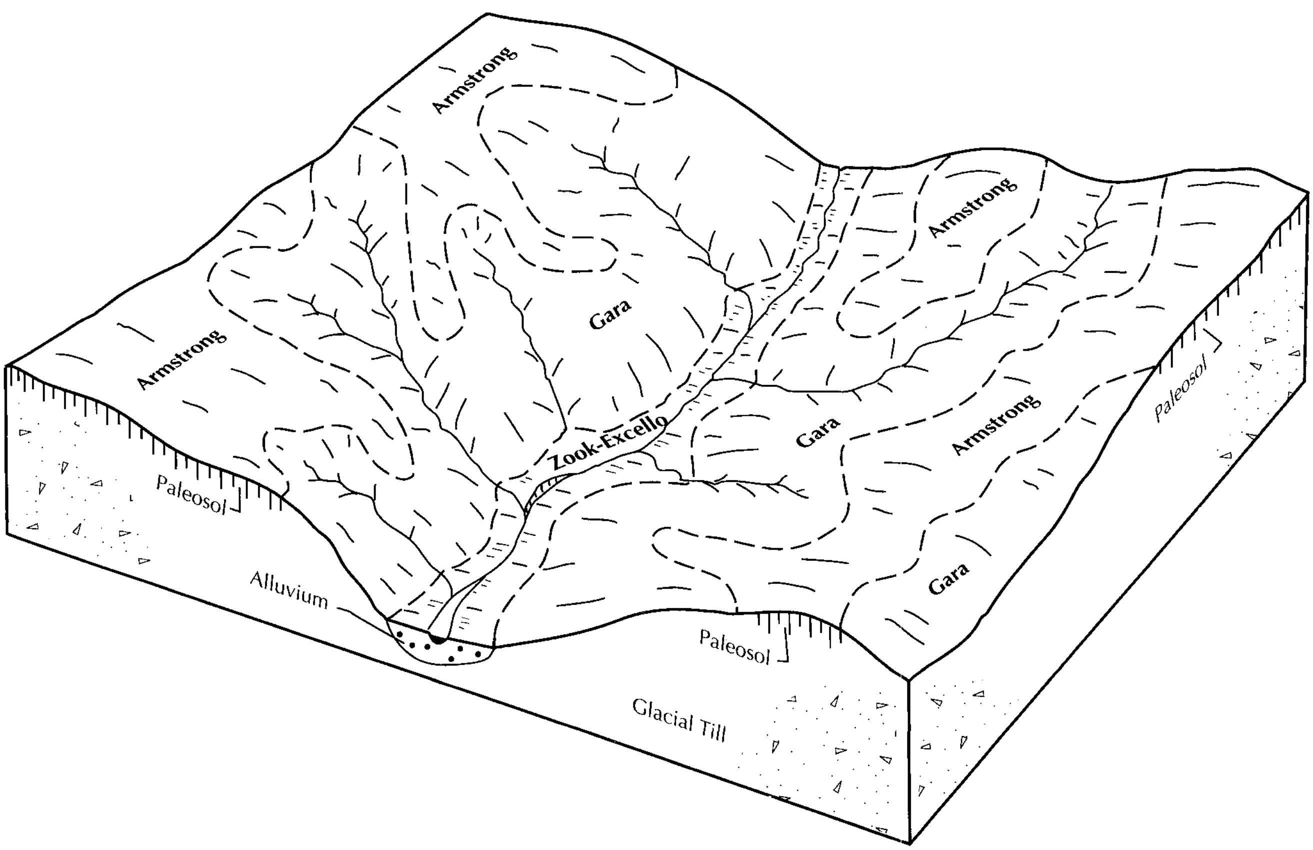

Figure 4.—Typical pattern of soils and parent material in the Gara-Armstrong association.

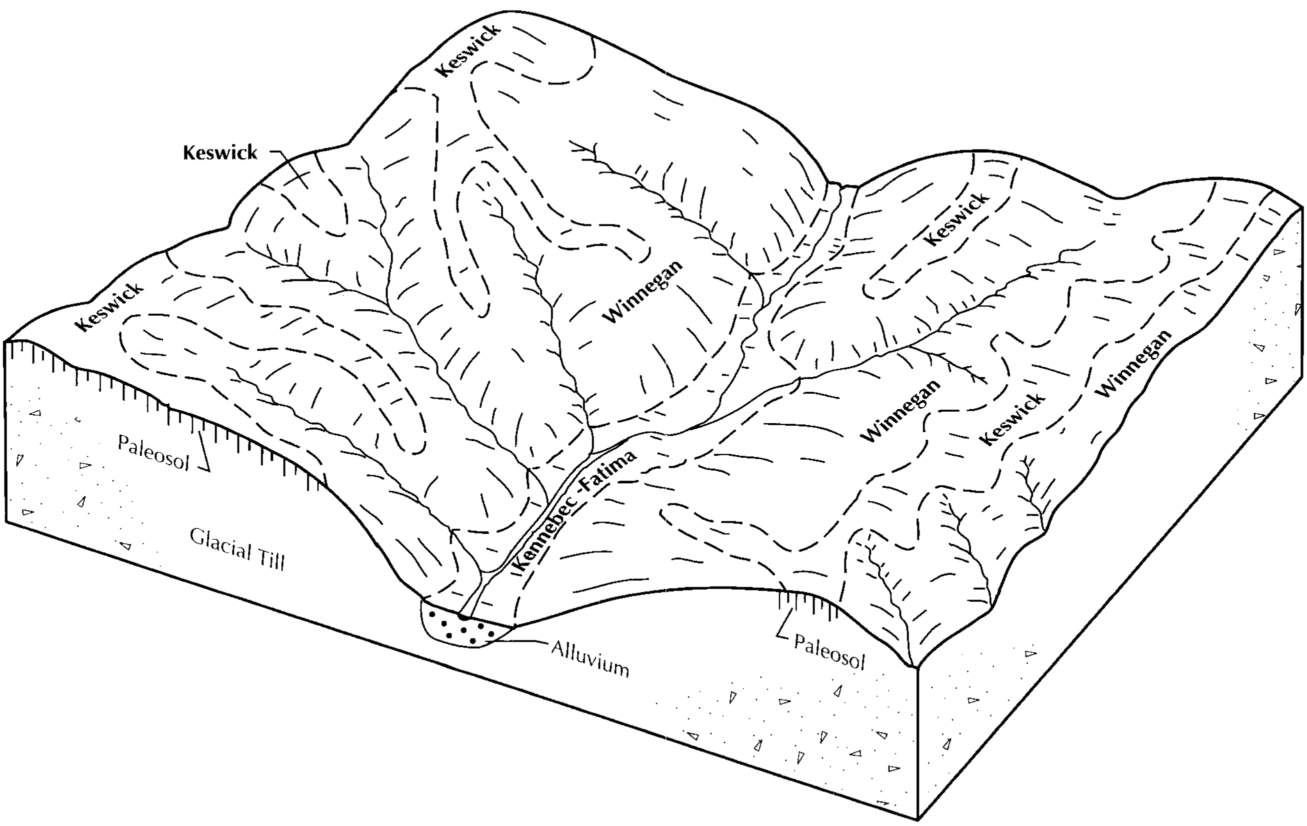

Figure 5.—Typical pattern of soils and parent material in the Winnegan-Keswick association.

limitation and seedling mortality are the main management concerns.

These soils generally are not used for building site development or waste disposal systems because of the slope, the severe hazard of erosion, and wetness.

4. Zook-Kennebec-Fatima Association

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

This association consists of soils on flood plains. Slopes range from 0 to 2 percent.

This association makes up about 12 percent of the county. It is about 63 percent Zook and similar soils, 33 percent Kennebec and Fatima and similar soils, and 4 percent soils of minor extent (fig. 6).

The poorly drained Zook soils are on flood plains. They are in backswamps and are farther from the original stream channels than the Kennebec and Fatima soils. Typically, they are very dark gray silty clay loam in the upper part and very dark gray and dark gray, mottled silty clay in the lower part.

The moderately well drained Kennebec soils are on flood plains near the original stream channels. Typically, the surface layer is very dark gray silt loam. The subsurface layers also are very dark gray silt loam. The substratum is very dark grayish brown and dark grayish brown silt loam.

The moderately well drained Fatima soils are on flood plains near the original stream channels. Typically, the surface layer is very dark gray loam. The subsurface layer is very dark gray silt loam. The substratum is dark grayish brown silt loam.

Of minor extent in this association are Excello and Vesser soils and Aquents. The somewhat poorly drained and poorly drained Excello soils are on alluvial fans and toeslopes at the base of the more sloping uplands and on narrow flood plains. The poorly drained Vesser soils are on the higher parts of the flood plains at the base of the uplands. The very poorly drained Aquents are in depressions on the flood plains.

This association is used mainly as cropland. Some areas are used for pasture and hay or as woodland. The poorly drained Zook soils are often tilled in the fall. The Kennebec and Fatima soils can be worked and planted earlier in the spring than the Zook soils. Flooding from local tributaries or levee breaks is a hazard.

Most areas of these soils are suited to pasture and hay, but most areas are used for cultivated crops. Overgrazing and grazing when the soils are wet are the main concerns affecting pasture management.

These soils are suited to timber production. Some areas still support timber. Seedling mortality and the equipment limitation resulting from wetness are the main management concerns.

These soils are unsuited to building site development and waste disposal systems. The shrink-swell potential, the potential for frost action, the wetness, and the hazard of flooding are the main concerns.

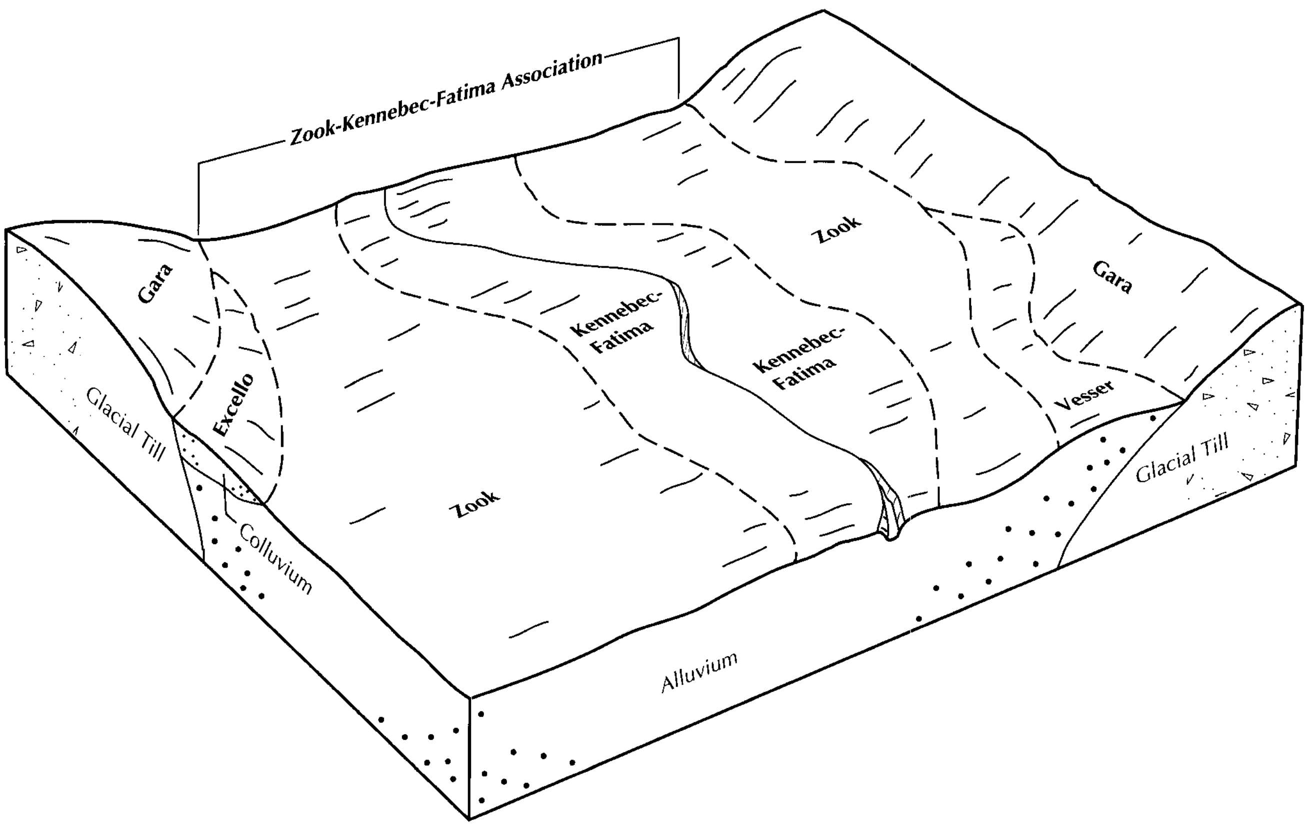

Figure 6.—Typical pattern of soils and parent material in the Zook-Kennebec-Fatima association.

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 on each map unit, or soil, 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, 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 or undifferentiated groups.

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Caleb-Mystic complex, 9 to 14 percent slopes, eroded, is an example.

An *undifferentiated group* is made up of two or more soils that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils in the mapped areas are not uniform. An area can be made up of only one of the major soils, or it can be made up of all of them. Kennebec and Fatima soils, frequently flooded, is an undifferentiated group in this survey area.

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.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see Contents) 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.

10C—Bevier silty clay loam, 3 to 8 percent slopes

This very deep, gently sloping and moderately sloping, somewhat poorly drained soil is on narrow, convex ridgetops and shoulders in the uplands. Individual areas are long and narrow and range from about 15 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 8 inches; very dark gray, friable silty clay loam

Subsurface layer:
8 to 12 inches; dark grayish brown and very dark gray, mottled, firm silty clay loam

Subsoil:
12 to 35 inches; grayish brown, mottled, firm silty clay

35 to 42 inches; light brownish gray, mottled, firm silty clay loam
42 to 68 inches; grayish brown and yellowish brown, mottled, firm silt loam
68 to 80 inches; yellowish brown, mottled, firm clay loam

In some areas the surface layer is silt loam. In other areas the subsoil is clay loam.

Included with this soil in mapping are small areas of the strongly sloping Armstrong and Gara soils. These soils are on the lower backslopes. They make up about 5 percent of the unit.

Important properties of the Bevier soil—

Permeability: Slow
Surface runoff: Medium
Available water capacity: High
Organic matter content: Moderate
Depth to the water table: 1.0 to 2.5 feet (perched)
Shrink-swell potential: High
Potential for frost action: High

Most areas of this soil are used for pasture and hay or for cultivated crops. A few small areas are wooded. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer can be easily tilled throughout a fairly wide range in moisture content. The hazard of erosion is severe. Common erosion-control practices include a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, terraces, underground tile outlets and grassed waterways, contour farming, and a conservation cropping system with rotations that include close-growing pasture and hay crops. Most areas are smooth and are suited to farming on the contour. Returning crop residue to the soil and regularly adding other organic material improve fertility, minimize crusting, increase the available water capacity, and increase the rate of water infiltration.

This soil is well suited to ladino clover and is moderately well suited to tall fescue, timothy, lespedeza, birdsfoot trefoil, indiangrass, and switchgrass. Species that are tolerant of wetness should be selected. Erosion during seedbed preparation is a hazard. Timely tillage and the quick establishment of ground cover help to control erosion. Proper grazing management and restricted use during wet periods help to prevent compaction and maintain good plant density.

This soil is suited to building site development. The shrink-swell potential and wetness are limitations on sites for dwellings. Using adequately reinforced concrete for basement walls, foundations, and footings and backfilling with sand and gravel help to prevent the damage caused by shrinking and swelling of the soil. Installing drainage tile around the footings and underneath the basement floors helps to prevent the damage caused by excessive wetness. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways help to prevent the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the wetness and the restricted permeability. Properly constructed lagoons should function adequately if the site can be leveled.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action are limitations on sites for local roads and streets. Strengthening the subgrade with crushed rock or other suitable base material can minimize the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage minimize the damage caused by wetness and by frost action.

The land capability classification is 3e. The woodland ordination symbol is 3C, and the indicator species is white oak.

11—Edina silt loam

This very deep, nearly level, poorly drained soil is on broad upland divides. Individual 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 8 inches; very dark grayish brown, friable silt loam

Subsurface layer:
8 to 14 inches; grayish brown, friable silt loam

Subsoil:
14 to 19 inches; very dark gray, mottled, very firm silty clay
19 to 38 inches; dark grayish brown and grayish brown, mottled, very firm silty clay
38 to 65 inches; olive gray, very firm silty clay loam

In some areas, the surface layer is thinner and the upper part of the subsoil is gray or dark gray.

Important soil properties—

Permeability: Very slow
Surface runoff: Slow
Available water capacity: High
Organic matter content: Moderate
Depth to the water table: 0.5 foot to 1.5 feet (perched)
Shrink-swell potential: Very high
Potential for frost action: Moderate

Most areas of this soil are used for cultivated crops or for hay and pasture. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. Wetness is the main management concern. The surface layer can be easily tilled throughout a fairly wide range in moisture content, but the soil is susceptible to crusting and puddling after periods of hard rain if the surface is not protected by plant cover or surface mulch. Shallow surface ditches and land grading can remove excess water. Using a system of conservation tillage and harvesting while the soil is at the proper moisture content or while the soil is frozen help to maintain soil structure and internal drainage. Returning crop residue to the soil also helps to maintain structure and the content of organic matter. Returning crop residue to the soil and regularly adding other organic material improve fertility, minimize crusting, increase the available water capacity, and increase the rate of water infiltration.

This soil is moderately well suited to birdsfoot trefoil, reed canarygrass, and switchgrass. Species that are tolerant of wetness should be selected. Proper grazing management and restricted use during wet periods help to prevent compaction and maintain good plant density. Surface drainage, small ditches, and land grading help to prevent the damage caused by wetness and minimize frost damage in stands of perennial plants.

This soil is suitable for building site development. The wetness and the shrink-swell potential are limitations on sites for dwellings. Using adequately reinforced concrete for basement walls, foundations, and footings and backfilling with sand and gravel can minimize the damage caused by shrinking and swelling of the soil. Installing drainage tile around footings and foundations helps to prevent the damage caused by excessive wetness. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways help to prevent the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the wetness and the restricted permeability. Properly designed sewage lagoons can be used for waste treatment.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action are limitations on sites for local roads and streets. Strengthening the subgrade with crushed rock or other suitable base material can minimize the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage minimize the damage caused by wetness and by frost action.

The land capability classification is 2w. No woodland ordination symbol is assigned.

14C2—Armstrong loam, 5 to 9 percent slopes, eroded

This very deep, moderately sloping, moderately well drained soil is on head slopes of drainageways and on low, narrow, convex ridgetops and backslopes in the uplands. 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 12 inches; dark brown, mottled, firm clay loam
12 to 42 inches; dark yellowish brown and strong brown, mottled, very firm clay loam
42 to 65 inches; yellowish brown, mottled, very firm clay loam

In some areas the surface layer is silt loam, silty clay loam, or clay loam. In other areas the upper part of the subsoil does not contain fine gravel. In places the grayish brown mottles start at a lower depth.

Included with this soil in mapping are small areas of the poorly drained Leonard soils and areas of Armstrong soils that are severely eroded. Leonard soils are in heads of drainageways and on shoulders of backslopes above the Armstrong soil. The severely eroded Armstrong soils are in the steepest areas of the unit. Included soils make up about 10 percent of the unit.

Important properties of the Armstrong soil—

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

Depth to the water table: 1 to 3 feet (perched)
Shrink-swell potential: High
Potential for frost action: High

Most areas are used for cultivated crops or for pasture and hay. A few areas are wooded. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer is friable and can be easily tilled within a moderate range in moisture content. Accelerated erosion has removed about one-half of the original topsoil. The hazard of erosion is severe. Common erosion-control measures include a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, terraces, underground tile outlets and grassed waterways, contour farming, and a conservation cropping system with rotations that include close-growing pasture and hay crops.

This soil is well suited to ladino clover and is moderately well suited to birdsfoot trefoil, alsike clover, crownvetch, tall fescue, timothy, switchgrass, big bluestem, and indiangrass. Wetness is a limitation. Erosion during seedbed preparation is the main concern. Proper grazing management and restricted use during wet periods help to prevent compaction and maintain good plant density (fig. 7).

This soil is suited to trees, and a few areas support hardwoods. Seedling mortality is a management concern. It is caused by wetness or by droughtiness during some periods in summer. Planting container-grown stock or reinforcement planting during the spring while seedlings are dormant increases the seedling survival rate.

This soil is suited to building site development. The shrink-swell potential and the wetness are limitations on sites for dwellings. Using adequately reinforced concrete for basement walls, foundations, and footings and backfilling with sand and gravel can minimize the damage caused by shrinking and swelling of the soil. Installing drainage tile around the footings and underneath the basement floors helps to prevent the damage caused by excessive wetness. Land grading may be needed because of the slope. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways help to prevent the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the wetness and the restricted permeability. Properly constructed lagoons should function adequately if the site can be leveled.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action are limitations on sites for local roads and streets. Strengthening the subgrade with crushed rock or other suitable base material can minimize the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage can minimize the damage caused by wetness and by frost action.

The land capability classification is 3e. The woodland ordination symbol is 3C, and the indicator species is white oak.

14D2—Armstrong clay loam, 9 to 14 percent slopes, eroded

This very deep, strongly sloping, moderately well drained soil is on ridgetops, shoulders, and backslopes in the uplands. Individual areas are irregular in shape and range from about 15 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; very dark grayish brown, friable clay loam

Subsoil:
6 to 13 inches; strong brown, mottled, firm clay loam
13 to 22 inches; yellowish brown, mottled, firm clay
22 to 65 inches; yellowish brown and strong brown, mottled, very firm and firm clay loam

In some areas, the surface layer is loam, silt loam, or silty clay loam and the upper part of the subsoil contains less sand and fine gravel. In other areas the grayish brown mottles start at a lower depth.

Included with this soil in mapping are small areas of the more sloping Gara soils, areas of Armstrong soils that are severely eroded, and areas of the nearly level Vesser soils. Gara soils are on the lower backslopes. The severely eroded Armstrong soils have a lighter colored surface layer than the major Armstrong soil. They are in convex areas. Vesser soils are along narrow drainageways and are occasionally flooded. Included soils make up about 10 percent of the unit.

Important properties of the Armstrong soil—

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

Figure 7.—Charolais cattle grazing in a weedy fescue pasture. The soil in the foreground is Armstrong loam, 5 to 9 percent slopes, eroded. Gara loam, 14 to 20 percent slopes, eroded, is in the background. Good pasture management, including weed and brush control, improves the quality and quantity of forage.

Depth to the water table: 1 to 3 feet (perched)
Shrink-swell potential: High
Potential for frost action: High

This soil is used mostly for hay and pasture or for cultivated crops. Some areas are wooded. Corn, soybeans, winter wheat, and grain sorghum are the commonly grown crops. This soil is suited to cultivated crops on a limited basis if erosion-control measures are applied. The surface layer is friable and can be easily tilled within a moderate range in moisture content. The hazard of erosion is severe. Accelerated erosion has removed about one-half of the original topsoil. Common erosion-control measures include a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, terraces, underground tile outlets and grassed waterways, contour farming, and a conservation cropping system with rotations that include close-growing pasture and hay crops.

This soil is well suited to ladino clover and is moderately well suited to birdsfoot trefoil, timothy, switchgrass, alsike clover, crownvetch, tall fescue, big bluestem, and indiangrass. Wetness is a limitation. Erosion during seedbed preparation is the main concern. Timely tillage and the quick establishment of ground cover help to control erosion. Proper grazing management and restricted use during wet periods help to prevent compaction and maintain good plant density.

This soil is suited to trees. Seedling mortality is a management concern. It is caused by wetness or by droughtiness during some periods in summer. Planting container-grown stock or reinforcement planting during the early spring while seedings are dormant increases the seedling survival rate.

This soil is suited to building site development. The shrink-swell potential, the wetness, and the slope are limitations on sites for dwellings. Using adequately reinforced concrete for basement walls, foundations, and footings and backfilling with sand and gravel can minimize the damage caused by shrinking and swelling of the soil. Installing drainage tile around the footings and underneath the basement floors helps to prevent the damage caused by excessive wetness. Land grading helps to overcome the slope. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways help to prevent the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the wetness, the slope, and the restricted permeability. Properly constructed lagoons should function adequately if the site can be leveled.

Low strength, the shrink-swell potential, the slope, the wetness, and the potential for frost action are limitations on sites for local roads and streets. Strengthening the subgrade with crushed rock or other suitable base material can minimize the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage can minimize the damage caused by wetness and by frost action. Designing the roads and streets so that they conform to the natural landscape minimizes the need for cutting and filling.

The land capability classification is 4e. The woodland ordination symbol is 3C, and the indicator species is white oak.

16D2—Caleb-Mystic complex, 9 to 14 percent slopes, eroded

This map unit consists of a very deep, strongly sloping, moderately well drained Caleb soil and a strongly sloping, moderately well drained Mystic soil. These soils are on convex risers and footslopes of high stream terraces. Individual areas are irregularly shaped and are parallel to the flood plains. They range from about 10 to more than 35 acres in size. The unit is about 70 percent Caleb soil and 30 percent Mystic soil. The two soils occur as areas too small or too irregular to be mapped separately at the scale used.

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

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

Subsurface layer:
8 to 14 inches; brown, friable loam

Subsoil:
14 to 20 inches; brown, friable loam
20 to 35 inches; dark yellowish brown, friable loam
35 to 42 inches; yellowish brown, very friable sandy loam
42 to 54 inches; light yellowish brown, loose loamy sand
54 to 60 inches; yellowish brown, firm sandy clay loam

In some areas the surface layer is silt loam or clay loam.

Important properties of the Caleb soil—

Permeability: Moderate
Surface runoff: Rapid
Available water capacity: High
Organic matter content: Moderate
Depth to the water table: 2 to 3 feet (perched)
Shrink-swell potential: Moderate
Potential for frost action: Moderate

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

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

Subsurface layer:
8 to 12 inches; yellowish brown, friable silt loam
12 to 16 inches; dark brown, mottled, friable clay loam

Subsoil:
16 to 39 inches; dark brown and brown, mottled, firm clay
39 to 50 inches; yellowish brown, mottled, firm sandy clay loam
50 to 60 inches; yellowish brown, mottled, friable sandy loam

In some gently sloping areas, the subsoil contains less sand.

Important properties of the Mystic soil—

Permeability: Slow
Surface runoff: Rapid
Available water capacity: High
Organic matter content: Moderate
Depth to the water table: 1.0 to 2.5 feet (perched)
Shrink-swell potential: High
Potential for frost action: High

The Caleb and Mystic soils are used mainly for hay and pasture. Some areas are used for cultivated crops. The soils are suited to cultivated crops on a limited basis if erosion-control measures are applied. The surface layer is friable and can be easily tilled within a moderate range in moisture content. The hazard of erosion is severe. Accelerated erosion has removed about one-half of the original topsoil. Common erosion-control measures include a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, terraces, underground tile outlets and grassed waterways, contour farming, and a conservation cropping system with rotations that include close-growing pasture and hay crops.

The Caleb soil is well suited to birdsfoot trefoil, crownvetch, ladino clover, red clover, bluegrass, red fescue, redtop, tall fescue, timothy, and switchgrass. It is moderately well suited to alfalfa, alsike clover, lespedeza, orchardgrass, smooth bromegrass, big bluestem, little bluestem, and indiangrass. Species that are tolerant of droughtiness should be selected. The Mystic soil is well suited to ladino clover and is moderately well suited to birdsfoot trefoil, timothy, switchgrass, alsike clover, crownvetch, tall fescue, big bluestem, and indiangrass. Species that are tolerant of wetness should be selected. Erosion during seedbed preparation is the main concern. Timely tillage and the quick establishment of ground cover help to control erosion. Proper grazing management and restricted use during wet periods help to prevent compaction and maintain good plant density.

These soils are suited to corn and soybeans on a limited basis in rotation with small grain and close-growing pasture or hay crops. The hazard of erosion is severe if the soils are used for continuous row crops. A system of conservation tillage that leaves a protective cover of crop residue on the surface throughout the year, contour farming, stripcropping, winter cover crops, and grassed waterways help to prevent excessive soil loss. 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 improves fertility, minimizes crusting, and increases the rate of water infiltration.

These soils are suited to trees. No major management concerns affect the production of timber.

These soils are suited to building site development. The shrink-swell potential, the wetness, and the slope are limitations on sites for dwellings. Using adequately reinforced concrete for basement walls, foundations, and footings and backfilling with sand and gravel can minimize the damage caused by shrinking and swelling of the soil. Installing drainage tile around the footings and underneath the basement floors helps to prevent the damage caused by excessive wetness. Land grading helps to overcome the slope. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways help to prevent the damage caused by frost action and by shrinking and swelling.

These soils generally are unsuited to conventional septic tank absorption fields because of the wetness, the slope, and the restricted permeability. A few areas may be suitable for septic tank absorption fields. Onsite investigation is needed to identify these areas. The soils generally are not used for lagoons because of the slope. There are typically areas of soils nearby that are suited to lagoons.

Low strength, the shrink-swell potential, the slope, the wetness, and the potential for frost action are limitations on sites for local roads and streets. Strengthening the subgrade with crushed rock or other suitable base material can minimize the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage can minimize the damage caused by wetness and by frost action. Cutting and filling and proper road placement help to overcome the slope.

The land capability classification is 4e. The woodland ordination symbol is 3A, and the indicator species is white oak.

17C—Bevier silt loam, terrace, 3 to 9 percent slopes

This very deep, gently sloping and moderately sloping, somewhat poorly drained soil is on treads, risers, and footslopes of high stream terraces. Individual areas are irregularly shaped and are parallel to the flood plains. They range from about 10 to more than 40 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 15 inches; grayish brown, friable silt loam

Subsoil:
15 to 23 inches; grayish brown, mottled, firm silty clay

23 to 32 inches; brown, grayish brown, and yellowish brown, firm silty clay loam
32 to 60 inches; gray and light brownish gray, mottled, firm silty clay loam

Substratum:
60 to 80 inches; light brownish gray, mottled, firm silty clay loam

In some areas the soil has more sand throughout. In other areas the surface layer is dark grayish brown or brown silty clay loam or loam.

Included with this soil in mapping are some steeper areas. These areas make up about 7 percent of the unit.

Important properties of the Bevier soil—

Permeability: Slow
Surface runoff: Medium
Available water capacity: High
Organic matter content: Moderate
Depth to the water table: 1.0 to 2.5 feet (perched)
Shrink-swell potential: High
Potential for frost action: High

Most areas are used for cultivated crops or for pasture and hay. A few areas are wooded. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer is friable and can be easily tilled within a moderate range in moisture content. The hazard of erosion is severe. Common erosion-control measures include a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, terraces, underground tile outlets and grassed waterways, contour farming, and a conservation cropping system with rotations that include close-growing pasture and hay crops.

This soil is well suited to ladino clover and is moderately well suited to birdsfoot trefoil, alsike clover, crownvetch, tall fescue, timothy, switchgrass, big bluestem, and indiangrass. Species that are tolerant of wetness should be selected. Erosion during seedbed preparation is the main concern. Timely tillage and the quick establishment of ground cover help to control erosion. Proper grazing management and restricted use during wet periods help to prevent compaction and maintain good plant density.

This soil is suited to trees. A few areas support hardwoods. Seedling mortality is a management concern. It is caused by wetness or by droughtiness during some periods in summer. Planting container-grown stock or reinforcement planting during the spring while seedlings are dormant increases the seedling survival rate.

This soil is suited to building site development. The shrink-swell potential and the wetness are limitations on sites for dwellings. Using adequately reinforced concrete for basement walls, foundations, and footings and backfilling with sand and gravel can minimize the damage caused by shrinking and swelling of the soil. Installing drainage tile around the footings and underneath the basement floors helps to prevent the damage caused by excessive wetness. Land grading may be needed because of the slope. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways help to prevent the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the wetness and the restricted permeability. Properly constructed lagoons should function adequately if the site can be leveled.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action are limitations on sites for local roads and streets. Strengthening the subgrade with crushed rock or other suitable base material can minimize the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage can minimize the damage caused by wetness and by frost action.

The land capability classification is 3e. The woodland ordination symbol is 3C, and the indicator species is white oak.

18C2—Gorin silty clay loam, 3 to 9 percent slopes, eroded

This very deep, gently sloping and moderately sloping, somewhat poorly drained soil is on convex ridgetops, shoulders, and footslopes in the uplands. Individual areas are long and narrow and range from about 15 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 7 inches; dark grayish brown, friable silty clay loam

Subsoil:
7 to 14 inches; brown, mottled, firm silty clay loam
14 to 23 inches; grayish brown, mottled, very firm silty clay
23 to 65 inches; yellowish brown, mottled, firm silty clay loam and friable loam

In some areas the surface layer and the upper part of the subsoil contain more sand and fine gravel.

Included with this soil in mapping are soils that are moderately sloping. These soils are at the edges and on the lower parts of the unit. They make up 5 to 8 percent of the unit.

Important properties of the Gorin soil—

Permeability: Slow
Surface runoff: Medium
Available water capacity: High
Organic matter content: Moderate
Depth to the water table: 1.5 to 2.5 feet (perched)
Shrink-swell potential: High
Potential for frost action: High

Most areas of this soil are used for pasture, hay, or timber, but some larger areas, particularly on the broader footslopes, are used for cultivated crops. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer is sticky when wet, however, and can be easily tilled within only a somewhat narrow range in moisture content. The hazard of erosion is severe. Accelerated erosion has removed about one-half of the original topsoil. Common erosion-control measures include a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, terraces, underground tile outlets and grassed waterways, contour farming, and a conservation cropping system with rotations that include close-growing pasture and hay crops. Although the available water capacity is moderate, insufficient soil moisture may affect row crops during the summer. High plant populations of corn and grain sorghum should be avoided. In its natural state the soil is quite acid and is low in fertility. Additions of lime and fertilizer are needed. Returning crop residue to the soil and regularly adding other organic material improve fertility, minimize crusting, increase the available water capacity, and increase the rate of water infiltration.

This soil is well suited to ladino clover and is moderately well suited to birdsfoot trefoil, crownvetch, tall fescue, timothy, big bluestem, and indiangrass. Species that are tolerant of wetness should be selected. Erosion during seedbed preparation is a hazard. Timely tillage and the quick establishment of ground cover help to control erosion. Proper grazing management and restricted use during wet periods help to prevent compaction and maintain good plant density.

This soil is well suited to trees, and many areas support hardwoods. Seedling mortality is a serious concern. It is caused by wetness associated with the seasonal high water table and by droughtiness during dry periods in summer. Planting container-grown stock and reinforcement planting during the early spring and fall while seedlings are dormant increase the seedling survival rate.

This soil is suited to building site development. The shrink-swell potential and the wetness are limitations on sites for dwellings. Using adequately reinforced concrete for basement walls, foundations, and footings and backfilling with sand and gravel can minimize the damage caused by shrinking and swelling of the soil. Installing drainage tile around the footings and underneath the basement floors helps to prevent the damage caused by excessive wetness. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways help to prevent the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the wetness and the restricted permeability. Properly constructed lagoons should function adequately if the site can be leveled.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action are limitations on sites for local roads and streets. Strengthening the subgrade with crushed rock or other suitable base material can minimize the damage caused by low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage can minimize the damage caused by wetness and by frost action.

The land capability classification is 3e. The woodland ordination symbol is 3C, and the indicator species is white oak.

20C2—Clarinda silty clay loam, 5 to 9 percent slopes, eroded

This very deep, gently sloping and moderately sloping, poorly drained soil is on concave head slopes of drainageways and on the shoulders of ridges in the uplands. Individual areas are generally crescent shaped and range from about 10 to more than 40 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, firm silty clay loam

Subsoil:
8 to 12 inches; very dark gray, mottled, firm silty clay

12 to 24 inches; grayish brown, mottled, very firm clay
24 to 65 inches; gray, mottled, very firm clay

In some areas the upper part of the subsoil is dark grayish brown or brown clay loam.

Included with this soil in mapping are areas of the strongly sloping Armstrong soils. These soils are on strongly sloping, convex backslopes in the lower areas of the unit. Also included are small areas in which the original surface layer has been eroded to such an extent that most of the present surface layer is made up of subsoil material. Included areas make up about 5 to 10 percent of the unit.

Important properties of the Clarinda soil—

Permeability: Very slow
Surface runoff: Medium
Available water capacity: High
Organic matter content: Moderate
Depth to the water table: 0.5 foot to 1.5 feet (perched)
Shrink-swell potential: High
Potential for frost action: High

Most areas of this soil are used for cultivated crops or for hay and pasture. This soil is suited to cultivated crops on a limited basis if erosion-control measures are applied. The surface layer is sticky when wet, however, and can be easily tilled within only a somewhat narrow range in moisture content. The hazard of erosion is severe. Accelerated erosion has removed about one-half of the original topsoil. Common erosion-control measures include a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, terraces, underground tile outlets and grassed waterways, contour farming, and a conservation cropping system with rotations that include close-growing pasture and hay crops. Many areas have slopes that are long and smooth enough to be farmed on the contour and terraced. Returning crop residue to the soil and regularly adding other organic material improve fertility, minimize crusting, increase the available water capacity, and increase the rate of water infiltration.

This soil is moderately well suited to hay and pasture. Shallow-rooted species that are tolerant of wetness should be selected. The soil is moderately well suited to reed canarygrass and switchgrass and is moderately suited to alsike clover, birdsfoot trefoil, tall fescue, big bluestem, and indiangrass. Erosion during seedbed preparation is the main concern. Timely tillage and the quick establishment of ground cover help to control erosion. Restricted use during wet periods helps to keep the pasture in good condition. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control improve the quantity and quality of forage.

This soil is suited to building site development. The shrink-swell potential and the wetness are limitations on sites for dwellings. Using adequately reinforced concrete for basement walls, foundations, and footings and backfilling with sand and gravel can minimize the damage caused by shrinking and swelling of the soil. Installing drainage tile around the footings and underneath the basement floors helps to prevent the damage caused by excessive wetness. Land grading may be needed because of the slope. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways help to prevent the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the wetness and the restricted permeability. Properly constructed lagoons should function adequately if the site can be leveled.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action are limitations on sites for local roads and streets. Strengthening the subgrade with crushed rock or other suitable base material can minimize the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage can minimize the damage caused by wetness and by frost action.

The land capability classification is 4e. No woodland ordination symbol is assigned.

22B—Adco silt loam, 1 to 3 percent slopes

This very deep, very gently sloping, somewhat poorly drained soil is on ridgetops in the uplands. Individual areas are long and branching and range from about 50 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 9 inches; very dark grayish brown, friable silt loam

Subsurface layer:
9 to 15 inches; dark grayish brown, friable silt loam

Subsoil:
15 to 20 inches; dark grayish brown, mottled, firm silty clay
20 to 25 inches; brown, firm silty clay
25 to 33 inches; brown, mottled, firm silty clay
33 to 64 inches; grayish brown, mottled, firm silty clay loam

Substratum:
64 to 80 inches; dark yellowish brown, mottled, firm silt loam

In some areas the surface layer is silty clay loam. In other areas the lower part of the subsoil contains more sand. In places the upper part of the subsoil is very dark gray.

Important soil properties—

Permeability: Very slow
Surface runoff: Medium
Available water capacity: High
Organic matter content: Moderate
Depth to the water table: 1.0 to 2.5 feet (perched)
Shrink-swell potential: High
Potential for frost action: High

Most areas of this soil are used for cultivated crops or for hay and pasture. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer can be easily tilled throughout a fairly wide range in moisture content. If the surface is not protected by plant cover or surface mulch, however, it tends to crust or puddle after periods of heavy rainfall, especially in areas where the plow layer contains subsoil material. Erosion is a major concern. Common erosion-control measures include a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, terraces, underground tile outlets and grassed waterways, contour farming, and a conservation cropping system with rotations that include close-growing pasture and hay crops. Returning crop residue to the soil and regularly adding other organic material improve fertility, minimize crusting, increase the available water capacity, and increase the rate of water infiltration.

This soil is well suited to ladino clover and is moderately well suited to tall fescue, timothy, lespedeza, birdsfoot trefoil, indiangrass, and switchgrass. Species that are tolerant of wetness should be selected. Erosion during seedbed preparation is the main management concern. Timely tillage and the quick establishment of ground cover help to control erosion. Proper grazing management and restricted use during wet periods help to prevent compaction and maintain good plant density.

This soil is suited to building site development. The wetness and the shrink-swell potential are limitations on sites for dwellings (fig. 8). Using adequately reinforced concrete for basement walls, foundations, and footings and backfilling with sand and gravel can minimize the damage caused by shrinking and swelling of the soil. Installing drainage tile around footings and foundations helps to prevent the damage caused by excessive wetness. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways help to prevent the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the wetness and the restricted permeability. Properly constructed lagoons should function adequately if the site can be leveled.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action are limitations on sites for local roads and streets. Constructing the roads on raised, well compacted fill material and strengthening them with crushed rock or other suitable base material help to overcome the low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage can minimize the damage caused by wetness and by frost action.

The land capability classification is 2e. No woodland ordination symbol is assigned.

23D2—Keswick clay loam, 5 to 14 percent slopes, eroded

This very deep, moderately sloping and strongly sloping, moderately well drained soil is on ridgetops and backslopes in the uplands. Individual areas are long and narrow or irregularly shaped and range from about 15 to more than 75 acres in size.

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

Surface layer:
0 to 6 inches; dark grayish brown, mottled, friable clay loam

Subsoil:
6 to 24 inches; strong brown and yellowish brown, mottled, very firm clay
24 to 65 inches; yellowish brown, mottled, firm clay loam

In some areas the surface layer and the upper part of the subsoil contain less sand and fine gravel.

Included with this soil in mapping are small areas of the moderately steep or steep Winnegan soils. These areas are at the edges and in the lower parts

Figure 8.—Urban development in an area of Adco silt loam, 1 to 3 percent slopes. Armstrong clay loam, 9 to 14 percent slopes, eroded, is in the background. The fine textured soils in Schuyler County have a high shrink-swell potential, and wetness is also a limitation affecting urban development. Using proper construction techniques and providing surface drainage can minimize the effects of these problems.

of the unit. They make up about 3 to 7 percent of the unit.

Important properties of the Keswick soil—

Permeability: Slow
Surface runoff: Medium
Available water capacity: Moderate
Organic matter content: Moderately low
Depth to the water table: 1 to 3 feet (perched)
Shrink-swell potential: High
Potential for frost action: High

Most areas of this soil are used for pasture, hay, or timber. Some of the larger areas are used for cultivated crops. In some areas, roads or trails have been built.

This soil is well suited to ladino clover and is moderately well suited to alsike clover, crownvetch, reed canarygrass, tall fescue, big bluestem, and indiangrass. Wetness is a limitation. Erosion during seedbed preparation is the main concern. Timely tillage and the quick establishment of ground cover help to control erosion. Proper grazing management and restricted use during wet periods help to prevent compaction and maintain good plant density.

This soil is suited to cultivated crops on a limited basis if erosion-control measures are applied. Corn, soybeans, winter wheat, and grain sorghum are the commonly grown crops. The surface layer is sticky when wet and can be easily tilled within only a somewhat narrow range in moisture content. The hazard of erosion is severe. Accelerated erosion has removed about one-half of the original topsoil. Common erosion-control measures include a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, terraces, underground tile outlets and grassed waterways, contour farming, and a conservation cropping system with rotations that include close-growing pasture and hay crops.

This soil is suited to trees. Seedling mortality is a management concern. It is caused by wetness associated with the seasonal high water table and by droughtiness during dry periods in summer. Planting container-grown stock or reinforcement planting during the early spring while seedlings are dormant helps to ensure an adequate stand.

This soil is suited to building site development. The shrink-swell potential, the wetness, and the slope are limitations on sites for dwellings. Using adequately reinforced concrete for basement walls, foundations, and footings and backfilling with sand and gravel can minimize the damage caused by shrinking and swelling of the soil. Installing drainage tile around the footings and underneath the basement floors helps to prevent the damage caused by excessive wetness. Land grading helps to overcome the slope. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways help to prevent the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the wetness, the slope, and the restricted permeability. Properly constructed lagoons should function adequately if the site can be leveled.

Low strength, the shrink-swell potential, the slope, the wetness, and the potential for frost action are limitations on sites for local roads and streets. Strengthening the subgrade with crushed rock or other suitable base material can minimize the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage can minimize the damage caused by wetness and by frost action. Designing the roads and streets so that they conform to the natural landscape minimizes the need for cutting and filling.

The land capability classification is 4e. The woodland ordination symbol is 3C, and the indicator species is white oak.

24E2—Gara loam, 14 to 20 percent slopes, eroded

This very deep, moderately steep, well drained soil is on backslopes in the uplands. Individual areas are irregular in shape and range from about 25 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, friable loam

Subsoil:
6 to 16 inches; brown, firm clay loam
16 to 65 inches; dark yellowish brown, mottled, firm clay loam and loam

In some areas the upper part of the subsoil is mottled. In other areas the surface layer is brown clay loam.

Included with this soil in mapping are small areas of the gently sloping, somewhat poorly drained Excello soils and the nearly level, poorly drained Vesser soils. Also included are some areas of severely eroded soils. Excello and Vesser soils are in drainageways. The severely eroded soils are in convex areas. Included soils make up about 8 percent of the unit.

Important properties of the Gara soil—

Permeability: Moderately slow
Surface runoff: Rapid
Available water capacity: High
Organic matter content: Moderate
Depth to the water table: More than 6 feet
Shrink-swell potential: Moderate
Potential for frost action: Moderate

Most areas are used for hay and pasture (fig. 9). Some areas are wooded, and some are used for cultivated crops. This soil generally is unsuited to cultivated crops because of the slope and the severe hazard of erosion. Accelerated erosion has removed one-half or more of the original topsoil.

This 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. The hazard of erosion is severe. Erosion during seedbed preparation and overgrazing are the main management concerns. If this soil is tilled for the reseeding of pasture or hay crops, a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, grassed waterways, and contour tillage help to control erosion. Timely seedbed preparation helps to ensure rapid growth and a good ground cover. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control can improve the quantity and quality of forage.

This soil is suited to trees, and some areas are wooded. The hazard of erosion and the equipment limitation are management concerns. Haul roads and skid trails should be established across the slope. Installing culverts and constructing water bars as necessary help to control erosion. On most existing stands, thinning and selective cutting of undesirable trees are needed. These practices also improve the

Figure 9.—Sheep grazing in a pasture of bluegrass and fescue on Gara loam, 14 to 20 percent slopes, eroded, and Lamoni loam, 5 to 9 percent slopes, eroded. These soils are suited to pasture if good management techniques are applied, and this use helps to keep the soils in good condition.

habitat for woodland wildlife, especially white-tailed deer and wild turkey.

This soil generally is not used for building site development or onsite waste disposal because of the slope.

Low strength, the shrink-swell potential, the potential for frost action, and the slope are limitations on sites for local roads and streets. Strengthening the subgrade with crushed rock or other suitable base material can minimize the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage help to prevent the damage caused by frost action. Designing the roads so that they conform to the natural landscape minimizes the need for cutting and filling.

The land capability classification is 6e. The woodland ordination symbol is 3R, and the indicator species is white oak.

24F2—Gara fine sandy loam, 20 to 35 percent slopes, eroded

This very deep, steep, well drained soil is on dissected, uneven backslopes in the uplands. Individual areas are irregular in shape and range from about 25 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 7 inches; very dark grayish brown, friable fine sandy loam

Subsoil:
7 to 13 inches; dark yellowish brown, firm clay loam
13 to 65 inches; yellowish brown, mottled, firm clay loam and loam

In some places the surface layer and the upper part of the subsoil contain less sand and fine gravel. In other places the surface layer is brown. In some less sloping areas, the subsoil is very dark gray.

Included with this soil in mapping are small areas of the poorly drained Zook soils. These soils are on narrow flood plains. They make up about 3 to 5 percent of the unit.

Important properties of the Gara soil—

Permeability: Moderately slow
Surface runoff: Rapid
Available water capacity: High
Organic matter content: Moderate
Depth to the water table: More than 6 feet
Shrink-swell potential: Moderate
Potential for frost action: Moderate

Most areas of this soil are used for pasture. Some areas are wooded. This soil generally is unsuited to cultivated crops because of the slope and the severe hazard of erosion. Accelerated erosion has removed one-half or more of the original topsoil. 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. Erosion during seedbed preparation and erosion resulting from overgrazing are the main management concerns. If this soil is tilled for the reseeding of pasture or hay crops, a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, and grassed waterways help to control erosion. Timely seedbed preparation helps to ensure rapid growth and a good ground cover. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control can improve the quantity and quality of forage.

This soil is suited to trees. The main management concerns are the equipment limitation and the hazard of erosion. Roads and skid trails should be established across the slope. Installing culverts and constructing water bars as necessary help to control erosion. On most existing stands, thinning and selective cutting of undesirable trees are needed. These practices also improve the habitat for woodland wildlife, especially white-tailed deer and wild turkey.

This soil generally is not used for building site development or onsite waste disposal because of the slope.

Low strength, the shrink-swell potential, the potential for frost action, and the slope are limitations on sites for local roads and streets. Strengthening the subgrade with crushed rock or other suitable base material can minimize the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage help to prevent the damage caused by frost action. Designing the roads and streets so that they conform to the natural landscape minimizes the need for cutting and filling.

The land capability classification is 6e. The woodland ordination symbol is 3R, and the indicator species is white oak.

26C2—Leonard silty clay loam, 2 to 9 percent slopes, eroded

This very deep, gently sloping and moderately sloping, poorly drained soil is on concave head slopes in the heads of drainageways and on the shoulders of ridges in the uplands. Individual areas are generally crescent shaped. They range from about 15 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 7 inches; very dark grayish brown and dark grayish brown, mottled, friable silty clay loam

Subsoil:
7 to 12 inches; dark grayish brown, mottled, firm silty clay loam
12 to 80 inches; grayish brown and gray, mottled, firm silty clay

In some areas the surface layer is silt loam.

Included with this soil in mapping are small areas of the strongly sloping Armstrong soils. These soils are generally in the lower areas. They make up less than 5 percent of the unit.

Important properties of the Leonard soil—

Permeability: Slow
Surface runoff: Medium
Available water capacity: Moderate
Organic matter content: Moderate
Depth to the water table: 0.5 foot to 1.5 feet (perched)
Shrink-swell potential: High
Potential for frost action: High

Most areas of this soil are used for cultivated crops or for hay and pasture. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer is sticky when wet, however, and can be easily tilled within only a somewhat narrow range in moisture content. The hazard of erosion is severe. Accelerated erosion has removed about one-half of the original topsoil. Common erosion-control measures include a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, terraces, underground tile outlets and grassed waterways, contour farming, and a conservation cropping system with rotations that include close-growing pasture and hay crops. Many areas have slopes that are long and smooth enough to be farmed on the contour and terraced. Returning crop residue to the soil and regularly adding other organic material improve fertility, minimize crusting, increase the available water capacity, and increase the rate of water infiltration.

This soil is moderately well suited to hay and pasture. Shallow-rooted species that are tolerant of wetness should be selected. The soil is moderately well suited to reed canarygrass, switchgrass, and birdsfoot trefoil and is moderately suited to alsike clover, tall fescue, big bluestem, and indiangrass. Erosion during seedbed preparation is the major concern. Timely tillage and the quick establishment of ground cover help to control erosion. Restricted use during wet periods helps to keep the pasture in good condition. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control can improve the quantity and quality of forage.

This soil is suited to building site development. The shrink-swell potential and the wetness are major limitations on sites for dwellings. Using adequately reinforced concrete for basement walls, foundations, and footings and backfilling with sand and gravel can minimize the damage caused by shrinking and swelling of the soil. Installing drainage tile around the footings and underneath the basement floors helps to prevent the damage caused by excessive wetness. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways help to prevent the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the wetness and the restricted permeability. Properly constructed lagoons should function adequately if the site can be leveled.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action are limitations on sites for local roads and streets. Strengthening the subgrade with crushed rock or other suitable base material can minimize the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage minimize the damage caused by wetness and by frost action.

The land capability classification is 3e. No woodland ordination symbol is assigned.

28E2—Winnegan clay loam, 14 to 20 percent slopes, eroded

This very deep, moderately steep, moderately well drained soil is on dissected, uneven backslopes in the uplands. Individual areas are irregular in shape and range from about 25 to more than 250 acres in size.

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

Surface layer:

0 to 6 inches; brown and very dark grayish brown, friable clay loam

Subsoil:

6 to 23 inches; yellowish brown, mottled, firm clay

23 to 65 inches; yellowish brown, mottled, firm clay loam

In some areas, the surface layer is silt loam and the upper part of the subsoil is silty clay loam.

Included with this soil in mapping are small areas of the frequently flooded Kennebec and Fatima soils. These soils are in drainageways. They make up about 5 percent of the unit.

Important properties of the Winnegan soil—

Permeability: Slow
Surface runoff: Rapid
Available water capacity: Moderate
Organic matter content: Moderately low
Depth to the water table: 2.0 to 3.5 feet (perched)
Shrink-swell potential: Moderate
Potential for frost action: Moderate

Most areas of this soil are used for hay and pasture. Some areas are used as woodland. This soil is generally unsuited to cultivated crops because of the slope and the severe hazard of erosion. Many areas that have been cultivated are being reseeded to grass. The cover of grass can protect the soil from further erosion.

This soil is well suited to birdsfoot trefoil, crownvetch, red fescue, redtop, and switchgrass and is moderately well suited to indiangrass. Accelerated erosion has removed about one-half of the original topsoil. Erosion during seedbed preparation and erosion resulting from overgrazing are the main management concerns. If this soil is tilled for the reseeding of pasture or hay crops, a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, grassed waterways, and contour tillage help to control erosion. Preparing the seedbed on the contour and in a timely manner helps to ensure rapid growth and a good ground cover. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control can improve the quantity and quality of forage.

This soil is suited to trees, and some areas support stands of hardwoods. The equipment limitation and the hazard of erosion are management concerns. Roads and skid trails should be established across the slope. Installing culverts and constructing water bars as necessary help to control erosion. On most existing stands, thinning and selective cutting of undesirable trees are needed. These practices also improve the habitat for woodland wildlife, especially white-tailed deer and wild turkey.

This soil generally is not used for building site development or onsite waste disposal because of the slope.

Low strength, the shrink-swell potential, the wetness, the potential for frost action, and the slope are limitations on sites for local roads and streets. Strengthening the subgrade with crushed rock or other suitable base material can minimize the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage can minimize the damage caused by wetness and by frost action. Designing the roads and streets so that they conform to the natural landscape minimizes the need for cutting and filling.

The land capability classification is 6e. The woodland ordination symbol is 3R, and the indicator species is post oak.

28F2—Winnegan loam, 20 to 35 percent slopes, eroded

This very deep, steep, moderately well drained soil is on highly dissected, uneven backslopes in the uplands. Individual areas are irregular in shape and range from about 25 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 2 inches; very dark grayish brown, friable loam

Subsurface layer:
2 to 5 inches; brown, friable loam

Subsoil:
5 to 15 inches; yellowish brown, firm clay
15 to 33 inches; yellowish brown, mottled, firm clay
33 to 65 inches; yellowish brown and dark yellowish brown, mottled, firm clay loam

In some areas, the surface layer is clay loam or silt loam and the upper part of the subsoil is silty clay loam. In other areas the surface soil is very dark gray or black.

Included with this soil in mapping are small areas of the frequently flooded Kennebec and Fatima soils. These soils are in drainageways. They make up about 5 percent of the unit.

Important properties of the Winnegan soil—

Permeability: Slow
Surface runoff: Rapid
Available water capacity: Moderate
Organic matter content: Low
Depth to the water table: 2.0 to 3.5 feet (perched)
Shrink-swell potential: High
Potential for frost action: Moderate

Most areas of this soil are wooded. Some areas are used for pasture. This soil generally is unsuited to cultivated crops because of the slope and the severe hazard of erosion. The soil is well suited to ladino clover, birdsfoot trefoil, red clover, tall fescue, timothy, crownvetch, red fescue, redtop, and switchgrass. It is moderately well suited to alfalfa, orchardgrass, smooth bromegrass, big bluestem, and indiangrass. Accelerated erosion has removed about one-half of the original topsoil. Erosion during seedbed preparation and erosion resulting from overgrazing are the main management concerns. If this soil is tilled for the reseeding of pasture, a system of conservation tillage that leaves a protective cover of crop residue on the surface and winter cover crops help to control erosion. Timely seedbed preparation helps to ensure rapid growth and a good ground cover. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control can improve the quantity and quality of forage.

This soil is suited to trees. Most areas support stands of hardwoods. The main management concerns are the equipment limitation and the hazard of erosion. Roads and skid trails should be established across the slope. Installing culverts and constructing water bars as necessary help to control erosion. On most existing stands, thinning and selective cutting of undesirable trees are needed. These practices also improve the habitat for woodland wildlife, especially white-tailed deer and wild turkey.

This soil generally is not used for building site development or onsite waste disposal because of the slope.

Low strength, the shrink-swell potential, the wetness, the potential for frost action, and the slope are limitations on sites for local roads and streets. Strengthening the subgrade with crushed rock or other suitable base material can minimize the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage can minimize the damage caused by wetness and by frost action. Designing the roads and streets so that they conform to the natural landscape minimizes the need for cutting and filling.

The land capability classification is 7e. The woodland ordination symbol is 3R, and the indicator species is post oak.

34B2—Seymour silty clay loam, 2 to 5 percent slopes, eroded

This very deep, gently sloping, somewhat poorly drained soil is on convex ridgetops and shoulders below nearly level upland divides. Individual areas are long and branching and range from about 10 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 gray, friable silty clay loam

Subsoil:
- 8 to 13 inches; dark grayish brown, mottled, firm silty clay
- 13 to 19 inches; grayish brown, mottled, very firm silty clay
- 19 to 56 inches; olive gray, mottled, firm silty clay loam

Substratum:
- 56 to 65 inches; light olive gray, mottled, firm silty clay loam

In some areas the surface layer is silt loam. In other areas, the substratum contains more sand and the surface layer is thinner. In places the soil has a subsurface layer of grayish brown or light brownish gray.

Included with this soil in mapping are small areas of the poorly drained Edina soils. These soils are on nearly level upland divides in the upper parts of the unit. They make up about 5 to 10 percent of the unit.

Important properties of the Seymour soil—

Permeability: Very slow
Surface runoff: Medium
Available water capacity: High
Organic matter content: Moderate
Depth to the water table: 1.0 to 2.5 feet (apparent)
Shrink-swell potential: High
Potential for frost action: Moderate

Most areas of this soil are used for cultivated crops or for hay and pasture. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer can be easily tilled throughout a fairly wide range in moisture content. If the surface is not protected by a plant cover or surface mulch, however, it tends to crust or puddle after periods of heavy rainfall, especially in areas where the plow layer contains subsoil material. Erosion is a major concern. Accelerated erosion has removed about one-half of the original topsoil. Common erosion-control measures include a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, terraces, underground tile outlets and grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops. Returning crop residue to the soil and regularly adding other organic material improve fertility, minimize crusting, increase the available water capacity, and increase the rate of water infiltration.

This soil is well suited to ladino clover and is moderately well suited to tall fescue, timothy, lespedeza, birdsfoot trefoil, indiangrass, and switchgrass. Species that are tolerant of wetness should be selected. Erosion during seedbed preparation is the main management concern. Timely tillage and the quick establishment of ground cover help to control erosion. Proper grazing management and restricted use during wet periods help to prevent compaction and maintain good plant density.

This soil is suitable for building site development. The shrink-swell potential and the wetness are major limitations on sites for dwellings. Using adequately reinforced concrete for basement walls, foundations, and footings and backfilling with sand and gravel can minimize the damage caused by shrinking and swelling of the soil. Installing drainage tile around the footings and underneath the basement floors can help to prevent the damage caused by excessive wetness. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways help to prevent the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the wetness and the restricted permeability. Properly constructed lagoons should function adequately if the site can be leveled.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action are limitations on sites for local roads and streets. Strengthening the subgrade with crushed rock or other suitable base material can minimize the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage can minimize the damage caused by wetness and by frost action.

The land capability classification is 3e. No woodland ordination symbol is assigned.

36C2—Lamoni loam, 5 to 9 percent slopes, eroded

This very deep, moderately sloping, somewhat poorly drained soil is on head slopes and on narrow ridgetops, shoulders, and backslopes in the uplands. Individual areas are generally crescent shaped or long, narrow, and branching. They 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 8 inches; very dark grayish brown, friable loam

Subsoil:
8 to 13 inches; dark yellowish brown, firm clay loam
13 to 34 inches; dark grayish brown and grayish brown, mottled, firm clay loam
34 to 65 inches; gray and strong brown, mottled, firm clay loam

In some areas the subsoil is silty clay.

Included with this soil in mapping are small areas of the poorly drained Clarinda soils. These gently sloping and moderately sloping soils are on convex head slopes in the upper part of the unit. They make up about 10 percent of the unit.

Important properties of the Lamoni soil—

Permeability: Slow
Surface runoff: Medium
Available water capacity: High
Organic matter content: Moderate
Depth to the water table: 1 to 3 feet (perched)
Shrink-swell potential: High
Potential for frost action: Moderate

Most areas are used for cultivated crops or for pasture and hay. A few areas are wooded. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer is sticky when wet, however, and can be easily tilled within only a somewhat narrow range in moisture content. The hazard of erosion is severe. Accelerated erosion has removed about one-half of the original topsoil. Common erosion-control measures include a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, terraces, underground tile outlets and grassed waterways, contour farming, and a conservation cropping system with rotations that include close-growing pasture and hay crops (fig. 10).

This soil is well suited to ladino clover and is moderately well suited to birdsfoot trefoil, alsike clover, crownvetch, tall fescue, timothy, switchgrass, big bluestem, and indiangrass. Species that are tolerant of wetness should be selected. Erosion during seedbed preparation is the main concern. Timely tillage and the quick establishment of ground cover help to control erosion. Proper grazing management and restricted use during wet periods help to prevent compaction and maintain good plant density.

This soil is suited to building site development. The shrink-swell potential and the wetness are limitations on sites for dwellings. Using adequately reinforced concrete for basement walls, foundations, and footings and backfilling with sand and gravel can minimize the damage caused by shrinking and swelling of the soil. Installing drainage tile around the footings and underneath the basement floors helps to prevent the damage caused by excessive wetness. Land grading may be needed because of the slope. Reinforced concrete, expansion joints, and a sand or gravel base for sidewalks and driveways help to prevent the damage caused by frost action and by shrinking and swelling.

This soil is unsuited to conventional septic tank absorption fields because of the wetness and the restricted permeability. Properly constructed lagoons should function adequately if the site can be leveled.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action are

Figure 10.—A pasture of bromegrass, orchardgrass, and timothy in an area of Lamoni loam, 5 to 9 percent slopes, eroded. Maintaining a cover of pasture or hay helps to control erosion in areas of this soil.

limitations on sites for local roads and streets. Strengthening the subgrade with crushed rock or other suitable base material can minimize the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage can minimize the damage caused by wetness and by frost action.

The land capability classification is 3e. No woodland ordination symbol is assigned.

40—Arbela and Humeston soils, occasionally flooded

These very deep, nearly level, poorly drained soils are on alluvial fans and high flood plains. They are flooded for brief periods. Individual areas are long and narrow or irregularly shaped and range from about 15 to more than 100 acres in size. The Arbela and Humeston soils were not mapped separately because the use and management of both soils are similar.

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

Surface layer:

0 to 10 inches; very dark grayish brown, friable silt loam

Subsurface layer:

10 to 17 inches; dark grayish brown and grayish brown, friable silt loam

Subsoil:

17 to 30 inches; dark gray, mottled, firm silty clay loam

30 to 44 inches; grayish brown, mottled, firm silty clay

44 to 65 inches; grayish brown, mottled, firm silty clay loam

In some areas the subsoil contains less than 35 percent clay. Some areas are subject to only rare flooding.

Important properties of the Arbela soil—

Permeability: Moderately slow
Surface runoff: Slow
Available water capacity: High
Organic matter content: Moderate
Seasonal high water table: At the surface to 1.5 feet below the surface (apparent)
Shrink-swell potential: Moderate
Potential for frost action: High

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

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

Subsurface layers:
7 to 13 inches; very dark gray, friable silt loam
13 to 26 inches; dark gray, mottled, friable silt loam
26 to 29 inches; dark gray, mottled, firm silty clay loam

Subsoil:
29 to 50 inches; very dark gray, mottled, firm silty clay
50 to 60 inches; dark gray, mottled, firm silty clay

In some areas the subsoil contains less than 35 percent clay. Some areas are subject to only rare flooding.

Important properties of the Humeston soil—

Permeability: Very slow
Surface runoff: Slow
Available water capacity: High
Organic matter content: Moderate
Seasonal high water table: At the surface to 1 foot below the surface (apparent)
Shrink-swell potential: High
Potential for frost action: High

Included with these soils in mapping are small areas of the frequently flooded Zook, Kennebec, and Fatima soils. These included soils are in the slightly lower positions at the edges of the unit. They make up about 5 percent of the unit.

Most areas of this unit are cultivated. A few areas are used for pasture and hay. These soils are suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer can be easily tilled throughout a fairly wide range in moisture content. If the surface is not protected by a plant cover or surface mulch, however, it tends to crust or puddle after periods of heavy rainfall, especially in areas where the plow layer contains subsoil material. Wetness is the major management concern. Diversions constructed at the base of adjacent upland slopes can help to keep excess water from flowing onto areas of these soils. Surface drains also can remove excess water. The excess water interferes with cultivation and harvesting.

These soils are suited to hay and pasture. Pasture and hay mixtures that include wetness-tolerant varieties, such as reed canarygrass and alsike clover, grow well. Proper stocking rates and timely deferment of grazing during wet periods help to keep the pasture in good condition. Rotation grazing and applications of lime and fertilizer can improve the quantity and quality of forage.

These soils are unsuited to building site development because of the occasional flooding.

These soils are unsuited to conventional septic tank absorption fields because of the wetness and the flooding. They also are unsuited to waste treatment by sewage lagoons.

The flooding, low strength, the shrink-swell potential, the wetness, and the potential for frost action are limitations if these soils are used as sites for local roads and streets. Constructing roads on raised, well compacted fill material and strengthening the subgrade with crushed rock or other suitable base material help to prevent the damage caused by flooding and low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage can minimize the damage caused by wetness and by frost action.

The land capability classification is 2w. No woodland ordination symbol is assigned.

45—Kennebec and Fatima soils, frequently flooded

These very deep, nearly level, moderately well drained soils are on flood plains. They are flooded for brief periods. Individual areas are long and narrow and range from about 25 to more than 200 acres in size. The Kennebec and Fatima soils were not mapped separately because the use and management of both soils are similar.

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

Surface layer:
0 to 10 inches; very dark gray, friable silt loam

Subsurface layer:
10 to 57 inches; very dark gray, friable silt loam

Substratum:
57 to 80 inches; very dark grayish brown and dark grayish brown, friable silt loam

In some places the soil contains more than 15 percent sand throughout. In some places the lower part of the soil is loam.

Important properties of the Kennebec soil—

Permeability: Moderate
Surface runoff: Slow
Available water capacity: Very high
Organic matter content: Moderate
Depth to the water table: 3 to 5 feet (apparent)
Shrink-swell potential: Moderate
Potential for frost action: High

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

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

Subsurface layer:
7 to 16 inches; very dark gray, friable silt loam

Subsoil:
16 to 31 inches; dark grayish brown, mottled, friable silt loam
31 to 54 inches; dark grayish brown, friable silt loam

Substratum:
54 to 69 inches; dark grayish brown, friable silt loam
69 to 80 inches; brown and grayish brown, mottled, firm loam

In some places the soil contains more than 15 percent sand throughout.

Important properties of the Fatima soil—

Permeability: Moderate
Surface runoff: Slow
Available water capacity: Very high
Organic matter content: Moderate
Depth to the water table: 2.0 to 3.5 feet (apparent)
Shrink-swell potential: Low
Potential for frost action: High

Included with these soils in mapping are small areas of the poorly drained Zook soils. These included soils are in depressions and on the edges of the unit. They make up about 7 percent of the unit.

Most areas of this unit are used for cultivated crops or for hay and pasture. These soils are suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer is friable and can be easily tilled within a moderate range in moisture content. Flooding is the main management concern. It delays planting and interferes with harvesting during some years, but summer annual crops commonly are planted and harvested with only minor damage. If flooding interferes with harvesting, delaying the harvest until the ground is frozen helps to overcome the equipment limitation.

These soils are moderately well suited to tall fescue, red clover, birdsfoot trefoil, and switchgrass. Flooding is the main management concern. Plants that are tolerant of wetness and flooding should be selected. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control can improve the quantity and quality of forage.

These soils are suited to trees, and a few small areas still support native hardwoods. No major limitations affect timber management. Planting and harvesting can be scheduled so that the periods of flooding are avoided. Selective cutting and timely harvesting of mature trees help to achieve the maximum growth potential.

These soils are unsuitable for building site development and onsite waste disposal systems because of the flooding and the wetness.

The flooding, the wetness, the shrink-swell potential, and the potential for frost action are limitations if these soils are used as sites for local roads and streets. Constructing roads on raised, well compacted, coarse fill material and strengthening the base with crushed rock or other suitable material helps to prevent the damage caused by flooding and by frost action. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage help to prevent the damage caused by wetness and by frost action.

The land capability classification is 3w. The woodland ordination symbol for the Kennebec soil is 3A, and the indicator species is black walnut. The woodland ordination symbol for the Fatima soil is 5W, and the indicator species is pin oak.

46—Vesser silt loam, occasionally flooded

This very deep, nearly level, poorly drained soil is on high flood plains. It is flooded for brief periods. Individual areas are long and narrow or irregularly shaped and range from about 15 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 10 inches; very dark grayish brown, friable silt loam

Subsurface layer:
10 to 18 inches; very dark gray, mottled, friable silt loam
18 to 31 inches; grayish brown, mottled, friable silt loam

Subsoil:
31 to 65 inches; grayish brown and dark gray, mottled, firm silty clay loam

In some areas the surface layer is loam. In other areas the subsoil is silty clay.

Included with this soil in mapping are small areas of the frequently flooded Kennebec and Fatima soils. These soils are in the slightly lower positions at the edges of the unit. They make up about 5 percent of the unit.

Important properties of the Vesser soil—

Permeability: Moderate
Surface runoff: Slow
Available water capacity: High
Organic matter content: Moderate
Depth to the water table: 0.5 foot to 1.5 feet (apparent)
Shrink-swell potential: Moderate
Potential for frost action: High

Most areas are cultivated. A few areas are used for pasture and hay. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer can be easily tilled throughout a fairly wide range in moisture content. If the surface is not protected by a plant cover or surface mulch, however, it tends to crust or puddle after periods of heavy rainfall. Wetness is the major management concern. Diversions constructed at the base of adjacent upland slopes help to keep excess water from flowing onto this soil. Surface drains also can remove excess water. The excess water interferes with cultivation and harvesting.

This soil is suited to hay and pasture. Pasture and hay mixtures that include wetness-tolerant varieties, such as reed canarygrass and alsike clover, grow well. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the wetness. Proper stocking rates and timely deferment of grazing during wet periods help to keep the pasture in good condition. Rotation grazing and applications of lime and fertilizer can improve the quantity and quality of forage.

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

The flooding, low strength, the shrink-swell potential, the wetness, and the potential for frost action are limitations on sites for local roads and streets. Constructing roads on raised, well compacted fill material and strengthening the subgrade with crushed rock or other suitable base material help to prevent the damage caused by flooding and low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage can minimize the damage caused by wetness and by frost action.

The land capability classification is 2w. No woodland ordination symbol is assigned.

47—Zook silty clay loam, overwash, frequently flooded

This very deep, nearly level, poorly drained soil is in backswamps and the broad lower areas of the flood plain. It is flooded for brief periods. Individual areas are irregularly shaped and range from about 50 to more than 300 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

Subsurface layer:
7 to 21 inches; very dark gray, firm silty clay loam

Subsoil:
21 to 49 inches; very dark gray, mottled, firm silty clay
49 to 80 inches; dark gray, mottled, firm silty clay

In some areas the surface layer and subsurface layer are silt loam or loam. In other areas the soil has been protected from flooding by levees.

Important soil properties—

Permeability: Slow
Surface runoff: Very slow
Available water capacity: High
Organic matter content: High
Seasonal high water table: At the surface to 2 feet below the surface (apparent)
Shrink-swell potential: High
Potential for frost action: High

Most areas are used for cultivated crops. Some areas are used for hay and pasture. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer is sticky when wet, however, and can be easily tilled within only a somewhat narrow range in moisture content. If the surface is not protected by a plant cover or surface mulch, it tends to crust or puddle after periods of heavy rainfall. Flooding delays planting and interferes with harvesting during most years. Crop damage caused by flooding is common. Field ditches improve the surface drainage if adequate outlets are available (fig. 11). Extremely wet areas can also be improved by land grading and shaping. Diversions at the base of upland slopes or stream terrace footslopes help to keep water from flowing onto this soil. A system of conservation tillage that leaves a protective cover of crop residue on the surface helps to maintain the content of organic matter, improves tilth, and increases the rate of water infiltration. In some years fall harvesting may be delayed until the ground is frozen because of the wetness and the flooding.

This soil is best suited to a pasture or hay mixture that includes varieties that are tolerant of wetness and flooding, such as reed canarygrass and alsike clover. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the seasonal high water table and the flooding. Proper stocking rates and timely deferment of grazing during wet periods help to keep the pasture in good condition. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control can improve the quantity and quality of forage.

This soil is unsuited to building site development and onsite waste disposal systems because of the flooding. The wetness and the shrink-swell potential are also limitations.

The flooding, low strength, the shrink-swell potential, the wetness, and the potential for frost action are limitations on sites for local roads and streets. Constructing roads on raised, well compacted fill material and strengthening the subgrade with crushed rock or other suitable base material can minimize the damage caused by flooding and low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage can minimize the damage caused by wetness and by frost action.

The land capability classification is 3w. No woodland ordination symbol is assigned.

51—Amana silty clay loam, occasionally flooded

This very deep, nearly level, somewhat poorly drained soil is on flood plains. It is flooded for brief periods. Individual areas are long and broad and range from about 25 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 12 inches; very dark grayish brown, friable silty clay loam

Subsurface layer:
12 to 23 inches; very dark gray, firm silty clay loam

Subsoil:
23 to 38 inches; dark grayish brown, mottled, firm silt loam
38 to 52 inches; dark grayish brown and brown, mottled, firm silt loam

Substratum:
52 to 80 inches; dark grayish brown, brown, and yellowish brown, friable silt loam

In some areas the soil has a thicker dark surface layer. In other areas the soil contains more than 15 percent sand throughout. In places the soil has been protected from flooding and thus is subject to only rare flooding.

Included with this soil in mapping are small areas of the poorly drained Zook soils. These soils are in depressions and at the edges of the unit. They make up about 7 percent of the unit.

Important properties of the Amana soil—

Permeability: Moderate
Surface runoff: Slow
Available water capacity: Very high
Organic matter content: Moderate
Depth to the water table: 2 to 4 feet (apparent)
Shrink-swell potential: Moderate
Potential for frost action: High

Most areas are used for cultivated crops or for hay and pasture. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer is friable and can be easily tilled within a moderately wide range in moisture content. Flooding delays planting and interferes with harvesting during some years, but summer annual crops commonly are planted and harvested with only minor damage. If flooding interferes with harvesting, delaying the harvest until the ground is frozen helps to overcome the equipment limitation.

This soil is moderately well suited to tall fescue, red clover, birdsfoot trefoil, and switchgrass. Flooding is the main management concern. Plants that are tolerant of wetness and flooding should be selected.

Figure 11.—A good stand of corn in an area of Zook silty clay loam, overwash, frequently flooded. This soil is on nearly level flood plains and is suited to cultivated crops. Shallow surface ditches and land grading have been used to drain excess surface water from the fields.

Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control can improve the quantity and quality of forage.

This soil is suited to trees, and a few small areas still support native hardwoods. No major limitations affect timber management. Planting and harvesting can be scheduled so that the periods of flooding are avoided. Selective cutting and timely harvesting of mature trees help to achieve the maximum growth potential.

This soil is unsuitable for building site development and onsite waste disposal because of the flooding. The wetness and the shrink-swell potential are also limitations.

The flooding, the wetness, the shrink-swell potential, and the potential for frost action are limitations on sites for local roads and streets. Constructing roads on raised, well compacted, coarse fill material and strengthening the base with crushed rock or other suitable material helps to prevent the damage caused by flooding. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage help to prevent the damage caused by wetness and by frost action.

The land capability classification is 2w. The woodland ordination symbol is 3A, and the indicator species is eastern cottonwood.

54B—Zook and Excello soils, fans, 2 to 5 percent slopes, rarely flooded

These very deep, gently sloping, poorly drained and somewhat poorly drained soils are on alluvial fans and toeslopes at the base of the more sloping uplands and adjacent to the nearly level flood plain. They are flooded for very brief periods. Individual areas are fan shaped or long and narrow and range from about 10 to more than 100 acres in size. The Zook and Excello soils were not mapped separately because the use and management of both soils are similar.

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

Surface layer:
0 to 6 inches; black, friable silty clay loam

Subsurface layer:
6 to 25 inches; black, firm silty clay loam
25 to 37 inches; very dark gray, mottled, firm silty clay loam

Subsoil:
37 to 65 inches; dark gray, mottled, firm silty clay loam

In some areas the surface layer is silt loam or loam.

Important properties of the Zook soil—

Permeability: Slow
Surface runoff: Medium
Available water capacity: High
Organic matter content: High
Seasonal high water table: At the surface to 2 feet below the surface (apparent)
Shrink-swell potential: High
Potential for frost action: High

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

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

Subsurface layer:
6 to 25 inches; very dark gray, friable silt loam

Subsoil:
25 to 34 inches; very dark gray, mottled, friable clay loam
34 to 47 inches; dark grayish brown and very dark gray, mottled, firm clay loam
47 to 65 inches; light olive brown, dark grayish brown, and yellowish brown, firm loam

In some places the surface layer and the upper part of the subsoil are dark grayish brown or brown. In some areas the soil is fine sandy loam.

Important properties of the Excello soil—

Permeability: Moderate
Surface runoff: Medium
Available water capacity: High
Organic matter content: Moderate
Depth to the water table: 1 to 3 feet (apparent)
Shrink-swell potential: Moderate
Potential for frost action: High

Included with these soils in mapping are small areas of Zook soils that are frequently flooded. These areas are at the lower elevations on the edges of the unit. They make up less than 5 percent of the unit.

Most areas of this unit are used for cultivated crops. A few areas are used for pasture and hay. These soils are suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer is sticky when wet and can be easily tilled within only a somewhat narrow range in moisture content. If the surface is not protected by a plant cover or surface mulch, it tends to crust or puddle after periods of heavy rainfall. Wetness is the major management concern. Diversions constructed at the base of adjacent upland slopes help to keep excess water from flowing onto these soils. Surface drains also can remove excess water. The excess water interferes with cultivation and harvesting.

These soils are suited to hay and pasture. They are suited to pasture and hay mixtures that contain wetness-tolerant varieties, such as reed canarygrass and alsike clover. Proper stocking rates and timely deferment of grazing during wet periods help to keep the pasture in good condition. Erosion during seedbed preparation is the main management concern. Timely tillage and the quick establishment of ground cover help to control erosion. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control can improve the quantity and quality of forage.

These soils are suited to building site development if they are protected from flooding or if the building sites are in areas above the known flood level. The flooding, the wetness, and the shrink-swell potential are limitations on sites for dwellings. If the soils are used as sites for dwellings, the damage caused by shrinking and swelling can be minimized by using adequately reinforced concrete in footings, foundations, and basement walls and by backfilling with sand and gravel. Additional reinforcement steel, expansion joints, and sand or gravel base for sidewalks and driveways help to prevent the damage caused by shrinking and swelling and by frost action. Constructing the buildings on raised, well compacted fill material and installing drainage tiles around footings and foundations help to prevent the damage caused by excessive wetness.

These soils are unsuited to conventional septic tank absorption fields because of the wetness and the restricted permeability. The Excello soil is poorly suited to waste treatment by lagoons because of seepage. Onsite investigation is necessary to determine whether seepage is a concern, and the lagoons should be properly designed and established above the areas that are subject to flooding.

Low strength, the shrink-swell potential, the wetness, and the potential for frost action are limitations on sites for local roads and streets. Strengthening the subgrade with crushed rock or other suitable base material can minimize the damage caused by low strength and by shrinking and swelling. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage can minimize the damage caused by wetness and by frost action.

The land capability classification is 2w. No woodland ordination symbol is assigned.

56B—Zook silty clay loam, rarely flooded-Excello loam, frequently flooded, complex, 0 to 5 percent slopes

This map unit occurs as areas of a very deep, gently sloping, poorly drained Zook soil on toeslopes and a somewhat poorly drained Excello soil on narrow flood plains. These soils are subject to frequent flooding for brief periods. Individual areas are long and narrow and range from about 5 to more than 200 acres in size. The two soils occur as areas too small or too irregular to be mapped separately at the scale used.

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

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

Subsurface layer:
7 to 13 inches; black, firm silty clay
13 to 24 inches; very dark gray, firm silty clay

Subsoil:
24 to 80 inches; very dark gray, mottled, firm silty clay loam

In some areas the surface layer and subsurface layer are silt loam or loam.

Important properties of the Zook soil—

Permeability: Slow
Surface runoff: Medium
Available water capacity: High
Organic matter content: High
Seasonal high water table: At the surface to 2 feet below the surface (apparent)
Shrink-swell potential: High
Potential for frost action: High

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

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

Subsurface layer:
8 to 16 inches; very dark gray, friable loam
16 to 20 inches; very dark gray, mottled, firm silty clay loam

Subsoil:
20 to 60 inches; very dark gray, mottled, firm silty clay loam
60 to 80 inches; dark gray, mottled, firm clay loam

In some areas the surface layer and subsurface layer are silt loam. In other areas the soil contains less than 18 percent clay throughout. In places the soil contains less than 15 percent sand throughout.

Important properties of the Excello soil—

Permeability: Moderate
Surface runoff: Medium
Available water capacity: High
Organic matter content: High
Depth to the water table: 1 to 3 feet (apparent)
Shrink-swell potential: Moderate
Potential for frost action: High

Most areas of this unit are used for hay and pasture or as woodland. Some areas are used for cultivated crops. Areas that are large enough are suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer is friable and can be easily tilled within a moderate range in moisture content. Erosion and wetness are the major management concerns. Common erosion-control measures include a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, terraces, underground tile outlets and grassed waterways, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops. Diversions constructed at the base of adjacent upland slopes help to keep excess water from flowing onto these soils. Surface drains also can remove excess water. The excess water interferes with cultivation and harvesting.

These soils are moderately well suited to reed canarygrass and are suited to birdsfoot trefoil, ladino clover, and bluegrass. Species that are tolerant of wetness should be selected. Erosion during seedbed preparation is the main management concern. Timely tillage and the quick establishment of ground cover help to control erosion. Proper grazing management and restricted use during wet periods help to prevent compaction and maintain good plant density. Diversions constructed at the base of adjacent upland slopes help to keep excess water from flowing onto these soils. Surface drains also can remove excess water.

This unit is poorly suited to building site development. The flooding, the wetness, and the shrink-swell potential are limitations on sites for dwellings. If this unit is used for dwellings, the damage caused by shrinking and swelling can be minimized by using adequately reinforced concrete in footings, foundations, and basement walls and by backfilling with sand and gravel. Additional reinforcement steel, expansion joints, and sand or gravel base for sidewalks and driveways help to prevent the damage caused by shrinking and swelling and by frost action. Constructing dwellings with basements on raised, well compacted fill material and installing drainage tiles around footings and foundations help to prevent the damage caused by excessive wetness.

This unit is generally unsuited to conventional septic tank absorption fields because of the flooding, the wetness, and the restricted permeability. Lagoons can be used for waste treatment, but wetness is a limitation.

The flooding, low strength, the shrink-swell potential, the wetness, and the potential for frost action are limitations if these soils are used as sites for local roads and streets. Constructing roads on raised, well compacted, coarse fill material and strengthening the base with crushed rock or other suitable base material help to prevent the damage caused by flooding. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage can minimize the damage caused by wetness and by frost action.

The land capability classification is 2w. No woodland ordination symbol is assigned.

60—Wabash silty clay, occasionally flooded

This very deep, nearly level, poorly drained soil is along low-lying drainageways and in broad depressional areas on the flood plain. It is flooded for brief periods. Individual areas are large and oval and range from about 50 to more than 300 acres in size.

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

Surface layer:
0 to 5 inches; very dark gray, firm silty clay

Subsurface layer:
5 to 17 inches; very dark gray, mottled, firm silty clay

Subsoil:
17 to 38 inches; very dark gray, mottled, firm silty clay
38 to 80 inches; dark gray, mottled, firm silty clay

In some places the upper part of the subsoil is gray or dark gray.

Important soil properties—

Permeability: Very slow
Surface runoff: Slow
Available water capacity: Moderate
Organic matter content: Moderate
Seasonal high water table: At the surface to 1 foot below the surface (apparent)
Shrink-swell potential: Very high
Potential for frost action: Moderate

Most areas are used for cultivated crops. Some areas are used for hay and pasture. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer is sticky when wet, however, and can be easily tilled within only a narrow range in moisture content. If the surface is not protected by a plant cover or surface mulch, it tends to crust or puddle after periods of heavy rainfall. Because of the slow runoff rate and the restricted internal drainage, removing excess water from cultivated areas is difficult. Shallow surface ditches and land grading can improve the surface drainage if adequate outlets are available. Diversions constructed at the base of the upland slopes or stream terrace footslopes can keep excess water from flowing onto this soil. A system of conservation tillage that leaves a protective cover of crop residue on the soil helps to maintain the content of organic matter, improves tilth, and increases the rate of water infiltration. Crop damage is common in areas that are not protected from flooding. Wetness delays planting and interferes with harvesting during most years. If flooding interferes with harvesting, delaying the harvest until the ground is frozen helps to overcome the equipment limitation.

This soil is best suited to a mixture of pasture and hay plants containing varieties that are tolerant of wetness and flooding, such as reed canarygrass and alsike clover. Deep-rooted legumes, such as alfalfa, generally do not grow well because of the seasonal high water table and the flooding. Proper stocking rates and timely deferment of grazing during wet periods help to keep the pasture in good condition. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control can improve the quantity and quality of forage.

This soil is poorly suited to building site development and onsite waste disposal systems because of the flooding and the wetness.

The flooding, low strength, the shrink-swell potential, the wetness, and the potential for frost action are limitations on sites for local roads and streets. Constructing roads on raised, well compacted fill material and strengthening the subgrade with crushed rock or other suitable base material can minimize the damage caused by flooding and low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage can minimize the damage caused by wetness and by frost action.

The land capability classification is 3w. The woodland ordination symbol is 4W, and the indicator species is pin oak.

64C2—Alvin loamy sand, 2 to 9 percent slopes, eroded

This very deep, gently sloping and moderately sloping, well drained soil is on high terraces. Individual areas are oval or long and narrow and range from about 5 to more than 50 acres in size.

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 loamy sand

Subsoil:
10 to 21 inches; brown, friable sandy loam
21 to 40 inches; dark yellowish brown, friable sandy loam
40 to 48 inches; yellowish brown, very friable loamy sand

Substratum:
48 to 80 inches; brownish yellow, loose sand

In some areas the surface layer and the upper part of the subsoil are very fine sandy loam or fine sandy loam.

Included with this soil in mapping are small areas of Vesser soils in the lower part of the unit. These soils make up about 5 to 10 percent of the unit.

Important properties of the Alvin soil—

Permeability: Moderately rapid
Surface runoff: Medium
Available water capacity: Moderate
Organic matter content: Low
Depth to the water table: More than 6 feet
Shrink-swell potential: Low
Potential for frost action: Moderate

Most areas of this soil are used for cultivated crops or for pasture and hay. A few areas are wooded. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer can be worked throughout a wide range in moisture content. Accelerated erosion has removed one-half or more of the original topsoil. Common erosion-control measures include a system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, contour farming, and a conservation cropping system that includes close-growing pasture or hay crops.

This soil is well suited to ladino clover, alsike clover, crownvetch, reed canarygrass, tall fescue, big bluestem, and indiangrass. Erosion during seedbed preparation is the main concern. Timely tillage and the quick establishment of ground cover help to control erosion. Deferred grazing, rotation grazing, applications of lime and fertilizer, and weed and brush control can improve the quantity and quality of forage.

This soil is suited to building site development.

This soil is suited to conventional septic tank absorption fields. It is not suited to waste treatment by lagoons because of seepage.

This soil is suited to use as a site for local roads and streets. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage help to maintain the roadbeds.

The land capability classification is 3e. No woodland ordination symbol is assigned.

67—Aquents, frequently flooded

These very poorly drained soils are in areas on the flood plain that are ponded or where the frequency of flooding has been increased by downstream structures. The soils are subject to frequent flooding and ponding for long periods. Individual areas are irregular in shape and range from about 10 to more than 30 acres in size.

These soils vary greatly in composition, but a typical sequence, depth, and composition of the layers are as follows—

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

Subsurface layer:
10 to 18 inches; dark gray and dark grayish brown, mottled, sticky and plastic silty clay loam
18 to 32 inches; very dark gray, mottled, sticky and plastic silty clay

Subsoil:
32 to 60 inches; very dark gray, mottled, sticky and plastic silty clay

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

Important properties of the Aquents—

Permeability: Moderate to slow
Surface runoff: Slow or very slow
Available water capacity: High
Organic matter content: Moderate or high
Seasonal high water table: 3 feet above to 1 foot below the surface (apparent)
Shrink-swell potential: High
Potential for frost action: High

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

The land capability classification is 7w. No woodland ordination symbol is assigned.

75—Ackmore silt loam, occasionally flooded

This very deep, nearly level, poorly drained soil is on alluvial fans and flood plains. It is subject to occasional flooding for brief periods. Individual areas are irregular in shape and range from about 20 to more than 50 acres in size.

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

Surface layer:
0 to 12 inches; very dark grayish brown and dark grayish brown, friable silt loam

Substratum:
12 to 24 inches; stratified grayish brown and dark gray, mottled, friable silt loam
24 to 80 inches; very dark gray, mottled, firm silty clay loam

In some areas the surface layer is dark brown. In other areas the surface layer is silty clay loam.

Important soil properties—

Permeability: Moderate
Surface runoff: Slow
Available water capacity: High
Organic matter content: Moderate
Seasonal high water table: At the surface to 1.5 feet below the surface (apparent)
Shrink-swell potential: High
Potential for frost action: High

Most areas are used for cultivated crops or for hay and pasture. Some areas are wooded. This soil is suited to corn, soybeans, winter wheat, and grain sorghum. The surface layer is friable and can be easily tilled within a moderate range in moisture content. Flooding delays planting and interferes with harvesting during some years. In most years the flooding is of such short duration that crop damage is minimal. Diversions at the base of upland slopes or terrace footslopes help to keep water from flowing onto this soil. A system of conservation tillage that leaves a protective cover of crop residue on the soil helps to maintain the content of organic matter, improves tilth, and increases the rate of water infiltration. If flooding interferes with harvesting, delaying the harvest until the ground is frozen helps to overcome the equipment limitation.

This soil is moderately suited to reed canarygrass and alsike clover. The wetness and the flooding are management concerns. Plants that are tolerant of these conditions should be selected. Proper grazing management and restricted use during wet periods help to prevent compaction and maintain good plant density.

This soil is unsuited to building site development and onsite waste disposal systems because of the flooding. The wetness and the shrink-swell potential are also limitations.

The flooding, low strength, the shrink-swell potential, the wetness, and the potential for frost action are limitations on sites for local roads and streets. Constructing roads on raised, well compacted fill material and strengthening the subgrade with crushed rock or other suitable base material can minimize the damage caused by flooding and low strength. Grading the roads so that they shed water, constructing roadside ditches, and installing culverts for drainage can minimize the damage caused by wetness and by frost action.

The land capability classification is 2w. No woodland ordination symbol is assigned.

Prime Farmland

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

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban 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 or the Missouri University Extension Service.

About 65,000 acres in the survey area, or about 33 percent of the total acreage, meets the soil requirements for prime farmland. Areas of prime farmland are scattered throughout the survey area, but most are in associations 1 and 4, which are described under the heading "General Soil Map Units." The crops grown on this land are mainly soybeans, corn, winter wheat, and grain sorghum.

Some prime farmland has been lost to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in Schuyler County 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."

Some soils that have a seasonal high water table and all soils that are frequently flooded during the growing season qualify as prime farmland only in areas where these limitations have been overcome by drainage measures or flood control. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not these limitations have 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. 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

Mark C. Palm, district conservationist, Natural Resources Conservation Service, helped prepare this section.

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

In 1986, approximately 169,400 acres in Schuyler County, or 90 percent of the total acreage, was used for crops and pasture. Of this total, about 100,400 acres was used for permanent pasture and approximately 69,000 acres was used for cultivated crops, mainly corn, soybeans, winter wheat, and grain sorghum, or as meadow in a cropland rotation. The remaining 26,440 acres was used mostly for conservation purposes or was idle land. In Schuyler County the conversion of cropland to urban development has been slight.

The potential of the soils in Schuyler County for the sustained production of food is good (fig. 12). About 65,000 acres in the county is prime farmland. Prime farmland is the land that is best suited to food, feed, forage, fiber, and oilseed crops. On cropland that is not considered prime farmland, more intensive management is required to keep erosion to a minimum and to maintain production. Marginal land that is being used for row crops should be converted to grassland cover, or adequate conservation systems should be applied.

Erosion on most of the cropland can be held to a tolerable level by using a system of conservation practices designed for specific sites and situations. The most effective tool for predicting soil loss is the Universal Soil Loss Equation (USLE). This survey can greatly facilitate the application of such technology.

Erosion by water is the major problem on nearly all of the sloping cropland and overgrazed pastureland in

Figure 12.—A good crop of corn in an area of Wabash silty clay, occasionally flooded, in the foreground. The fescue pasture in the background is in an area of Winnegan clay loam, 14 to 20 percent slopes, eroded. The nearly level soils on flood plains are suited to cultivated crops, and the sloping uplands are best suited to pasture. Erosion can be kept to a minimum by maintaining a cover of grass in the uplands and by diverting runoff before it flows onto the flood plain.

Schuyler County. All soils that have slopes of more than 2 percent are susceptible to damage from erosion.

Loss of the surface layer through erosion is damaging for several reasons. Productivity is reduced because 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. Erosion on farmland results in the sedimentation of streams, lakes, and ponds. Controlling erosion minimizes the pollution of streams by sediment and improves the quality of water for municipal and recreational uses and for fish and wildlife. Erosion-control measures also prolong the useful life of ponds and lakes by slowing the rate at which they fill up with sediment.

In many fields, seedbed preparation and tillage are difficult in clayey areas where the original friable surface soil has been eroded away. Some areas of Adco, Armstrong, Gorin, Leonard, and Bevier soils are examples.

Erosion control protects the soil surface, reduces the runoff rate, and increases the rate of water infiltration. A cropping system that keeps plant cover on the soil for extended periods reduces the hazard of erosion and preserves the productive capacity of the soil. Growing grasses and legumes for pasture and hay is an effective erosion-control practice. Including legumes, such as clover and alfalfa, in the crop rotation improves tilth and provides nitrogen for the following crop.

Terraces shorten the length of the slope and thereby reduce the hazard of erosion. Special construction and management techniques are necessary for the effective functioning of terrace systems in most moderately sloping areas of the eroded Armstrong and Leonard soils. Using cropping systems that provide substantial vegetative cover in conjunction with the terrace system also helps to control erosion.

Conservation tillage provides a protective surface cover and therefore reduces the runoff rate and increases the rate of water infiltration. Conservation tillage methods include the use of tillage equipment that leaves much of the crop residue on the surface.

Contour stripcropping, grassed waterways, and diversions reduce the hazard of erosion by maintaining strips of permanent vegetation that are planted on the contour. These strips of grass or a combination of grass and legumes is generally used for hay. The areas between the strips are cultivated, and row crops are planted on the contour. Contour stripcropping can also be used with alternating strips of row crops and close-growing crops, such as winter wheat.

Surface drainage and flood control are management concerns on all of the soils on flood plains in Schuyler County. Flooding is a problem on Fatima, Kennebec, and Zook soils. If flooding occurs, it commonly is during the period from November through May. Vesser and Arbela soils are naturally so wet that crop production tends to be hindered.

Edina soils are on broad, nearly level ridgetops in the uplands. They are slowly permeable. When these soils receive excess water, they stay wet for long periods. Excess water can be removed from most soils by land grading and field ditches.

Natural fertility is relatively low in most of the eroded soils. All of the soils in the survey area, however, require additional plant nutrients for maximum production. Most of the soils in Schuyler County are naturally acid in the upper part of the rooting zone and require applications of agricultural lime to raise the pH sufficiently for optimum plant growth. On all soils, the additions of lime and fertilizer should be based on the results of soil tests, on the needs of the specific crop, and on the production level desired. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer and lime needed.

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. Most of the uneroded upland soils used for crops have a surface layer of silt loam or silty clay loam. Generally, tillage and compaction weaken the structure of soils that have a surface layer of silt loam. As a result, a crust can form on the surface of these soils during periods of intense rainfall. The crust becomes hard when it dries. Such a crust can reduce the rate of water infiltration, increase the runoff rate, and inhibit seedling emergence. Regularly adding crop residue, manure, and other organic material improves soil structure and tilth.

All of the eroded upland soils have more clay in the surface layer, poorer tilth, a slower infiltration rate, and a more rapid runoff rate than the uneroded upland soils. On all soils that have slopes of more than 2 percent, appropriate conservation systems are needed to reduce the hazard of further erosion.

Fall plowing is used to some extent in Schuyler County, but it is a poor practice on most of the upland soils. These soils generally are sloping and are subject to damaging erosion if they are plowed in the fall.

Corn and soybeans are the field crops best suited to the soils and climate of the county and are the crops most commonly grown. For the crop year 1989, an estimated 13,200 acres of soybeans and 9,700 acres of corn was harvested. Grain sorghum was grown on less than 500 acres. Winter wheat is the most common close-growing crop. In 1989, this crop was grown on about 2,400 acres (Missouri Department of Agriculture, 1988).

The soils and climate in Schuyler County are suited to pasture and hay crops. Several legumes, cool-season grasses, and warm-season native grasses are managed for pasture and hay crops. Alfalfa and red clover are the common legumes grown for hay. They are also used in mixtures that include bromegrass or orchardgrass. Birdsfoot trefoil can be used alone or in mixtures that include bromegrass, orchardgrass, tall fescue, and bluegrass. Warm-season native grasses adapted to the county are big bluestem, indiangrass, and switchgrass. These grasses are productive during the summer when the cool-season species are in a dormant condition. The management techniques needed for the establishment and grazing of warm-season grasses are different from those needed for the establishment and grazing of cool-season grasses.

Very deep, moderately well drained and well drained soils, such as Winnegan and Gara soils, are well suited to alfalfa. Other legumes and most grasses grow well on most of the upland soils. Zook soils are frequently flooded and stay wet for long periods. These soils are better suited to short-season summer annuals or to wetness-tolerant species, such as reed canarygrass.

The major concerns affecting pasture management are overgrazing, surface compaction, and erosion. Control of grazing is needed to keep plants at maximum production levels. Keeping grasses at a desirable height reduces the runoff rate and helps to control erosion. Deferring grazing during periods when the surface soil contains excess moisture can minimize surface compaction.

Specialty crops grown in the survey area include apples, Christmas trees, and various garden vegetables. The latest information on growing specialty crops can be obtained from local offices of the Cooperative Extension Service and the Natural Resources Conservation Service.

Yields per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 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 the numbers 1 through 8. The numbers indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class 1 soils have few limitations that restrict their use.

Class 2 soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class 3 soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class 4 soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class 5 soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class 6 soils have severe limitations that make them generally unsuitable for cultivation.

Class 7 soils have very severe limitations that make them unsuitable for cultivation.

Class 8 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,* or *s,* to the class numeral, for example, 2e. The letter *e* shows that the main hazard is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); and *s* shows that the soil is limited mainly because it is shallow, droughty, or stony.

In class 1 there are no subclasses because the soils of this class have few limitations. Class 5 contains only the subclasses indicated by *w* or *s* because the soils in class 5 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

Douglas C. Wallace, forester, Natural Resources Conservation Service, helped prepare this section.

Approximately 11 percent of Schuyler County is forested, according to 1986 woodland survey estimates by the Missouri Department of Conservation. Tree species and growth rates vary, depending upon site conditions, soil types, and past management (Geissman and others, 1986).

Site characteristics that affect tree growth include aspect and topographic position. These site characteristics influence the amount of available sunlight, air drainage, soil temperature, soil moisture, and relative humidity. Generally, north and east aspects and the lower slope positions, which are cooler and have better moisture conditions, are the best upland sites for tree growth.

Soil properties are fundamentally important for woodland production. A quarter or more of a tree's mass is in the soil, which serves as a reservoir for moisture, provides an anchor for roots, and supplies essential plant nutrients. Soil properties that affect the growth of trees include reaction (pH), fertility, drainage, texture, structure, slope, and depth. Soils in which these properties are not extreme and that have an effective rooting depth of more than 40 inches provide the best medium for timber production.

Soil wetness is the result of a high water table, flooding, or ponding. It causes seedling mortality, limits the use of equipment, and increases the windthrow hazard by restricting the rooting depth of some trees. Soils that have a perched water table include the moderately well drained Armstrong soils. Ruts form easily if wheeled skidders are used when these soils are wet. Deep ruts tend to restrict lateral drainage, result in damage to tree roots, and alter soil structure. Flooding is a problem on Excello and Zook soils. On flooded or ponded soils, equipment should be used only during dry periods or when the ground is frozen.

Slope can limit the use of forestry equipment. On soils that have slopes of 15 percent or more, the use of equipment is restricted in logging areas, on skid trails, in yarding areas, and on unsurfaced logging roads. Erosion is a hazard in these disturbed areas. Using special erosion-control measures, such as water bars or dips, and designing logging roads and skid trails so that the steepness and length of slope and the concentration of water are minimized can reduce the hazard of erosion. Steep slopes are a safety hazard and further restrict the use of equipment. Forestry equipment should be operated on the contour when possible. In some extremely sloping areas, it may be necessary to move the logs uphill to skid trails and yarding areas.

Management activities can influence woodland productivity and should be aimed at eliminating the factors that cause tree stress. Generally, such management includes thinning young stands, harvesting mature trees, and preventing destructive fire and grazing by livestock. Fire and grazing have very negative impacts on forest growth and quality. Although forest fires are no longer a major problem in the county, about 30 percent of the woodland is subject to grazing. Grazing destroys the leaf layer on the surface, compacts the soil, and kills or damages tree seedlings. Woodland sites that have not been grazed or burned have the highest potential for optimum timber production.

Timbered areas have been extensively cleared in areas of the Lamoni-Seymour-Leonard and Gara-Armstrong associations, which are described under the heading "General Soil Map Units." Some acreage remains wooded, primarily on steep backslopes and in narrow drainageways. Common tree species are white oak, black oak, post oak, shagbark hickory, pin oak, and black walnut.

The Winnegan-Keswick association has the largest acreage of upland forest in the county. Typical species are white oak, northern red oak, black oak, mockernut hickory, post oak, ash, and black walnut. Species composition and growth vary from one site to another. Vigorous stands of almost pure white oak are on some north- and east-facing slopes. Species of lower quality that grow more slowly, such as post oak, generally are on the south-facing slopes and ridgetops. Forested areas of undisturbed Winnegan soils are highly productive.

Wooded areas of the Gara-Armstrong association have been heavily grazed. This practice has encouraged the growth of low-quality species, such as shingle oak and shagbark hickory (fig. 13). In protected areas, isolated stands of white oak and northern red oak are on north- and east-facing slopes.

The Zook-Kennebec-Fatima association supports bottom-land hardwoods. Most areas of this association have been cleared of trees and are used for crops. In areas of the Kennebec soils that support trees, typical species include green ash, pin oak, swamp white oak, sycamore, common hackberry,

Figure 13.—Improved pasture in an area of Armstrong loam, 5 to 9 percent slopes, eroded, in the foreground and grazed woodland in an area of Gara loam, 14 to 20 percent slopes, eroded, in the background. Allowing grazing in wooded areas reduces the productivity of the stands.

and river birch. Some areas of Zook and Wabash soils support a high percentage of eastern cottonwood and silver maple.

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 *L*, low strength. 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 L.

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 the 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 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.

Plant competition ratings indicate the degree to which undesirable species are expected to invade and grow when openings are made in the tree canopy. The main factors that affect plant competition are depth to the water table and the available water capacity. A rating of *slight* indicates that competition from undesirable plants is not likely to prevent natural regeneration or suppress the more desirable species. Planted seedlings can become established without undue competition. A rating of *moderate* indicates that competition may delay the establishment of desirable species. Competition may hamper stand development, but it will not prevent the eventual development of fully stocked stands. A rating of *severe* indicates that competition can be expected to prevent regeneration unless precautionary measures are applied.

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

Douglas C. Wallace, forester, Natural Resources Conservation Service, helped prepare this section.

A need for well designed farmstead, feedlot, and field windbreaks exists throughout Schuyler County, especially in the prairie areas of the Lamoni-Seymour-Leonard and Zook-Kennebec-Fatima associations. These associations are described under the heading "General Soil Map Units." Windbreaks can reduce the energy required to heat a home by 10 to 30 percent and can moderate the effects of cold winter winds, thereby increasing the comfort of humans and animals (Van Haverbeke, 1978). Animals can show significant gains over winter when they are protected by windbreaks. Research has also shown that crop production increases when the fields are protected by a field windbreak (Ogbuehi and Brandle).

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, the Missouri Department of Conservation, or the Cooperative Extension Service or from a commercial nursery.

Recreation

Recreational facilities in Schuyler County include game courts, picnic areas, campgrounds, hunting areas, a shooting preserve, a shooting range, hiking trails, fishing lakes and ponds, and recreational lakes.

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 large stones on the surface. 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 are gently sloping 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

Keith Jackson, biologist, Missouri Department of Conservation, helped prepare this section.

Schuyler County is one of 21 counties in Missouri that make up the Northeast Riverbreaks Zoogeographic Region (Nagel, 1970). The diversity of cover types makes this region one of the richest game areas in the State. As the transition zone between the prairie and the Ozark Border, the region provides a variety and profusion of edge-growth that makes excellent wildlife habitat. Major problems affecting the county's wildlife resource have been identified as the conversion of woodland to grassland and cropland and the loss of hedgerows and brushy waterways. Also, tillage in the fall rather than in the spring reduces the amount of food available to wildlife.

More than 116 fish and wildlife species have been recorded for Schuyler County. Another 180 species are believed to inhabit the survey area. Some, like the osprey, are rarely seen in the county, but many others migrate through the area in the spring and fall. Typical nongame species include red-winged blackbird, house wren, red-tailed hawk, red-sided garter snake, fathead minnow, western chorus frog, and deer mouse. The most common game species include bobwhite quail, white-tailed deer, eastern wild turkey, fox squirrel, gray squirrel, eastern cottontail rabbit, largemouth bass, channel catfish, bluegill, common snapping turtle, and raccoon.

The federally endangered Indiana bat has been observed in the county. Other species identified by the State as rare and endangered have been sighted in the survey area. These include the least weasel and river otter. Eleven additional rare and endangered species are thought to exist in the county.

The furbearer population in Schuyler County is good. Raccoon, muskrat, opossum, coyote, red fox, beaver, mink, and gray fox are the principal species trapped in the county.

The Lamoni-Seymour-Leonard, Gara-Armstrong, and Zook-Kennebec-Fatima associations provide the majority of the openland habitat for wildlife. These associations are described under the heading "General Soil Map Units." The Winnegan-Keswick association also has some acreages of hayland and grassland. Small blocks of timber, waterways, hedgerows, fence rows, and other areas providing woody or brushy cover are scattered throughout much of the county (fig. 14). Such "hard cover" areas supply an important type of habitat that is rapidly disappearing in many parts of the State that are presently devoted to intensive agricultural uses. Typical openland species include bobwhite quail, dickcissel, eastern meadowlark, and Franklin's ground squirrel.

The bobwhite quail is one of the county's most popular game species. It is heavily hunted. The resident dove population is poor, and fall migratory flights of this bird are minimal. The populations of ring-necked pheasant are good in the agricultural areas.

Most of the woodland in the county is in areas of the Winnegan-Keswick association. About 11 percent of the county has some form of wooded habitat, which includes the smaller brushy plant species (Missouri Department of Conservation, 1984). Common woodland wildlife species include turkey, raccoon, short-tailed shrew, tufted titmouse, American toad, downy woodpecker, and white-breasted nuthatch.

A good deer population is in the county. Interest in deer hunting is very high. The turkey population is quite good, and hunter interest is high for this game bird. The population of squirrel is good, but hunting pressure is light. Woodcock are scarce, and hunter interest in this game species is low because of limited migratory flights in the area.

Nearly all of the remaining wetland habitat is in the Zook-Kennebec-Fatima association. This association is in areas of bottom land and provides the primary waterfowl habitat in Schuyler County. Small reservoirs provide resting areas for Canada geese, snow geese, and blue geese and for mallard, pintail, scaup, and teal. Populations of wood ducks are fair where riparian timber grows along streams. River

Figure 14.—A typical landscape in an area of Gara loam, 14 to 20 percent slopes, eroded. Zook and Excello soils are between the hillslopes. The trees along the drainageway provide cover for openland wildlife species.

otters have been stocked by the Department of Conservation.

Prime fishing is available in rivers, streams, lakes, and farm ponds. The most important permanently flowing streams are the Chariton River and the Fabius River. Anglers fish for channel catfish, carp, drum, bullheads, and sunfish.

Wildlife habitat could be improved throughout the county. Practices that can improve the habitat include using conservation tillage and other soil conservation measures on cropland, saving existing hedgerows and woody draws, planting windbreaks, providing legumes and native prairie grasses for forage production, eliminating grazing in woodlands, and planting areas of marginal cropland to grass-legume mixtures or to trees.

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, winter wheat, oats, millet, soybeans, and grain sorghum.

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 bluegrass, tall fescue, switchgrass, orchardgrass, bluestem, indiangrass, clover, alfalfa, trefoil, and crownvetch.

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

Hardwood trees and woody understory produce nuts or other fruits, 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, cherry, apple, hawthorn, dogwood, hickory, blackberry, wild plum, sumac, persimmon, Osage-orange, and eastern redcedar. Examples of fruit-producing shrubs suitable for planting on soils rated *good* are crabapple, wild plum, hawthorn, and hazelnut.

Coniferous plants furnish winter cover, browse, and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, cedar, and juniper.

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

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, meadowlark, field sparrow, cottontail, red fox, woodchuck, and mourning dove.

Habitat for woodland wildlife consists of areas of woody 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, woodchuck, 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, herons, 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 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, and shrinking and swelling can cause the movement of footings. A high water table, depth to bedrock, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 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, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

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

Sanitary Facilities

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

Table 12 also shows the suitability of the soils for use as daily cover for 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, and flooding affect absorption of the effluent. Large stones and bedrock interfere with installation.

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

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

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

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

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation 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, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, soil reaction, and content of salts and sodium affect trench 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 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; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

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

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

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

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

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

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

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

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

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

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

Soil Properties

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

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

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

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

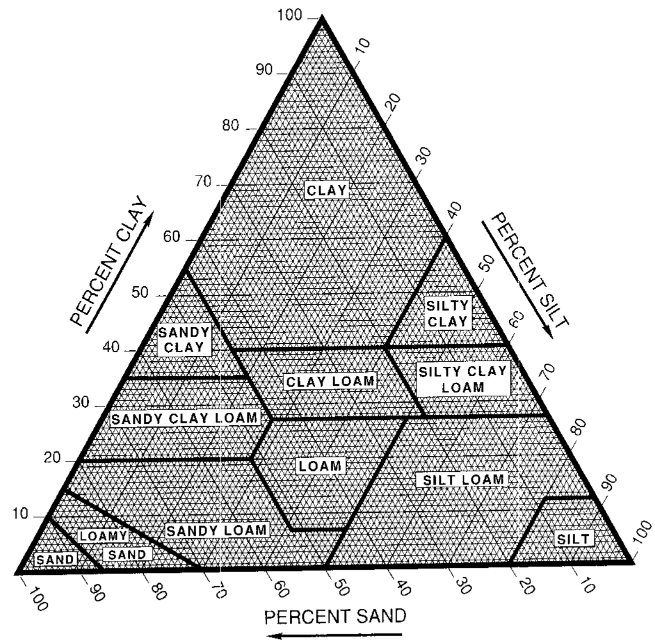

Figure 15.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

millimeters in diameter (fig. 15). "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 1/3-bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems 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 change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

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

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

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

1. 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 or by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (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. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

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 creates 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. Twelve 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. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Hapludalfs.

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

Ackmore Series

The Ackmore series consists of very deep, poorly drained, moderately permeable soils on alluvial fans and flood plains. These soils formed in alluvium. Slopes range from 0 to 2 percent.

These soils are classified as fine-silty, mixed, nonacid, mesic Aeric Fluvaquents.

Typical pedon of Ackmore silt loam, occasionally flooded, 2,250 feet east and 4,800 feet south of the northwest corner of sec. 23, T. 65 N., R. 16 W.; Lavonia quadrangle, lat. 40 degrees 25 minutes 3 seconds N. and long. 92 degrees 39 minutes 36 seconds W.

Ap1—0 to 5 inches; very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak medium platy structure parting to weak fine granular; friable; common very fine roots; few very fine tubular pores; neutral; clear smooth boundary.

Ap2—5 to 12 inches; very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak medium platy structure parting to weak fine subangular blocky; friable; common very fine roots; few very fine tubular pores; few fine dark accumulations of iron and manganese oxides; neutral; clear smooth boundary.

Cg—12 to 24 inches; 50 percent grayish brown (10YR 5/2) and 50 percent dark gray (10YR 4/1) silt loam; massive with weak thin bedding planes; friable; few very fine roots; few fine and many very fine tubular pores; common fine prominent strong brown (7.5YR 4/6) iron masses in the matrix; few fine dark accumulations of iron and manganese oxides; neutral; abrupt smooth boundary.

2Ab1—24 to 32 inches; very dark gray (N 3/0) silty clay loam; weak medium prismatic structure parting to weak fine subangular blocky; firm; few very fine roots; common very fine tubular pores; few fine prominent strong brown (7.5YR 4/6) iron masses in the matrix; few fine dark accumulations of iron and manganese oxides; neutral; gradual smooth boundary.

2Ab2—32 to 55 inches; very dark gray (N 3/0) silty clay loam; weak medium prismatic structure parting to weak fine subangular blocky; firm; few very fine roots; common very fine tubular pores; common pressure faces; common fine prominent strong brown (7.5YR 4/6) iron masses in the matrix; few fine concretions of iron and manganese oxides; neutral; gradual smooth boundary.

2Bgb—55 to 70 inches; very dark gray (10YR 3/1) silty clay loam; weak coarse prismatic structure parting to weak fine subangular blocky; firm; common very fine tubular pores; common fine prominent brown (7.5YR 4/4) and common fine prominent yellowish brown (10YR 5/6) iron masses in the matrix; few fine concretions of iron and manganese oxides; common pressure faces; neutral; gradual smooth boundary.

2Cg—70 to 80 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak coarse prismatic structure parting to weak fine subangular blocky along prism faces; firm; common very fine tubular pores; common medium prominent strong brown (7.5YR 4/6) iron masses in the matrix; few fine concretions of iron and manganese oxides; few sheens on faces of peds; neutral.

Depth to the 2Ab horizon ranges from 20 to 36 inches. The Ap horizon has value of 2 to 4 and chroma of 1 or 2. The Cg horizon has value of 2 to 5 and chroma of 1 or 2. It is silt loam or silty clay loam. The 2Ab horizon has value of 2 or 3 and chroma of 0 or 1.

Adco Series

The Adco series consists of very deep, somewhat poorly drained, very slowly permeable soils on uplands. These soils formed in loess or in loess and loamy sediments. Slopes range from 1 to 3 percent.

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

Typical pedon of Adco silt loam, 1 to 3 percent slopes, 2,200 feet east and 3,250 feet south of the northwest corner of sec. 9, T. 65 N., R. 13 W.; Downing quadrangle, lat. 40 degrees 27 minutes 13 seconds N. and long. 92 degrees 21 minutes 43 seconds W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure parting to weak fine granular; friable; many very fine roots; few fine tubular pores; neutral; abrupt smooth boundary.

E—9 to 15 inches; dark grayish brown (10YR 4/2) silt loam; weak thick platy structure parting to weak fine subangular blocky; friable; few very fine roots; few fine and common very fine tubular pores; few fine concretions of iron and manganese oxides; slightly acid; abrupt smooth boundary.

Btg—15 to 20 inches; dark grayish brown (10YR 4/2) silty clay; weak fine subangular blocky structure; firm; few very fine roots; few very fine tubular pores; common distinct clay films on faces of peds; common fine distinct dark yellowish brown

(10YR 4/6) iron masses in the matrix; few fine dark accumulations of iron and manganese oxides; slightly acid; abrupt smooth boundary.

Bt1—20 to 25 inches; brown (10YR 4/3) silty clay; weak fine subangular blocky structure; firm; few very fine roots; few very fine tubular and vesicular pores; common distinct clay films on faces of peds; few fine dark accumulations of iron and manganese oxides; slightly acid; clear smooth boundary.

Bt2—25 to 33 inches; brown (10YR 5/3) silty clay; weak fine subangular blocky structure; firm; few very fine roots; common very fine tubular pores; common faint clay films; common fine distinct yellowish brown (10YR 5/6) iron masses in the matrix; few fine dark accumulations of iron and manganese oxides; neutral; clear smooth boundary.

B′tg1—33 to 44 inches; grayish brown (10YR 5/2) silty clay loam; weak fine subangular blocky structure; firm; few very fine roots; few fine and many very fine tubular pores; common faint clay films; common fine distinct dark yellowish brown (10YR 4/6) and few medium prominent strong brown (7.5YR 4/6) iron masses in the matrix; few fine dark accumulations of iron and manganese oxides; organic coatings in fine tubular pores; neutral; clear smooth boundary.

B′tg2—44 to 54 inches; grayish brown (2.5Y 5/2) silty clay loam; weak medium prismatic structure parting to weak fine subangular blocky along prism faces; firm; few very fine roots; few fine and common very fine tubular pores; few faint clay films on faces of peds; common fine distinct yellowish brown (10YR 5/6) and few medium prominent strong brown (7.5YR 4/6) iron masses in the matrix; few fine dark accumulations of iron and manganese oxides; few medium stains of iron and manganese oxides; neutral; gradual smooth boundary.

2Btg—54 to 64 inches; grayish brown (2.5Y 5/2) silty clay loam; weak medium prismatic structure parting to weak fine angular blocky; firm; very few very fine roots; many very fine tubular pores; few faint clay films on faces of peds; many medium distinct yellowish brown (10YR 5/6) iron masses in the matrix; few fine dark accumulations of iron and manganese oxides; neutral; gradual smooth boundary.

2BC—64 to 80 inches; dark yellowish brown (10YR 4/4) silt loam; weak coarse prismatic structure parting to weak medium angular blocky; firm; common very fine tubular pores; few faint clay films; common medium distinct grayish brown (10YR 5/2) iron depletions; few fine dark accumulations of iron and manganese oxides; neutral.

Depth to the 2BC horizon or to a zone where a marked increase in sand content occurs ranges from 40 to more than 60 inches. The Ap horizon has chroma of 1 or 2. The E horizon has value of 4 or 5 and chroma of 2 or 3. It is silt loam or silty clay loam.

Some pedons have a BE horizon. This horizon has value of 4 or 5 and chroma of 2 or 3. It is silt loam or silty clay loam.

The Bt horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 3 or 4. It is silty clay or silty clay loam. The Btg horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. It is silty clay or silty clay loam.

The 2BCg horizon has hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 1 to 8. It is silty clay loam, clay loam, or silt loam.

Alvin Series

The Alvin series consists of very deep, well drained soils on high stream terraces. These soils formed in glaciofluvial sands. Permeability is moderately rapid. Slopes range from 2 to 9 percent.

The Alvin soils in this survey area are taxadjuncts because they have a mollic epipedon. This difference, however, does not significantly affect the use and management of the soils. The soils are classified as coarse-loamy, mixed, mesic Typic Argiudolls.

Typical pedon of Alvin loamy sand, 2 to 9 percent slopes, eroded, 3,200 feet east and 1,200 feet south of the northwest corner of sec. 15, T. 64 N., R. 16 W.; Connelsville quadrangle, lat. 40 degrees 21 minutes 17 seconds N. and long. 92 degrees 40 minutes 30 seconds W.

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) loamy sand, grayish brown (10YR 5/2) dry; weak fine and medium granular structure; friable; few very fine roots; moderately acid; abrupt smooth boundary.

Bt1—10 to 21 inches; brown (10YR 4/3) sandy loam; moderate fine medium subangular blocky structure; friable; few very fine roots; common very fine tubular pores; few distinct clay films on faces of peds; slightly acid; clear smooth boundary.

Bt2—21 to 30 inches; dark yellowish brown (10YR 4/4) sandy loam; weak fine and medium subangular blocky structure; friable; few very fine roots; few very fine tubular pores; few distinct clay films on faces of peds; slightly acid; clear smooth boundary.

Bt3—30 to 40 inches; dark yellowish brown (10YR 4/4) sandy loam; weak medium and coarse subangular blocky structure; friable; few very fine roots; common very fine tubular pores; few distinct clay films on faces of peds; slightly acid; gradual smooth boundary.

BC—40 to 48 inches; yellowish brown (10YR 5/6) loamy sand; massive; very friable; neutral; clear smooth boundary.

C—48 to 80 inches; brownish yellow (10YR 6/6) sand; single grain; loose; neutral in the upper part and strongly acid in the lower part.

The Ap horizon has value of 3 or 4 and chroma of 2 or 3.

Some pedons have an E horizon. This horizon has value of 4 or 5 and chroma of 2 or 3.

The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is very fine sandy loam, loam, fine sandy loam, or sandy loam.

The C horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 to 6. It is sandy loam, loamy sand, or sand.

Amana Series

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

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

Typical pedon of Amana silty clay loam, occasionally flooded, 1,300 feet south and 5,100 feet east of the northwest corner of sec. 33, T. 67 N., R. 16 W.; Coatesville quadrangle, lat. 40 degrees 34 minutes 15 seconds N. and long. 92 degrees 41 minutes 34 seconds W.

Ap1—0 to 7 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; few fine and common very fine roots; few fine and few very fine tubular pores; neutral; clear smooth boundary.

Ap2—7 to 12 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; moderate fine and medium angular blocky structure; friable; few fine and few very fine roots; few fine and few very fine tubular pores; neutral; clear smooth boundary.

A—12 to 23 inches; very dark gray (10YR 3/1) silty clay loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; firm; few very fine roots; few fine and common very fine tubular pores; neutral; abrupt smooth boundary.

Bw1—23 to 38 inches; dark grayish brown (10YR 4/2) silt loam; weak medium subangular blocky structure; firm; few very fine roots; few fine and many very fine tubular pores; common fine faint dark yellowish brown (10YR 4/4) iron masses in the matrix; slightly acid; gradual smooth boundary.

Bw2—38 to 52 inches; dark grayish brown (10YR 4/2) and brown (10YR 4/3) silt loam; weak medium subangular blocky structure; firm; few very fine roots; few fine and many very fine tubular pores; common fine faint yellowish brown (10YR 5/4) iron masses in the matrix; slightly acid; gradual smooth boundary.

C1—52 to 62 inches; 90 percent dark grayish brown (10YR 4/2) and brown (10YR 4/3) and 10 percent yellowish brown (10YR 5/4) silt loam; massive; friable; few very fine roots; common fine and many very fine tubular pores; many prominent silt flows in tubular pores; slightly acid; gradual smooth boundary.

C2—62 to 75 inches; dark grayish brown (10YR 4/2) silt loam; massive; friable; common fine and common very fine tubular pores; common medium prominent gray (10YR 5/1) iron depletions; few fine dark accumulations of iron and manganese oxides; slightly acid; gradual smooth boundary.

C3—75 to 80 inches; brown (10YR 4/3) silt loam; massive; friable; few fine and common very fine tubular pores; few fine and medium faint grayish brown (10YR 5/2) iron depletions; slightly acid.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The Bw horizon has value of 4 or 5 and chroma of 2 or 3. The C horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 to 4.

Arbela Series

The Arbela series consists of very deep, poorly drained, moderately slowly permeable soils on alluvial fans and high flood plains. These soils formed in alluvium. Slopes range from 0 to 2 percent.

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

Typical pedon of Arbela silt loam, in an area of Arbela and Humeston soils, occasionally flooded, 1,300 feet east and 4,350 feet south of the northwest corner of sec. 15, T. 65 N., R. 16 W.; Lavonia quadrangle, lat. 40 degrees 25 minutes 58 seconds N. and long. 92 degrees 40 minutes 57 seconds W.

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

E—10 to 17 inches; dark grayish brown (10YR 4/2) silt loam; weak medium platy structure; friable; few very fine roots; few fine and common very fine tubular pores; strongly acid; clear smooth boundary.

Btg1—17 to 20 inches; dark gray (10YR 4/1) silty clay loam; weak fine subangular blocky structure; firm; few very fine roots; common very fine tubular pores; common distinct clay depletions on faces of peds; slightly acid; abrupt smooth boundary.

Btg2—20 to 30 inches; dark gray (10YR 4/1) silty clay loam; moderate fine angular blocky structure; firm; few very fine roots; common very fine tubular pores; common distinct clay films on faces of peds; few fine distinct dark yellowish brown (10YR 4/4) iron masses in the matrix; few fine dark accumulations of iron and manganese oxides; common distinct very dark gray (10YR 3/1) organic coatings on faces of peds; slightly acid; clear smooth boundary.

Btg3—30 to 44 inches; grayish brown (10YR 5/2) silty clay; weak medium prismatic structure parting to weak fine subangular blocky; firm; few very fine roots; few very fine tubular pores; common fine distinct yellowish brown (10YR 5/6) iron masses in the matrix; few distinct clay films on faces of peds; neutral; gradual smooth boundary.

Btg4—44 to 52 inches; grayish brown (2.5Y 5/2) silty clay loam; weak medium prismatic structure; firm; common very fine tubular pores; few distinct clay films on faces of peds; common fine and medium prominent yellowish brown (10YR 5/6) iron masses in the matrix; few fine dark accumulations of iron and manganese oxides; neutral; gradual smooth boundary.

BCg—52 to 65 inches; grayish brown (2.5Y 5/2) silty clay loam; weak medium prismatic structure parting to weak fine subangular blocky; firm; common very fine tubular pores; common fine and medium prominent yellowish brown (10YR 5/6) iron masses in the matrix; few fine dark accumulations of iron and manganese oxides; neutral.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The E horizon has value of 4 or 5 and chroma of 1 or 2. The Btg horizon has value of 4 or 5 and chroma of 1 or 2. The BCg horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2.

Armstrong Series

The Armstrong series consists of very deep, moderately well drained, slowly permeable soils on uplands. These soils formed in 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, 4,400 feet east and 450 feet south of the northwest corner of sec. 5, T. 65 N., R. 14 W.; Downing Northwest quadrangle, lat. 40 degrees 28 minutes 30 seconds N. and long. 92 degrees 29 minutes 12 seconds W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate very fine and fine granular structure; friable; many very fine roots; common very fine tubular pores; dark yellowish brown (10YR 4/4) subsoil material mixed in the lower part; 2 percent fine gravel; neutral; abrupt smooth boundary.

Bt1—6 to 12 inches; dark brown (7.5YR 4/3) clay loam; moderate very fine and fine subangular blocky structure; firm; common very fine roots; common very fine tubular pores; stone line at the base of the horizon; few faint clay films on faces of peds; common fine prominent red (2.5YR 4/6) iron masses in the matrix; common very dark grayish brown (10YR 3/2) organic coatings; 5 percent fine gravel; moderately acid; abrupt smooth boundary.

Bt2—12 to 20 inches; dark yellowish brown (10YR 4/4) clay loam; moderate fine subangular blocky structure; very firm; common very fine roots; common very fine tubular pores; common faint clay films on faces of peds; common fine faint grayish brown (10YR 5/2) iron depletions in the matrix and many prominent red (2.5YR 4/6) iron masses in the matrix; few fine dark accumulations of iron and manganese oxides; 2 percent fine gravel; strongly acid; clear smooth boundary.

Bt3—20 to 31 inches; strong brown (7.5YR 4/6) clay loam; weak fine subangular blocky structure; very firm; few very fine roots; common very fine tubular pores; many faint clay films on faces of peds; many fine prominent light brownish gray (10YR 6/2) iron depletions in the matrix and common red (2.5YR 4/6) iron masses in the matrix; common dark accumulations of iron and manganese oxides; 8 percent fine gravel; strongly acid; clear smooth boundary.

Bt4—31 to 42 inches; strong brown (7.5YR 5/6) clay loam; moderate medium prismatic structure parting to weak fine subangular blocky; very firm; few medium roots; common faint clay films on faces of peds; many coarse prominent light brownish gray (10YR 6/2) iron depletions in the matrix and common fine distinct dark yellowish brown (10YR 4/4) iron masses in the matrix; few stains of iron and manganese oxides; few fine dark accumulations of iron and manganese oxides; 5 percent fine gravel; slightly acid; clear smooth boundary.

Bt5—42 to 65 inches; yellowish brown (10YR 5/6) clay loam; moderate medium prismatic structure parting to weak very fine subangular blocky; very firm; few very fine roots in cracks; few very fine tubular pores; few faint clay films in tubular pores; many medium prominent light brownish gray (10YR 6/2) iron depletions in the matrix and common fine and medium distinct dark yellowish brown (10YR 4/4) iron masses in the matrix; common organic coatings in root channels, in tubular pores, or both; few fine dark accumulations of iron and manganese oxides; 8 percent fine gravel; neutral.

The depth to carbonates ranges from 42 to more than 60 inches. The Ap horizon has chroma of 1 or 2. It is loam or clay loam.

Some pedons have an E horizon. This horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is loam or silt loam.

The Bt horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 to 6. Some pedons have a 2Bt horizon. This horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 to 6.

Some pedons have a 2BC horizon, which has hue of 10YR or 2.5Y and chroma of 3 to 6. Some pedons have a Bk horizon. This horizon has hue of 2.5Y or 10YR, value of 4 to 6, and chroma of 3 to 6. It is clay loam or loam.

Bevier Series

The Bevier series consists of very deep, somewhat poorly drained, slowly permeable soils on uplands and stream terraces. These soils formed in loess and loamy sediments and in weathered glacial till. Slopes range from 3 to 9 percent.

These soils are classified as fine, montmorillonitic, mesic Aeric Vertic Epiaqualfs.

Typical pedon of Bevier silty clay loam, 3 to 8 percent slopes, 2,000 feet east and 5,075 feet south of the northwest corner of sec. 35, T. 67 N., R. 15 W.; Lancaster quadrangle, lat. 40 degrees 33 minutes 46 seconds N. and long. 92 degrees 33 minutes 7 seconds 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; many very fine roots; few very fine tubular pores; neutral; clear smooth boundary.

BE—8 to 12 inches; dark grayish brown (10YR 4/2) silty clay loam, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure; firm; many very fine roots; few very fine tubular pores; streaks of very dark gray (10YR 3/1) surface soil; few fine prominent brownish yellow (10YR 6/8) iron masses in the matrix; neutral; abrupt smooth boundary.

Btg1—12 to 24 inches; grayish brown (10YR 5/2) silty clay; weak very fine subangular blocky structure; firm; common very fine roots; common distinct clay films on faces of peds; many fine prominent reddish yellow (7.5YR 6/8) iron masses in the matrix; neutral; clear smooth boundary.

Btg2—24 to 35 inches; grayish brown (2.5Y 5/2) silty clay; weak very fine subangular blocky structure; firm; few very fine roots; few very fine tubular pores; common distinct clay films on faces of peds; few fine prominent yellowish brown (10YR 5/8) iron masses in the matrix; few fine dark accumulations of iron and manganese oxides; neutral; clear smooth boundary.

Btg3—35 to 42 inches; light brownish gray (2.5Y 6/2) silty clay loam; weak medium prismatic structure parting to weak fine subangular blocky; firm; few very fine roots; few very fine tubular pores; common distinct clay films on faces of peds; common fine prominent dark yellowish brown (10YR 4/6) iron masses in the matrix; few fine dark accumulations of iron and manganese oxides; neutral; clear smooth boundary.

2Btg4—42 to 53 inches; grayish brown (2.5Y 5/2) silt loam; moderate medium prismatic structure parting to moderate fine subangular blocky; firm; few very fine roots; common very fine tubular pores; common distinct clay films on faces of peds; common fine and medium prominent dark yellowish brown (10YR 4/6) iron masses in the matrix; few fine dark accumulations of iron and manganese oxides; neutral; abrupt smooth boundary.

2BCg—53 to 68 inches; grayish brown (10YR 5/2) and yellowish brown (10YR 5/4 and 5/6) silt loam;

weak medium platy structure parting to weak fine subangular blocky; firm; very few very fine roots; few fine and few very fine tubular pores; few fine dark accumulations of iron and manganese oxides; neutral; gradual smooth boundary.

3Btb—68 to 80 inches; yellowish brown (10YR 5/4) clay loam; moderate medium prismatic structure parting to moderate fine angular blocky; firm; many prominent clay films on faces of peds; few fine distinct grayish brown (10YR 5/2) iron depletions; less than 1 percent fine gravel; neutral.

The depth to the 2Bt horizon ranges from 20 to 48 inches. The Ap horizon has chroma of 1 or 2. Some pedons have an E or BE horizon. This horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 or 3.

The Bt horizon has value of 4 to 6 and chroma of 2 to 4. The Btg horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4.

The 2Bt horizon has hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 1 to 6. It is silt loam, loam, clay loam, or silty clay loam. Some pedons have a 2Cg horizon.

Caleb Series

The Caleb series consists of very deep, moderately well drained, moderately permeable soils on high stream terraces. These soils formed in alluvium derived from glaciers. Slopes range from 9 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, 9 to 14 percent slopes, eroded, 470 feet west and 75 feet south of the center of sec. 20, T. 68 N., R. 13 W., in Davis County, Iowa:

Ap—0 to 8 inches; very dark gray (10YR 3/1) loam, grayish brown (10YR 5/2) dry; mixed with some streaks and pieces of brown (10YR 4/3) subsoil material; weak fine subangular blocky structure parting to weak fine granular; few thin plates in the lower part; friable; many fine roots; few fine silt coatings on faces of peds; neutral; abrupt smooth boundary.

BE—8 to 14 inches; brown (10YR 4/3) loam; common very dark grayish brown (10YR 3/2) coatings on faces of peds; weak thick platy structure parting to weak fine and very fine subangular blocky; friable; few fine roots; few distinct silt coatings on faces of peds; slightly acid; clear smooth boundary.

Bt1—14 to 20 inches; brown (10YR 4/3) loam; common dark grayish brown (10YR 4/2) coatings on faces of peds; weak fine subangular blocky structure; friable; few fine roots; few distinct silt coatings on faces of peds; strongly acid; gradual smooth boundary.

Bt2—20 to 30 inches; dark yellowish brown (10YR 4/4) loam; common dark grayish brown (10YR 4/2) coatings on faces of peds; moderate medium subangular blocky structure; friable; few fine roots; common distinct clay films on faces of peds; moderately acid; gradual smooth boundary.

BC1—30 to 35 inches; dark yellowish brown (10YR 4/4) loam; moderate medium subangular blocky structure; very friable; few fine roots; moderately acid; clear smooth boundary.

BC2—35 to 42 inches; yellowish brown (10YR 5/4) sandy loam; weak medium subangular blocky structure; very friable; few fine roots; moderately acid; clear smooth boundary.

2C1—42 to 54 inches; light yellowish brown (10YR 6/4) loamy sand; single grain; loose; moderately acid; clear smooth boundary.

3C2—54 to 60 inches; yellowish brown (10YR 5/6) sandy clay loam; weak coarse prismatic structure; firm; moderately acid.

The Ap horizon has chroma of 1 or 2. The Bt horizon has value of 4 or 5 and chroma of 3 to 6. It is clay loam, loam, or sandy clay loam. Strata of sandy loam, loamy sand, or sand are below a depth of 36 inches.

Clarinda Series

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

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

Typical pedon of Clarinda silty clay loam, 5 to 9 percent slopes, eroded, 3,730 feet south and 850 feet east of the northwest corner of sec. 16, T. 65 N., R. 15 W.; Queen City quadrangle, lat. 40 degrees 26 minutes 17 seconds N. and long. 92 degrees 35 minutes 21 seconds 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; firm; many very fine roots; neutral; abrupt smooth boundary.

2Bt—8 to 12 inches; very dark gray (10YR 3/1) silty clay, grayish brown (10YR 5/2) dry; moderate very fine subangular blocky structure; firm; many very fine roots; common faint dark gray (10YR 4/1) clay films on faces of peds; common fine faint dark grayish brown (10YR 4/2) iron depletions in the matrix; few fine soft black masses (oxides); 3 percent coarse and very coarse white sand grains; slightly acid; clear smooth boundary.

2Btg1—12 to 24 inches; grayish brown (2.5Y 5/2) clay; weak very fine subangular blocky structure; very firm; common very fine roots; many faint dark gray (N 4/0) clay films on faces of peds; common fine prominent strong brown (7.5YR 5/6) and few fine prominent yellowish red (5YR 4/6) iron masses in the matrix; few fine soft black masses; common fine black (10YR 2/1) organic stains; 2 percent coarse and very coarse white sand grains; strongly acid; gradual smooth boundary.

2Btg2—24 to 36 inches; gray (5Y 5/1) clay; weak medium prismatic structure parting to moderate very fine angular blocky; very firm; common very fine roots; few very fine tubular pores; common faint dark gray (5Y 4/1) clay films on faces of peds; many fine and medium prominent strong brown (7.5YR 5/6) and few fine prominent yellowish red (5YR 4/6) iron masses in the matrix; few fine soft black masses; common fine very dark gray (10YR 3/1) organic stains; 3 percent coarse and very coarse white sand grains; strongly acid; gradual smooth boundary.

2Btg3—36 to 65 inches; gray (5Y 5/1) clay; weak medium prismatic structure parting to moderate very fine angular blocky; very firm; few very fine roots; few very fine tubular pores; many faint dark gray (5Y 4/1) clay films on faces of peds; common fine prominent strong brown (7.5YR 5/6) and few fine prominent yellowish red (5YR 4/6) iron masses in the matrix; common fine black and yellowish red stains (oxides); 4 percent coarse and very coarse white sand grains; neutral.

The Ap horizon has value of 2 or 3. Some pedons have an AB horizon. The Btg horizon has hue of 10YR to 5Y and value of 4 or 5. Some pedons have a 2C horizon.

Edina Series

The Edina series consists of very deep, poorly drained, very slowly permeable soils on uplands. 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, 100 feet east and 5,180 feet south of the northwest corner of sec. 26, T. 65 N., R. 15 W.; Queen City quadrangle, lat. 40 degrees 24 minutes 11 seconds N. and long. 92 degrees 33 minutes 14 seconds W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak very fine granular structure; friable; many very fine roots; few fine and common very fine tubular pores; neutral; abrupt smooth boundary.

Eg—8 to 14 inches; grayish brown (10YR 5/2) silt loam; weak thick platy structure parting to weak very fine granular; friable; common very fine roots; few fine and common very fine tubular pores; common black (10YR 2/1) and yellowish brown (10YR 5/6) stains of iron and manganese oxides throughout; common fine rounded concretions of iron and manganese oxides; neutral; abrupt smooth boundary.

Btg1—14 to 19 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; strong very fine subangular blocky structure; very firm; common very fine roots; few very fine tubular pores; many faint clay films on faces of peds; few fine distinct dark yellowish brown (10YR 4/4) iron masses in the matrix; common black (10YR 2/1) and yellowish brown (10YR 5/6) stains of iron and manganese oxides; common fine rounded concretions of iron and manganese oxides; strongly acid; clear smooth boundary.

Btg2—19 to 23 inches; dark grayish brown (2.5Y 4/2) silty clay; moderate fine angular blocky structure parting to very fine subangular blocky; very firm; common very fine roots; few very fine tubular pores; many faint clay films on faces of peds; many fine distinct very dark gray (10YR 3/1) iron depletions in the matrix and few dark yellowish brown (10YR 4/4) iron masses in the matrix; common black (10YR 2/1) and yellowish brown (10YR 5/6) stains of iron and manganese oxides; common fine rounded concretions of iron and manganese oxides; moderately acid; clear smooth boundary.

Btg3—23 to 38 inches; grayish brown (2.5Y 5/2) silty clay; weak fine subangular blocky structure; very firm; few very fine roots; few very fine tubular pores; common fine distinct very dark gray (10YR 3/1) iron masses in the matrix in the upper part; many distinct clay films on faces of peds; common fine prominent yellowish brown (10YR 5/6 and 5/8) iron masses in the matrix; common fine concretions of iron and manganese oxides; moderately acid; clear smooth boundary.

Btg4—38 to 48 inches; olive gray (5Y 5/2) silty clay loam; weak fine subangular blocky structure; very firm; many very fine tubular pores; few distinct clay films on faces of peds and black stains throughout; few fine dark concretions of iron and manganese oxides; slightly acid; clear smooth boundary.

BCg—48 to 65 inches; olive gray (5Y 5/2) silty clay loam; weak coarse prismatic structure parting to weak fine angular blocky; firm; common very fine tubular pores; many fine prominent yellowish brown (10YR 5/8 and 5/6) and dark yellowish brown (10YR 4/4) iron masses in the matrix; few black stains throughout; few fine dark concretions of iron and manganese oxides; slightly acid.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The E horizon has value of 4 or 5 and chroma of 1 or 2. The Bt horizon has hue of 10YR or 2.5Y and value of 2 or 3. It is silty clay or silty clay loam. The Btg horizon has hue of 10YR to 5Y, value of 3 to 5, and chroma of 1 or 2. It is silty clay or silty clay loam. The Cg horizon has hue of 10YR to 5Y, value of 4 or 5, and chroma of 1 or 2.

Excello Series

The Excello series consists of very deep, poorly drained and somewhat poorly drained, moderately permeable soils on alluvial fans, toeslopes, and flood plains. These soils formed in colluvium. Slopes range from 2 to 5 percent.

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

Typical pedon of Excello silty clay loam, in an area of Zook and Excello soils, fans, 2 to 5 percent slopes, rarely flooded, 4,700 feet east and 3,350 feet south of the northwest corner of sec. 9, T. 65 N., R. 14 W.; Downing Northwest quadrangle, lat. 40 degrees 27 minutes 11 seconds N. and long. 92 degrees 27 minutes 55 seconds W.

Ap—0 to 6 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure in the upper 2 inches; weak fine and very fine subangular blocky structure in the lower part; friable; many very fine roots; neutral; gradual smooth boundary.

A1—6 to 13 inches; very dark gray (N 3/0) silt loam, very dark gray (10YR 3/1) dry; weak fine and very fine subangular blocky structure; friable; common very fine roots; few very fine tubular pores; neutral; gradual smooth boundary.

A2—13 to 25 inches; very dark gray (N 3/0) silt loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; few very fine roots; common very fine tubular pores; neutral; gradual smooth boundary.

Bg1—25 to 34 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; moderate medium prismatic structure parting to moderate medium angular blocky; friable; few very fine roots; few very fine tubular pores; common fine distinct brown (10YR 4/3) iron masses in the matrix; few fine dark accumulations of iron and manganese oxides; neutral; gradual smooth boundary.

Bg2—34 to 47 inches; dark grayish brown (2.5Y 4/2) and very dark gray (10YR 3/1) clay loam; weak coarse prismatic structure parting to weak medium angular blocky; firm; few very fine roots; common very fine tubular pores; common fine prominent yellowish brown (10YR 5/4) iron masses in the matrix; few fine dark accumulations of iron and manganese oxides; neutral; gradual smooth boundary.

Bg3—47 to 65 inches; light olive brown (2.5Y 5/4), dark grayish brown (2.5Y 4/2), and yellowish brown (10YR 5/6) loam; weak coarse prismatic structure; firm; few fine and common very fine tubular pores; many prominent organic coatings in fine tubular pores; common fine dark accumulations of iron and manganese oxides; few fine concretions of iron and manganese oxides; 1 percent fine gravel; neutral.

The A horizon has value of 2 or 3 and chroma of 0 to 2. The Bg horizon has value of 3 or 4 and chroma of 1 to 4, but chroma of 2 or less is dominant.

Fatima Series

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

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

Typical pedon of Fatima loam, in an area of Kennebec and Fatima soils, frequently flooded, 3,600 feet east and 100 feet south of the northwest corner of sec. 26, T. 66 N., R. 14 W.; Bunker Hill quadrangle, lat. 40 degrees 30 minutes 19 seconds N. and long 92 degrees 25 minutes 53 seconds W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) loam, grayish brown (10YR 5/2) dry; weak medium platy structure in the upper 2 inches; weak fine subangular blocky structure in the lower part;

friable; many very fine roots; few very fine tubular pores; slightly acid; gradual smooth boundary.

A—7 to 16 inches; very dark gray (10YR 3/1) silt loam, grayish brown (10YR 5/2) dry; moderate fine and very fine subangular blocky structure; friable; many very fine roots; few fine and common very fine tubular pores; neutral; abrupt smooth boundary.

Bw—16 to 31 inches; dark grayish brown (10YR 4/2) silt loam; weak thick platy structure parting to weak fine angular blocky; friable; common very fine roots; few fine and common very fine tubular pores; few fine prominent yellowish red (5YR 4/6) iron masses in the matrix at a depth of 27 inches; neutral; clear smooth boundary.

Bg—31 to 54 inches; dark grayish brown (10YR 4/2) silt loam; weak fine angular blocky structure; friable; few very fine roots; common very fine tubular pores; neutral; gradual smooth boundary.

Cg1—54 to 69 inches; dark grayish brown (10YR 4/2) silt loam; massive; friable; few very fine roots; few fine and many very fine tubular pores; neutral; gradual smooth boundary.

Cg2—69 to 80 inches; grayish brown (10YR 5/2) and brown (10YR 5/3) loam; massive with weak bedding planes; firm; few fine and common very fine tubular pores; common fine dark yellowish brown (10YR 4/4) and few fine brown (7.5YR 4/4) iron masses in the matrix; few fine gray (10YR 5/1) iron depletions in the matrix; few fine strata of sandy loam; neutral.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The Bw horizon has value of 4 or 5 and chroma of 2 or 3. The C horizon is silt loam or loam.

Gara Series

The Gara series consists of very deep, well drained, moderately slowly permeable soils on uplands. These soils formed in glacial till. Slopes range from 14 to 35 percent.

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

Typical pedon of Gara loam, 14 to 20 percent slopes, eroded, 2,300 feet east and 3,730 feet south of the northwest corner of sec. 16, T. 65 N., R. 15 W.; Downing Northwest quadrangle, lat. 40 degrees 28 minutes 49 seconds N. and long. 92 degrees 29 minutes 23 seconds W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak very fine subangular blocky structure; friable; many very fine roots; brown (7.5YR 4/4) mixed in the lower part; few fine black stains of iron and manganese oxides; 2 percent fine gravel; neutral; abrupt smooth boundary.

Bt1—6 to 16 inches; brown (7.5YR 4/4) clay loam; moderate fine and very fine subangular blocky structure; firm; common very fine roots; common faint clay films on faces of peds; very dark grayish brown (10YR 3/2) organic stains in the upper part; few fine black stains of iron and manganese oxides; 1 percent fine gravel; slightly acid; clear smooth boundary.

Bt2—16 to 28 inches; dark yellowish brown (10YR 4/4) clay loam; a 2-inch band of strong brown (7.5YR 5/6) sandy clay loam material at the bottom of the horizon; weak medium prismatic structure parting to moderate fine subangular blocky; firm; common very fine roots; many distinct clay films on faces of peds; few fine faint dark grayish brown (10YR 4/2) iron depletions in the matrix and common fine distinct strong brown (7.5YR 5/6) iron masses in the matrix; common fine dark accumulations of iron and manganese oxides; 3 percent fine gravel; moderately acid; clear smooth boundary.

Bt3—28 to 42 inches; dark yellowish brown (10YR 4/4) clay loam; weak medium prismatic structure parting to weak very fine subangular blocky; firm; common very fine roots decreasing in number with increasing depth; common distinct clay films on faces of prisms and in root channels; few fine and medium faint dark grayish brown (10YR 4/2) iron depletions in the matrix; common fine stains of iron and manganese oxides; 10 percent fine gravel, mostly concentrated in a 3-inch band; slightly acid; clear smooth boundary.

Bk—42 to 65 inches; dark yellowish brown (10YR 4/4) loam; a 3-inch band of strong brown (7.5YR 5/6) sandy loam material; weak medium prismatic structure; firm; few very fine roots along prism faces; few faint clay films on faces of prisms and in old root channels; common medium distinct light brownish gray (10YR 6/2) iron depletions on faces of peds; common fine distinct strong brown (7.5YR 5/6) iron masses in the matrix; common fine to coarse concretions of calcium carbonate; common fine black stains of manganese oxides; 5 percent fine gravel; strongly effervescent; slightly alkaline.

The depth to carbonates ranges from 40 to more than 60 inches. The Ap horizon has chroma of 1 or 2. It is loam or fine sandy loam. The Bt horizon has hue of 10YR or 7.5YR and chroma of 3 to 6. The Bk horizon has value of 4 or 5 and chroma of 4 to 6. It is loam or clay loam.

Gorin Series

The Gorin series consists of very deep, somewhat poorly drained, slowly permeable soils on uplands. These soils formed in loess and loamy sediments and glacial till. Slopes range from 3 to 9 percent.

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

Typical pedon of Gorin silty clay loam, 3 to 9 percent slopes, eroded, 4,380 feet east and 55 feet south of the northwest corner of sec. 5, T. 66 N., R. 14 W.; Bunker Hill quadrangle, lat. 40 degrees 33 minutes 46 seconds N. and long. 92 degrees 29 minutes 11 seconds W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silty clay loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; many very fine roots throughout; common very fine tubular pores; brown (10YR 5/3) subsoil material mixed in the lower part; few faint very dark grayish brown (10YR 3/2) coatings on faces of peds; slightly acid; abrupt smooth boundary.

Bt—7 to 14 inches; brown (10YR 5/3) silty clay loam; moderate very fine subangular blocky structure; firm; many very fine roots throughout; few very fine tubular pores; common faint clay films on faces of peds; many fine prominent strong brown (7.5YR 5/6) iron masses in the matrix; common dark grayish brown (10YR 4/2) organic coatings; strongly acid; clear smooth boundary.

Btg—14 to 23 inches; grayish brown (10YR 5/2) silty clay; moderate fine subangular blocky structure; very firm; common very fine roots throughout; few very fine tubular pores; many faint clay films on faces of peds; many fine prominent strong brown (7.5YR 5/6) iron masses in the matrix; few fine stains of iron and manganese oxides; strongly acid; clear smooth boundary.

B′t1—23 to 36 inches; yellowish brown (10YR 5/4) silty clay loam; weak fine and medium subangular blocky structure; firm; few very fine roots throughout; few very fine tubular pores; common faint clay films on faces of peds; many medium distinct light brownish gray (10YR 6/2) iron depletions in the matrix and common fine prominent strong brown (7.5YR 5/6) iron masses in the matrix; common fine dark accumulations of iron and manganese oxides; slightly acid; clear smooth boundary.

B′t2—36 to 46 inches; yellowish brown (10YR 5/4) silty clay loam; weak very fine and fine subangular blocky structure; firm; few very fine roots throughout; common faint clay films on faces of peds and in tubular pores; many fine distinct light brownish gray (10YR 6/2) iron depletions in the matrix; common fine stains of iron and manganese oxides on faces of peds; neutral; abrupt smooth boundary.

2Bt3—46 to 58 inches; yellowish brown (10YR 5/4) loam; weak very fine subangular blocky structure; friable; brittle; common very fine tubular pores; increase in sand content; few faint clay films on faces of peds and in tubular pores; many fine faint brown (10YR 5/3) iron masses in the matrix; few fine dark accumulations of iron and manganese oxides on faces of peds; 1 percent fine gravel; neutral; gradual smooth boundary.

2Bt4—58 to 65 inches; yellowish brown (10YR 5/6) loam; weak very fine subangular blocky structure; friable; brittle; common very fine tubular pores; few faint clay films on faces of peds; few fine dark accumulations of iron and manganese oxides; 3 percent fine gravel; neutral.

The Ap horizon has value of 3 or 4 and chroma of 1 or 2. Some pedons have an E horizon, which has hue of 10YR, value of 4 or 5, and chroma of 1 to 3.

The upper part of the Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. The lower part has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 6.

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

Some pedons have a 3Btb horizon. This horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 to 6. It is clay loam or clay.

Humeston Series

The Humeston series consists of very deep, poorly drained, very slowly permeable soils on low stream terraces and on high flood plains. These soils formed in alluvium. Slopes range from 0 to 2 percent.

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

Typical pedon of Humeston silt loam, in an area of Arbela and Humeston soils, occasionally flooded, 660 feet south and 140 feet east of the center of sec. 31, T. 69 N., R. 12 W., in Davis County, Iowa:

Ap—0 to 7 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; moderate fine and very fine granular structure; friable; few fine roots; neutral; abrupt smooth boundary.

A—7 to 13 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak fine subangular blocky structure; friable; few fine roots; moderately acid; clear smooth boundary.

E1—13 to 21 inches; dark gray (10YR 4/1) silt loam; very dark gray (10YR 3/1) coatings on faces of peds in the upper part; few fine distinct yellowish brown (10YR 5/6) iron masses in the matrix; weak thin and medium platy structure; friable; few fine roots; few distinct light gray (10YR 7/1 dry) silt coatings on faces of peds; strongly acid; clear smooth boundary.

E2—21 to 26 inches; dark gray (10YR 4/1) silt loam; few very dark gray (10YR 3/1) coatings in root channels; common fine prominent yellowish brown (10YR 5/6) iron masses in the matrix; weak thin and medium platy structure parting to weak medium subangular blocky; friable; few fine roots; few distinct light gray (10YR 7/1 dry) silt coatings on faces of peds; strongly acid; clear smooth boundary.

BE—26 to 29 inches; dark gray (10YR 4/1) silty clay loam; moderate medium subangular blocky structure; firm; few fine roots; few distinct clay films on faces of peds; few distinct light gray (10YR 7/1 dry) silt coatings on faces of peds; moderately acid; clear smooth boundary.

Bt1—29 to 34 inches; very dark gray (10YR 3/1) silty clay; common fine distinct strong brown (7.5YR 4/6) iron masses in the matrix; weak medium prismatic structure parting to moderate medium subangular blocky; firm; common distinct clay films on faces of peds; slightly acid; clear smooth boundary.

Bt2—34 to 50 inches; very dark gray (10YR 3/1) silty clay; few fine distinct dark yellowish brown (10YR 4/6) iron masses in the matrix; weak medium prismatic structure parting to moderate medium subangular blocky; firm; common distinct clay films on faces of peds; slightly acid; gradual smooth boundary.

Btg—50 to 60 inches; dark gray (10YR 4/1) silty clay; few fine distinct dark yellowish brown (10YR 4/6) iron masses in the matrix; weak medium prismatic structure parting to moderate medium subangular blocky; firm; common distinct clay films on faces of peds; neutral.

The Ap and A horizons have value of 2 or 3. Depth to the E horizon ranges from 10 to 16 inches. The E horizon has value of 4 or 5.

The Bt horizon has value of 2 to 4 and chroma of 1 or less. It is silty clay or silty clay loam.

Kennebec Series

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

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

Typical pedon of Kennebec silt loam, in an area of Kennebec and Fatima soils, frequently flooded, 3,615 feet east and 100 feet south of the northwest corner of sec. 26, T. 66 N., R. 14 W.; Bunker Hill quadrangle, lat. 40 degrees 30 minutes 19 seconds N. and long. 92 degrees 25 minutes 53 seconds W.

Ap—0 to 10 inches; very dark gray (10YR 3/1) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; common very fine roots; few very fine tubular pores; neutral; clear smooth boundary.

A1—10 to 27 inches; very dark gray (10YR 3/1) silt loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; few very fine roots; few fine and common very fine tubular pores; neutral; clear smooth boundary.

A2—27 to 46 inches; very dark gray (10YR 3/1) silt loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; few very fine roots; few fine and common very fine tubular pores; neutral; gradual smooth boundary.

AC—46 to 57 inches; very dark gray (10YR 3/1) silt loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; friable; few very fine roots; few fine and common very fine tubular pores; common fine distinct dark grayish brown (10YR 4/2) iron depletions in the matrix; neutral; gradual smooth boundary.

C—57 to 80 inches; very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) silt loam, grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) dry; massive with weak bedding planes; friable; few very fine roots; few fine and common very fine tubular pores; neutral.

The Ap horizon has value of 2 to 4 and chroma of 1 or 2. The C horizon has value of 3 to 5 and chroma of 1 or 2. It is silt loam or silty clay loam.

Keswick Series

The Keswick series consists of very deep, moderately well drained, slowly permeable soils on uplands. These soils formed in a 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 clay loam, 5 to 14 percent slopes, eroded, 2,730 feet south and 100 feet east of the northwest corner of sec. 36, T. 66 N., R. 16 W.; Lavonia quadrangle, lat. 40 degrees 28 minutes 51 seconds N. and long. 92 degrees 39 minutes 9 seconds W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) clay loam, pale brown (10YR 6/3) dry; moderate fine subangular blocky structure parting to weak fine granular; friable; many very fine roots; common faint very dark gray (10YR 3/1) stains in the upper part; few fine prominent yellowish red (5YR 5/8) iron masses in the matrix in the lower part; 2 percent fine gravel; strongly acid; abrupt smooth boundary.

Bt1—6 to 15 inches; strong brown (7.5YR 5/6) clay; moderate fine subangular blocky structure; very firm; common very fine roots; few very fine tubular pores; many distinct clay films on faces of peds; dark grayish brown (10YR 4/2) silt coatings on faces of peds; few fine distinct yellowish red (5YR 5/8) iron masses in the matrix; 2 percent fine gravel; strongly acid; clear smooth boundary.

Bt2—15 to 24 inches; yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) clay; weak fine subangular blocky structure; firm; few very fine roots; common very fine tubular pores; common distinct clay films on faces of peds; common fine prominent light brownish gray (10YR 6/2) iron depletions and few distinct yellowish red (5YR 5/6 and 5/8) iron masses in the matrix; 2 percent fine gravel; strongly acid; clear smooth boundary.

Bt3—24 to 34 inches; yellowish brown (10YR 5/6) clay loam; weak fine subangular blocky structure; firm; few very fine roots; few very fine tubular pores; common distinct clay films on faces of peds; many fine and medium prominent light brownish gray (10YR 6/2) iron depletions and few fine yellowish red (5YR 5/6) iron masses in the matrix; 8 percent fine gravel; strongly acid; clear smooth boundary.

Bk1—34 to 42 inches; yellowish brown (10YR 5/6) clay loam; moderate medium prismatic structure parting to weak fine subangular blocky; firm; few very fine tubular pores; brown (7.5YR 4/2) clay flows on prism faces; many fine and medium prominent light brownish gray (2.5Y 6/2) iron depletions along ped faces and many medium and coarse faint yellowish brown (10YR 5/8) iron masses in the matrix; few fine stains of manganese oxides; few fine accumulations of calcium carbonate; 8 percent fine gravel; strongly effervescent; slightly alkaline; clear smooth boundary.

Bk2—42 to 65 inches; yellowish brown (10YR 5/6) clay loam; moderate medium prismatic structure; firm; few very fine tubular pores; many coarse prominent light brownish gray (2.5Y 6/2) iron depletions along prism faces and many medium and coarse faint yellowish brown (10YR 5/8) iron masses in the matrix; common black stains of manganese oxides throughout; many fine to coarse accumulations of calcium carbonate; 8 percent fine gravel; strongly effervescent; moderately alkaline.

The depth to carbonates ranges from 34 to more than 60 inches.

The Ap horizon has value of 3 or 4. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is clay or clay loam. The Bk horizon has hue of 7.5YR to 2.5Y, value of 4 or 5, and chroma of 1 to 6.

Lamoni Series

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

The Lamoni soils in this survey area are taxadjuncts because they do not have a mollic epipedon. This difference, however, does not significantly affect the use and management of the soils. The soils are classified as fine, montmorillonitic, mesic Vertic Epiaqualfs.

Typical pedon of Lamoni loam, 5 to 9 percent slopes, eroded, 1,120 feet east and 2,400 feet south of the northwest corner of sec. 15, T. 66 N., R. 14 W.; Bunker Hill quadrangle, lat. 40 degrees 31 minutes 43 seconds N. and long. 92 degrees 27 minutes 35 seconds 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 very fine roots throughout; many very fine tubular pores; many fine faint very dark gray (10YR 3/1) iron masses in the matrix; dark yellowish brown (10YR 4/4) subsoil material mixed in the lower part; 1 percent fine gravel; neutral; abrupt smooth boundary.

2Bt1—8 to 13 inches; dark yellowish brown (10YR 4/4) clay loam; moderate very fine subangular blocky structure; firm; many very fine roots throughout; common very fine tubular pores;

common very dark gray (10YR 3/1) organic coatings on faces of peds and few faint clay films on faces of peds; 1 percent fine gravel; neutral; clear smooth boundary.

2Bt2—13 to 19 inches; dark grayish brown (10YR 4/2) clay loam; moderate very fine subangular blocky structure; very firm; common very fine roots throughout; common very fine tubular pores; common faint clay films on faces of peds; many fine faint dark yellowish brown (10YR 4/4) and common prominent strong brown (7.5YR 4/6) iron masses in the matrix; few very dark gray (10YR 3/1) organic coatings; few fine stains of iron and manganese oxides; 1 percent fine gravel; moderately acid; clear smooth boundary.

2Btg1—19 to 28 inches; grayish brown (2.5Y 5/2) clay loam; weak fine prismatic structure parting to moderate very fine subangular blocky; very firm; common very fine roots throughout; few very fine tubular pores; common faint clay films on faces of peds; many fine prominent dark yellowish brown (10YR 4/4) and many strong brown (7.5YR 4/6) iron masses in the matrix; common stains of iron and manganese oxides; few fine dark accumulations of iron and manganese oxides; 2 percent fine gravel; slightly acid; clear smooth boundary.

2Btg2—28 to 34 inches; grayish brown (2.5Y 5/2) clay loam; weak fine prismatic structure parting to moderate fine subangular blocky; firm; common very fine roots throughout; few very fine tubular pores; common faint clay films on faces of peds; many fine prominent strong brown (7.5YR 5/6) iron masses in the matrix; common stains of iron and manganese oxides; few fine dark accumulations of iron and manganese oxides; 2 percent fine gravel; slightly acid; clear smooth boundary.

2Btg3—34 to 50 inches; gray (5Y 5/1) clay loam; weak fine prismatic structure parting to moderate very fine and fine subangular blocky; firm; few very fine roots throughout; common very fine tubular pores; few faint clay films on faces of peds; common fine prominent yellowish red (5YR 4/6) and many strong brown (7.5YR 4/6) iron masses in the matrix; few fine and medium stains of iron and manganese oxides; few fine dark accumulations of iron and manganese oxides; 3 percent fine gravel; neutral; clear smooth boundary.

2BCg—50 to 65 inches; gray (5Y 6/1) and strong brown (7.5YR 5/6) clay loam; moderate fine prismatic structure; firm; few very fine roots in cracks; few very fine tubular pores; few prominent dark gray (10YR 4/1) clay films in root channels, in tubular pores, or both; few fine and medium stains of iron and manganese oxides on vertical faces of peds; 5 percent fine gravel; neutral.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The 2Bt horizon has hue of 10YR or 2.5Y.

Leonard Series

The Leonard series consists of very deep, poorly drained, slowly permeable soils on uplands. These soils formed in a thin mantle of loess and in the underlying pedisediments or glacial till. Slopes range from 2 to 9 percent.

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

Typical pedon of Leonard silty clay loam, 2 to 9 percent slopes, eroded, 1,050 feet east and 5,000 feet south of the northwest corner of sec. 13, T. 64 N., R. 15 W.; Greentop quadrangle, lat. 40 degrees 20 minutes 43 seconds N. and long. 92 degrees 31 minutes 54 seconds W.

Ap—0 to 7 inches; 70 percent very dark grayish brown (10YR 3/2) and 30 percent dark grayish brown (10YR 4/2) silty clay loam, brown (10YR 5/3) dry; weak fine granular structure; friable; many very fine roots; common very fine tubular pores; few fine prominent yellowish brown (10YR 5/6) iron masses in the matrix; neutral; clear smooth boundary.

Btg1—7 to 12 inches; dark grayish brown (10YR 4/2) silty clay loam; weak fine and very fine subangular blocky structure; firm; few very fine roots; common very fine tubular pores; few distinct clay films on faces of peds; common fine prominent yellowish brown (10YR 5/6) iron masses in the matrix; neutral; clear smooth boundary.

Btg2—12 to 17 inches; grayish brown (10YR 5/2) silty clay; weak fine and very fine subangular blocky structure; firm; few very fine roots; few fine and common very fine tubular pores; common distinct clay films on faces of peds; common fine prominent yellowish brown (10YR 5/6) iron masses in the matrix; slightly acid; clear smooth boundary.

2Btg3—17 to 26 inches; grayish brown (10YR 5/2) and gray (10YR 5/1) silty clay; weak fine and very fine subangular blocky structure; firm; few very fine roots; few very fine tubular pores; common distinct clay films on faces of peds; common fine prominent and common medium prominent yellowish brown (10YR 5/6) iron masses in the matrix; slightly acid; gradual smooth boundary.

2Btg4—26 to 36 inches; grayish brown (2.5Y 5/2) silty clay; weak very fine subangular blocky structure; firm; few very fine roots; common very fine tubular pores; common distinct clay films on faces of peds; common fine and medium prominent brown (10YR 4/3) iron masses in the matrix; few fine dark accumulations of iron and manganese oxides; slightly acid; gradual smooth boundary.

2Btg5—36 to 50 inches; gray (10YR 5/1) silty clay; weak fine subangular blocky structure; firm; few very fine roots; common very fine tubular pores; common distinct clay films on faces of peds; common fine prominent yellowish brown (10YR 5/6) and common fine prominent yellowish red (5YR 4/6) iron masses in the matrix; few fine dark accumulations of iron and manganese oxides; slightly acid; gradual smooth boundary.

2Btg6—50 to 65 inches; gray (10YR 5/1) silty clay; weak medium prismatic structure parting to moderate fine and very fine angular blocky; firm; few very fine tubular pores; common distinct clay films on faces of peds; few fine prominent yellowish brown (10YR 5/6) and common fine prominent strong brown (7.5YR 4/6) iron masses in the matrix; common fine dark accumulations of iron and manganese oxides; neutral; clear smooth boundary.

2Btg7—65 to 80 inches; gray (10YR 6/1) silty clay; moderate medium prismatic structure parting to moderate fine angular blocky; firm; common distinct clay films on faces of peds; common fine and medium prominent yellowish red (5YR 5/8) and few fine and medium prominent strong brown (7.5YR 5/8) iron masses in the matrix; common fine and medium accumulations of iron and manganese oxides; slightly acid.

The Ap horizon has value of 2 or 3 chroma of 1 or 2. The upper part of the Btg horizon has value of 4 or 5 and chroma of 1 or 2. It is silty clay loam or silty clay. The lower part of the Btg horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. It is silty clay loam, silty clay, or clay loam.

Mystic Series

The Mystic series consists of very deep, moderately well drained, slowly permeable soils on stream terraces. These soils formed in alluvium derived from glaciers. Slopes range from 9 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, 9 to 14 percent slopes, eroded, 1,770 feet north and 1,590 feet east of the southwest corner of sec. 26, T. 70 N., R. 15 W., in Davis County, Iowa:

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; some yellowish brown (10YR 5/4) silt loam from the subsurface layer; moderate fine and medium granular structure; friable; neutral; abrupt smooth boundary.

E—8 to 12 inches; yellowish brown (10YR 5/4) silt loam, light yellowish brown (10YR 6/4) dry; few very dark grayish brown (10YR 3/2) coatings on faces of peds; weak medium platy structure parting to weak fine subangular blocky; friable; few distinct light gray (10YR 7/2) clay depletions on faces of peds; strongly acid; gradual smooth boundary.

BE—12 to 16 inches; dark brown (7.5YR 4/4) clay loam; moderate fine subangular blocky structure; friable; grayish brown (10YR 5/2) iron depletions in the matrix and common fine distinct yellowish red (5YR 4/6) and yellowish brown (10YR 5/4) iron masses in the matrix; common distinct light gray (10YR 7/2) clay depletions on faces of peds; strongly acid; gradual smooth boundary.

Bt1—16 to 22 inches; brown (7.5YR 4/4) clay; moderate fine subangular blocky structure; firm; common distinct clay films on faces of peds; common fine and medium distinct grayish brown (10YR 5/2) iron depletions in the matrix and common fine and medium distinct yellowish red (5YR 4/6) and brown (10YR 5/3) iron masses in the matrix; few distinct light gray (10YR 7/2) clay depletions on faces of peds; few fine concretions of iron and manganese oxides; strongly acid; gradual smooth boundary.

Bt2—22 to 30 inches; brown (7.5YR 5/2) clay; moderate medium subangular blocky structure; firm; few faint clay films on faces of peds; common fine distinct yellowish red (5YR 4/6) and brown (7.5YR 4/4) iron masses in the matrix; common fine dark concretions of iron and manganese oxides; strongly acid; gradual smooth boundary.

Bt3—30 to 39 inches; brown (7.5YR 5/2) clay; moderate medium subangular blocky structure; firm; common distinct clay films on faces of peds; common fine distinct brown (7.5YR 4/4), yellowish red (5YR 4/6), and brown (10YR 5/3) iron masses in the matrix; common fine dark concretions of iron and manganese oxides; strongly acid; gradual smooth boundary.

Bt4—39 to 50 inches; yellowish brown (10YR 5/6) sandy clay loam; common fine distinct light brownish gray (2.5Y 6/2), brown (7.5YR 4/4), and strong brown (7.5YR 5/6) iron masses in the matrix; moderate medium subangular blocky structure; firm; few distinct clay films on faces of peds; common fine dark concretions of iron and manganese oxides; moderately acid; gradual smooth boundary.

BC—50 to 60 inches; yellowish brown (10YR 5/6) sandy loam; weak medium subangular blocky structure; friable; common fine distinct light brownish gray (2.5Y 6/2) iron depletions in the matrix and brown (7.5YR 4/4) and strong brown (7.5YR 5/6) iron masses in the matrix; common fine dark concretions of iron and manganese oxides; moderately acid.

The Ap horizon has chroma of 1 or 2. The E horizon has value of 4 or 5 and chroma of 2 or 3. The Bt horizon has hue of 7.5YR to 2.5Y, value of 3 to 5, and chroma of 2 to 4. The BC horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 8. It is loam, sandy loam, or sandy clay loam.

Seymour Series

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

The Seymour soils in this survey area are taxadjuncts because they do not have a mollic epipedon. This difference, however, does not significantly affect the use and management of the soils. The soils are classified as fine, montmorillonitic, mesic Vertic Epiaqualfs.

Typical pedon of Seymour silty clay loam, 2 to 5 percent slopes, eroded, 3,000 feet east and 1,400 feet south of the northwest corner of sec. 19, T. 67 N., R. 14 W.; Lancaster quadrangle, lat. 40 degrees 35 minutes 23 seconds N. and long. 92 degrees 30 minutes 35 seconds W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak fine granular structure; friable; many very fine roots; common very fine tubular pores; moderately acid; abrupt smooth boundary.

Bt—8 to 13 inches; dark grayish brown (10YR 4/2) silty clay; weak very fine and fine subangular blocky structure; firm; common very fine roots; common distinct clay films on faces of peds; common fine prominent strong brown (7.5YR 5/6) iron masses in the matrix; common organic coatings on faces of peds; few fine dark accumulations of iron and manganese oxides; moderately acid; clear smooth boundary.

Btg1—13 to 19 inches; grayish brown (2.5Y 5/2) silty clay; moderate fine subangular blocky structure; very firm; common very fine roots; few fine and common very fine tubular pores; many distinct clay films on faces of peds; common fine prominent strong brown (7.5YR 5/6) iron masses in the matrix; common organic coatings on faces of peds; few fine dark accumulations of iron and manganese oxides; strongly acid; clear smooth boundary.

Btg2—19 to 26 inches; olive gray (5Y 5/2) silty clay loam; moderate fine subangular blocky structure; firm; common very fine roots; common very fine tubular pores; common distinct clay films on faces of peds; common fine prominent dark yellowish brown (10YR 4/4) iron masses in the matrix; common organic coatings and few black stains of iron and manganese oxides on faces of peds; few fine dark accumulations of manganese oxides; strongly acid; clear smooth boundary.

Btg3—26 to 34 inches; olive gray (5Y 5/2) silty clay loam; weak fine subangular blocky structure; firm; common very fine roots; common very fine tubular pores; common distinct clay films on faces of peds; common fine prominent dark yellowish brown (10YR 4/4) and common fine prominent strong brown (7.5YR 5/6 and 5/8) iron masses in the matrix; common organic coatings on faces of peds; common medium stains of manganese oxides; moderately acid; clear smooth boundary.

Btg4—34 to 56 inches; olive gray (5Y 5/2) silty clay loam; weak fine prismatic structure parting to weak very fine subangular blocky; firm; few very fine roots; many very fine tubular pores; few distinct clay films on faces of peds; common fine and medium prominent yellowish brown (10YR 5/6) and common fine prominent strong brown (7.5YR 5/8) iron masses in the matrix; few organic coatings and common black stains of iron and manganese oxides on faces of peds; few fine dark accumulations of iron and manganese oxides; moderately acid; clear smooth boundary.

Cg—56 to 65 inches; light olive gray (5Y 6/2) silty clay loam; massive; firm; common very fine tubular pores; many fine prominent dark yellowish brown (10YR 4/6), yellowish brown

(10YR 5/6), and strong brown (7.5YR 5/6) iron masses in the matrix; common black stains; slightly acid.

The Ap 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 and value of 4 or 5. The lower part has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. The C horizon has hue of 2.5Y or 5Y, value of 5 or 6, and chroma of 1 or 2.

Vesser Series

The Vesser series consists of very deep, poorly drained, moderately permeable soils on the higher parts of the flood plain. These soils formed in alluvium. Slopes range from 0 to 2 percent.

These soils are classified as fine-silty, mixed, mesic Argiaquic Argialbolls.

Typical pedon of Vesser silt loam, occasionally flooded, 2,250 feet east and 650 feet south of the northwest corner of sec. 9, T. 64 N., R. 13 W.; Bible Grove quadrangle, lat. 40 degrees 22 minutes 24 seconds N. and long. 92 degrees 21 minutes 39 seconds W.

Ap—0 to 10 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak very fine and fine subangular blocky structure; friable; common very fine roots; common very fine tubular pores; neutral; clear smooth boundary.

A—10 to 18 inches; very dark gray (10YR 3/1) silt loam, grayish brown (10YR 5/2) dry; moderate fine angular blocky structure; friable; few very fine roots; few fine and common very fine tubular pores; common fine prominent strong brown (7.5YR 5/6) iron masses in the matrix; neutral; abrupt smooth boundary.

E—18 to 31 inches; grayish brown (10YR 5/2) silt loam; weak thick platy structure parting to weak fine subangular blocky; friable; few very fine roots; few fine and few very fine tubular pores; common fine prominent yellowish brown (10YR 5/8) iron masses in the matrix; few fine concretions of iron and manganese oxides; moderately acid; abrupt smooth boundary.

Btg1—31 to 44 inches; grayish brown (10YR 5/2) silty clay loam; moderate fine subangular blocky structure; firm; few very fine tubular pores; few distinct clay films on faces of peds; common fine and medium prominent yellowish brown (10YR 5/6) iron masses in the matrix; few fine concretions of iron and manganese oxides; many light gray (10YR 7/1) clay depletions on faces of peds; slightly acid; clear smooth boundary.

Btg2—44 to 50 inches; dark gray (10YR 4/1) silty clay loam; weak medium prismatic structure parting to weak fine subangular blocky; firm; few very fine tubular pores; few distinct clay films on faces of peds; common medium prominent brown (7.5YR 4/4) iron masses in the matrix; few fine concretions of iron and manganese oxides; few clay depletions on faces of peds; slightly acid; gradual smooth boundary.

Btg3—50 to 65 inches; dark gray (10YR 4/1) silty clay loam; weak medium subangular blocky structure; firm; common distinct clay films on faces of peds; common medium prominent strong brown (7.5YR 5/6) iron masses in the matrix; few fine concretions of iron and manganese oxides; few clay depletions on faces of peds; slightly acid.

The Ap 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 Btg horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 1 or 2.

Wabash Series

The Wabash series consists of very deep, poorly drained, very slowly permeable soils on flood plains. These soils formed in alluvium. Slopes range from 0 to 2 percent.

These soils are classified as fine, montmorillonitic, mesic Cumulic Vertic Endoaquolls.

Typical pedon of Wabash silty clay, occasionally flooded, 5,240 feet east and 3,800 feet south of the northwest corner of sec. 22, T. 65 N., R. 16 W.; Lavonia quadrangle, lat. 40 degrees 25 minutes 12 seconds N. and long. 92 degrees 40 minutes 5 seconds W.

Ap—0 to 5 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; weak fine subangular blocky structure; firm; many very fine roots; few fine and common very fine tubular pores; neutral; clear smooth boundary.

A—5 to 17 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; moderate fine angular blocky structure; firm; few very fine roots; few fine tubular pores; common fine prominent strong brown (7.5YR 4/6) iron masses in the matrix; neutral; clear smooth boundary.

Bg1—17 to 28 inches; very dark gray (N 3/0) silty clay, gray (10YR 6/1 and 5/1) dry; moderate medium prismatic structure parting to weak fine and medium subangular blocky; firm; few very fine roots; few fine and few very fine tubular pores; common fine prominent red (2.5YR 4/8) iron masses in the matrix; few fine concretions of iron and manganese oxides; slightly acid; clear smooth boundary.

Bg2—28 to 33 inches; very dark gray (N 3/0) silty clay, gray (10YR 5/1) dry; moderate medium prismatic structure parting to moderate fine angular blocky; firm; few very fine roots; few fine and common very fine tubular pores; common pressure faces; common medium prominent yellowish red (5YR 4/6) iron masses in the matrix; slightly acid; clear smooth boundary.

Bg3—33 to 38 inches; very dark gray (N 3/0) silty clay, gray (10YR 5/1) dry; weak coarse prismatic structure parting to weak fine subangular blocky; firm; very few very fine roots; few very fine tubular pores; common pressure faces and common slickensides; common fine prominent strong brown (7.5YR 5/6) iron masses in the matrix; slightly acid; gradual smooth boundary.

Bg4—38 to 49 inches; dark gray (N 4/0) silty clay; moderate coarse prismatic structure parting to weak fine subangular blocky; firm; very few very fine roots; few very fine tubular pores; common pressure faces and slickensides; common fine prominent strong brown (7.5YR 5/6) iron masses in the matrix; slightly acid; gradual smooth boundary.

Bg5—49 to 80 inches; dark gray (N 4/0) silty clay; weak coarse prismatic structure parting to weak fine subangular blocky; firm; few very fine tubular pores; common fine prominent dark yellowish brown (10YR 4/6) iron masses in the matrix; few fine concretions of iron and manganese oxides; common pressure faces and slickensides; neutral.

The Ap and A horizons have hue of 10YR to 5Y or are neutral in hue. They have value of 2 or 3 and chroma of 0 to 2. The Bg horizon has hue of 10YR to 5Y or is neutral in hue. It has value of 2 to 5 and chroma of 0 to 2. It is silty clay or clay.

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, 20 to 35 percent slopes, eroded, 950 feet east and 1,200 feet south of the northwest corner of sec. 35, T. 66 N., R. 16 W.; Lavonia quadrangle, lat. 40 degrees 29 minutes 5 seconds N. and long. 92 degrees 40 minutes 6 seconds W.

A—0 to 2 inches; very dark grayish brown (10YR 3/2) loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; few fine and many very fine roots; 1 percent fine gravel; neutral; abrupt smooth boundary.

E—2 to 5 inches; brown (10YR 5/3) loam; weak thick platy structure parting to weak fine and medium granular; friable; few fine and common very fine roots; 1 percent fine gravel; moderately acid; abrupt smooth boundary.

Bt1—5 to 15 inches; yellowish brown (10YR 5/6) clay; moderate fine subangular blocky structure; firm; common very fine roots; common very fine tubular pores; many distinct clay films on faces of peds; 1 percent fine gravel; moderately acid; clear smooth boundary.

Bt2—15 to 28 inches; yellowish brown (10YR 5/6) clay; weak fine subangular blocky structure; firm; few very fine roots; few very fine tubular pores; common distinct clay films on faces of peds; few fine distinct light brownish gray (10YR 6/2) iron depletions in the matrix; moderately acid; clear smooth boundary.

Bt3—28 to 33 inches; yellowish brown (10YR 5/6) clay; weak medium prismatic structure parting to weak fine subangular blocky; firm; few very fine roots; few distinct clay films on faces of peds; few fine distinct light brownish gray (10YR 6/2) iron depletions in the matrix; common fine dark accumulations of iron and manganese oxides; neutral; abrupt smooth boundary.

Btk1—33 to 41 inches; yellowish brown (10YR 5/4 and 5/6) clay loam; weak medium prismatic structure parting to weak fine subangular blocky; firm; few very fine roots; common distinct clay films on faces of peds; few fine distinct grayish brown (10YR 5/2) iron depletions in the matrix; few fine dark accumulations of iron and manganese oxides; common fine concretions of calcium carbonate; slightly effervescent; slightly alkaline; clear smooth boundary.

Btk2—41 to 52 inches; yellowish brown (10YR 5/6 and 5/4) and dark yellowish brown (10YR 4/4) clay loam; weak coarse prismatic structure parting to weak fine and medium subangular blocky; firm; few very fine roots along prism faces; common distinct clay films on faces of peds; few fine distinct grayish brown (10YR 5/2) iron depletions in the matrix; common medium stains of iron and manganese oxides; common fine and medium concretions of calcium carbonate; violently effervescent; slightly alkaline; gradual smooth boundary.

Bk—52 to 65 inches; yellowish brown (10YR 5/6 and 5/4) clay loam; weak coarse prismatic structure; firm; few fine distinct grayish brown (10YR 5/2) iron depletions in the matrix; common fine and medium concretions of calcium carbonate; violently effervescent; slightly alkaline.

Masses of soft calcium carbonate are at a depth of 24 to 40 inches. The A horizon has value and chroma of 2 or 3.

Some pedons have an Ap horizon. This horizon has value of 4 or 5 and chroma of 2 or 3. It is clay loam or loam. The E horizon has value of 4 to 6 and chroma of 2 to 4. It is loam, clay loam, or silt loam.

Some pedons have a BE horizon. This horizon has hue of 10YR, value of 4 to 6, and chroma of 3 to 6. It is loam or clay loam.

The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 8. The Bk horizon has hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 2 to 6. It is clay loam or loam.

Zook Series

The Zook series consists of very deep, poorly drained, slowly permeable soils on flood plains. These soils formed in alluvium. Slopes range from 0 to 5 percent.

These soils are classified as fine, montmorillonitic, mesic Cumulic Vertic Endoaquolls.

Typical pedon of Zook silty clay loam, overwash, frequently flooded, 4,350 feet east and 2,100 feet south of the northwest corner of sec. 25, T. 66 N., R. 14 W.; Bunker Hill quadrangle, lat. 40 degrees 30 minutes 01 second N. and long. 92 degrees 24 minutes 34 seconds W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) silty clay loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; friable; many very fine roots; few fine and few very fine tubular pores; neutral; clear smooth boundary.

A1—7 to 17 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; moderate fine and very fine angular blocky structure; friable; few fine and common very fine roots; few fine and common very fine tubular pores; neutral; abrupt smooth boundary.

A2—17 to 21 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; moderate very fine angular blocky structure; firm; few very fine roots; few very fine tubular pores; neutral; abrupt smooth boundary.

Bg1—21 to 37 inches; very dark gray (N 3/0) silty clay, dark gray (2.5Y 4/1) dry; weak medium prismatic structure parting to moderate very fine angular blocky; firm; few very fine roots; few fine and common very fine tubular pores; few fine prominent yellowish brown (10YR 5/6) iron masses in the matrix in the lower 10 inches; few fine concretions of iron and manganese oxides; common pressure faces; neutral; gradual smooth boundary.

Bg2—37 to 49 inches; very dark gray (N 3/0) silty clay, dark gray (5Y 4/1) dry; weak medium prismatic structure parting to moderate very fine angular blocky; firm; few very fine and few fine roots; few very fine tubular pores; common fine prominent olive brown (2.5Y 4/4) and common fine prominent dark yellowish brown (10YR 4/4) iron masses in the matrix; few fine dark accumulations of iron and manganese oxides; common pressure faces; neutral; gradual smooth boundary.

Bg3—49 to 80 inches; dark gray (2.5Y 4/1) silty clay; weak coarse prismatic structure parting to moderate fine subangular blocky along prism faces; firm; few very fine tubular pores; common pressure faces; common fine prominent dark yellowish brown (10YR 4/6) iron masses in the matrix; few fine dark accumulations of iron and manganese oxides; neutral.

The Ap horizon has value of 2 or 3 and chroma of 0 to 2. The Bg horizon has hue of 10YR to 5Y and value of 2 to 5. It is silty clay, silty clay loam, or clay loam. The Cg horizon has hue of 10YR to 5Y and value of 2 to 4. It is silty clay or silty clay loam.

Formation of the Soils

Soil forms through processes that act on accumulated or deposited geologic material. The characteristics of a soil are determined by the type of parent material; the plant and animal life on and in the soil; the climate under which the soil has formed; the relief, or lay of the land; and the length of time that the forces of soil formation have acted on the soil material. Human activities also affect soil formation.

Parent material affects the kind of soil profile that forms and, in extreme cases, determines it almost entirely. Plants and animals affect the content of organic matter, structure, and porosity of the soil. Climate determines the amount of water available for leaching and the soil temperature, which causes physical changes and influences the rate of chemical changes. Together, climate and plant and animal life 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. Relief modifies the effects of the other factors. Finally, time is needed for the transformation of the parent material into a soil that has distinct horizons. Some time is always required for the differentiation of soil horizons. Generally, a long time is required for the formation of distinct horizons.

The effects of the factors of soil formation are so closely interrelated 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 characteristics of this material determine the limits of the chemical and mineralogical composition of the soils. The soils in Schuyler County formed in residuum, or material weathered from bedrock; in glacial till, or material deposited by glacial ice; in loess, or material deposited by the wind; and in alluvium, or material deposited by water. Some of the soils formed in more than one kind of parent material.

The residuum in Schuyler County consists of material weathered from limestone, shale, and sandstone. The weathering of limestone, shale, and sandstone formed some of the soils on the lower slopes that have been mapped as inclusions with the Winnegan soils. These soils are on moderately steep to very steep, convex backslopes that parallel streams in the western part of the county.

Loess is silty material that was transported by the wind. The source of the material is generally thought to be flood plains. The original loess material contained less than 3 percent sand, 25 to 40 percent clay, and 60 to 75 percent silt. The texture was silt loam or silty clay loam. After many years of weathering, the loess material has developed a layer that has a clay content ranging from 40 to 65 percent and a silt content ranging from 35 to 60 percent. The texture of this layer is now silty clay loam, silty clay, or clay. Loess mantles most of the ridges in Schuyler County and ranges from a few inches to 6 feet in thickness. In the areas of prairie along the Grand Divide, the loess was deposited on wide, nearly level or gently sloping divides and ridgetops. Edina and Adco soils formed partly or entirely in the loess on these divides and ridgetops. The deposits of loess are thinner on narrow ridgetops than in other areas. Gorin and Bevier soils formed in these deposits and in the underlying pedisediment and glacial till material.

Glacial till is a heterogeneous mass of sand, silt, clay, and rock that was mixed and moved by large masses of slowly moving ice. Glacial till ranges from a few feet to more than 200 feet in thickness. The texture of the original glacial till varies greatly, but most of the till was clay loam or loam before it was subjected to weathering. The original glacial till contained 15 to 90 percent sand, 0 to 70 percent silt, and 4 to 40 percent clay; the average was 37 percent sand, 34 percent silt, and 29 percent clay. After many years of weathering, the glacial till material has developed a layer that has a clay content ranging from 30 to 50 percent. In some areas, soil formed in the glacial till before loess was deposited on top of it. In many of these areas the old soils are now exposed. A surface layer, which varies in thickness, formed at a later time. Clarinda, Lamoni, Armstrong, and Keswick soils are examples of soils that formed in this old glacial till. In the steeper areas, the unweathered glacial till material was exposed by geologic erosion at a later time. Gara and Winnegan soils formed in this material.

Alluvium is soil material that was transported by water and deposited on nearly level flood plains along streams. Most of this material came from the surrounding uplands. The material ranges from clay and silt to coarse sand. Wabash soils formed in material that contains 40 to 60 percent clay. Zook soils formed in material that contains 35 to 45 percent clay. Excello, Fatima, Kennebec, Vesser, and Amana soils formed in material that contains 18 to 35 percent clay.

Glaciofluvial deposits are made up of materials produced by glaciers and carried, sorted, and deposited by water that originated mainly from the melting of glacial ice. These deposits are above the present-day flood plain. Mystic, Caleb, and Alvin soils formed in this material.

Some of the soils in the county formed in more than one kind of parent material. For example, Bevier and Gorin soils formed in both loess and glacial till.

Plants and Animals

The native vegetation of prairie grasses and trees has influenced soil formation in Schuyler County. The rooting habits, lifespan, and mineral composition of prairie grasses differ markedly from those of deciduous trees. The micro-organisms and animals associated with each also differ significantly.

Organic matter is an important component of the soil. Plants, insects and other animals, bacteria, and fungi provide the organic matter. Chemicals in the soil move from plant roots to the parts of the plants growing above the surface. As they return to the soil and decay, leaves and other parts of plants add nutrients and organic matter. Roots help to loosen the soil. When they decay, they leave channels for the movement of water and air.

Leaves, twigs, and logs are low in bases and are acid. These materials slowly decompose on the surface and add organic matter to the soils in forested areas. The soils in these areas develop a very thin, dark surface layer and a leached subsurface layer. In contrast, the organic matter added to soils that formed under prairie grasses is largely the residue from the yearly decay of annual and biennial plants, which are higher in bases than the forest vegetation and result in neutral or basic soils. The tops of annual and biennial plants decompose on the surface, but much of the organic material is in the roots. The soils that form under prairie grasses have a dark surface layer that is much thicker than that of the forest soils.

Worms, insects, burrowing animals, and large animals affect soil formation. The effects of bacteria and fungi, which cause the rotting of organic material, improve tilth, and fix nitrogen in the soil, are more significant than the effects of animals. The population of organisms is directly related to the rate at which organic material decomposes in the soil. The kinds of organisms in a given area and their activity are determined by differences in vegetation.

In a remarkably short time, human activities have profoundly affected soil formation in Schuyler County. The major alterations have resulted from changes in vegetation, drainage, relief, accelerated erosion, and soil chemistry. Prairie grasses have been replaced by cool-season grasses and row crops. Nearly all of the flood plains and many of the areas on uplands have been cleared and are farmed. Fertilizers, pesticides, and lime have been applied, wet soils have been drained, and sloping soils have been terraced. As much as 50 percent or more of the original surface soil has been eroded from the sloping upland soils. A new cycle of soil formation has begun in areas where the surface soil has been removed by erosion, in areas where soil has been deposited by wind, water, or gravitational forces, and in areas where earthmoving equipment has completely rearranged soil profiles.

Many of the changes humans have made have increased the production of food and fiber. In terms of sustained productivity, however, the net effect of human activities in many areas of the county has been harmful. Accelerated erosion, for example, has reduced the potential productivity of many of the soils on uplands.

Climate

Climate has been an important factor in the formation of the soils in Schuyler County. Climate affects the rate of geologic erosion, which in turn affects the shape and character of landforms. The relative abundance of plants and animals and the species composition are altered by climatic change. Present climatic conditions favor the growth of trees rather than prairie grasses.

Schuyler County has a subhumid midcontinental climate. This climate has changed significantly since the last period of glaciation. Changes in climate caused the glacial periods. During many years of cool temperatures and high precipitation, massive ice sheets formed. These ice sheets moved across a mature bedrock topography of gently undulating hills and dissected plains, which were of less relief than the current Ozark topography to the south (Work and others, 1982). Warmer temperatures later resulted in the retreat of glacial ice. As the ice retreated, the rate of geologic erosion was accelerated and very fine sands and silt were subject to being transported by the wind. Soils formed and were later covered by loess, truncated, mixed by erosion, or completely eroded away. Bevier soils, for example, formed in loess and in the underlying pedisediment or glacial till.

Extreme changes in climate have occurred in Schuyler County. There were periods when different types of vegetation grew. During drier, warmer periods, forested areas were replaced by prairie grasses. Mollisols, which have a thick, dark surface layer, formed during these periods.

The higher temperatures and larger amounts of rainfall characteristic of the current climate result in relatively rapid chemical changes and physical disintegration. The current climate has resulted in the rapid breakdown of minerals, forming clay within the soil. As the clay is moved downward, it accumulates in the subsoil. This process is known as illuviation. All of the upland soils in Schuyler County show the effects of this process and have developed a subsoil layer that has a higher clay content than the surface layer or the underlying material. In addition, calcium carbonates and other soluble salts have been removed from the upper horizons of the soil by leaching and the level of fertility has decreased. A layer of accumulation of calcium carbonate has developed lower in the soil profile.

Relief

Relief is the difference in elevation of the landscape. Relief varies, depending on the parent material and the position in the watershed.

Relief influences soil formation through its effect on drainage, runoff, erosion, and exposure to sunlight and wind. The length, shape, and gradient of slopes affect soil-water relationships. The amount of water entering and leaching through the soil depends on the slope, the position on the landscape, the permeability of the soil, and the amount and intensity of rainfall.

The soils on steep, south-facing slopes are more droughty than the soils on north-facing slopes because they receive more direct sunrays. The droughtiness affects soil formation by influencing the amount and kind of vegetation that grows on the slope and the susceptibility of the soils to erosion and to freezing and thawing. Because the north-facing slopes receive less direct sunrays, the soils on these slopes are cooler and moister than those on other aspects.

On nearly level or gently sloping soils in the uplands, runoff is slow and most of the water that the soils receive passes through the profile. As a result, these soils are characterized by maximum profile development. Over long periods of time, a subsoil with a clay content ranging from 50 to 60 percent forms under a leached subsurface layer. This kind of development has occurred in Edina and Adco soils. On the steeper soils, such as Winnegan soils, runoff is rapid and less water leaches through the profile. Consequently, thinner horizons develop. The results of weathering are partially eliminated by geologic erosion.

Time

Time allows climate, living organisms, and relief to affect the parent material. The degree to which the material is altered determines the age of a soil. Thus, the age is inferred from the morphology of the soil.

The most fertile and productive soils in the county formed in recent alluvium. They are young soils. Amana, Fatima, Kennebec, and Zook soils are examples.

Soils on terraces are intermediate in age between the soils on flood plains and those on uplands. Arbela and Vesser soils, for example, exhibit some maturity, as indicated by a reduced level of fertility and by the formation of argillic horizons. However, these soils still retain stratification in the lower part of the substratum, which is characteristic of soils that formed in recent alluvium on flood plains.

Glaciers deposited parent material more than 350,000 years ago. With climatic changes, areas of this glacier-deposited material were exposed to extreme weathering. This weathered glacial till (paleosol) is of late to early Sangamon age, about 140,000 to 38,000 years old (Ruhe and others, 1967). Armstrong soils formed in this weathered material. On many of the lower backslopes, the paleosol eroded down to the original unweathered glacial deposits. More recent soils formed on these surfaces. Gara and Winnegan soils are examples.

Loess, or windblown material, was deposited on the upland landscapes and consisted of a layer of fine soil particles (silt and clay). The loess material eroded off the dissected slopes but remains on nearly level to moderately sloping ridgetops and in the heads of drainageways. Edina and Adco soils formed in this Wisconsin loess, which is probably 14,000 to 16,000 years old.

Soils on uplands generally show evidence of maturity, as indicated by a reduced level of fertility and a strongly expressed argillic horizon. These soils tend to be on the older landforms. Nearly level to gently sloping soils at the highest elevations are the oldest soils in the county. They are characterized by the maximum development of distinct horizons. The oldest soils are Clarinda and Lamoni soils, which formed during an interglacial period. These soils were later buried and then re-exposed by geologic erosion and subjected to the present-day soil-forming processes. The oldest soils that formed in more recently deposited loess are Adco and Edina soils. The carbonates that originally were in the parent material have been leached to a great depth, leaving the soils quite acid throughout. Clay has been formed by weathering and has been translocated by water into a distinct subsoil. A highly bleached subsurface horizon is formed as weatherable material is leached out.

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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.

Argillic horizon. A subsoil horizon characterized by an accumulation of illuvial clay.

Aspect. The direction in which a slope faces.

Association, soil. A group of soils or miscellaneous areas 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

Backslope. The geomorphic component that forms the steepest inclined surface and principal element of many hillsides. Backslopes in profile are commonly steep, are linear, and may or may not include cliff segments.

Basal till. Compact glacial till deposited beneath the ice.

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 strata, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediment.

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.

Chert. A hard, dense or compact, dull to semivitreous, cryptocrystalline sedimentary rock, consisting of cryptocrystalline silica and lesser amounts of micro- or cryptocrystalline quartz and amorphous silica.

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.

Coarse textured soil. Sand or loamy sand.

Cobble (or cobblestone). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Cobbly soil material. Material that is 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. Very cobbly soil material has 35 to 60 percent of these rock fragments, and extremely cobbly soil material has more than 60 percent.

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 or miscellaneous areas 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 or miscellaneous areas are somewhat similar in all areas.

Concretions. Cemented bodies with crude internal symmetry organized around a point, a line, or a plane. They typically take the form of concentric layers visible to the naked eye. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up concretions. If formed in place, concretions of iron oxide or manganese oxide are generally considered a type of redoximorphic concentration.

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. Refers to the degree of cohesion and adhesion of soil material and its resistance to deformation when ruptured. Consistence includes resistance of soil material to rupture and to penetration; plasticity, toughness, and stickiness of puddled soil material; and the manner in which the soil material behaves when subject to compression. Terms describing consistence are defined in the "Soil Survey Manual."

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.

Depth, soil. Generally, the thickness of the soil over bedrock. Very deep soils are more than 60 inches deep over bedrock; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

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 wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized—*excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained,* and *very poorly drained.* These classes are defined in the "Soil Survey Manual."

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, such as a fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grain is 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.

Flaggy soil material. Material that is, by volume, 15 to 35 percent flagstones. Very flaggy soil material has 35 to 60 percent flagstones, and extremely flaggy soil material has more than 60 percent flagstones.

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.

Footslope. 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 drift. Pulverized and other rock material transported by glacial ice and then deposited. Also, the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial till. Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors.

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 as much as 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, as much as 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. 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 material 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, the geomorphic components of a simple hillslope may include shoulder, backslope, footslope, and toeslope.

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. An explanation of the subdivisions is given in the "Soil Survey Manual." The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

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 A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

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 soil material. 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.—Consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but it 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 potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties are depth to a seasonal high water table, the infiltration rate and permeability after prolonged wetting, and depth to a very slowly permeable layer. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff.

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.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Landform. Any recognizable physical feature of the earth's surface, having a characteristic shape and produced by natural causes. Included are mountains, plateaus, plains, valleys, flood plains, and terraces. Together, the landforms make up the surface configuration of the earth.

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.

Mollic epipedon. A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

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. 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).

Muck. Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

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 of 6.6 to 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan.*

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedisediment. A thin layer of alluvial material that mantles an erosion surface and has been transported to its present position from higher lying areas of the erosion surface.

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 affects the specified use.

Permeability. The quality of the soil that enables water or air to move downward through the profile. The rate at which a saturated soil transmits water is accepted as a measure of this quality. In soil physics, the rate is referred to as "saturated hydraulic conductivity," which is defined in the "Soil Survey Manual." In line with conventional usage in the engineering profession and with traditional usage in published soil surveys, this rate of flow continues to be expressed as "permeability." Terms describing permeability, measured in inches per hour, are as follows:

Extremely slow	0.0 to 0.01 inch
Very slow	0.01 to 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 flooding.

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.

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:

Ultra acid	less than 3.5
Extremely acid	3.5 to 4.4
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, typically sharp crested with steep sides forming an extended upland between valleys.

Rill. A steep-sided channel resulting from accelerated erosion. A rill generally is 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.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. 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.

Shoulder. The hillslope position that forms the uppermost inclined surface near the top of a hillslope. It comprises the transition zone from backslope to summit. The surface is dominantly convex in profile and erosional in origin.

Shrink-swell (in tables). The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

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.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

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
Very gently sloping	1 to 3 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 35 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.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in 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 material below the solum. 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 that provide vegetative barriers to soil blowing 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 soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

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 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, considered collectively. 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. Soils are recognized as taxadjuncts only when one or more of their characteristics are slightly outside the range defined for the family of the series for which the soils are named.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field generally is built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material 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.

Toeslope. The outermost inclined surface at the base of a hill; part of a footslope.

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

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Water bars. Smooth, shallow ditches or depressional areas that are excavated at an angle across a sloping road. They are used to reduce the downward velocity of water and divert it off and away from the road surface. Water bars can easily be driven over if constructed properly.

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.

Windthrow. The uprooting and tipping over of trees by the wind.

Tables

Table 1.--Temperature and Precipitation

(Recorded in the period 1961-90 at Kirksville, Missouri)

Month	Temperature						Precipitation				
				2 years in 10 will have--				2 years in 10 will have--			
	Average daily maximum	Average daily minimum	Average	Maximum temperature higher than--	Minimum temperature lower than--	Average number of growing degree days*	Average	Less than--	More than--	Average number of days with 0.10 inch or more	Average snowfall
	^{o}F	^{o}F	^{o}F	^{o}F	^{o}F	Units	In	In	In		In
January----	32.8	14.4	23.6	61	-17	12	1.14	0.28	2.06	2	6.2
February---	38.0	18.8	28.4	67	-12	27	.90	.44	1.36	2	4.8
March------	50.7	30.0	40.3	80	4	150	2.65	1.42	3.72	5	4.1
April------	64.3	41.7	53.0	86	20	388	3.20	1.60	4.60	6	1.1
May--------	73.6	51.3	62.5	89	33	697	4.36	2.50	6.02	7	.0
June-------	82.2	60.5	71.3	95	43	938	4.20	1.78	6.25	6	.0
July-------	87.1	65.1	76.1	99	49	1,040	3.80	1.53	5.72	5	.0
August-----	84.6	62.4	73.5	99	46	999	3.70	1.34	5.66	5	.0
September--	77.0	54.8	65.9	93	34	749	4.27	1.86	6.32	6	.0
October----	66.1	44.0	55.1	87	24	456	3.19	1.36	4.94	5	.2
November---	51.1	32.2	41.7	75	7	144	2.09	.69	3.51	3	2.0
December---	36.6	19.6	28.1	65	-12	26	1.75	.78	2.68	3	4.8
Yearly:											
Average---	62.0	41.2	51.6	---	---	---	---	---	---	---	---
Extreme---			---	101	-18	---	---	---	---	---	---
Total-----	---	---	---	---	---	5,626	35.25	26.75	41.79	55	23.2

* 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 (40 degrees F).

Table 2.--Freeze Dates in Spring and Fall

(Recorded in the period 1961-90 at Kirksville, 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. 16	Apr. 20	May 5
2 years in 10 later than--	Apr. 12	Apr. 16	Apr. 29
5 years in 10 later than--	Apr. 3	Apr. 10	Apr. 20
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 24	Oct. 8	Sept. 26
2 years in 10 earlier than--	Oct. 28	Oct. 13	Oct. 1
5 years in 10 earlier than--	Nov. 6	Oct. 24	Oct. 10

Table 3.--Growing Season

(Recorded in the period 1961-90 at Kirksville, 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	180	175	152
8 years in 10	187	180	159
5 years in 10	201	191	172
2 years in 10	215	202	185
1 year in 10	222	208	192

Table 4.--Acreage and Proportionate Extent of the Soils

Map symbol	Soil name	Acres	Percent
10C	Bevier silty clay loam, 3 to 8 percent slopes	3,750	1.9
11	Edina silt loam	3,950	2.0
14C2	Armstrong loam, 5 to 9 percent slopes, eroded	19,700	10.0
14D2	Armstrong clay loam, 9 to 14 percent slopes, eroded	12,050	6.1
16D2	Caleb-Mystic complex, 9 to 14 percent slopes, eroded	280	0.1
17C	Bevier silt loam, terrace, 3 to 9 percent slopes	630	0.3
18C2	Gorin silty clay loam, 3 to 9 percent slopes, eroded	2,300	1.2
20C2	Clarinda silty clay loam, 5 to 9 percent slopes, eroded	1,350	0.7
22B	Adco silt loam, 1 to 3 percent slopes	5,300	2.7
23D2	Keswick clay loam, 5 to 14 percent slopes, eroded	7,050	3.6
24E2	Gara loam, 14 to 20 percent slopes, eroded	30,610	15.5
24F2	Gara fine sandy loam, 20 to 35 percent slopes, eroded	15,550	7.9
26C2	Leonard silty clay loam, 2 to 9 percent slopes, eroded	2,700	1.4
28E2	Winnegan clay loam, 14 to 20 percent slopes, eroded	2,100	1.1
28F2	Winnegan loam, 20 to 35 percent slopes, eroded	28,100	14.2
34B2	Seymour silty clay loam, 2 to 5 percent slopes, eroded	8,000	4.0
36C2	Lamoni loam, 5 to 9 percent slopes, eroded	9,700	4.9
40	Arbela and Humeston soils, occasionally flooded	2,350	1.2
45	Kennebec and Fatima soils, frequently flooded	7,750	3.9
46	Vesser silt loam, occasionally flooded	1,600	0.8
47	Zook silty clay loam, overwash, frequently flooded	6,900	3.5
51	Amana silty clay loam, occasionally flooded	2,300	1.2
54B	Zook and Excello soils, fans, 2 to 5 percent slopes, rarely flooded	2,050	1.0
56B	Zook silty clay loam, rarely flooded-Excello loam, frequently flooded, complex, 0 to 5 percent slopes	17,900	9.1
60	Wabash silty clay, occasionally flooded	2,950	1.5
64C2	Alvin loamy sand, 2 to 9 percent slopes, eroded	164	*
67	Aquents, frequently flooded	170	*
75	Ackmore silt loam, occasionally flooded	250	0.1
	Water	44	*
	Total	197,548	100.0

* Less than 0.05 percent. The combined extent of the soils assigned an asterisk in the "Percent" column is about 0.1 percent of the survey area.

Table 5.--Prime Farmland

Map symbol	Soil name
11	Edina silt loam (where drained)
22B	Adco silt loam, 1 to 3 percent slopes
34B2	Seymour silty clay loam, 2 to 5 percent slopes, eroded
40	Arbela and Humeston soils, occasionally flooded (where drained)
45	Kennebec and Fatima soils, frequently flooded (where protected from flooding or not frequently flooded during the growing season)
46	Vesser silt loam, occasionally flooded (where drained)
47	Zook silty clay loam, overwash, frequently flooded (where drained and protected from flooding or not frequently flooded during the growing season)
51	Amana silty clay loam, occasionally flooded
54B	Zook and Excello soils, fans, 2 to 5 percent slopes, rarely flooded
56B	Zook silty clay loam, rarely flooded-Excello loam, frequently flooded, complex, 0 to 5 percent slopes (where drained and protected from flooding or not frequently flooded during the growing season)
60	Wabash silty clay, occasionally flooded (where drained)
64C2	Alvin loamy sand, 2 to 9 percent slopes, eroded
75	Ackmore silt loam, occasionally flooded (where drained)

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. They are for nonirrigated areas. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Map symbol and soil name	Land capability	Corn	Soybeans	Grain sorghum	Winter wheat	Orchardgrass-red clover hay	Tall fescue	Switchgrass
		Bu	Bu	Bu	Bu	Tons	AUM*	AUM*
10C:								
Bevier	3e	93	31	73	38	3.1	6.2	6.6
11:								
Edina	2w	113	37	89	46	3.9	7.6	7.6
14C2:								
Armstrong	3e	93	30	72	37	3.1	6.1	6.2
14D2:								
Armstrong	4e	80	26	62	32	2.7	5.4	5.4
16D2:								
Caleb	4e	87	29	68	34	3.1	6.0	6.0
Mystic	4e	66	22	52	26	2.3	4.4	4.4
17C:								
Bevier	3e	70	24	55	28	2.6	5.0	5.0
18C2:								
Gorin	3e	88	29	68	35	2.9	5.9	6.0
20C2:								
Clarinda	4e	88	29	69	35	2.9	5.9	5.8
22B:								
Adco	2e	108	36	84	43	3.6	7.1	6.8
23D2:								
Keswick	4e	70	22	57	29	2.3	4.5	5.5
24E2:								
Gara	6e	---	---	---	---	---	6.0	6.2
24F2:								
Gara	6e	---	---	---	---	---	5.0	5.2
26C2:								
Leonard	3e	88	29	68	32	3.0	5.9	5.8

See footnote at end of table.

Table 6.--Land Capability and Yields per Acre of Crops and Pasture--Continued

Map symbol and soil name	Land capability	Corn	Soybeans	Grain sorghum	Winter wheat	Orchardgrass-red clover hay	Tall fescue	Switchgrass
		Bu	Bu	Bu	Bu	Tons	AUM*	AUM*
28E2:								
Winnegan	6e	---	---	---	---	2.5	4.5	5.0
28F2:								
Winnegan	7e	---	---	---	---	---	4.5	5.0
34B2:								
Seymour	3e	109	37	84	43	3.6	7.1	7.3
36C2:								
Lamoni	3e	99	33	78	40	3.4	6.6	6.8
40:								
Arbela	2w	114	38	89	46	3.9	7.6	7.7
Humeston	2w	114	38	89	46	3.9	7.6	8.0
45:								
Kennebec	3w	125	43	91	49	4.1	8.0	8.0
Fatima	3w	120	40	90	48	4.0	8.0	9.0
46:								
Vesser	2w	114	38	89	46	3.9	7.6	7.6
47:								
Zook	3w	100	32	78	39	3.3	5.5	5.0
51:								
Amana	2w	138	46	108	55	4.0	8.0	9.0
54B:								
Zook	2w	104	34	81	41	3.7	7.0	7.2
Excello	2w	108	36	84	43	3.8	7.2	7.2
56B:								
Zook	2w	108	36	84	43	3.8	7.2	7.2
Excello	2w	108	36	84	43	3.8	7.2	7.2
60:								
Wabash	3w	90	32	80	39	3.0	6.0	4.5

See footnote at end of table.

Table 6.--Land Capability and Yields per Acre of Crops and Pasture--Continued

Map symbol and soil name	Land capability	Corn	Soybeans	Grain sorghum	Winter wheat	Orchardgrass-red clover hay	Tall fescue	Switchgrass
		Bu	Bu	Bu	Bu	Tons	AUM*	AUM*
64C2:								
Alvin-----------	3e	80	28	63	40	2.7	5.2	5.2
67:								
Aquents---------	7w	---	---	---	---	---	---	---
75:								
Ackmore---------	2w	120	40	94	48	4.0	8.0	9.0

*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)

Map symbol and soil name	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Potential productivity: Common trees	Site index	Volume*	Trees to plant
10C: Bevier	3C	Slight	Slight	Severe	Slight	Moderate	White oak	55	38	White oak, eastern white pine.
14C2: Armstrong	3C	Slight	Slight	Moderate	Slight	Slight	White oak Northern red oak Black oak	55 65 61	38 38 44	Sugar maple, eastern white pine, northern red oak, black oak, European larch.
14D2: Armstrong	3C	Slight	Slight	Moderate	Slight	Slight	White oak Northern red oak Black oak	55 55 61	38 38 44	Sugar maple, eastern white pine, northern red oak, black oak, European larch.
16D2: Caleb	3A	Slight	Slight	Slight	Slight	Slight	White oak Northern red oak	55 55	38 38	Sugar maple, black walnut, red pine, eastern white pine.
Mystic	3A	Slight	Slight	Slight	Slight	Moderate	White oak Northern red oak	55 55	38 38	Sugar maple, black walnut, red pine, eastern white pine.
17C: Bevier	3C	Slight	Slight	Severe	Slight	Moderate	White oak	55	38	Eastern white pine, white oak.
18C2: Gorin	3C	Slight	Slight	Moderate	Slight	Severe	White oak Northern red oak Black oak	53 62 61	36 44 45	White oak, northern red oak, black oak.
23D2: Keswick	3C	Slight	Slight	Moderate	Slight	Slight	White oak Northern red oak	55 55	38 38	Sugar maple, red pine, eastern white pine.
24E2: Gara	3R	Moderate	Moderate	Slight	Slight	Slight	White oak Northern red oak Black oak	56 57 59	39 40 41	Red pine, eastern white pine, white oak, northern red oak.

See footnote at end of table.

Table 7.--Woodland Management and Productivity--Continued

Map symbol and soil name	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Potential productivity: Common trees	Site index	Volume*	Trees to plant
24F2:										
Gara	3R	Moderate	Moderate	Slight	Slight	Slight	White oak	56	39	Red pine, eastern white pine, white oak, northern red oak.
							Northern red oak	57	40	
							Black oak	59	41	
28E2:										
Winnegan	3R	Moderate	Moderate	Slight	Slight	Moderate	Post oak	57	40	White oak, northern red oak, black oak.
							White oak	---	---	
							Black oak	---	---	
28F2:										
Winnegan	3R	Moderate	Moderate	Slight	Slight	Moderate	Post oak	57	40	White oak, northern red oak, black oak.
							White oak	---	---	
							Black oak	---	---	
45:										
Kennebec	3A	Slight	Slight	Slight	Slight	Moderate	Black walnut	79	48	Hackberry, green ash, black walnut, American sycamore, eastern cottonwood, bur oak.
							Bur oak	63	46	
							Hackberry	---	---	
							Eastern cottonwood	---	---	
							Green ash	---	---	
Fatima	5W	Slight	Moderate	Slight	Slight	Severe	Pin oak	86	68	Pecan, black walnut, American sycamore, eastern cottonwood.
							Black walnut	---	---	
							Bur oak	---	---	
51:										
Amana	3A	Slight	Slight	Slight	Slight	Moderate	Eastern cottonwood	95	116	Black walnut.
							Pin oak	80	62	
							Green ash	---	---	
60:										
Wabash	4W	Slight	Severe	Severe	Moderate	Severe	Pin oak	75	57	Pecan, eastern cottonwood, pin oak.

* 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

(Only the soils suitable for windbreaks and environmental plantings are listed. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
10C: Bevier	Fragrant sumac	Amur maple, gray dogwood, possumhaw, ninebark.	Hackberry, eastern redcedar, Norway spruce.	Honeylocust, Austrian pine, pin oak.	---
11: Edina	Buttonbush	Possumhaw	Hackberry, eastern redcedar, northern whitecedar, nannyberry viburnum.	Pin oak, baldcypress.	Eastern cottonwood.
14C2: Armstrong	Fragrant sumac	Amur maple, gray dogwood, possumhaw, ninebark.	Hackberry, eastern redcedar, Norway spruce.	Honeylocust, Austrian pine, pin oak.	---
14D2: Armstrong	Fragrant sumac	Amur maple, gray dogwood, possumhaw, ninebark.	Hackberry, eastern redcedar, Norway spruce.	Honeylocust, Austrian pine, pin oak.	---
16D2: Caleb	Fragrant sumac	Gray dogwood, American plum, arrowwood.	Eastern redbud, Washington hawthorn, eastern redcedar.	White fir, green ash, yellow-poplar, northern red oak.	Eastern white pine.
Mystic	Fragrant sumac	Amur maple, gray dogwood, possumhaw, ninebark.	Hackberry, eastern redcedar, Norway spruce.	Honeylocust, Austrian pine, pin oak.	---
17C: Bevier	Fragrant sumac	Amur maple, gray dogwood, possumhaw, ninebark.	Hackberry, eastern redcedar, Norway spruce.	Honeylocust, Austrian pine, pin oak.	---
18C2: Gorin	Fragrant sumac	Amur maple, gray dogwood, possumhaw, ninebark.	Hackberry, eastern redcedar, Norway spruce.	Honeylocust, Austrian pine, pin oak.	---
20C2: Clarinda	Fragrant sumac	Amur maple, gray dogwood, possumhaw, ninebark.	Hackberry, eastern redcedar, Norway spruce.	Honeylocust, Austrian pine, pin oak.	---
22B: Adco	Fragrant sumac	Amur maple, gray dogwood, possumhaw, ninebark.	Hackberry, eastern redcedar, Norway spruce.	Honeylocust, Austrian pine, pin oak.	---

Table 8.--Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
24E2:					
Gara	Fragrant sumac	Gray dogwood, American plum, arrowwood.	Eastern redbud, Washington hawthorn, eastern redcedar.	White fir, green ash, yellow-poplar, northern red oak.	Eastern white pine.
24F2:					
Gara	Fragrant sumac	Gray dogwood, American plum, arrowwood.	Eastern redbud, Washington hawthorn, eastern redcedar.	White fir, green ash, yellow-poplar, northern red oak.	Eastern white pine.
26C2:					
Leonard	Fragrant sumac	Amur maple, gray dogwood, possumhaw, ninebark.	Hackberry, eastern redcedar, Norway spruce.	Honeylocust, Austrian pine, pin oak.	---
28E2:					
Winnegan	Fragrant sumac	Amur maple, gray dogwood, possumhaw, ninebark.	Hackberry, eastern redcedar, Norway spruce.	Honeylocust, Austrian pine, pin oak.	---
28F2:					
Winnegan	Fragrant sumac	Amur maple, gray dogwood, possumhaw, ninebark.	Hackberry, eastern redcedar, Norway spruce.	Honeylocust, Austrian pine, pin oak.	---
34B2:					
Seymour	Fragrant sumac	Amur maple, gray dogwood, possumhaw, ninebark.	Hackberry, eastern redcedar, Norway spruce.	Honeylocust, Austrian pine, pin oak.	---
40:					
Arbela	Fragrant sumac	Gray dogwood, American plum, blackhaw.	Washington hawthorn, eastern redcedar, nannyberry viburnum.	Green ash, sweetgum, eastern white pine, baldcypress.	Pin oak.
Humeston	Buttonbush	Possumhaw	Hackberry, eastern redcedar, northern whitecedar, nannyberry viburnum.	Pin oak, baldcypress.	Eastern cottonwood.
45:					
Kennebec.					
Fatima	Fragrant sumac	Gray dogwood, American plum, blackhaw.	Washington hawthorn, eastern redcedar, nannyberry viburnum.	Green ash, sweetgum, eastern white pine, baldcypress.	Pin oak.

Table 8.--Windbreaks and Environmental Plantings--Continued

Map symbol and soil name	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
47:					
Zook	Buttonbush	Possumhaw	Hackberry, eastern redcedar, northern whitecedar, nannyberry viburnum.	Pin oak, baldcypress.	Eastern cottonwood.
54B:					
Zook	Buttonbush	Possumhaw	Hackberry, eastern redcedar, northern whitecedar, nannyberry viburnum.	Pin oak, baldcypress.	Eastern cottonwood.
Excello.					
56B:					
Zook	Buttonbush	Possumhaw	Hackberry, eastern redcedar, northern whitecedar, nannyberry viburnum.	Pin oak, baldcypress.	Eastern cottonwood.
Excello.					
60:					
Wabash	Buttonbush	Possumhaw	Hackberry, eastern redcedar, northern whitecedar, nannyberry viburnum.	Pin oak, baldcypress.	Eastern cottonwood.
64C2:					
Alvin	Fragrant sumac	Gray dogwood, American plum.	Amur maple, Washington hawthorn, eastern redcedar, nannyberry viburnum.	Hackberry, green ash, eastern white pine, northern red oak, baldcypress	---
75:					
Ackmore	Fragrant sumac	Gray dogwood, American plum, blackhaw.	Washington hawthorn, eastern redcedar, nannyberry viburnum.	Green ash, sweetgum, eastern white pine, baldcypress.	Pin oak.

Table 9.--Recreational Development

(The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. See text for definitions of terms used in this table)

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
10C:					
Bevier----------	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
11:					
Edina-----------	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
14C2:					
Armstrong-------	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.
14D2:					
Armstrong-------	Severe: wetness.	Moderate: slope, wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness, slope.
16D2:					
Caleb-----------	Moderate: slope, wetness.	Moderate: slope, wetness.	Severe: slope.	Slight-----------	Moderate: slope.
Mystic----------	Severe: wetness.	Moderate: slope, wetness, percs slowly.	Severe: slope, wetness.	Severe: erodes easily.	Moderate: wetness, slope.
17C:					
Bevier----------	Severe: wetness.	Severe: wetness.	Severe: slope, wetness.	Severe: wetness.	Severe: wetness.
18C2:					
Gorin-----------	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: slope.	Moderate: wetness.	Moderate: wetness.
20C2:					
Clarinda--------	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: slope, wetness, percs slowly.	Severe: wetness.	Severe: wetness.
22B:					
Adco------------	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
23D2:					
Keswick---------	Severe: wetness.	Moderate: slope, wetness, percs slowly.	Severe: slope, wetness.	Severe: erodes easily.	Moderate: wetness, slope.

Table 9.--Recreational Development--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
24E2:					
Gara	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
24F2:					
Gara	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
26C2:					
Leonard	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
28E2:					
Winnegan	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
28F2:					
Winnegan	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
34B2:					
Seymour	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
36C2:					
Lamoni	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: slope, wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
40:					
Arbela	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Humeston	Severe: flooding, wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
45:					
Kennebec	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
Fatima	Severe: flooding.	Moderate: flooding, wetness.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
46:					
Vesser	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
47:					
Zook	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.
51:					
Amana	Severe: flooding.	Moderate: wetness.	Moderate: wetness, flooding.	Slight	Moderate: flooding.

Table 9.--Recreational Development--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
54B:					
Zook	Severe: flooding, wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Excello	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
56B:					
Zook	Severe: flooding, wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Excello	Severe: flooding, wetness.	Moderate: flooding, wetness.	Severe: wetness, flooding.	Moderate: wetness, flooding.	Severe: flooding.
60:					
Wabash	Severe: flooding, wetness, percs slowly.	Severe: wetness, too clayey, percs slowly.	Severe: too clayey, wetness, percs slowly.	Severe: wetness, too clayey.	Severe: wetness, too clayey.
64C2:					
Alvin	Slight	Slight	Moderate: slope.	Slight	Slight.
67:					
Aquents	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, flooding.	Severe: ponding, flooding.
75:					
Ackmore	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.

Table 10.--Wildlife Habitat

(See text for definitions of terms used in this table)

Map symbol and soil name	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
10C:										
Bevier----------	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
11:										
Edina-----------	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
14C2, 14D2:										
Armstrong-------	Fair	Good	Good	Good	Fair	Very poor.	Very poor.	Good	Good	Very poor.
16D2:										
Caleb-----------	Fair	Good	Fair	Good	Fair	Poor	Poor	Fair	Good	Poor.
Mystic----------	Fair	Good	Fair	Good	Fair	Very poor.	Poor	Fair	Good	Very poor.
17C:										
Bevier----------	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
18C2:										
Gorin-----------	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
20C2:										
Clarinda--------	Poor	Fair	Poor	Fair	Poor	Poor	Poor	Fair	Fair	Poor.
22B:										
Adco------------	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
23D2:										
Keswick---------	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
24E2:										
Gara------------	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Good	Fair	Very poor.
24F2:										
Gara------------	Very poor.	Fair	Good	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.
26C2:										
Leonard---------	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
28E2:										
Winnegan--------	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
28F2:										
Winnegan--------	Very poor.	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
34B2:										
Seymour---------	Good	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.

Table 10.--Wildlife Habitat--Continued

Map symbol and soil name	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
36C2:										
Lamoni----------	Fair	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.
40:										
Arbela----------	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Humeston--------	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
45:										
Kennebec--------	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Fatima----------	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
46:										
Vesser----------	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
47:										
Zook------------	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
51:										
Amana-----------	Good	Good	Good	Good	Fair	Good	Good	Good	Good	Good.
54B, 56B:										
Zook------------	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
Excello---------	Fair	Good	Good	Fair	Fair	Good	Fair	Good	Fair	Fair.
60:										
Wabash----------	Poor	Poor	Poor	Poor	Poor	Poor	Good	Poor	Poor	Fair.
64C2:										
Alvin-----------	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
67:										
Aquents---------	Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
75:										
Ackmore---------	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.

Table 11.--Building Site Development

(The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. See text for definitions of terms used in this table)

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
10C:						
Bevier----------	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, frost action.	Moderate: wetness.
11:						
Edina-----------	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
14C2:						
Armstrong-------	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, frost action.	Moderate: wetness.
14D2:						
Armstrong-------	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell, slope.	Severe: shrink-swell, low strength, frost action.	Moderate: wetness, slope.
16D2:						
Caleb-----------	Severe: wetness.	Moderate: wetness, shrink-swell, slope.	Severe: wetness.	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, frost action.	Moderate: wetness, slope.
17C:						
Bevier----------	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
18C2:						
Gorin-----------	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell, slope.	Severe: low strength, frost action.	Moderate: wetness.
20C2:						
Clarinda--------	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
22B:						
Adco------------	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, frost action.	Moderate: wetness.

Table 11.--Building Site Development--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
23D2:						
Keswick	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell, slope.	Severe: shrink-swell, low strength, frost action.	Moderate: wetness, slope.
24E2, 24F2:						
Gara	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
26C2:						
Leonard	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
28E2:						
Winnegan	Severe: wetness, slope.	Severe: slope.	Severe: wetness, slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
28F2:						
Winnegan	Severe: wetness, slope.	Severe: shrink-swell, slope.	Severe: wetness, slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength, slope.	Severe: slope.
34B2:						
Seymour	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength.	Moderate: wetness.
36C2:						
Lamoni	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength.	Moderate: wetness.
40:						
Arbela	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness.
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.
45:						
Kennebec	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding, frost action.	Severe: flooding.
Fatima	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength, flooding, frost action.	Severe: flooding.

Table 11.--Building Site Development--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
46:						
Vesser----------	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness.
47:						
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, flooding.
51:						
Amana-----------	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength, flooding, frost action.	Moderate: flooding.
54B:						
Zook------------	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, frost action.	Moderate: wetness.
Excello---------	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, frost action.	Moderate: wetness.
56B:						
Zook------------	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, frost action.	Moderate: wetness.
Excello---------	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Severe: flooding.
60:						
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.
64C2:						
Alvin-----------	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Moderate: frost action.	Slight.
67:						
Aquents---------	Severe: ponding, flooding.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, low strength, shrink-swell.	Severe: flooding, ponding.
75:						
Ackmore---------	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 12.--Sanitary Facilities

(The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. See text for definitions of terms used in this table)

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
10C:					
Bevier----------	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
11:					
Edina-----------	Severe: wetness, percs slowly.	Moderate: seepage.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
14C2, 14D2:					
Armstrong-------	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness.	Severe: wetness.	Poor: wetness.
16D2:					
Caleb-----------	Severe: wetness.	Severe: slope, wetness.	Moderate: wetness, slope, too clayey.	Moderate: wetness, slope.	Fair: too clayey, slope, wetness.
Mystic----------	Severe: wetness, percs slowly.	Severe: seepage, slope.	Severe: seepage, wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
17C:					
Bevier----------	Severe: wetness, percs slowly.	Severe: slope, wetness.	Severe: wetness.	Severe: wetness.	Poor: hard to pack, wetness.
18C2:					
Gorin-----------	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness.	Moderate: wetness.	Fair: too clayey, wetness.
20C2:					
Clarinda--------	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
22B:					
Adco------------	Severe: wetness, percs slowly.	Moderate: seepage, slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
23D2:					
Keswick---------	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness.	Severe: wetness.	Poor: wetness.

Table 12.--Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
24E2, 24F2:					
Gara------------	Severe: wetness, percs slowly, slope.	Severe: slope.	Severe: wetness, slope.	Severe: slope.	Poor: slope.
26C2:					
Leonard---------	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
28E2:					
Winnegan--------	Severe: wetness, percs slowly, slope.	Severe: slope, wetness.	Severe: slope.	Severe: slope.	Poor: slope.
28F2:					
Winnegan--------	Severe: wetness, percs slowly, slope.	Severe: slope.	Severe: slope, too clayey.	Severe: slope.	Poor: too clayey, slope.
34B2:					
Seymour---------	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness.	Severe: wetness.	Poor: hard to pack, wetness.
36C2:					
Lamoni----------	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness.	Severe: wetness.	Poor: wetness.
40:					
Arbela----------	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, wetness.
Humeston--------	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
45:					
Kennebec--------	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: wetness.
Fatima----------	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: wetness.
46:					
Vesser----------	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.

Table 12.--Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
47:					
Zook------------	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
51:					
Amana-----------	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: wetness.
54B:					
Zook------------	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness.	Severe: wetness.	Poor: hard to pack, wetness.
Excello---------	Severe: wetness.	Moderate: slope.	Severe: wetness.	Severe: wetness.	Poor: wetness.
56B:					
Zook------------	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
Excello---------	Severe: flooding, wetness.	Moderate: slope.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
60:					
Wabash----------	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
64C2:					
Alvin-----------	Slight------------	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: thin layer.
67:					
Aquents---------	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Poor: ponding, hard to pack.
75:					
Ackmore---------	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.

Table 13.--Construction Materials

(The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. See text for definitions of terms used in this table)

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
10C: Bevier	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
11: Edina	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
14C2, 14D2: Armstrong	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
16D2: Caleb	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
Mystic	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
17C: Bevier	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
18C2: Gorin	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
20C2: Clarinda	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
22B: Adco	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
23D2: Keswick	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
24E2: Gara	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
24F2: Gara	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.

Table 13.--Construction Materials--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
26C2:				
Leonard	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
28E2:				
Winnegan	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, slope.
28F2:				
Winnegan	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
34B2:				
Seymour	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
36C2:				
Lamoni	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
40:				
Arbela	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
Humeston	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
45:				
Kennebec	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Fatima	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
46:				
Vesser	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
47:				
Zook	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
51:				
Amana	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
54B:				
Zook	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, thin layer.

Table 13.--Construction Materials--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
54B:				
Excello	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
56B:				
Zook	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, thin layer.
Excello	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
60:				
Wabash	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
64C2:				
Alvin	Good	Probable	Improbable: too sandy.	Good.
67:				
Aquents	Poor: wetness, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, too clayey.
75:				
Ackmore	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.

Table 14.--Water Management

(The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation. See text for definitions of terms used in this table)

Map symbol and soil name	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Limitations for-- Aquifer-fed excavated ponds	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
10C:							
Bevier	Moderate: slope.	Moderate: hard to pack, wetness.	Severe: no water.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
11:							
Edina	Slight	Severe: hard to pack, wetness.	Severe: no water.	Percs slowly	Wetness, percs slowly, erodes easily.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
14C2:							
Armstrong	Moderate: slope.	Moderate: wetness.	Severe: no water.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Wetness	Wetness, percs slowly.
14D2:							
Armstrong	Severe: slope.	Moderate: wetness.	Severe: no water.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Slope, wetness.	Wetness, slope, percs slowly.
16D2:							
Caleb	Severe: slope.	Moderate: thin layer, wetness.	Severe: no water.	Slope	Slope, wetness, rooting depth.	Slope, wetness.	Slope, rooting depth.
Mystic	Severe: seepage, slope.	Moderate: thin layer, hard to pack, wetness.	Severe: no water.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Slope, erodes easily, wetness.	Wetness, slope, erodes easily.
17C:							
Bevier	Moderate: slope.	Severe: wetness.	Severe: no water.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Erodes easily, wetness.	Wetness, erodes easily, percs slowly.
18C2:							
Gorin	Moderate: slope.	Moderate: piping, wetness.	Severe: no water.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Erodes easily, wetness.	Erodes easily, percs slowly.

Table 14.--Water Management--Continued

Map symbol and soil name	Limitations for--			Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
20C2: Clarinda	Moderate: slope.	Severe: wetness.	Severe: no water.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
22B: Adco	Slight	Severe: hard to pack.	Severe: no water.	Percs slowly, frost action.	Wetness, percs slowly.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
23D2: Keswick	Severe: slope.	Moderate: wetness.	Severe: no water.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Slope, erodes easily, wetness.	Wetness, slope, erodes easily.
24E2, 24F2: Gara	Severe: slope.	Moderate: wetness.	Severe: slow refill.	Deep to water	Slope, rooting depth.	Slope	Slope, rooting depth.
26C2: Leonard	Moderate: slope.	Severe: wetness.	Severe: no water.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
28E2: Winnegan	Severe: slope.	Moderate: piping, wetness.	Severe: no water.	Percs slowly, slope.	Slope, wetness, percs slowly.	Slope, wetness.	Slope, percs slowly.
28F2: Winnegan	Severe: slope.	Moderate: wetness.	Severe: no water.	Percs slowly, slope.	Slope, wetness, percs slowly.	Slope, wetness, percs slowly.	Slope, percs slowly.
34B2: Seymour	Moderate: slope.	Severe: wetness.	Severe: slow refill.	Percs slowly, slope.	Slope, wetness, percs slowly.	Erodes easily, wetness.	Wetness, erodes easily, percs slowly.
36C2: Lamoni	Moderate: slope.	Moderate: wetness.	Severe: no water.	Percs slowly, slope.	Slope, wetness, percs slowly.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.

Table 14.--Water Management--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
40:							
Arbela	Slight	Severe: wetness.	Severe: slow refill.	Flooding, frost action.	Wetness, flooding.	Erodes easily, wetness.	Wetness, erodes easily.
Humeston	Moderate: seepage.	Severe: wetness.	Severe: slow refill.	Percs slowly, flooding, frost action.	Wetness, percs slowly, erodes easily.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
45:							
Kennebec	Moderate: seepage.	Moderate: thin layer, piping, wetness.	Moderate: deep to water, slow refill.	Deep to water	Flooding	Favorable	Favorable.
Fatima	Moderate: seepage.	Moderate: thin layer, piping, wetness.	Moderate: deep to water, slow refill.	Flooding, frost action.	Wetness, flooding.	Wetness	Favorable.
46:							
Vesser	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness, flooding.	Erodes easily, wetness.	Wetness, erodes easily.
47:							
Zook	Slight	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, flooding, frost action.	Wetness, percs slowly, flooding.	Wetness, percs slowly.	Wetness, percs slowly.
51:							
Amana	Moderate: seepage.	Moderate: piping, wetness.	Moderate: deep to water, slow refill.	Flooding, frost action.	Wetness, erodes easily, flooding.	Erodes easily, wetness.	Erodes easily.
54B:							
Zook	Moderate: slope.	Severe: wetness.	Severe: slow refill.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Wetness	Wetness, percs slowly.
Excello	Moderate: seepage, slope.	Severe: wetness.	Moderate: slow refill.	Frost action, slope.	Slope, wetness.	Wetness	Wetness.

Table 14.--Water Management--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
56B:							
Zook	Moderate: slope.	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly.
Excello	Moderate: seepage, slope.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action, slope.	Slope, wetness, flooding.	Wetness	Wetness.
60:							
Wabash	Slight	Severe: hard to pack, wetness.	Severe: slow refill.	Percs slowly, flooding.	Wetness, droughty, slow intake.	Wetness, percs slowly.	Wetness, droughty, percs slowly.
64C2:							
Alvin	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water	Slope, fast intake, soil blowing.	Soil blowing	Favorable.
67:							
Aquents	Slight	Severe: hard to pack, ponding.	Slight	Ponding, flooding, frost action.	Ponding, flooding.	Ponding	Wetness.
75:							
Ackmore	Moderate: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Wetness, flooding.	Wetness	Wetness.

Table 15.--Engineering Index Properties

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: > 10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct	Pct					Pct	
10C:												
Bevier----------	0-8	Silty clay loam	CL	A-7	0	0	100	100	95-100	85-95	42-48	22-27
	8-35	Silty clay, silty clay loam.	CH	A-7	0	0	100	100	95-100	85-95	55-65	30-40
	35-42	Silty clay loam	CL, CH	A-7	0	0	100	100	95-100	85-95	43-56	20-33
	42-68	Silt loam, loam, clay loam.	CL, CH	A-6, A-7	0	0	95-100	95-100	80-100	55-85	36-56	17-33
	68-80	Clay loam, clay	CH	A-7	0	0	95-100	95-100	85-100	65-90	51-65	30-40
11:												
Edina-----------	0-8	Silt loam------	CL-ML, CL	A-4, A-6	0	0	100	100	95-100	85-100	25-40	5-15
	8-14	Silt loam------	CL-ML, CL	A-4, A-6	0	0	100	100	95-100	85-100	25-40	5-15
	14-38	Silty clay, clay.	CH	A-7	0	0	100	100	95-100	90-100	55-75	30-45
	38-65	Silty clay loam	CL, CH	A-6, A-7	0	0	100	100	95-100	90-100	35-60	15-35
14C2:												
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
	6-31	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
	31-65	Clay loam------	CL	A-6	0	0-5	90-100	80-95	70-90	55-80	30-40	15-20
14D2:												
Armstrong-------	0-6	Clay loam------	CL	A-6, A-7	0	0-5	90-100	80-95	75-90	55-80	35-45	15-25
	6-32	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
	32-65	Clay loam------	CL	A-6	0	0-5	90-100	80-95	70-90	55-80	30-40	15-20
16D2:												
Caleb-----------	0-8	Loam-----------	CL	A-6	0	0	95-100	85-100	70-90	60-80	30-40	10-20
	8-35	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
	35-60	Loamy sand, 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

Table 15.--Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: > 10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct	Pct					Pct	
16D2:												
Mystic----------	0-12	Silt loam------	CL	A-6, A-7	0	0	100	100	80-100	65-90	30-45	10-25
	12-39	Clay loam, clay, silty clay.	CL, CH	A-7	0	0	100	90-100	80-100	65-80	40-55	25-35
	39-50	Sandy clay loam, loam.	SC, CL, SC-SM, CL-ML	A-6, A-4	0	0-5	90-100	80-100	70-95	40-65	25-40	5-20
	50-60	Sandy loam-----	SC-SM, SC, CL-ML, CL	A-4, A-2, A-6	0	0-5	90-100	80-100	65-95	30-60	20-35	5-15
17C:												
Bevier----------	0-15	Silt loam------	CL	A-6, A-7	0	0	100	100	90-100	70-90	34-44	15-20
	15-32	Silty clay, silty clay loam.	CH	A-7	0	0	100	100	95-100	85-95	55-65	30-40
	32-80	Silty clay loam	CL, CH	A-7	0	0	100	100	95-100	85-95	43-56	20-33
18C2:												
Gorin-----------	0-7	Silty clay loam	CL, CL-ML	A-4, A-6	0	0	100	100	95-100	85-100	25-40	5-18
	7-14	Silty clay loam, silty clay.	CL	A-6, A-7	0	0	100	100	95-100	90-100	35-50	15-30
	14-23	Silty clay, silty clay loam.	CH	A-7	0	0	100	100	95-100	90-100	50-65	30-40
	23-46	Silty clay loam, clay loam.	CL	A-6, A-7	0	0	100	100	80-95	70-90	30-50	12-30
	46-65	Loam, silt loam	CL	A-4, A-6	0	0	100	95-100	85-100	65-90	25-35	8-15
20C2:												
Clarinda--------	0-8	Silty clay loam	CL	A-7	0	0	100	95-100	90-100	85-100	40-50	20-30
	8-36	Silty clay, clay.	CH	A-7	0	0	100	95-100	85-100	80-100	55-70	30-40
	36-65	Clay, silty clay.	CH	A-7	0	0	95-100	95-100	80-95	75-90	55-70	35-45

Table 15.--Engineering Index Properties--Continued

Map symbol and soil name	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	
22B:												
Adco-------------	0-9	Silt loam------	CL	A-6, A-7	0	0	100	100	100	95-100	30-45	13-25
	9-15	Silt loam, silty clay loam.	CL	A-6, A-7	0	0	100	100	100	95-100	30-45	13-25
	15-25	Silty clay, clay.	CH	A-7	0	0	100	100	100	95-100	66-76	41-49
	25-44	Silty clay loam, silty clay.	CL, CH	A-7	0	0	100	100	100	90-100	43-66	22-41
	44-80	Silt loam, silty clay loam, clay loam.	CL	A-6, A-7	0	0	100	100	95-100	75-100	31-51	13-29
23D2:												
Keswick---------	0-6	Clay loam------	CL	A-6, A-7	0	0-5	90-100	80-100	75-90	60-80	35-50	15-25
	6-34	Clay loam, clay	CH, CL	A-7	0	0-5	90-100	80-100	70-90	55-80	40-70	20-40
	34-65	Clay loam------	CL	A-6	0	0-5	90-100	80-100	70-90	55-80	30-40	15-25
24E2:												
Gara------------	0-6	Loam-----------	CL	A-6, A-7	0	0	90-95	85-95	70-85	55-75	35-45	15-25
	6-42	Clay loam, loam	CL	A-6	0	0-5	90-95	85-95	70-85	55-75	30-40	15-25
	42-65	Clay loam, loam	CL	A-6	0	0-5	90-95	85-95	70-85	55-75	30-40	15-25
24F2:												
Gara------------	0-7	Fine sandy loam	SM, SC, SC-SM	A-2, A-4	0	0	100	100	80-95	30-50	15-30	NP-10
	7-42	Clay loam, loam	CL	A-6	0	0-5	90-95	85-95	70-85	55-75	30-40	15-25
	42-65	Clay loam, loam	CL	A-6	0	0-5	90-95	85-95	70-85	55-75	30-40	15-25
26C2:												
Leonard---------	0-7	Silty clay loam	CL	A-6, A-7	0	0	100	95-100	90-100	85-100	30-45	15-25
	7-12	Silty clay loam, silty clay.	CL	A-6, A-7	0	0	100	95-100	90-100	85-100	35-50	20-30
	12-36	Silty clay, clay, silty clay loam.	CH	A-7	0	0	100	95-100	85-100	80-100	55-70	30-40
	36-80	Silty clay, clay loam, silty clay loam.	CL, CH	A-7	0	0	95-100	95-100	90-100	75-90	45-60	25-35

Table 15.--Engineering Index Properties--Continued

Map symbol and soil name	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	
28E2:												
Winnegan---------	0-6	Clay loam------	CL	A-6	0	0	95-100	95-100	80-90	65-80	25-40	11-20
	6-16	Loam, clay loam	CL-ML, CL	A-4, A-6	0	0	95-100	95-100	80-90	60-80	20-30	5-15
	16-23	Clay loam, clay	CL	A-7	0	0	95-100	95-100	85-95	65-85	40-50	20-30
	23-65	Clay loam, loam	CL	A-6	0	0	95-100	95-100	85-95	60-80	25-40	10-20
28F2:												
Winnegan---------	0-2	Loam-----------	CL-ML, CL	A-4, A-6	0	0	95-100	95-100	80-90	60-80	20-30	5-15
	2-5	Loam, clay loam	CL-ML, CL	A-4, A-6	0	0	95-100	95-100	80-90	60-80	20-30	5-15
	5-33	Clay loam, clay	CL	A-7	0	0	95-100	95-100	85-95	65-85	40-50	20-30
	33-52	Clay loam, clay	CL	A-7	0	0	95-100	95-100	85-95	65-85	40-50	20-30
	52-65	Clay loam, loam	CL	A-6	0	0	95-100	95-100	85-95	60-80	25-40	10-20
34B2:												
Seymour----------	0-8	Silty clay loam	CL	A-7, A-6	0	0	100	100	100	95-100	35-50	15-25
	8-34	Silty clay, silty clay loam.	CH	A-7	0	0	100	100	100	95-100	55-70	30-40
	34-65	Silty clay loam	CH, CL	A-7	0	0	100	100	100	95-100	40-55	20-30
36C2:												
Lamoni-----------	0-8	Loam-----------	CL	A-6	0	0	95-100	95-100	80-95	70-95	25-40	10-20
	8-28	Clay loam, clay	CH	A-7	0	0	95-100	95-100	90-100	85-100	50-60	25-35
	28-65	Clay loam------	CL	A-6, A-7	0	0	95-100	95-100	70-90	55-85	35-50	15-30
40:												
Arbela-----------	0-10	Silt loam------	CL-ML, CL	A-4, A-6	0	0	100	100	95-100	90-100	25-40	5-15
	10-17	Silt loam, silty clay loam.	CL-ML, CL	A-4, A-6	0	0	100	100	95-100	90-100	25-35	5-15
	17-52	Silty clay loam, silty clay.	CL	A-6, A-7	0	0	100	100	95-100	90-100	35-50	20-30
	52-65	Silty clay loam, clay loam.	CL	A-6	0	0	100	100	90-100	70-95	30-40	15-25
Humeston---------	0-13	Silt loam------	CL, CL-ML	A-4, A-6	0	0	100	100	95-100	95-100	25-40	5-15
	13-26	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

Table 15.--Engineering Index Properties--Continued

Map symbol and soil name	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	
45:												
Kennebec----------	0-46	Silt loam------	CL	A-6, A-7	0	0	100	100	95-100	90-100	25-45	10-20
	46-60	Silt loam, silty clay loam.	CL, CL-ML	A-6, A-4	0	0	100	100	95-100	90-100	25-40	5-15
Fatima----------	0-7	Loam-----------	CL-ML, CL	A-4, A-6	0	0	100	100	90-100	65-90	25-40	5-18
	7-54	Silt loam------	CL	A-6	0	0	100	100	95-100	80-90	30-40	12-18
	54-80	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
46:												
Vesser----------	0-18	Silt loam------	CL	A-6	0	0	100	100	98-100	95-100	30-40	10-20
	18-31	Silt loam------	CL	A-6	0	0	100	100	98-100	95-100	30-40	10-20
	31-65	Silty clay loam	CL	A-7	0	0	100	100	98-100	95-100	40-50	15-25
47:												
Zook------------	0-21	Silty clay loam	CH, CL	A-7	0	0	100	100	95-100	95-100	45-65	20-35
	21-80	Silty clay, silty clay loam.	CH	A-7	0	0	100	100	95-100	95-100	60-85	35-55
51:												
Amana-----------	0-23	Silty clay loam	CL	A-6	0	0	100	100	95-100	90-95	30-40	10-20
	23-80	Silt loam------	CL	A-6	0	0	100	100	95-100	75-95	30-40	10-20
54B:												
Zook------------	0-37	Silty clay loam	CH, CL	A-7	0	0	100	100	95-100	95-100	45-65	20-35
	37-65	Silty clay, silty clay loam.	CH	A-7	0	0	100	100	95-100	95-100	60-85	35-55
Excello---------	0-6	Silty clay loam	CL	A-6, A-7	0	0	100	100	95-100	85-95	35-45	15-25
	6-25	Silt loam, loam, clay loam.	CL	A-6, A-7	0	0	100	100	80-100	50-80	30-45	11-25
	25-47	Clay loam, sandy clay loam, loam.	CL	A-6, A-7	0	0	100	100	80-100	50-85	30-45	11-25
	47-65	Loam, clay loam, sandy clay loam.	CL	A-6, A-7	0	0	100	100	80-100	50-85	30-45	11-25

Table 15.--Engineering Index Properties--Continued

Map symbol and soil name	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	
56B:												
Zook	0-24	Silty clay loam	CH, CL	A-7	0	0	100	100	95-100	95-100	45-65	20-35
	24-80	Silty clay, silty clay loam.	CH	A-7	0	0	100	100	95-100	95-100	60-85	35-55
Excello	0-16	Loam	CL	A-6	0	0	100	100	85-100	60-90	30-40	11-20
	16-36	Clay loam, sandy clay loam, loam.	CL	A-6, A-7	0	0	100	100	80-100	50-85	30-45	11-25
	36-80	Loam, clay loam, sandy clay loam.	CL	A-6, A-7	0	0	100	100	80-100	50-85	30-45	11-25
60:												
Wabash	0-17	Silty clay	CH	A-7	0	0	100	100	100	95-100	50-75	30-50
	17-80	Silty clay, clay.	CH	A-7	0	0	100	100	100	95-100	52-78	30-55
64C2:												
Alvin	0-10	Loamy sand	SM	A-2	0	0	100	100	50-75	15-30	0-20	NP-4
	10-40	Very fine sandy loam, sandy loam, loam.	SM, SC, CL, ML	A-2, A-4, A-6	0	0	100	100	70-100	20-80	15-40	NP-15
	40-80	Very fine sand, fine sandy loam, loamy fine sand.	SP, SP-SM, SM	A-2, A-3, A-1	0	0	95-100	90-100	45-95	4-35	0-20	NP-4
67:												
Aquents	0-10	Silty clay loam	CH, CL	A-7	0	0	100	100	95-100	95-100	30-65	10-35
	10-32	Silty clay loam, silty clay.	CH, CL	A-7	0	0	100	100	95-100	95-100	30-85	20-35
	32-60	Silty clay loam, silty clay.	CH, CL	A-7	0	0	100	100	95-100	95-100	30-85	20-55

Table 15.--Engineering Index Properties--Continued

Map symbol and soil name	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	
75:												
Ackmore---------	0-12	Silt loam------	CL, ML	A-4, A-6, A-7	0	0	100	100	95-100	85-100	25-50	8-20
	12-24	Silt loam, silty clay loam.	CL, ML	A-4, A-6, A-7	0	0	100	100	95-100	85-100	25-50	8-20
	24-80	Silty clay loam, silt loam.	CH, CL	A-7, A-6	0	0	100	100	95-100	85-100	35-60	15-30

Table 16.--Physical and Chemical Properties of the Soils

(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)

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
10C:											
Bevier----------	0-8	27-32	1.30-1.50	0.20-0.60	0.20-0.23	5.6-7.3	Moderate	0.37	3	7	2-4
	8-35	35-52	1.30-1.50	0.06-0.20	0.11-0.20	5.1-7.3	High-----	0.28			
	35-42	27-40	1.30-1.50	0.20-0.60	0.18-0.20	5.1-7.3	High-----	0.32			
	42-68	20-40	1.30-1.50	0.20-0.60	0.14-0.18	5.1-7.3	High-----	0.32			
	68-80	35-50	1.35-1.55	0.06-0.20	0.12-0.16	5.1-7.3	High-----	0.32			
11:											
Edina-----------	0-8	15-27	1.35-1.45	0.60-2.00	0.22-0.24	5.1-7.3	Moderate	0.37	3	6	2-4
	8-14	15-27	1.35-1.45	0.60-2.00	0.20-0.22	5.1-7.3	Moderate	0.37			
	14-38	45-60	1.30-1.45	0.00-0.06	0.11-0.13	5.1-7.3	Very high	0.37			
	38-65	27-40	1.35-1.50	0.06-0.20	0.18-0.20	6.1-7.3	High-----	0.37			
14C2:											
Armstrong-------	0-6	22-27	1.45-1.50	0.60-2.00	0.20-0.22	5.6-7.3	Moderate	0.32	3	6	2-3
	6-31	36-60	1.55-1.60	0.06-0.20	0.11-0.16	4.5-6.5	High-----	0.32			
	31-65	30-36	1.55-1.70	0.20-0.60	0.14-0.16	5.1-7.8	Moderate	0.32			
14D2:											
Armstrong-------	0-6	27-40	1.45-1.50	0.20-0.60	0.18-0.20	5.6-7.3	Moderate	0.32	3	4	2-3
	6-32	36-60	1.55-1.60	0.06-0.20	0.11-0.16	4.5-6.5	High-----	0.32			
	32-65	30-36	1.55-1.70	0.20-0.60	0.14-0.16	5.1-7.8	Moderate	0.32			
16D2:											
Caleb-----------	0-8	22-27	1.45-1.50	0.60-2.00	0.14-0.18	4.5-7.3	Low------	0.28	5	6	2-3
	8-35	20-35	1.45-1.65	0.60-2.00	0.14-0.18	4.5-6.0	Moderate	0.32			
	35-60	5-30	1.55-1.75	0.60-2.00	0.12-0.16	6.1-6.5	Low------	0.32			
Mystic----------	0-12	22-27	1.40-1.45	0.60-2.00	0.22-0.24	4.5-7.3	Moderate	0.37	3	6	2-3
	12-39	30-48	1.55-1.65	0.06-0.20	0.15-0.19	4.5-6.5	High-----	0.37			
	39-50	20-35	1.65-1.75	0.60-2.00	0.16-0.18	6.1-6.5	Moderate	0.37			
	50-60	10-20	1.65-1.75	0.60-6.00	0.11-0.13	6.1-7.3	Low------	0.24			
17C:											
Bevier----------	0-15	18-27	1.25-1.45	0.60-2.00	0.22-0.24	5.6-7.3	Low------	0.37	3	6	2-4
	15-32	35-52	1.30-1.50	0.06-0.20	0.11-0.20	5.1-7.3	High-----	0.28			
	32-80	27-40	1.30-1.50	0.20-0.60	0.18-0.20	5.1-7.3	High-----	0.32			
18C2:											
Gorin-----------	0-7	27-30	1.30-1.50	0.60-2.00	0.22-0.24	4.5-7.3	Moderate	0.43	3	6	2-3
	7-14	27-42	1.30-1.45	0.06-0.60	0.18-0.20	4.5-6.5	Moderate	0.32			
	14-23	35-60	1.30-1.40	0.06-0.20	0.11-0.16	4.5-6.0	High-----	0.32			
	23-46	27-40	1.30-1.45	0.20-0.60	0.18-0.20	4.5-7.3	Moderate	0.32			
	46-65	20-27	1.30-1.45	0.20-0.60	0.17-0.20	4.5-7.3	Moderate	0.37			
20C2:											
Clarinda--------	0-8	27-38	1.45-1.50	0.20-0.60	0.17-0.19	5.1-7.3	Moderate	0.37	3	7	2-3
	8-36	40-60	1.50-1.65	0.00-0.60	0.14-0.16	5.1-6.5	High-----	0.37			
	36-65	40-60	1.50-1.65	0.00-0.06	0.14-0.16	5.6-8.4	High-----	0.37			
22B:											
Adco------------	0-9	15-27	1.20-1.40	0.60-2.00	0.20-0.24	4.5-7.3	Low------	0.32	3	6	2-4
	9-15	15-30	1.20-1.40	0.60-2.00	0.16-0.20	4.5-6.5	Low------	0.32			
	15-25	50-60	1.20-1.40	0.00-0.06	0.09-0.11	5.1-6.5	High-----	0.43			
	25-44	32-50	1.25-1.45	0.06-0.20	0.12-0.18	5.1-7.3	High-----	0.43			
	44-80	15-35	1.30-1.50	0.06-0.20	0.14-0.18	5.6-7.3	Moderate	0.43			

Table 16.--Physical and Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
23D2:											
Keswick---------	0-6	27-40	1.45-1.50	0.20-0.60	0.17-0.19	4.5-7.3	Moderate	0.37	3	4	1-2
	6-34	35-60	1.55-1.60	0.06-0.20	0.11-0.15	4.5-6.0	High-----	0.37			
	34-65	30-40	1.60-1.75	0.20-0.60	0.12-0.16	4.5-7.8	Moderate	0.37			
24E2:											
Gara------------	0-6	7-27	1.50-1.55	0.20-0.60	0.16-0.18	5.6-7.3	Moderate	0.32	5	6	2-3
	6-42	25-38	1.55-1.75	0.20-0.60	0.16-0.18	4.5-6.5	Moderate	0.32			
	42-65	24-38	1.65-1.75	0.20-0.60	0.16-0.18	5.6-8.4	Moderate	0.37			
24F2:											
Gara------------	0-7	12-18	1.50-1.55	2.00-6.00	0.12-0.15	5.6-7.3	Low------	0.20	5	6	2-3
	7-42	25-38	1.55-1.75	0.20-0.60	0.16-0.18	4.5-6.5	Moderate	0.32			
	42-65	24-38	1.65-1.75	0.20-0.60	0.16-0.18	5.6-8.4	Moderate	0.37			
26C2:											
Leonard---------	0-7	27-35	1.20-1.40	0.20-0.60	0.22-0.24	6.1-7.3	Moderate	0.37	3	7	2-3
	7-12	35-45	1.30-1.45	0.06-0.20	0.11-0.13	4.5-6.5	High-----	0.37			
	12-36	35-50	1.20-1.35	0.06-0.20	0.10-0.12	4.5-6.5	High-----	0.37			
	36-80	32-50	1.25-1.40	0.06-0.20	0.11-0.14	5.1-7.8	High-----	0.37			
28E2:											
Winnegan--------	0-6	27-35	1.20-1.40	0.20-0.60	0.17-0.19	4.5-7.3	Moderate	0.32	5	6	1-2
	6-16	20-30	1.25-1.45	0.20-0.60	0.15-0.19	4.5-6.5	Moderate	0.32			
	16-23	35-45	1.35-1.55	0.06-0.20	0.09-0.15	4.5-6.5	High-----	0.32			
	23-65	20-35	1.40-1.60	0.20-0.60	0.09-0.15	7.4-8.4	Moderate	0.32			
28F2:											
Winnegan--------	0-2	18-27	1.20-1.40	0.60-2.00	0.20-0.24	4.5-7.3	Low------	0.32	3	6	.5-1
	2-5	20-30	1.25-1.45	0.20-0.60	0.15-0.19	4.5-6.5	Moderate	0.32			
	5-33	35-45	1.35-1.55	0.06-0.20	0.09-0.15	4.5-6.5	High-----	0.32			
	33-52	35-45	1.35-1.55	0.06-0.20	0.09-0.15	7.4-8.4	High-----	0.32			
	52-65	20-35	1.40-1.60	0.20-0.60	0.09-0.15	7.4-8.4	Moderate	0.32			
34B2:											
Seymour---------	0-8	28-38	1.40-1.45	0.20-0.60	0.18-0.20	5.6-7.3	Moderate	0.37	3	7	2-3
	8-34	36-55	1.40-1.45	0.00-0.06	0.12-0.18	5.1-6.5	High-----	0.28			
	34-65	35-40	1.45-1.50	0.20-0.60	0.18-0.20	5.6-7.3	High-----	0.43			
36C2:											
Lamoni----------	0-8	22-27	1.40-1.45	0.20-0.60	0.17-0.21	5.1-7.3	Moderate	0.37	3	6	2-3
	8-28	38-50	1.55-1.65	0.00-0.20	0.13-0.17	5.1-6.5	High-----	0.37			
	28-65	32-40	1.60-1.70	0.06-0.20	0.14-0.18	5.6-7.3	High-----	0.37			
40:											
Arbela----------	0-10	20-27	1.30-1.50	0.60-2.00	0.20-0.22	5.6-7.3	Low------	0.32	5	6	2-4
	10-17	18-30	1.35-1.55	0.60-2.00	0.20-0.22	5.1-6.5	Low------	0.43			
	17-52	35-45	1.30-1.40	0.20-0.60	0.18-0.20	4.5-7.3	Moderate	0.43			
	52-65	27-36	1.30-1.40	0.20-0.60	0.16-0.20	4.5-6.5	Moderate	0.43			
Humeston--------	0-13	24-27	1.35-1.40	0.60-2.00	0.21-0.23	5.1-7.3	Low------	0.43	4	6	2-4
	13-26	20-26	1.30-1.35	0.20-2.00	0.20-0.22	4.5-6.0	Moderate	0.43			
	26-60	30-48	1.35-1.50	0.00-0.06	0.13-0.15	4.5-6.5	High-----	0.32			
45:											
Kennebec--------	0-46	22-27	1.25-1.35	0.60-2.00	0.22-0.24	5.6-7.3	Moderate	0.28	5	6	2-4
	46-60	24-28	1.35-1.40	0.60-2.00	0.20-0.22	6.1-7.3	Moderate	0.43			
Fatima----------	0-7	15-27	1.30-1.45	0.60-2.00	0.22-0.24	6.1-7.3	Low------	0.28	5	6	2-4
	7-54	18-27	1.35-1.55	0.60-2.00	0.20-0.22	5.6-7.3	Low------	0.28			
	54-80	18-30	1.35-1.55	0.60-2.00	0.20-0.22	6.1-7.3	Low------	0.28			

Table 16.--Physical and Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permea-bility	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
46:											
Vesser----------	0-18	20-27	1.30-1.35	0.60-2.00	0.20-0.24	5.6-7.3	Moderate	0.28	5	6	2-3
	18-31	18-22	1.35-1.40	0.60-2.00	0.18-0.22	5.1-6.0	Moderate	0.43			
	31-65	30-35	1.40-1.45	0.60-2.00	0.17-0.21	5.1-6.5	Moderate	0.43			
47:											
Zook------------	0-21	35-40	1.30-1.35	0.20-0.60	0.21-0.23	5.6-7.3	High-----	0.28	5	4	4-6
	21-80	35-45	1.30-1.45	0.06-0.20	0.11-0.13	5.6-7.3	High-----	0.28			
51:											
Amana-----------	0-23	27-35	1.20-1.30	0.60-2.00	0.22-0.24	5.6-7.3	Moderate	0.37	5	7	2-4
	23-80	18-27	1.25-1.40	0.60-2.00	0.20-0.22	5.6-6.5	Moderate	0.37			
54B:											
Zook------------	0-37	35-40	1.30-1.35	0.20-0.60	0.21-0.23	5.6-7.3	High-----	0.28	5	4	4-6
	37-65	35-45	1.30-1.45	0.06-0.20	0.11-0.13	5.6-7.3	High-----	0.28			
Excello---------	0-6	27-35	1.40-1.50	0.60-2.00	0.20-0.22	6.1-7.3	Moderate	0.28	5	7	2-4
	6-25	18-35	1.40-1.50	0.60-2.00	0.15-0.19	6.1-7.3	Moderate	0.28			
	25-47	18-35	1.40-1.55	0.60-2.00	0.14-0.18	6.1-7.3	Moderate	----			
	47-65	18-35	1.40-1.55	0.60-2.00	0.14-0.18	6.1-7.3	Moderate	----			
56B:											
Zook------------	0-24	35-40	1.30-1.35	0.20-0.60	0.21-0.23	5.6-7.3	High-----	0.28	5	4	4-6
	24-80	35-45	1.30-1.45	0.06-0.20	0.11-0.13	5.6-7.3	High-----	0.28			
Excello---------	0-16	18-27	1.35-1.45	0.60-2.00	0.20-0.24	6.1-7.3	Moderate	0.28	5	6	2-4
	16-36	18-35	1.40-1.55	0.60-2.00	0.14-0.18	6.1-7.3	Moderate	----			
	36-80	18-35	1.40-1.55	0.60-2.00	0.14-0.18	6.1-7.3	Moderate	----			
60:											
Wabash----------	0-17	40-46	1.25-1.45	0.00-0.06	0.12-0.14	5.1-7.3	Very high	0.28	5	4	2-4
	17-80	40-60	1.20-1.45	0.00-0.06	0.08-0.12	5.1-7.8	Very high	0.28			
64C2:											
Alvin-----------	0-10	5-10	1.45-1.65	6.00-20.00	0.09-0.12	4.5-7.3	Low------	0.17	5	2	.5-1
	10-40	15-22	1.40-1.65	2.00-6.00	0.14-0.18	4.5-7.3	Low------	0.24			
	40-80	3-10	1.45-1.65	2.00-6.00	0.10-0.15	5.1-8.4	Low------	0.24			
67:											
Aquents---------	0-10	22-35	1.25-1.45	0.06-2.0	0.18-0.22	5.1-7.3	Moderate	0.37	5	4	3-7
	10-32	27-45	1.20-1.45	0.06-2.0	0.17-0.20	5.1-7.3	High-----	0.28			
	32-60	27-45	1.20-1.45	0.06-2.0	0.10-0.20	5.1-7.3	High-----	0.28			
75:											
Ackmore---------	0-12	18-27	1.25-1.30	0.60-2.00	0.21-0.23	5.6-7.3	Moderate	0.32	5	6	2-4
	12-24	18-30	1.25-1.30	0.60-2.00	0.21-0.23	5.6-7.3	Moderate	0.32			
	24-80	26-38	1.30-1.40	0.60-2.00	0.18-0.20	5.6-7.8	High-----	0.32			

Table 17.--Soil and Water Features

(See text for definitions of terms used in this table. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Map symbol and soil name	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Water table depth	High water table: Kind of water table	High water table: Months	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft					
10C:										
Bevier	C	None	---	---	1.0-2.5	Perched	Nov-Apr	High	High	Moderate.
11:										
Edina	D	None	---	---	0.5-1.5	Perched	Nov-Apr	Moderate	High	Moderate.
14C2, 14D2:										
Armstrong	C	None	---	---	1.0-3.0	Perched	Nov-May	High	High	Moderate.
16D2:										
Caleb	B	None	---	---	2.0-3.0	Perched	Nov-May	Moderate	Moderate	Moderate.
Mystic	C	None	---	---	1.0-2.5	Perched	Nov-May	High	Moderate	Moderate.
17C:										
Bevier	C	None	---	---	1.0-2.5	Perched	Nov-Apr	High	High	Moderate.
18C2:										
Gorin	C	None	---	---	1.5-2.5	Perched	Nov-Apr	High	High	Moderate.
20C2:										
Clarinda	D	None	---	---	0.5-1.5	Perched	Nov-Jul	High	High	Moderate.
22B:										
Adco	D	None	---	---	1.0-2.5	Perched	Nov-May	High	High	Moderate.
23D2:										
Keswick	C	None	---	---	1.0-3.0	Perched	Nov-Apr	High	High	Moderate.
24E2, 24F2:										
Gara	C	None	---	---	>6.0	---	---	Moderate	Moderate	Moderate.
26C2:										
Leonard	D	None	---	---	0.5-1.5	Perched	Nov-May	High	High	Moderate.
28E2, 28F2:										
Winnegan	C	None	---	---	2.0-3.5	Perched	Nov-Apr	Moderate	High	High.
34B2:										
Seymour	C	None	---	---	1.0-2.5	Apparent	Nov-May	Moderate	High	Moderate.
36C2:										
Lamoni	C	None	---	---	1.0-3.0	Perched	Nov-May	Moderate	High	Moderate.
40:										
Arbela	C	Occasional	Brief	Nov-Apr	0-1.5	Apparent	Nov-May	High	High	Moderate.
Humeston	C/D	Occasional	Very brief	Nov-Apr	0-1.0	Apparent	Nov-May	High	High	Moderate.
45:										
Kennebec	B	Frequent	Brief	Nov-May	3.0-5.0	Apparent	Nov-May	High	Moderate	Low.
Fatima	B	Frequent	Brief	Nov-May	2.0-3.5	Apparent	Nov-May	High	Moderate	Low.
46:										
Vesser	C	Occasional	Brief	Nov-May	0.5-1.5	Apparent	Nov-Jun	High	High	Moderate.
47:										
Zook	C	Frequent	Brief	Nov-May	0-2.0	Apparent	Nov-Jun	High	High	Moderate.

Table 17.--Soil and Water Features--Continued

Map symbol and soil name	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Water table depth (Ft)	High water table: Kind of water table	High water table: Months	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
51:										
Amana	B	Occasional	Brief	Nov-May	2.0-4.0	Apparent	Nov-May	High	High	Moderate.
54B:										
Zook	C	Rare	---	---	0-2.0	Apparent	Nov-May	High	High	Moderate.
Excello	B/D	Rare	---	---	1.0-3.0	Apparent	Nov-May	High	High	Low.
56B:										
Zook	C	Rare	---	---	0-2.0	Apparent	Nov-May	High	High	Moderate.
Excello	B/D	Frequent	Brief	Nov-Jun	1.0-3.0	Apparent	Nov-May	High	High	Low.
60:										
Wabash	D	Occasional	Brief	Nov-May	0-1.0	Apparent	Nov-May	Moderate	High	Moderate.
64C2:										
Alvin	B	None	---	---	>6.0	---	---	Moderate	Low	High.
67:										
Aquents	D	Frequent	Long	Jan-Dec	+3.0-1.0	Apparent	Jan-Dec	High	High	Moderate.
75:										
Ackmore	B	Occasional	Brief	Nov-May	0-1.5	Apparent	Nov-May	High	High	Low.

Table 18.--Classification of the Soils

(An asterisk in the first column indicates a taxadjunct to the series. See text for a description of those characteristics that are outside the range of the series)

Soil name	Family or higher taxonomic class
Ackmore	Aeric Fluvaquents, fine-silty, mixed, nonacid, mesic
Adco	Aeric Vertic Albaqualfs, fine, montmorillonitic, mesic
*Alvin	Typic Hapludalfs, coarse-loamy, mixed, mesic
Amana	Aquic Hapludolls, fine-silty, mixed, mesic
Aquents	Fluvaquents, fine, montmorillonitic, mesic
Arbela	Argiaquic Argialbolls, fine, montmorillonitic, mesic
Armstrong	Aquertic Hapludalfs, fine, montmorillonitic, mesic
Bevier	Aeric Vertic Epiaqualfs, fine, montmorillonitic, mesic
Caleb	Mollic Hapludalfs, fine-loamy, mixed, mesic
Clarinda	Vertic Argiaquolls, fine, montmorillonitic, mesic
Edina	Vertic Argialbolls, fine, montmorillonitic, mesic
Excello	Cumulic Endoaquolls, fine-loamy, mixed, mesic
Fatima	Fluvaquentic Hapludolls, fine-silty, mixed, mesic
Gara	Mollic Hapludalfs, fine-loamy, mixed, mesic
Gorin	Aquertic Chromic Hapludalfs, fine, montmorillonitic, mesic
Humeston	Argiaquic Argialbolls, fine, montmorillonitic, mesic
Kennebec	Cumulic Hapludolls, fine-silty, mixed, mesic
Keswick	Aquertic Chromic Hapludalfs, fine, montmorillonitic, mesic
*Lamoni	Aquertic Argiudolls, fine, montmorillonitic, mesic
Leonard	Vertic Epiaqualfs, fine, montmorillonitic, mesic
Mystic	Aquertic Hapludalfs, fine, montmorillonitic, mesic
*Seymour	Aquertic Argiudolls, fine, montmorillonitic, mesic
Vesser	Argiaquic Argialbolls, fine-silty, mixed, mesic
Wabash	Cumulic Vertic Endoaquolls, fine, montmorillonitic, mesic
Winnegan	Oxyaquic Hapludalfs, fine, mixed, mesic
Zook	Cumulic Vertic Endoaquolls, fine, montmorillonitic, mesic

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