United States
Department of
Agriculture

Natural
Resources
Conservation
Service

In cooperation with
Missouri Agricultural
Experiment Station

Soil Survey of Sullivan County, Missouri

How To Use This Soil Survey

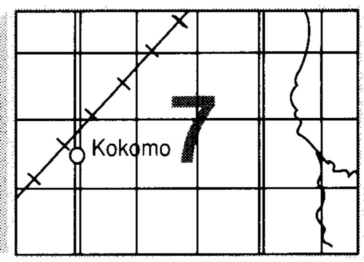
General Soil Map

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

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

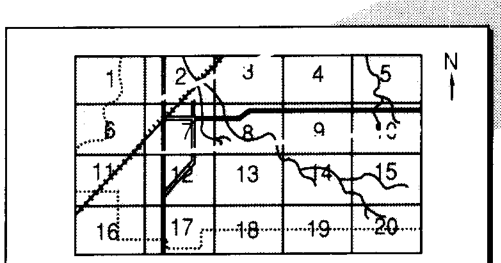
Detailed Soil Maps

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



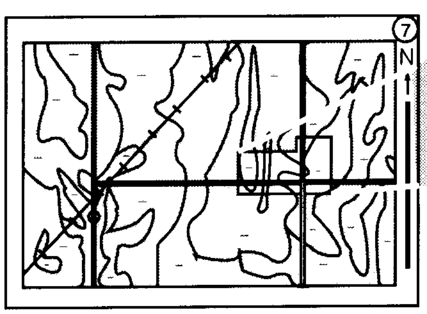
MAP SHEET

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



INDEX TO MAP SHEETS

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



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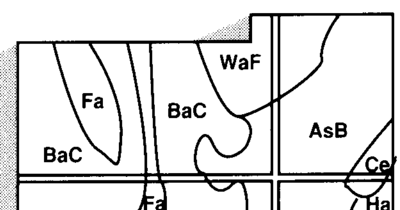

AREA OF INTEREST

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

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

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

Major fieldwork for this soil survey was completed in 1989. Soil names and descriptions were approved in 1992. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1990. This survey was made cooperatively by the Natural Resources Conservation Service and the Missouri Agricultural Experiment Station. Funding for district soil scientists was provided by the Missouri Department of Natural Resources and administered through the Sullivan County Soil and Water Conservation District. The Sullivan County Commission provided office space during part of the survey. The survey is part of the technical assistance furnished to the Sullivan County Soil and Water Conservation District.

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

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

Cover: Red clover-smooth bromegrass in an area of Pershing silty clay loam, 2 to 5 percent slopes, eroded. Armstrong clay loam, 5 to 9 percent slopes, eroded, is in the background.

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Issued April 1995

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Summary of Tables

Foreword

This soil survey contains information that can be used in land-planning programs in Sullivan 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 over bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to 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.

Russell C. Mills
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Soil Survey of Sullivan County, Missouri

By Ken E. Benham, Natural Resources Conservation Service

Fieldwork by Ken E. Benham, Mike Burney, and Earl D. Lockridge, Natural Resources Conservation Service, and Thomas G. Morgan and Don R. Ammons, Sullivan County Soil and Water Conservation District

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

SULLIVAN COUNTY is in north-central Missouri, in the second row of counties south of the Missouri-Iowa border (fig. 1). It is bounded on the south by Linn County, on the west by Grundy and Mercer Counties, on the north by Putnam County, and on the east by Putnam and Adair Counties. Its shape is a rectangle measuring 24 miles from north to south and 27 miles from east to west. The county has an area of 651.8 square miles, or 417,158 acres. Milan, the county seat, is nearly in the center of the county. In 1980, the population of Milan was 1,947. Other towns in the county with a population of more than 100 include Greencastle, Green City, Harris, Humphreys, Newtown, and Pollock. In 1980, the urban population in Sullivan County was about 3,450 and the rural population was about 4,000 *(23)*.

The economy of the county is dominated by livestock farms and crop production. One medium-sized manufacturing firm in Milan employs about 750 people.

Soil scientists have determined that about 22 different kinds of soils are in the survey area. The soils range widely in texture, natural drainage, and other characteristics. The upland soils on the broader ridgetops and on the intermediate ridgetops above Medicine and Locust Creeks formed in loess. Soils on the upland back slopes and narrow ridgetops formed in loess over glacial till or in glacial till. In a few steep areas, primarily along Locust and Spring Creeks, the soils are moderately deep over sandstone and siltstone. Soils in the flatter areas in the uplands are well suited to cultivated crops, but the sloping soils in the uplands are subject to severe erosion. In most places, the soils on stream terraces and flood plains are well suited to cultivated crops.

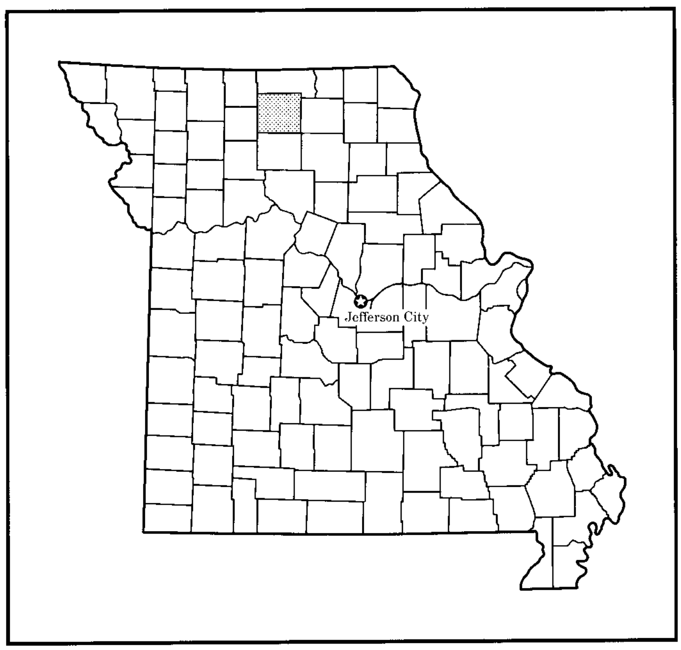

Figure 1.—Location of Sullivan County in Missouri.

This soil survey updates an earlier survey of Sullivan County published in 1911 *(10)*. It provides additional information and has larger maps, which show the soils in more detail.

General Nature of the County

This section provides general information about Sullivan County. It describes climate; physiography, geology, and drainage; history and development; transportation facilities; agriculture; and water supply.

Climate

Table 1 gives data on temperature and precipitation for the survey area as recorded at Kirksville 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 27 degrees F and the average daily minimum temperature is 18 degrees. The lowest temperature on record, which occurred at Kirksville on December 28, 1924, is -23 degrees. In summer, the average temperature is 74 degrees and the average daily maximum temperature is 85 degrees. The highest recorded temperature, which occurred on July 15, 1936, is 113 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 35.25 inches. Of this, 23.53 inches, or about 67 percent, usually falls in April through September. The growing season for most crops falls within this period. 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, and most occur in May.

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 heaviest 1-day snowfall on record was 18 inches.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 83 percent. The sun shines 66 percent of the time possible in summer and 49 percent in winter. The prevailing wind is from the south-southeast. Average windspeed is highest, 12 miles per hour, in spring.

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

Physiography, Geology, and Drainage

Sullivan County lies in the glaciated region of northern Missouri. Glacial till is 70 to 110 feet thick over most of the upland part of the county *(12)*. The till is completely gone in a few upland areas, primarily along Locust Creek and Spring Creek. It is more than 200 feet thick in buried major stream valleys.

The most gently sloping areas of the county are in the southwestern part. The primary drainage divide is occupied by Green City in the north-central part of the county.

The northeastern part of the county is the most dissected and has the steepest back slopes and the greatest differences in elevation between the tops of the ridges and the valley floors. The highest point in the county, about 1,060 feet above sea level, is on the primary divide between the Chariton River and Grand River drainage basins along the Putnam County line northwest of Green City. The lowest point in the county, about 740 feet above sea level, is where Locust Creek flows out of the county, near the town of Browning.

All of the larger streams in the county flow generally from north to south, except Spring Creek in the northeast corner of the county, which flows to the southeast. Except for the eastern edge, the county is in the Grand River drainage basin. The major streams are Medicine Creek, the several forks of Locust Creek, and Yellow Creek. The eastern edge of the county is part of the Chariton River drainage basin. Mussel Creek and Spring Creek drain this area. The present upland drainage system has developed almost entirely in a thick mantle of glacial till. The postglacial drainage pattern is considerably different from the preglacial drainage pattern *(12, 19)*, but both patterns flowed toward the south.

History and Development

In 1682, Sieur de La Salle claimed all of the territory west of the Mississippi River for France. The United States purchased this territory from France in 1803. At that time, the area that is now Sullivan County was used for hunting by various Indian tribes, including the Sacs, Foxes, Iowas, and Pottawattomies *(1)*.

The first settlers in the survey area, Dr. Jacob Holland and his son, Robert, arrived in 1836. The number of settlers had increased to 200 or more by 1840, and soon after that the Indians gave up their hunting grounds and moved farther west.

Sullivan County, formerly called Highland County, was attached to Linn County for civil and military purposes until February 14, 1845. At that time, Sullivan County was created by an act of the State Legislature.

The county was named for John Sullivan, a general in the Revolutionary War. By 1876, the population of the county had grown to about 15,000.

Union sentiment prevailed in Sullivan County during the Civil War *(6)*. Groups of men were recruited several different times by the State for duty during the Civil War, and some Sullivan County soldiers made their way into the Union Army via the Missouri State Militia. Some of them participated in the battle of Shiloh, and others participated in various battles from Tennessee to Louisiana. Military activity in Sullivan County during the Civil War was limited to a few incidents involving bushwhackers.

Because adequate transportation facilities were not available during the first decades after settlement, most of the crops in Sullivan County were produced for local consumption. Eventually, purebred livestock became the most important agricultural product. Currently, the main livestock enterprise is beef cattle. Some hogs are also produced. The main cash crops are corn and soybeans.

Transportation Facilities

One State highway, Route 6, crosses Sullivan County from east to west. Three State routes run generally from north to south. Route 129 runs through the eastern part of the county, Route 5 runs through the central part of the county, and Route 139 is near the western border of the county. There are also a number of paved county roads.

One railway line runs through the county. It runs north and south near the western border of the county and serves the community of Newtown.

Agriculture

Sullivan County is primarily rural, although a considerable population shift has occurred since tractor power replaced horse power for farming. The population was lower in 1980 than it was in 1870. The population of the county was highest, just over 20,000, in 1900, but it has stabilized since the early 1970's *(5)*. Much of the decrease in population has been in the rural areas, as the number of farms decreased from about 3,100 in 1900 to slightly under 900 in 1982 *(11)*. As the number of farms decreased, the size of the farms increased from about 130 acres in 1900 to about 385 acres in 1982.

The introduction of soybeans to the area caused the biggest shift in cropping practices during this century. The number of acres used for soybeans increased from 4,800 in 1950 to 50,000 in 1982 *(11)*. As soybean production increased, corn production declined significantly. The number of acres used for corn dropped from a high of about 77,500 in 1920 to a low of 11,000 in 1983.

The production of winter wheat has fluctuated over the past 60 years from a high of nearly 15,000 acres to a low of about 1,000 acres. Weather conditions at planting time and problems resulting from excess soil moisture in some years have a greater influence on the production of wheat than of any other crop. Wheat is the only important cash crop planted in the fall.

The acreage used for grain sorghum also fluctuates considerably from year to year. In most years less than 3,000 acres is planted to grain sorghum.

The acreage used for hay has fluctuated from about 50,000 acres to about 75,000 acres since 1900. The number of acres used for pasture has decreased somewhat in the past few decades as the production of soybeans has increased sharply.

The largest livestock enterprise in the county is beef cattle. Since 1970, the number of beef cattle produced in the county has been more than 60,000 per year. About 93,500 head of cattle were produced in 1975. In 1985, the beef cattle population was about 62,000.

The hog population in Sullivan County responds more quickly to market price fluctuations than the beef cattle population. Hog numbers since 1970 have ranged from a high of about 44,000 to a low of about 17,000.

Dairy cattle, sheep, and horses become less significant to the economy of the survey area with each passing decade. Dairy cattle numbers have gradually declined from about 10,500 in 1940 to about 700 in 1985. Sheep numbers have declined from about 41,000 in 1940 to 1,600 in 1983. In the early 1900's, horses were a significant part of the livestock population of the county. Now there are only a few hundred horses in the county. Some are working stock horses, and the rest are used for pleasure riding.

Water Supply

Water from wells in the glacial till and the underlying consolidated bedrock in Sullivan County is mineralized and of marginal quality for domestic use *(12)*. Yields seldom exceed 15 gallons per minute. Such yields are sufficient for normal domestic use but are not adequate for irrigation purposes or for municipal uses. No irrigation wells currently exist in the county. The only site where drilling an irrigation well might be feasible is in a drift-filled valley in the extreme northwest corner of the county *(12)*.

Surface water from streams and impoundments is less mineralized and of better quality for domestic use than well water. Several permanent streams flow partially or completely through Sullivan County, but they have a rather low flow during the summer. They are not dependable as an only source of water for irrigation or for municipal uses. Impoundments are the primary source of water for most towns and for irrigation. Most of the soils in the uplands are suitable for the construction of ponds and small lakes for livestock water and for household use. Rural water districts, supplied by lakes, currently furnish water for the household needs of many rural residents.

How This Survey Was Made

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

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

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

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

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

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

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

The descriptions, names, and delineations of the soils in this survey area do not fully agree with those of the soils in adjacent survey areas. Differences are the result of additional soil data, variations in the intensity of mapping and in the extent of the soils in the survey areas, and correlation decisions that reflect local conditions.

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

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

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

Soil Descriptions

1. Gara-Armstrong Association

Gently sloping to moderately steep, moderately well drained and somewhat poorly drained soils that formed in glacial till or in pedisediments and a paleosol weathered from glacial till; on uplands

This association consists of soils on convex ridgetops, on back slopes dissected by small, V-shaped drainageways, and on narrow flood plains (fig. 2). Slopes range from 2 to 20 percent.

This association makes up about 66 percent of the survey area. It is about 52 percent Gara and similar soils, 40 percent Armstrong and similar soils, and 8 percent minor soils.

Gara soils are moderately well drained and are strongly sloping to moderately steep. They are on back slopes of upland ridges. Typically, the surface layer is very dark grayish brown clay loam. The subsoil is yellowish brown, mottled clay loam and clay.

Armstrong soils are somewhat poorly drained and are gently sloping to strongly sloping. They are on ridgetops and back slopes. Typically, the surface layer is very dark grayish brown clay loam. The upper part of the subsoil is dark brown, mottled clay loam, and the lower part is brown and yellowish brown, mottled clay and clay loam.

Of minor extent in this association are Pershing, Landes, Lenzburg, Rinda, Tice, and Zook soils. Pershing soils are on broad ridgetops. The well drained Landes and somewhat poorly drained Tice soils are on the wider flood plains. The well drained Lenzburg soils are in current or abandoned limestone quarries. The poorly drained Rinda soils are on head slopes on the broader ridges. The poorly drained Zook soils are on very narrow flood plains.

Approximately 25 percent of the acreage in this association is used for cultivated crops. The main crops are corn, soybeans, and winter wheat. A small acreage is used for grain sorghum. Most of this association is used for pasture and hay. A few areas are wooded. The woodland is primarily in the steeper areas and on small flood plains.

The gently sloping and moderately sloping soils in this association are well suited to row crops and winter wheat if adequate erosion-control measures are applied. Erosion is a severe hazard in most cultivated areas of these soils.

These soils are well suited to hay and pasture crops. The slope and the severe hazard of erosion are major management concerns. Gullying is a hazard in overgrazed areas. Brush control is needed on some pastures.

In many of the forested areas, improvement of the stands is needed. The use of equipment for logging activities is limited in the steeper areas. Erosion is a hazard along logging roads and skid trails.

If the soils in this association are used for building sites, wetness, a high shrink-swell potential, and the slope are major concerns. The soils are suited to sewage lagoons in most of the gently sloping and moderately sloping areas if the lagoon sites can be leveled. Conventional septic tank absorption fields function poorly because of the wetness, restricted

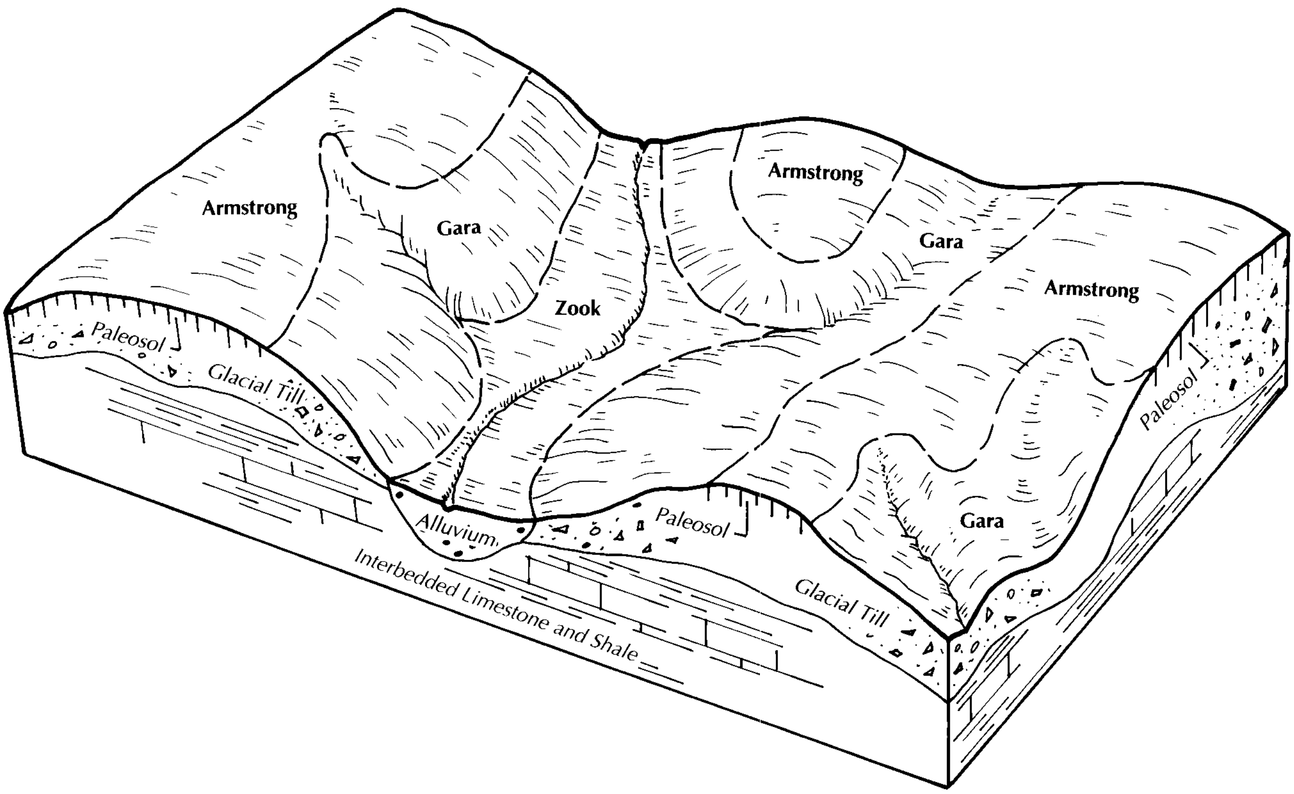

Figure 2.—Typical pattern of soils and parent material in the Gara-Armstrong association.

permeability, and, in some places, the slope.

2. Winnegan-Keswick Association

Moderately sloping to very steep, moderately well drained soils that formed in glacial till or in pedisediments and a paleosol weathered from glacial till; on uplands

This association consists of soils on narrow, convex ridgetops and on back slopes highly dissected by narrow, V-shaped drainageways (fig. 3). Slopes range from 5 to 40 percent.

This association makes up about 19 percent of the survey area. It is about 52 percent Winnegan and similar soils, 34 percent Keswick and similar soils, and 14 percent minor soils.

Winnegan soils are strongly sloping to steep. They are on some narrow ridgetops and back slopes. Typically, the surface layer is dark grayish brown loam, and the subsurface layer is brown loam. The upper part of the subsoil is yellowish brown clay loam and clay, and the lower part is yellowish brown, mottled clay loam.

Keswick soils are moderately sloping and strongly sloping. They are on narrow ridgetops and a few of the upper back slopes. Typically, the surface layer is dark grayish brown loam. The upper part of the subsoil is dark brown, mottled clay loam. The next part is reddish brown and strong brown, mottled clay. The lower part is dark yellowish brown and yellowish brown, mottled clay loam.

Of minor extent in this association are Gorin, Landes, Reger, and Zook soils. Gorin soils are on broad ridgetops. The moderately well drained Landes soils are on flood plains, primarily along the larger streams. The moderately deep Reger soils are on some of the lower back slopes. The poorly drained Zook soils are on flood plains in the smaller drainageways.

More than 90 percent of the acreage in this association was originally forested, but a significant amount of the forested areas has been cleared. Only a small part of the association is used for cultivated crops. Most of the cleared acreage is used for hay and pasture. Some of the pastured areas support scattered trees, and numerous tracts of timber remain on the steeper slopes.

The soils in this association generally are unsuited to cultivated crops because of the slope and a severe hazard of erosion. Some areas on narrow ridgetops and

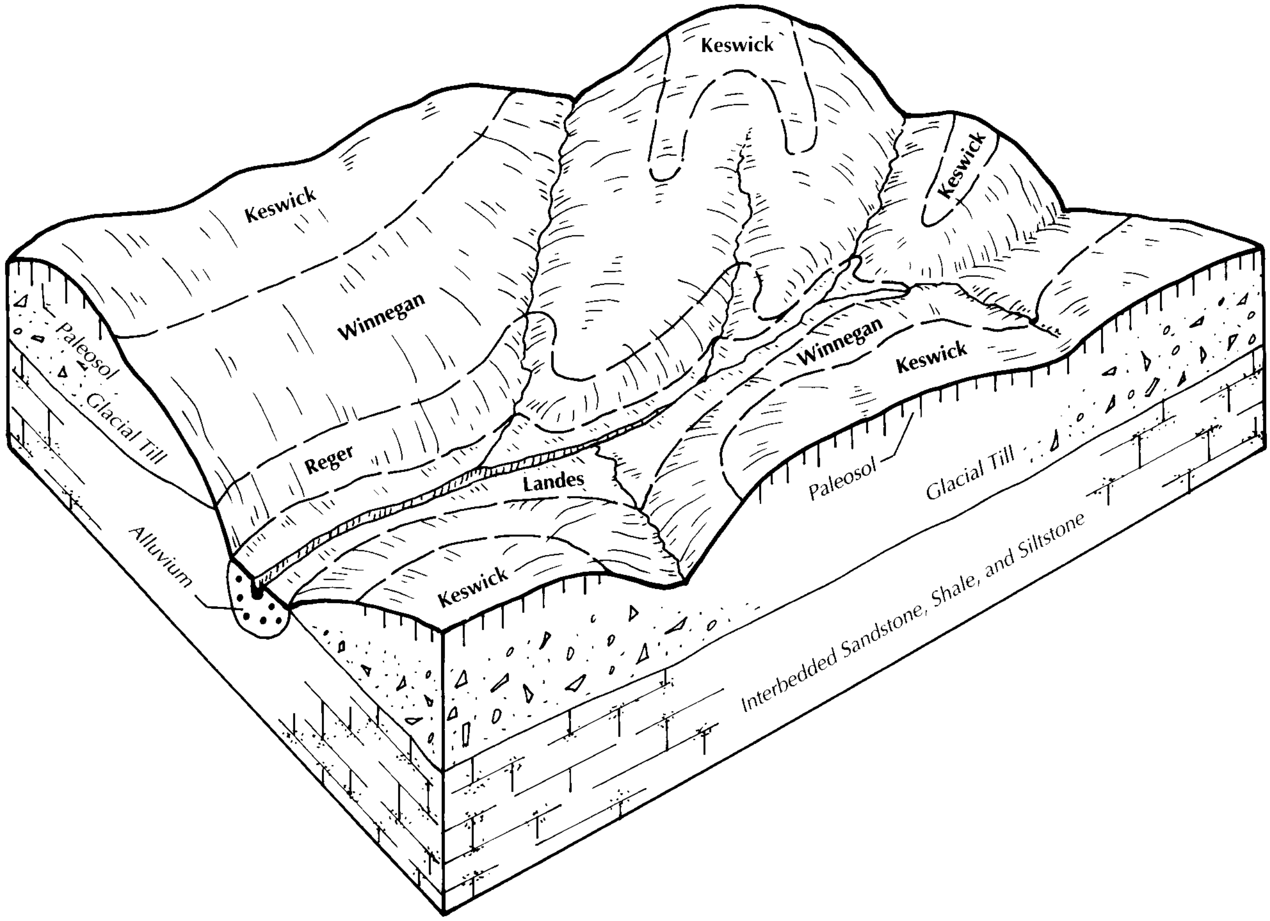

Figure 3.—Typical pattern of soils and parent material in the Winnegan-Keswick association.

on the flood plains along small streams are used for winter wheat.

If these soils are used for pasture, the slope and the hazard of erosion are important concerns. Overgrazing is the major management concern in pastured areas because it can cause severe erosion and gullying. Brush control is needed on many pastures.

The timber is mostly on the steeper slopes and on narrow flood plains in small areas that are not easily accessible. Proper forest management is needed in these areas to ensure optimum production. Logging activities are particularly difficult in the steep and very steep areas. Because of the slope, erosion is a hazard along logging roads and skid trails.

Some areas of this association can be used for building sites. The slope, wetness, and the shrink-swell potential are the major concerns affecting building site development and onsite sewage disposal systems.

3. Armstrong-Pershing-Gara Association

Gently sloping to moderately steep, somewhat poorly drained and moderately well drained soils that formed in pedisediments and a paleosol weathered from glacial till, in loess, or in glacial till; on uplands

This association consists of soils on moderately wide ridgetops, moderately dissected back slopes, and narrow flood plains. Slopes range from 2 to 20 percent.

This association makes up about 4 percent of the survey area. It is about 39 percent Armstrong soils, 31 percent Pershing and similar soils, 14 percent Gara soils, and 16 percent minor soils.

Armstrong soils are somewhat poorly drained and are gently sloping to strongly sloping. They are on narrow ridgetops and back slopes. Typically, the surface layer is very dark grayish brown clay loam. The upper part of the subsoil is dark brown, mottled clay loam, and the

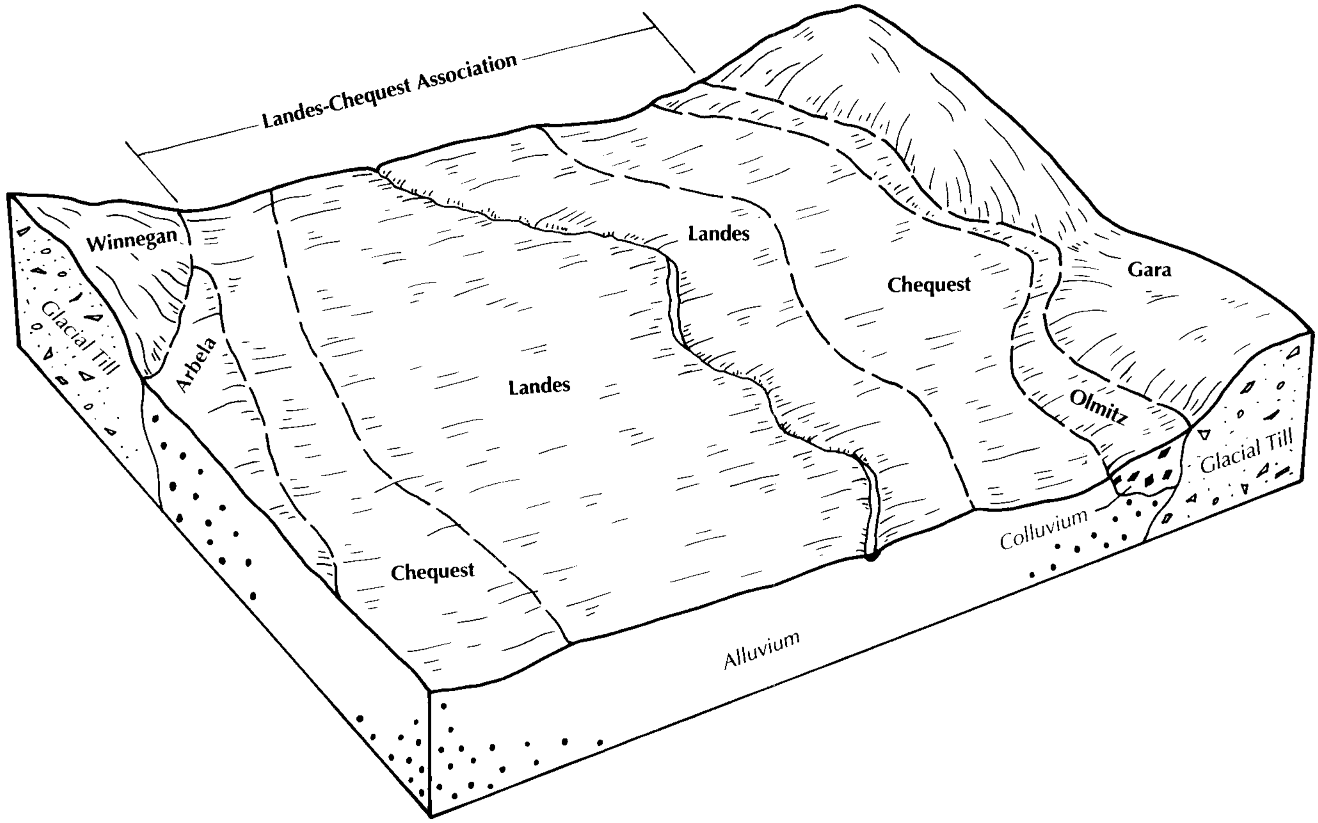

Figure 4.—Typical pattern of soils and parent material in the Landes-Chequest association.

lower part is brown and yellowish brown, mottled clay and clay loam.

Pershing soils are somewhat poorly drained and are gently sloping. They are on narrow ridgetops and back slopes. Typically, the surface layer is very dark gray silty clay loam. The upper part of the subsoil is brown and dark grayish brown, mottled silty clay, and the lower part is light brownish gray and grayish brown, mottled silty clay loam. The substratum is grayish brown, mottled silt loam.

Gara soils are moderately well drained and are strongly sloping and moderately steep. They are on back slopes and on the nose slopes of upland ridges. Typically, the surface layer is very dark grayish brown clay loam. The subsoil is yellowish brown, mottled clay loam and clay.

Of minor extent in this association are Arbela, Belinda, Landes, Rinda, Tice, and Zook soils. The nearly level Arbela soils are on high flood plains, commonly adjacent to the uplands. The poorly drained Rinda soils are on the side slopes of wide ridgetops and on the head slopes of drainageways. Landes, Tice, and Zook soils are on the flood plains along streams.

Most areas of this association are used for cultivated crops. The main crops are corn, soybeans, and winter wheat. Some areas are used for pasture and hay. A few small areas are forested.

The soils in this association are suited to cultivated crops. Erosion is the major concern. Erosion-control practices are needed on all of the soils, especially in areas that have relatively long slopes.

These soils are well suited to many kinds of grasses and legumes for pasture and hay. Erosion and overgrazing are the main management concerns in the more sloping areas. The gently sloping areas are subject to surface compaction if grazing is allowed during wet periods.

The soils in this association are suitable for building site development. Wetness, the shrink-swell potential, and the slope are the main concerns. The soils can be used for sewage lagoons in most areas, but conventional septic tank absorption fields function poorly because of the wetness and restricted permeability.

4. Landes-Chequest Association

Nearly level, well drained and poorly drained soils that formed in alluvium; on flood plains

This association consists of soils on the major flood plains along the forks of Locust Creek, Medicine Creek, West Yellow Creek, Spring Creek, and Mussel Creek (fig. 4). Slopes range from 0 to 2 percent.

This association makes up about 11 percent of the survey area. It is about 52 percent Landes soils, 27 percent Chequest and similar soils, and 21 percent minor soils.

Landes soils are well drained. They are adjacent to the stream channels on the flood plain or to the former stream channels in areas where the channels have been straightened. Typically, the surface layer is very dark grayish brown loam. The substratum is dark yellowish brown and dark brown loam, fine sandy loam, and silt loam.

Chequest soils are poorly drained. They commonly are between areas of the Landes soils along the present or former stream channels. Typically, the surface layer and subsurface layer are very dark gray silty clay loam. The subsoil is dark gray, mottled silty clay loam.

Of minor extent in this association are Arbela, Olmitz, and Tice soils. Arbela soils are more silty in the upper part than the Chequest soils. They are on high flood plains. The gently sloping and moderately sloping Olmitz soils are on upland toe slopes along the edge of the larger flood plains. Tice soils are wetter and more silty than the Landes soils. They are on some alluvial fans adjacent to the uplands and on flood plains adjacent to areas of the Landes soils.

About 75 percent of the acreage in this association is used for cultivated crops. Corn and soybeans are the main crops. Smaller acreages are planted to winter wheat and grain sorghum. Some areas are used for pasture, hayland, or timber. The timber consists primarily of soft maple, ash, water oak, and bur oak.

The soils in this association are well suited to cultivated crops. The primary management needs are artificial drainage and protection from flooding. Also, diversions are needed along the base of the uplands to reduce the accumulation of runoff water on the flood plain.

The soils in this association are best suited to wetness-tolerant grasses and legumes for pasture and hay. The main management need is deferring grazing when the soils are wet.

These soils are suited to trees, and some areas support native timber. The wetness and the flooding are the main management concerns.

Extensive site preparation is needed if these soils are used for building sites because of the flooding and the wetness. More suitable sites generally are available in areas of the adjacent uplands.

Detailed Soil Map Units

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

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

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

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

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Gara clay loam, 9 to 14 percent slopes, eroded, is a phase of the Gara series.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. 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 "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The "Glossary" defines many of the terms used in describing the soils.

Soil Descriptions

12—Belinda silt loam. This nearly level, poorly drained soil is on the flatter parts of a few ridgetops in the uplands. Individual areas are irregular in shape and range from about 10 to more than 120 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 silt loam

Subsurface layer:

7 to 10 inches, dark grayish brown, friable silt loam

10 to 17 inches, light brownish gray, mottled, friable silt loam

Subsoil:

17 to 43 inches, dark grayish brown and grayish brown, mottled, firm silty clay

43 to 60 inches, light brownish gray, mottled, firm silty clay loam

In some areas the upper part of the subsoil is grayish brown. In other areas the dark surface layer is less than 6 inches thick. In places the subsoil has more clay.

Important soil properties—

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

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, grain sorghum, and winter wheat. Wetness is the main limitation. Shallow surface ditches and land grading can improve field operations in most areas. Returning crop residue to the soil or adding other organic material improves tilth, increases the rate of water infiltration, and helps to maintain fertility.

This soil is moderately well suited to birdsfoot trefoil and switchgrass. It is moderately suited to ladino clover, tall fescue, big bluestem, and indiangrass. Species that are tolerant of wetness should be selected. Restricting grazing during wet periods helps to keep the pasture in good condition.

This soil is suited to trees, but few areas currently support timber. The equipment limitation, seedling mortality, and the windthrow hazard are management concerns. Trees should be harvested during periods when the ground is dry or frozen. Reinforcement planting or planting container-grown nursery stock improves the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely.

This soil is suitable for building site development. The wetness and the shrink-swell potential are limitations on sites for dwellings. Constructing the foundations and footings with adequately reinforced concrete and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing tile drains around the foundations and footings minimizes the damage caused by excessive wetness. Using adequate guttering and landscaping the areas around buildings help to overcome the very slow runoff rate.

This soil is not suited to conventional septic tank absorption fields because of the wetness and the restricted permeability. Sewage lagoons are suitable for onsite waste disposal. Grading the areas around the lagoons helps to divert the flow of surface water.

This soil is suitable for local roads and streets. Constructing the subgrade on raised, well compacted fill material and adequately strengthening the subgrade with crushed rock or other suitable material minimize the damage caused by low strength. Constructing roadside ditches and installing culverts for drainage minimize the damage caused by shrinking and swelling, wetness, and frost action.

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

16B2—Pershing silty clay loam, 2 to 5 percent slopes, eroded. This gently sloping, somewhat poorly drained soil is on ridgetops in the uplands. Erosion has removed some of the original surface layer. Individual areas are irregular in shape and range from about 10 to more than 120 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 gray, friable silty clay loam

Subsoil:
6 to 11 inches, brown, friable silty clay
11 to 23 inches, dark grayish brown and brown, mottled, firm silty clay
23 to 51 inches, grayish brown, mottled, firm silty clay loam

Substratum:
51 to 60 inches, grayish brown, mottled, firm silt loam

In places the surface layer is thicker and is silt loam.

Included with this soil in mapping are a few areas of the moderately sloping, eroded Armstrong soils in the lower positions on the landscape. These soils have glacial sand and pebbles throughout. They make up about 5 percent of the unit.

Important properties of the Pershing soil—

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

Most areas are used for cultivated crops or for pasture. This soil is suited to corn, soybeans, grain sorghum, and winter wheat. Erosion is a moderate hazard if cultivated crops are grown. A system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, and a crop rotation that includes a small grain or grass crop help to control erosion. Returning crop residue to the soil or adding other organic material improves tilth, increases the rate of water infiltration, and helps to maintain fertility.

This soil is well suited to ladino clover. It is moderately well suited to birdsfoot trefoil, tall fescue, timothy, big bluestem, indiangrass, and switchgrass. The species that can withstand wetness grow best. Erosion during seedbed preparation may be a management problem. Timely tillage and a quickly established ground cover help to control erosion.

This soil is suited to trees, but few areas currently support timber. Seedling mortality and the windthrow hazard are management concerns. Reinforcement planting or planting container-grown nursery stock improves the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely.

This soil is suitable for building site development.

The wetness and the high shrink-swell potential are limitations on sites for dwellings. Constructing the foundations and footings with adequately reinforced concrete and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing tile drains around the foundations and footings minimizes the damage caused by excessive wetness.

This soil is not suitable for conventional septic tank absorption fields because of the restricted permeability and the wetness. Sewage lagoons can function adequately if the site is leveled.

This soil is suitable for local roads and streets. Strengthening the subgrade with crushed rock or other suitable material minimizes the damage caused by low strength. Constructing roadside ditches and installing culverts for drainage minimize the damage caused by shrinking and swelling, wetness, and frost action.

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

17C—Gorin silt loam, bench, 3 to 9 percent slopes. This gently sloping, somewhat poorly drained soil is on high benches in the uplands. Individual areas are irregular in shape and range from about 5 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 4 inches, dark grayish brown, friable silt loam

Subsurface layer:
4 to 8 inches, dark grayish brown, friable silt loam
8 to 13 inches, brown, friable silt loam

Subsoil:
13 to 27 inches, dark yellowish brown, mottled, firm silty clay loam
27 to 36 inches, brown and dark yellowish brown, mottled, firm silty clay
36 to 56 inches, brown, mottled, firm silty clay loam

Substratum:
56 to 60 inches, mottled dark yellowish brown and grayish brown, firm silty clay loam

In places the surface layer is silty clay loam.

Included with this soil in mapping are a few areas of the moderately well drained Keswick soils on the lower back slopes. These soils make up about 15 percent of the unit.

Important properties of the Gorin soil—

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

Most areas are used for pasture, hay, timber, or cultivated crops. This soil is well suited to ladino clover and moderately well suited to birdsfoot trefoil, tall fescue, timothy, switchgrass, big bluestem, and indiangrass. The species that can withstand wetness grow best. Erosion during seedbed preparation may be a management problem. Timely tillage and a quickly established ground cover help to control erosion.

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

This soil is suited to corn, soybeans, grain sorghum, and winter wheat. If it is used for cultivated crops, further erosion is a hazard. A system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, and a crop rotation that includes a small grain or grass crop help to control erosion. Returning crop residue to the soil or adding other organic material improves tilth, increases the rate of water infiltration, and helps to maintain fertility.

This soil is suitable for building site development. The wetness and the shrink-swell potential are limitations on sites for dwellings. Constructing the foundations and footings with adequately reinforced concrete and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing tile drains around the foundations and footings minimizes the damage caused by excessive wetness.

This soil is not suitable for conventional septic tank absorption fields because of the restricted permeability and the wetness. Sewage lagoons can function adequately if the site can be leveled.

This soil is suitable for local roads and streets. Strengthening the subgrade with crushed rock or other suitable material minimizes the damage caused by low strength. Constructing roadside ditches and installing culverts for drainage minimize the damage caused by shrinking and swelling, wetness, and frost action.

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

17C2—Gorin silt loam, 5 to 9 percent slopes, eroded. This moderately sloping, somewhat poorly drained soil is on ridgetops and back slopes in the uplands. Erosion has removed some of the original surface layer. Individual areas are irregular in shape and range from about 10 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 7 inches, dark grayish brown, friable silt loam

Subsoil:
7 to 14 inches, yellowish brown, friable silty clay loam
14 to 43 inches, brown, mottled, firm silty clay and silty clay loam

Substratum:
43 to 49 inches, mottled dark gray, dark yellowish brown, and light brownish gray, firm silty clay loam
49 to 60 inches, light brownish gray, mottled, firm loam

In places the surface layer is yellowish brown silty clay loam.

Included with this soil in mapping are a few areas of the moderately well drained Winnegan soils on the lower back slopes and on ridgetops. Also included are areas of the moderately well drained Keswick soils on the more convex parts of some ridges. Included soils make up about 15 percent of the unit.

Important properties of the Gorin soil—

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

Most areas are used for pasture, hay, timber, or cultivated crops. This soil is well suited to ladino clover and moderately well suited to birdsfoot trefoil, tall fescue, timothy, switchgrass, big bluestem, and indiangrass. The species that can withstand wetness grow best. Erosion during seedbed preparation may be a management problem. Timely tillage and a quickly established ground cover help to control erosion.

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

This soil is suited to corn, soybeans, grain sorghum, and winter wheat. If it is used for cultivated crops, further erosion is a hazard. A system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, and a crop rotation that includes a small grain or grass crop help to control erosion. Returning crop residue to the soil or adding other organic material improves tilth, increases the rate of water infiltration, and helps to maintain fertility.

This soil is suitable for building site development. The wetness and the shrink-swell potential are limitations. Constructing the foundations and footings with adequately reinforced concrete and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing tile drains around the foundations and footings minimizes the damage caused by excessive wetness.

This soil is not suitable for conventional septic tank absorption fields because of the restricted permeability and the wetness. Sewage lagoons can function adequately if the site can be leveled.

This soil is suitable for local roads and streets. Strengthening the subgrade with crushed rock or other suitable material minimizes the damage caused by low strength. Constructing roadside ditches and installing culverts for drainage minimize the damage caused by shrinking and swelling, wetness, and frost action.

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

21B—Cantril loam, 2 to 5 percent slopes. This moderately sloping, somewhat poorly drained soil is on foot slopes. Individual areas are irregular in shape and range from 5 to 30 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 loam

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

Subsoil:
10 to 42 inches, dark grayish brown, mottled, firm clay loam
42 to 60 inches, yellowish brown and gray, mottled, firm clay loam

In a few places the soil has less sand.

Included with this soil in mapping are a few areas of Arbela soils on the flatter parts of the landscape. These soils have a thicker dark surface layer than the Cantril soil and have less sand. They make up less than 10 percent of the unit.

Important properties of the Cantril soil—

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

Shrink-swell potential: Moderate
Depth to the water table: 2 to 4 feet

Some areas are used for cultivated crops. Other areas are used for pasture and hay. This soil is suited to corn, soybeans, grain sorghum, and winter wheat. If it is used for cultivated crops, erosion is a hazard. Diversions help to control erosion, and a few areas of this soil are large enough for terraces. Contour farming, stripcropping, and a system of conservation tillage that leaves a protective cover of crop residue on the surface help to control erosion, help to maintain fertility and the content of organic matter, improve tilth, and increase the rate of water infiltration.

This soil is well suited to ladino clover and moderately well suited to alsike clover, birdsfoot trefoil, crownvetch, lespedeza, bluegrass, tall fescue, timothy, big bluestem, indiangrass, and switchgrass. Erosion during seedbed preparation is the main management concern. Timely tillage and a quickly established ground cover help to control erosion.

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

If this soil is used for building site development, the wetness and the shrink-swell potential are limitations. Run-on from adjacent areas may also be a concern. In some places it may be necessary to construct dwellings on raised, well compacted fill material. Properly designing and constructing foundations and footings, using adequately reinforced concrete, and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing tile drains around the foundations and footings minimizes the damage caused by excessive wetness.

This soil is not suitable for conventional septic tank absorption fields because of the restricted permeability and the wetness. Properly constructed sewage lagoons can function adequately if the site can be leveled.

This soil is suitable for local roads and streets. Strengthening the subgrade with crushed rock or other suitable material minimizes the damage caused by low strength. Constructing roadside ditches and installing culverts for drainage minimize the damage caused by shrinking and swelling, wetness, and frost action.

The land capability classification is IIe. The woodland ordination symbol is 4A.

27B—Adco silt loam, 1 to 5 percent slopes. This very gently sloping and gently sloping, somewhat poorly drained soil is on wide ridgetops in the uplands. Individual areas are irregular in shape and range from about 10 to more than 120 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 13 inches, grayish brown, friable silty clay loam

Subsoil:
13 to 27 inches, dark grayish brown and brown, mottled, firm silty clay
27 to 53 inches, light brownish gray, mottled, firm silty clay loam

Substratum:
53 to 60 inches, grayish brown, mottled, firm silty clay loam

In a few places the subsurface layer is less than 3 inches thick. In some areas the soil does not have a subsurface layer.

Included with this soil in mapping are a few areas of the poorly drained Belinda soils on the flatter parts of the landscape.

Important properties of the Adco soil—

Permeability: Very slow
Surface runoff: Slow
Available water capacity: Moderate
Organic matter content: Moderate
Shrink-swell potential: High
Seasonal high water table: Perched at a depth of 2 to 4 feet

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, grain sorghum, and winter wheat. A system of conservation tillage that leaves a protective cover of crop residue on the surface, winter cover crops, and a crop rotation that includes a small grain or grass crop help to control erosion. Returning crop residue to the soil or adding other organic material improves tilth, increases the rate of water infiltration, and helps to maintain fertility.

This soil is well suited to ladino clover. It is moderately well suited to birdsfoot trefoil, switchgrass, tall fescue, big bluestem, and indiangrass. Species that are tolerant of wetness should be selected. Restricting grazing during wet periods helps to keep the pasture in good condition.

This soil is suitable for building site development. The wetness and the shrink-swell potential are limitations. Constructing the foundations and footings with adequately reinforced concrete and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing tile drains around the foundations and footings minimizes the damage caused by excessive wetness.

Sewage lagoons are suitable for onsite waste disposal. Grading the areas around the lagoons helps to divert the flow of surface water.

This soil is suitable for local roads and streets. Constructing the subgrade on raised, well compacted fill material and adequately strengthening the subgrade with crushed rock or other suitable material minimize the damage caused by low strength. Constructing roadside ditches and installing culverts for drainage minimize the damage caused by shrinking and swelling, wetness, and frost action.

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

30D2—Shelby clay loam, 9 to 14 percent slopes, eroded. This strongly sloping, moderately well drained soil is on back slopes in the uplands. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from about 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 gray, friable clay loam

Subsoil:
7 to 12 inches, dark brown, friable clay loam
12 to 21 inches, dark yellowish brown, firm clay loam
21 to 60 inches, dark yellowish brown, mottled, firm clay loam

In places the dark surface layer is less than 10 inches thick. In a few areas grayish brown mottles are within the upper 10 inches of the subsoil. In a few other areas the depth to free carbonates is less than 30 inches.

Included with this soil in mapping are small areas of the somewhat poorly drained Lamoni soils, primarily in narrow bands along the upper parts of the landscape. These soils make up 5 to 10 percent of the unit.

Important properties of the Shelby soil—

Permeability: Moderately slow
Surface runoff: Medium
Available water capacity: High
Organic matter content: Moderate
Shrink-swell potential: Moderate
Seasonal high water table: Perched at a depth of 3 to 5 feet

Most areas are used for pasture and hay. This soil is well suited to ladino clover, red clover, birdsfoot trefoil, tall fescue, timothy, and switchgrass. It is moderately well suited to alfalfa, big bluestem, and indiangrass. Erosion during seedbed preparation is the main management concern. It can be minimized by timely tillage and a quickly established ground cover. Erosion can be severe if the stands of grasses are depleted by overgrazing.

This soil is suited to corn, soybeans, grain sorghum, and winter wheat only on a limited basis because of the severe hazard of erosion. Crop rotations that include several years of pasture and hay crops are effective in controlling erosion. Only a few areas have slopes that are long enough or smooth enough to be terraced. A system of conservation tillage that leaves a protective cover of crop residue on the surface helps to control erosion, helps to maintain the content of organic matter, improves tilth, and increases the rate of water infiltration.

This soil is suitable for building site development if foundations and footings are properly designed and constructed. The wetness, the shrink-swell potential, and the slope are limitations on sites for dwellings. Using adequately reinforced concrete and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing tile drains around the foundations and footings minimizes the damage caused by wetness, poor surface drainage, or gutter failure. Designing the dwellings so that they conform to the natural slope of the land reduces the need for land shaping.

This soil generally is not used for conventional septic tank absorption fields because of the restricted permeability. Properly constructed sewage lagoons can function adequately if the site can be leveled.

This soil is suitable for local roads and streets. Strengthening the subgrade with crushed rock or other suitable material minimizes the damage caused by low strength. Constructing roadside ditches and installing culverts for drainage minimize the damage caused by shrinking and swelling, wetness, and frost action. Designing the roads and streets so that they conform to the natural slope of the land reduces the need for cutting and filling.

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

30E2—Shelby clay loam, 14 to 20 percent slopes, eroded. This moderately steep, moderately well drained soil is on back slopes in the uplands. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from about 10 to more than 50 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 clay loam

Subsoil:
8 to 13 inches, dark brown, friable clay loam
13 to 26 inches, dark brown and yellowish brown, mottled, firm clay loam
26 to 60 inches, yellowish brown, mottled, firm clay loam

In places the dark surface layer is more than 10 inches thick. In a few areas grayish brown mottles are within the upper 6 inches of the subsoil. In a few other areas the depth to free carbonates is less than 30 inches.

Included with this soil in mapping are small areas of the somewhat poorly drained Lamoni soils, primarily in narrow bands along the upper parts of the landscape. These soils make up 5 to 10 percent of the unit.

Important properties of the Shelby soil—

Permeability: Moderately slow
Surface runoff: Rapid
Available water capacity: High
Organic matter content: Moderate
Shrink-swell potential: Moderate
Seasonal high water table: Perched at a depth of 3 to 5 feet

Most areas are used for pasture and hay. A few areas are used for cultivated crops. This soil is suited to cultivated crops only on a limited basis because of the slope and the severe hazard of erosion. Cultivated crops should be grown in rotations with pasture and hay crops. A system of conservation tillage that leaves a protective cover of crop residue on the surface helps to control erosion, helps to maintain the content of organic matter, and increases the rate of water infiltration.

This soil is well suited to ladino clover, red clover, birdsfoot trefoil, tall fescue, timothy, and switchgrass. It is moderately well suited to alfalfa, big bluestem, and indiangrass. Erosion during seedbed preparation is the main management concern. It can be minimized by timely tillage and a quickly established ground cover. Erosion can be severe if the stands of grasses are depleted by overgrazing.

This soil generally is not used for building site development because of the slope. Overcoming the slope is generally not economically feasible.

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

31D2—Gara clay loam, 9 to 14 percent slopes, eroded. This strongly sloping, moderately well drained soil is on back slopes in the uplands. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from about 15 to more than 150 acres in size.

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

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

Subsoil:
7 to 13 inches, yellowish brown, friable clay loam
13 to 60 inches, yellowish brown, mottled, firm clay loam

In places the surface layer is brown or dark grayish brown clay loam. In a few areas grayish brown mottles are within the upper 10 inches of the subsoil.

Included with this soil in mapping are small areas of the somewhat poorly drained Armstrong soils, primarily in narrow bands along the upper parts of the landscape. Also included are small areas of the moderately deep Reger soils in narrow bands on the lower back slopes. Included soils make up 5 to 10 percent of the unit.

Important properties of the Gara soil—

Permeability: Moderately slow
Surface runoff: Medium
Available water capacity: High
Organic matter content: Moderate
Shrink-swell potential: Moderate
Seasonal high water table: Perched at a depth of 3 to 5 feet

Most areas are used for pasture and hay (fig. 5). This soil is well suited to ladino clover. It is moderately well suited to birdsfoot trefoil, tall fescue, timothy, indiangrass, and switchgrass. Erosion during seedbed preparation is the main management problem. It can be minimized by timely tillage and a quickly established ground cover. Erosion can be severe if the stands of grasses are depleted by overgrazing.

This soil is suited to corn, soybeans, grain sorghum, and winter wheat only on a limited basis because of the severe hazard of erosion. Crop rotations that include several years of pasture and hay crops are effective in controlling erosion. Only a few areas have slopes that are long enough or smooth enough to be terraced. A system of conservation tillage that leaves a protective cover of crop residue on the surface helps to control erosion, helps to maintain the content of organic matter,

Figure 5.—Orchardgrass hay in an area of Gara clay loam, 9 to 14 percent slopes, eroded.

improves tilth, and increases the rate of water infiltration.

Some areas support native hardwoods. This soil is suited to trees. Improving the stands increases timber production and quality. No major limitations or hazards affect planting or harvesting.

This soil is suitable for building site development if foundations and footings are properly designed and constructed. The wetness, the shrink-swell potential, and the slope are limitations on sites for dwellings. Using adequately reinforced concrete and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing tile drains around the foundations and footings minimizes the damage caused by wetness, poor surface drainage, or gutter failure. Designing the dwellings so that they conform to the natural slope of the land reduces the need for land shaping.

This soil generally is not used for conventional septic tank absorption fields because of the restricted permeability. Properly constructed sewage lagoons can function adequately if the site can be leveled.

This soil is suitable for local roads and streets. Strengthening the subgrade with crushed rock or other suitable material minimizes the damage caused by low strength. Constructing roadside ditches and installing culverts for drainage minimize the damage caused by shrinking and swelling and by frost action. Designing the roads and streets so that they conform to the natural slope of the land reduces the need for cutting and filling.

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

31E2—Gara clay loam, 14 to 20 percent slopes, eroded. This moderately steep, moderately well drained soil is on back slopes in the uplands. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from about 10 to more than 200 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 60 inches, dark yellowish brown, yellowish brown, and light yellowish brown, mottled, firm clay loam

In places the dark surface layer is more than 7 inches thick. In some severely eroded areas, the surface layer is brown clay loam or dark grayish brown loam.

Included with this soil in mapping are areas of the moderately deep Reger soils on the lower part of back slopes. Also included, in a few places along the east side of Medicine Creek and the main fork of Locust Creek, are soils that are sandier than the Gara soil. Included soils make up about 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
Shrink-swell potential: Moderate
Seasonal high water table: Perched at a depth of 3 to 5 feet

Most areas are used for pasture or trees. This soil generally is not suited to cultivated crops because of the slope and a severe hazard of erosion. It is well suited to ladino clover. It is moderately well suited to birdsfoot trefoil, tall fescue, timothy, big bluestem, indiangrass, and switchgrass. Erosion during seedbed preparation is an important management concern. Tilling and seeding only during optimum moisture and growing conditions help to establish a good ground cover and reduce the hazard of further erosion. Erosion can be particularly severe if the stands of grasses are depleted by overgrazing. Measures that control brush and maintain fertility are needed.

This soil is suited to trees. Large areas support native hardwoods. The equipment limitation and the hazard of erosion are management concerns. Establishing logging roads and skid trails on the contour helps to overcome the steepness and length of the slopes. Constructing water breaks on haul roads helps to control erosion. Seeding of disturbed areas may be necessary after harvesting is completed. Because of the slope, the safe use of equipment may be a problem. In some areas the logs should be yarded uphill to logging roads or skid trails. Hand planting or direct seeding may be needed. Most existing stands can benefit from selective cutting and thinning of undesirable trees.

This soil generally is not used for building site development because of the slope. Overcoming the slope is generally not economically feasible.

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

32D3—Gara clay loam, 9 to 14 percent slopes, severely eroded. This strongly sloping, moderately well drained soil is on back slopes in the uplands. Erosion has removed most of the original surface soil. The present surface layer is mostly subsoil material. Individual areas are irregular in shape and range from 15 to 45 acres in size.

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

Surface layer:
0 to 4 inches, dark brown, firm clay loam

Subsoil:
4 to 27 inches, yellowish brown, mottled, firm clay loam
27 to 60 inches, dark yellowish brown and yellowish brown, friable clay loam

In places the surface layer is very dark grayish brown clay loam or loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Armstrong soils, primarily in narrow bands along the upper parts of the landscape. Also included are small areas of the moderately deep Reger soils in narrow bands on the lower back slopes. Included soils make up about 5 percent of the unit.

Important properties of the Gara soil—

Permeability: Moderately slow
Surface runoff: Medium
Available water capacity: Moderate
Organic matter content: Low
Shrink-swell potential: Moderate
Seasonal high water table: Perched at a depth of 3 to 5 feet

Most areas are used for pasture. A few areas are used for cultivated crops. This soil generally is not suited to cultivated crops because of the severe hazard of erosion. It is well suited to ladino clover. It is moderately well suited to birdsfoot trefoil, tall fescue, timothy, big bluestem, indiangrass, and switchgrass. Erosion during seedbed preparation is the main management concern. Establishing a good stand of vegetation may be difficult. Tilling and seeding during optimum moisture and growing conditions help to establish a good ground cover and reduce the hazard of further erosion. Erosion can be particularly severe if the stands of grasses are depleted by overgrazing. Brush control is needed in most areas.

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

This soil is suitable for building site development if foundations and footings are properly designed and constructed. The wetness, the shrink-swell potential, and the slope are limitations on sites for dwellings. Using adequately reinforced concrete and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing tile drains around the foundations and footings minimizes the damage caused by wetness, poor surface drainage, or gutter failure. Designing the dwellings so that they conform to the natural slope of the land reduces the need for land shaping.

This soil generally is not used for conventional septic tank absorption fields because of the restricted permeability. Properly constructed sewage lagoons can function adequately if the site can be leveled.

This soil is suitable for local roads and streets. Strengthening the subgrade with crushed rock or other suitable material minimizes the damage caused by low strength. Constructing roadside ditches and installing culverts for drainage minimize the damage caused by shrinking and swelling and by frost action. Designing the roads and streets so that they conform to the natural slope of the land reduces the need for cutting and filling.

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

32E3—Gara clay loam, 14 to 20 percent slopes, severely eroded. This moderately steep, moderately well drained soil is on back slopes in the uplands. Erosion has removed most of the original surface soil. The present surface layer is mostly subsoil material. Individual areas are irregular in shape and range from about 5 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 4 inches, dark brown, firm clay loam

Subsoil:
4 to 8 inches, dark brown, firm clay loam
8 to 13 inches, yellowish brown, firm clay loam
13 to 40 inches, mottled dark yellowish brown, brown, and light brownish gray, firm clay loam

Substratum:
40 to 60 inches, mottled yellowish brown and light brownish gray, very firm clay loam

In places the surface layer is very dark grayish brown loam.

Included with this soil in mapping are areas of the moderately deep Reger soils on the lower part of back slopes. These soils make up about 5 percent of the unit.

Important properties of the Gara soil—

Permeability: Moderately slow
Surface runoff: Rapid
Available water capacity: Moderate
Organic matter content: Low
Shrink-swell potential: Moderate
Seasonal high water table: Perched at a depth of 3 to 5 feet

Most areas are used for pasture. A few areas are used for cultivated crops. This soil generally is not suited to cultivated crops because of the slope and the hazard of further erosion. It is well suited to ladino clover. It is moderately well suited to birdsfoot trefoil, tall fescue, timothy, big bluestem, indiangrass, and switchgrass. Erosion during seedbed preparation is a serious management concern. Establishing a good stand of vegetation may be difficult. Tilling and seeding during optimum moisture and growing conditions help to establish a good ground cover and greatly reduce the hazard of further erosion. Erosion can be particularly severe if the stands of grasses are depleted by overgrazing. Measures that control brush and maintain fertility are needed.

This soil is suited to trees. A few abandoned areas have regenerated to brush. The equipment limitation and the hazard of erosion are management concerns. Establishing logging roads and skid trails on the contour helps to overcome the steepness and length of the slopes and helps to prevent the concentration of water. Constructing water breaks and seeding disturbed areas after harvesting help to control erosion. Because of the slope, the safe use of equipment is a concern. In some areas the logs should be yarded uphill to logging roads or skid trails. Hand planting or direct seeding may be needed.

This soil generally is not used for building site development because of the slope. Overcoming the slope is generally not economically feasible.

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

34D2—Winnegan loam, 9 to 14 percent slopes, eroded. This strongly sloping, moderately well drained soil is on narrow ridgetops and back slopes in the uplands. Erosion has removed some of the original surface layer. Individual areas are irregular in shape 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 5 inches, dark grayish brown and dark brown, friable loam

Subsoil:
- 5 to 16 inches, dark yellowish brown and strong brown, firm clay loam
- 16 to 25 inches, strong brown, mottled, firm clay loam
- 25 to 39 inches, mottled light brownish gray and yellowish brown, firm clay loam
- 39 to 60 inches, yellowish brown and dark yellowish brown, mottled, firm clay loam

In places the surface layer is very dark grayish brown loam about 6 inches thick. In a few areas red or gray mottles are within the upper 10 inches of the subsoil.

Included with this soil in mapping are areas of the somewhat poorly drained Gorin soils on narrow ridgetops and the moderately deep Reger soils in narrow bands on the lower back slopes. Also included, in a few places along the east side of Medicine Creek and the main fork of Locust Creek, are soils that are much sandier than the Winnegan soil. Included soils make up about 15 percent of the unit.

Important properties of the Winnegan soil—

Permeability: Slow
Surface runoff: Medium
Available water capacity: Moderate
Organic matter content: Low
Shrink-swell potential: High
Seasonal high water table: Perched at a depth of 2.0 to 3.5 feet

Most areas are used for pasture, hay, or timber. This soil is well suited to ladino clover. It is moderately well suited to birdsfoot trefoil, tall fescue, timothy, big bluestem, indiangrass, and switchgrass. Erosion during seedbed preparation is the main management concern. It can be minimized by timely tillage and a quickly established ground cover. Erosion can be particularly severe if the stands of grasses are depleted by overgrazing. Brush management generally is needed.

This soil is suited to trees. Some areas support native hardwoods. No major limitations or hazards affect planting or harvesting. Most areas can benefit from selective cutting and thinning of undesirable trees.

This soil is suited to corn, soybeans, grain sorghum, and winter wheat only on a limited basis because of the severe hazard of erosion. Using a system of conservation tillage that leaves a protective cover of crop residue on the surface and growing winter cover crops help to control erosion, maintain the content of organic matter, improve tilth, and increase the rate of water infiltration.

This soil is suitable for building site development if foundations and footings are properly designed and constructed. The wetness, the shrink-swell potential, and the slope are limitations on sites for dwellings. Using adequately reinforced concrete and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing tile drains around the foundations and footings minimizes the damage caused by excessive wetness. Designing the dwellings so that they conform to the natural slope of the land reduces the need for land shaping.

This soil is not suitable for conventional septic tank absorption fields because of the restricted permeability and the wetness. If lagoons are used, the site should be leveled. Placing a compacted layer of slowly permeable material on the bottom and sides of the lagoon minimizes seepage.

This soil is suitable for local roads and streets. Strengthening the subgrade with crushed rock or other suitable material minimizes the damage caused by low strength. Constructing roadside ditches and installing culverts for drainage minimize the damage caused by shrinking and swelling, wetness, and frost action. Designing the roads and streets so that they conform to the natural slope of the land reduces the need for cutting and filling.

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

34E2—Winnegan loam, 14 to 20 percent slopes, eroded. This moderately steep, moderately well drained soil is on back slopes in the uplands. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are elongated and range from about 15 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 4 inches, dark grayish brown, friable loam

Subsurface layer:
4 to 8 inches, yellowish brown, friable loam

Subsoil:
8 to 60 inches, yellowish brown, mottled, firm clay loam

In some severely eroded areas, the surface layer is firm clay loam. In a few places grayish brown mottles are within the upper 10 inches of the subsoil.

Included with this soil in mapping are areas of the moderately deep Reger soils in narrow bands on the lower back slopes. Also included, in a few places along the east side of Medicine Creek and the main fork of Locust Creek, are soils that are much sandier than the Winnegan soil. Included soils 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
Shrink-swell potential: High
Seasonal high water table: Perched at a depth of 2.0 to 3.5 feet

Most areas are used for pasture or timber. This soil is not suited to cultivated crops because of the slope and the severe hazard of erosion. It is well suited to ladino clover and moderately well suited to birdsfoot trefoil, tall fescue, timothy, big bluestem, indiangrass, and switchgrass. Erosion during seedbed preparation is the main management concern. Tilling and seeding during optimum moisture and growing conditions help to establish a good ground cover and reduce the hazard of further erosion. Erosion can be particularly severe if the stands of grasses are depleted by overgrazing. Measures that control brush and maintain fertility are needed.

This soil is suited to trees. Large areas support native hardwoods. The equipment limitation and the hazard of erosion are management concerns. Establishing logging roads and skid trails on the contour helps to overcome the steepness and length of the slopes. Constructing water breaks on haul roads and seeding disturbed areas after harvesting help to control erosion. Because of the slope, the safe use of equipment is a concern. In some areas the logs should be yarded uphill to logging roads or skid trails. Hand planting or direct seeding may be needed. Most existing stands can benefit from selective cutting and thinning of undesirable trees.

This soil generally is not used for building site development because of the slope. Overcoming the slope is generally not economically feasible.

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

34F—Winnegan loam, 20 to 40 percent slopes. This steep and very steep, moderately well drained soil is on back slopes in the uplands. Individual areas are elongated 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 2 inches, dark grayish brown, friable loam

Subsurface layer:
2 to 6 inches, brown, friable loam

Subsoil:
6 to 18 inches, yellowish brown, firm clay loam
18 to 60 inches, yellowish brown, mottled, firm clay loam

In a few places the surface layer is very dark grayish brown and is more than 6 inches thick. In a few areas the surface layer is brown clay loam. In places the subsoil is dark grayish brown clay.

Included with this soil in mapping are areas of the moderately deep Reger soils in narrow bands on the lower back slopes along upland drainageways. Also included, in a few places along the east side of Medicine Creek and the main fork of Locust Creek, are soils that are much sandier than the Winnegan soil. Included soils 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
Shrink-swell potential: High
Seasonal high water table: Perched at a depth of 2.0 to 3.5 feet

Most areas are used for timber or pasture. This soil is not suited to cultivated crops because of the slope and a severe hazard of erosion. It is suited to trees, and large areas support native hardwoods. The equipment limitation and the hazard of erosion are the major management concerns. Establishing logging roads and skid trails on the contour helps to overcome the steepness and length of the slopes. Constructing water breaks on haul roads and seeding disturbed areas after harvesting help to control erosion. Because of the slope, the safe use of equipment is a concern. In some areas the logs should be yarded uphill to logging roads or skid trails. Hand planting or direct seeding may be needed. Most existing stands can benefit from selective cutting and thinning of undesirable trees.

This soil is well suited to ladino clover. It is moderately well suited to birdsfoot trefoil, tall fescue, timothy, big bluestem, indiangrass, and switchgrass. Because the slope limits the use of equipment, preparing a seedbed is difficult. Erosion during seedbed preparation is also a concern, and establishing a good stand of vegetation can be difficult. No-till seeding can be effective in establishing new stands of grasses and legumes. Competing vegetation can be controlled by chemical methods. Erosion can be particularly severe if the stands of grasses are depleted by overgrazing. Measures that control brush and maintain fertility are needed.

This soil generally is not used for building site development because of the slope. Overcoming the slope is generally not economically feasible.

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

35D3—Winnegan clay loam, 9 to 14 percent slopes, severely eroded. This strongly sloping, moderately well drained soil is on back slopes in the uplands. Erosion has removed most of the original surface soil. The present surface layer is mostly subsoil material. Individual areas are irregular in shape 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 4 inches, brown, friable clay loam

Subsoil:
4 to 14 inches, strong brown, firm clay loam
14 to 60 inches, yellowish brown and light brownish gray, mottled, firm clay loam

In places the surface layer is very dark grayish brown loam. In a few areas red or gray mottles are within the upper 10 inches of the subsoil.

Included with this soil in mapping are areas of the moderately deep Reger soils in narrow bands on the lower back slopes. These soils make up about 5 percent of the unit.

Important properties of the Winnegan soil—

Permeability: Slow
Surface runoff: Medium
Available water capacity: Moderate
Organic matter content: Low
Shrink-swell potential: High
Seasonal high water table: Perched at a depth of 2.0 to 3.5 feet

Most areas are used for pasture and hay. A few areas are used for cultivated crops. This soil generally is not suited to cultivated crops because of the slope and the severe hazard of erosion.

This soil is well suited to ladino clover. It is moderately well suited to birdsfoot trefoil, tall fescue, timothy, big bluestem, indiangrass, and switchgrass. Erosion during seedbed preparation is the main management concern. Establishing a good stand of vegetation may be difficult. Tilling and seeding during optimum moisture and growing conditions help to establish a good ground cover and reduce the hazard of further erosion. Erosion can be particularly severe if the stands of grasses are depleted by overgrazing. Measures that control brush and maintain fertility are needed.

This soil is suited to trees. A few areas have regenerated to brush. No major limitations or hazards affect planting or harvesting.

This soil is suitable for building site development if foundations and footings are properly designed and constructed. The wetness, the shrink-swell potential, and the slope are limitations on sites for dwellings. Using adequately reinforced concrete and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing tile drains around the foundations and footings minimizes the damage caused by excessive wetness. Designing the building sites so that they conform to the natural slope of the land reduces the need for land shaping. Adding topsoil helps to establish a suitable lawn.

This soil is not suitable for conventional septic tank absorption fields because of the restricted permeability. Properly constructed sewage lagoons can function adequately if the site can be leveled.

This soil is suitable for local roads and streets. Strengthening the subgrade with crushed rock or other suitable material minimizes the damage caused by low strength. Constructing roadside ditches and installing culverts for drainage minimize the damage caused by shrinking and swelling, wetness, and frost action.

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

35E3—Winnegan clay loam, 14 to 20 percent slopes, severely eroded. This moderately steep, moderately well drained soil is on back slopes in the uplands. Erosion has removed most of the original surface soil. The present surface layer is mostly subsoil material. Individual areas generally are irregular in shape and range from about 5 to more than 25 acres in size.

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

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

Subsoil:
3 to 18 inches, dark brown and dark yellowish brown, firm clay loam
18 to 60 inches, yellowish brown and light brownish gray, mottled, firm clay loam

In places the surface layer is loam.

Included with this soil in mapping are areas of the moderately deep Reger soils in narrow bands on the lower back slopes. These soils make up about 10 percent of the unit.

Important properties of the Winnegan soil—

Permeability: Slow
Surface runoff: Rapid
Available water capacity: Moderate
Organic matter content: Low
Shrink-swell potential: High
Seasonal high water table: Perched at a depth of 2.0 to 3.5 feet

Most areas are used for pasture or support brush. This soil generally is not suited to cultivated crops because of the slope and the severe hazard of erosion. It is well suited to ladino clover and moderately well suited to birdsfoot trefoil, tall fescue, timothy, big bluestem, indiangrass, and switchgrass. Erosion during seedbed preparation is the main management concern. Establishing a good stand of vegetation may be difficult. Tilling and seeding during optimum moisture and growing conditions help to establish a good ground cover and reduce the hazard of further erosion. Erosion can be particularly severe if the stands of grasses are depleted by overgrazing. Measures that control brush and maintain fertility are needed.

This soil is suited to trees. A few abandoned areas have regenerated to brush. The equipment limitation and the hazard of erosion are the major management concerns. Establishing logging roads and skid trails on the contour helps to overcome the steepness and length of the slopes. Constructing water breaks on haul roads and seeding disturbed areas after harvesting help to control erosion. Because of the slope, the safe use of equipment is a concern. In some areas the logs should be yarded uphill to logging roads or skid trails. Hand planting or direct seeding may be needed. Most existing stands can benefit from selective cutting and thinning of undesirable trees.

This soil generally is not used for building site development because of the slope. Overcoming the slope is generally not economically feasible.

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

41C2—Rinda silty clay loam, 3 to 9 percent slopes, eroded. This gently sloping, poorly drained soil is on the upper side slopes and head slopes in the uplands. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from about 10 to more than 50 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 gray, friable silty clay loam

Subsoil:
6 to 11 inches, dark grayish brown, mottled, firm silty clay loam
11 to 60 inches, dark grayish brown, mottled, firm clay

In some severely eroded areas, the surface layer is dark grayish brown clay loam.

Included with this soil in mapping are a few areas of the somewhat poorly drained Armstrong soils along the lower edge of the mapped areas. Also included are areas of the somewhat poorly drained Lamoni soils along the upper edge of the mapped areas. Included soils make up about 5 percent of the unit.

Important properties of the Rinda soil—

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

Most areas are used for pasture. Some areas are used for cultivated crops. This soil is moderately well suited to reed canarygrass and switchgrass. It is moderately suited to birdsfoot trefoil, tall fescue, big bluestem, and indiangrass. The species that can withstand wetness grow best. Erosion during seedbed preparation is the main management concern. It can be minimized by timely tillage and a quickly established ground cover.

This soil is suitable for corn, soybeans, grain sorghum, and winter wheat on a limited basis. If it is used for row crops, erosion is a severe hazard. A conservation cropping system that includes pasture or hay crops in the rotation, contour farming, terraces, no-till farming, stripcropping, and a system of conservation tillage that leaves a protective cover of crop residue on the surface help to control erosion. Additions of crop residue or other organic material maintain the content of organic matter, improve tilth, increase the rate of water infiltration, and maintain fertility.

This soil is suited to building site development. The shrink-swell potential and the wetness are the major limitations on sites for dwellings. Foundations and footings should be properly designed and constructed. Using adequately reinforced concrete and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing tile drains around the foundations and footings minimizes the damage caused by excessive wetness.

This soil is not suitable for conventional septic tank absorption fields because of the restricted permeability and the wetness. Properly constructed sewage lagoons can function adequately if the site can be leveled.

This soil is suitable for local roads and streets. Strengthening the subgrade with crushed rock or other suitable material minimizes the damage caused by low strength. Constructing roadside ditches and installing culverts for drainage minimize the damage caused by shrinking and swelling, wetness, and frost action.

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

43C2—Keswick loam, 5 to 9 percent slopes, eroded. This moderately sloping, moderately well drained soil is on ridgetops and back slopes in the uplands. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the subsurface layer and, in some places, with the upper part of the subsoil. Individual areas are elongated and range from about 10 to more than 80 acres in size.

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

Surface layer:
0 to 4 inches, dark grayish brown, friable loam

Subsoil:
4 to 11 inches, dark brown, mottled, firm clay loam
11 to 27 inches, reddish brown and strong brown, mottled, firm clay
27 to 60 inches, dark yellowish brown and yellowish brown, mottled, firm clay loam

In some areas the surface layer is silt loam. In other areas the upper part of the subsoil does not have gray or red mottles. In places the subsoil is much grayer.

Important soil properties—

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

Most areas are used for pasture or for cultivated crops. This soil is well suited to ladino clover and moderately well suited to birdsfoot trefoil, tall fescue, timothy, big bluestem, switchgrass, and indiangrass. The species that can withstand wetness grow best. Erosion during seedbed preparation is the main management concern. It can be minimized by timely tillage and a quickly established ground cover.

This soil is suited to corn, soybeans, grain sorghum, and winter wheat. If it is used for cultivated crops, the hazard of further erosion is severe because of the slope. Installing terraces and waterways and applying a system of conservation tillage that leaves a protective cover of crop residue on the surface help to control erosion. Additions of crop residue or other organic material maintain the content of organic matter, improve tilth, increase the rate of water infiltration, and maintain fertility.

This soil is suited to trees. A few areas support native hardwoods. Seedling mortality and the windthrow hazard are the main management concerns. Reinforcement planting or planting container-grown nursery stock improves the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely.

This soil is suitable for building site development if foundations and footings are properly designed and constructed. Using adequately reinforced concrete and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing tile drains around the foundations and footings minimizes the damage caused by excessive wetness.

This soil is not suitable for conventional septic tank absorption fields because of the restricted permeability and the wetness. Properly constructed sewage lagoons can function adequately if the site can be leveled.

This soil is suitable for local roads and streets. Strengthening the subgrade with crushed rock or other suitable material minimizes the damage caused by low strength. Constructing roadside ditches and installing culverts for drainage minimize the damage caused by shrinking and swelling, wetness, and frost action.

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

43D2—Keswick loam, 9 to 14 percent slopes, eroded. This strongly sloping, moderately well drained soil is on back slopes in the uplands. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the subsurface layer and, in some places, with the upper part of the subsoil. Individual areas are irregular in shape and range from about 5 to more than 60 acres in size.

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

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

Subsoil:
7 to 21 inches, strong brown and yellowish brown, mottled, firm clay loam
21 to 53 inches, brown and pale brown, mottled, firm clay loam

Substratum:
53 to 60 inches, reddish yellow, mottled, firm sandy clay loam

In places the upper part of the subsoil does not have gray or red mottles. In some areas the subsoil is much grayer. In a few places the soil is silt loam throughout.

Included with this soil in mapping are areas of the moderately deep Reger soils on the lower back slopes. Also included, in some severely eroded areas, are soils that have a surface layer of brown clay loam. Included soils make up about 10 percent of the unit.

Important properties of the Keswick soil—

Permeability: Slow
Surface runoff: Rapid
Available water capacity: Moderate
Organic matter content: Low
Shrink-swell potential: High
Seasonal high water table: Perched at a depth of 1 to 3 feet

Most areas are used for pasture and hay. A few areas are used for cultivated crops. This soil is well suited to ladino clover and moderately well suited to birdsfoot trefoil, tall fescue, timothy, big bluestem, switchgrass, and indiangrass. Erosion during seedbed preparation is the main management concern. It can be minimized by timely tillage and a quickly established ground cover. Erosion can be particularly severe if the stands of grasses are depleted by overgrazing. Brush control may be needed.

This soil is suited to corn, soybeans, grain sorghum, and winter wheat only on a limited basis because of a severe hazard of erosion. A system of conservation tillage that leaves a protective cover of crop residue on the surface, a conservation cropping system, winter cover crops, and grassed waterways help to control erosion. Additions of crop residue or other organic material improve fertility and tilth and increase the rate of water infiltration.

This soil is suited to trees. A few areas support native hardwoods. Improving the existing stands increases the quality of the timber. Seedling mortality and the windthrow hazard are the main management concerns. Reinforcement planting or planting container-grown nursery stock improves the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely.

This soil is suitable for building site development if foundations and footings are properly designed and constructed. Using adequately reinforced concrete and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing tile drains around the foundations and footings minimizes the damage caused by excessive wetness.

This soil is not suitable for conventional septic tank absorption fields because of the restricted permeability and the wetness. Properly constructed sewage lagoons can function adequately if the site can be leveled.

This soil is suitable for local roads and streets. Strengthening the subgrade with crushed rock or other suitable material minimizes the damage caused by low strength. Constructing roadside ditches and installing culverts for drainage minimize the damage caused by shrinking and swelling, wetness, and frost action.

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

43D3—Keswick clay loam, 9 to 14 percent slopes, severely eroded. This strongly sloping, moderately well drained soil is on back slopes in the uplands. Erosion has removed most of the original surface layer. The present surface layer is mostly subsoil material. Individual areas are irregular in shape and range from about 5 to more than 60 acres in size.

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

Surface layer:
0 to 4 inches, dark yellowish brown, friable clay loam

Subsoil:
4 to 14 inches, dark brown and brown, mottled, firm clay loam
14 to 60 inches, light brownish gray, mottled, firm clay loam

In some areas the surface layer is loam or silt loam. In other areas the upper part of the subsoil does not have gray or red mottles. In places the subsoil is not as gray.

Included with this soil in mapping are areas of the moderately deep Reger soils on the lower back slopes. Also included are some areas of the steep Winnegan soils on the lower back slopes and the moderately sloping Gorin soils on high benches adjacent to the flood plain. Included soils make up about 15 percent of the unit.

Important properties of the Keswick soil—

Permeability: Slow
Surface runoff: Rapid
Available water capacity: Moderate
Organic matter content: Low
Shrink-swell potential: High
Seasonal high water table: Perched at a depth of 1 to 3 feet

Most areas are used for pasture and hay. A few areas are used for cultivated crops. This soil generally is not suited to cultivated crops because of the slope and the severe hazard of erosion.

This soil is well suited to ladino clover and moderately well suited to birdsfoot trefoil, tall fescue, timothy, big bluestem, switchgrass, and indiangrass. Erosion during seedbed preparation is the main management concern. Establishing a good stand of vegetation may be difficult. Tilling and seeding during optimum moisture and growing conditions help to establish a good ground cover and reduce the hazard of further erosion. Erosion can be particularly severe if the stands of grasses are depleted by overgrazing. Brush control may be needed.

This soil is suited to trees. A few areas support native hardwoods. Improving the existing stands increases the quality of the timber. Seedling mortality and the windthrow hazard are management concerns. Reinforcement planting or planting container-grown nursery stock improves the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely.

This soil is suitable for building site development if foundations and footings are properly designed and constructed. Using adequately reinforced concrete and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing tile drains around the foundations and footings minimizes the damage caused by excessive wetness.

This soil is not suitable for conventional septic tank absorption fields because of the restricted permeability and the wetness. Properly constructed sewage lagoons can function adequately if the site can be leveled.

This soil is suitable for local roads and streets. Strengthening the subgrade with crushed rock or other suitable material minimizes the damage caused by low strength. Constructing roadside ditches and installing culverts for drainage minimize the damage caused by shrinking and swelling, wetness, and frost action.

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

44B—Armstrong loam, 2 to 5 percent slopes. This gently sloping, somewhat poorly drained soil is on narrow, rounded ridgetops and the upper back slopes in the uplands. Individual areas are long and narrow and range from about 10 to more than 80 acres in size.

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

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

Subsoil:
8 to 13 inches, brown, friable clay loam
13 to 32 inches, brown, mottled, firm clay loam and clay
32 to 60 inches, dark yellowish brown and yellowish brown, mottled, firm clay loam

In places the upper part of the subsoil does not have gray or red mottles. In some areas the subsoil is much grayer.

Included with this soil in mapping, in some severely eroded areas, are soils that have a surface layer of brown clay loam. These soils make up about 5 percent of the unit.

Important properties of the Armstrong soil—

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

Most areas are used for cultivated crops or for pasture. This soil is suited to corn, soybeans, grain sorghum, and winter wheat. Because of the slope, the hazard of erosion is moderate in cultivated areas. Applying a system of conservation tillage that leaves a protective cover of crop residue on the surface helps to control erosion, maintains the content of organic matter, improves tilth, increases the rate of water infiltration, and maintains fertility.

This soil is well suited to ladino clover and moderately well suited to birdsfoot trefoil, tall fescue, timothy, big bluestem, switchgrass, and indiangrass. The species that can withstand wetness grow best.

Erosion during seedbed preparation is the main management concern. It can be minimized by timely tillage and a quickly established ground cover.

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

This soil is suitable for building site development if foundations and footings are properly designed and constructed. Using adequately reinforced concrete and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing tile drains around the foundations and footings minimizes the damage caused by excessive wetness.

This soil is not suitable for conventional septic tank absorption fields because of the restricted permeability and the wetness. Properly constructed sewage lagoons can function adequately if the site is leveled.

This soil is suitable for local roads and streets. Strengthening the subgrade with crushed rock or other suitable material minimizes the damage caused by low strength. Constructing roadside ditches and installing culverts for drainage minimize the damage caused by shrinking and swelling, wetness, and frost action.

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

44C2—Armstrong clay loam, 5 to 9 percent slopes, eroded. This moderately sloping, somewhat poorly drained soil is on back slopes in the uplands. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from about 20 to more than 200 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 clay loam

Subsoil:
- 8 to 13 inches, dark brown, friable clay loam
- 13 to 27 inches, brown, mottled, firm clay
- 27 to 60 inches, yellowish brown, mottled, firm clay loam

In some areas the upper part of the subsoil does not have gray or red mottles. In places the subsoil is much grayer.

Included with this soil in mapping, in some severely eroded areas, are soils that have a surface layer of brown, firm clay loam and soils that are fine sandy loam throughout. Included soils make up about 10 percent of the area.

Important properties of the Armstrong soil—

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

Most areas are used for cultivated crops, hay, or pasture. This soil is suited to corn (fig. 6), soybeans, grain sorghum, and winter wheat. Because of the slope, the hazard of further erosion is severe in cultivated areas. Some areas have slopes that are long enough and smooth enough to be terraced and farmed on the contour. Stripcropping is also suitable in these areas. 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. Returning crop residue to the soil or adding other organic material improves fertility and tilth and increases the rate of water infiltration.

This soil is well suited to ladino clover and moderately well suited to birdsfoot trefoil, red clover, tall fescue, timothy, big bluestem, switchgrass, and indiangrass. The species that can withstand wetness grow best. Erosion during seedbed preparation is the main management concern. It can be minimized by timely tillage and a quickly established ground cover.

This soil is suited to trees. A few areas support native hardwoods. Seedling mortality and the windthrow hazard are the main management concerns. Reinforcement planting or planting container-grown nursery stock improves the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely.

This soil is suitable for building site development if foundations and footings are properly designed and constructed. Using adequately reinforced concrete and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing tile drains around the foundations and footings minimizes the damage caused by excessive wetness.

This soil is not suitable for conventional septic tank absorption fields because of the restricted permeability and the wetness. Properly constructed sewage lagoons can function adequately if the site can be leveled.

This soil is suitable for local roads and streets. Strengthening the subgrade with crushed rock or other suitable material minimizes the damage caused by

Figure 6.—Corn and red clover in an area of Armstrong clay loam, 5 to 9 percent slopes, eroded.

low strength. Constructing roadside ditches and installing culverts for drainage minimize the damage caused by shrinking and swelling, wetness, and frost action.

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

44D2—Armstrong clay loam, 9 to 14 percent slopes, eroded. This strongly sloping, somewhat poorly drained soil is on back slopes. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from 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 6 inches, very dark grayish brown, very friable clay loam

Subsoil:

6 to 15 inches, brown, friable clay loam

15 to 60 inches, yellowish brown, mottled, firm clay loam

In some areas the upper part of the subsoil does not have gray or red mottles. In places the subsoil is much grayer.

Included with this soil in mapping, in some severely eroded areas, are soils that have a surface layer of brown, firm clay loam. Also included are the moderately well drained Gara soils at the ends of ridges. Included soils make up about 10 percent of the unit.

Important properties of the Armstrong soil—

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

Most areas are used for cultivated crops, hay, or pasture. This soil is suited to corn, soybeans, grain sorghum, and winter wheat only on a limited basis because of a severe hazard of erosion. Crop rotations that include several years of pasture and hay crops are effective in controlling erosion. A system of conservation tillage that leaves a protective cover of crop residue on the surface helps to control erosion, maintains the content of organic matter, improves tilth, and increases the rate of water infiltration.

This soil is well suited to ladino clover and moderately well suited to birdsfoot trefoil, tall fescue, timothy, big bluestem, switchgrass, and indiangrass. Erosion during seedbed preparation is the main management concern. It can be minimized by timely tillage and a quickly established ground cover. Erosion can be particularly severe if the stands of grasses are depleted by overgrazing.

This soil is suited to trees. A few areas support native hardwoods. Seedling mortality and the windthrow hazard are the main management concerns. Reinforcement planting or planting container-grown nursery stock improves the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely.

This soil is suitable for building site development if foundations and footings are properly designed and constructed. Using adequately reinforced concrete and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing tile drains around the foundations and footings minimizes the damage caused by excessive wetness. Designing the dwellings so that they conform to the natural slope of the land reduces the need for land shaping.

This soil is not suitable for conventional septic tank absorption fields because of the restricted permeability and the wetness. Properly constructed sewage lagoons can function adequately if the site can be leveled.

This soil is suitable for local roads and streets. Strengthening the subgrade with crushed rock or other suitable material minimizes the damage caused by low strength. Constructing roadside ditches and installing culverts for drainage minimize the damage caused by shrinking and swelling, wetness, and frost action. Designing the roads and streets so that they conform to the natural slope of the land reduces the need for cutting and filling.

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

45C3—Armstrong clay loam, 5 to 9 percent slopes, severely eroded. This moderately sloping, somewhat poorly drained soil is on back slopes in the uplands. Erosion has removed most of the original surface layer. The present surface layer is mostly subsoil material. Individual areas are irregular in shape 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 6 inches, brown, firm clay loam

Subsoil:
6 to 25 inches, yellowish brown, mottled, firm clay
25 to 56 inches, dark yellowish brown and light brownish gray, mottled, firm clay

Substratum:
56 to 60 inches, light brownish gray, mottled, firm sandy clay loam

In some areas the surface layer is very dark grayish brown clay loam. In other areas the upper part of the subsoil does not have gray or red mottles. In places the subsoil is much grayer.

Important soil properties—

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

Most areas are used for cultivated crops, hay, or pasture. This soil is suited to cultivated crops only on a limited basis. Gullies, poor tilth, low fertility, and a severe hazard of further erosion are major concerns in areas used for cultivated 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. Returning crop residue to the soil or adding other organic material improves fertility and tilth and increases the rate of water infiltration.

This soil is well suited to ladino clover and moderately well suited to birdsfoot trefoil, tall fescue, timothy, big bluestem, switchgrass, and indiangrass. The species that can withstand wetness grow best. Erosion during seedbed preparation is the main management concern. Establishing a good stand of vegetation may be difficult. Tilling and seeding only under optimum moisture and growing conditions help to establish a ground cover and reduce the hazard of further erosion.

This soil is suited to trees. Seedling mortality and the windthrow hazard are the main management concerns. Reinforcement planting or planting container-grown nursery stock improves the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely.

This soil is suitable for building site development if foundations and footings are properly designed and constructed. Using adequately reinforced concrete and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing tile drains around the foundations and footings minimizes the damage caused by excessive wetness. Adding topsoil helps to establish a suitable lawn.

This soil is not suitable for conventional septic tank absorption fields because of the restricted permeability and the wetness. Properly constructed sewage lagoons can function adequately if the site can be leveled.

This soil is suitable for local roads and streets. Strengthening the subgrade with crushed rock or other suitable material minimizes the damage caused by low strength. Constructing roadside ditches and installing culverts for drainage minimize the damage caused by shrinking and swelling, wetness, and frost action.

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

45D3—Armstrong clay loam, 9 to 14 percent slopes, severely eroded. This strongly sloping, somewhat poorly drained soil is on back slopes in the uplands. Erosion has removed most of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from 5 to about 50 acres in size.

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

Surface layer:
0 to 5 inches, dark brown, friable clay loam

Subsoil:
5 to 10 inches, dark yellowish brown, mottled, firm clay
10 to 60 inches, mottled yellowish brown, grayish brown, and dark yellowish brown, firm clay loam

In some moderately eroded areas, the surface layer is very dark grayish brown clay loam. In places the upper part of the subsoil does not have gray or red mottles. In some areas the subsoil is much grayer.

Included with this soil in mapping are areas of the moderately well drained Gara soils on nose slopes. These soils make up about 10 percent of the unit.

Important properties of the Armstrong soil—

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

Most areas are used for cultivated crops, hay, or pasture. This soil generally is not suited to cultivated crops because of the severe hazard of further erosion. It is suited to winter wheat on a limited basis. Crop rotations that include several years of pasture and hay crops are effective in controlling erosion. Applying a system of conservation tillage that leaves a protective cover of crop residue on the surface helps to control erosion, maintains the content of organic matter, improves tilth, and increases the rate of water infiltration.

This soil is well suited to ladino clover and moderately well suited to birdsfoot trefoil, tall fescue, timothy, big bluestem, switchgrass, and indiangrass. Erosion during seedbed preparation is the main management concern. It can be minimized by timely tillage and a quickly established ground cover. Erosion can be particularly severe if the stands of grasses are depleted by overgrazing.

This soil is suited to trees. A few areas support hardwoods. Seedling mortality and the windthrow hazard are management concerns. Reinforcement planting or planting container-grown nursery stock improves the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely.

This soil is suitable for building site development if foundations and footings are properly designed and constructed. Using adequately reinforced concrete and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing tile drains around the foundations and footings minimizes the damage caused by excessive wetness. Designing the dwellings so that they conform to the natural slope of the land reduces the need for land shaping. Adding topsoil helps to establish a suitable lawn.

This soil is not suitable for conventional septic tank absorption fields because of the restricted permeability and the wetness. Properly constructed sewage lagoons can function adequately if the site can be leveled.

This soil is suitable for local roads and streets. Strengthening the subgrade with crushed rock or other suitable material minimizes the damage caused by low strength. Constructing roadside ditches and installing culverts for drainage minimize the damage caused by shrinking and swelling, wetness, and frost action. Designing the roads and streets so that they conform to the natural slope of the land reduces the need for cutting and filling.

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

48C2—Lamoni clay loam, 5 to 9 percent slopes, eroded. This moderately sloping, somewhat poorly drained soil is on narrow ridgetops and back slopes. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the upper part of the subsoil. Individual areas are irregular in shape and range from about 10 to more than 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 gray, friable clay loam

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

In places the surface layer is loam. In some areas the upper part of the subsoil has red mottles. In other areas the subsoil is dark gray.

Included with this soil in mapping are the moderately well drained Shelby soils along the lower edge of the mapped areas. These soils make up about 5 percent of the unit.

Important properties of the Lamoni soil—

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

Most areas are used for cultivated crops, hay, or pasture. This soil is suited to corn, soybeans, grain sorghum, and winter wheat. Because of the slope, the hazard of further erosion is severe in cultivated areas. Some areas have slopes that are long enough and smooth enough to be terraced and farmed on the contour. Stripcropping is also suitable in these areas. 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. Returning crop residue to the soil or adding other organic material improves fertility and tilth and increases the rate of water infiltration.

This soil is well suited to ladino clover and moderately well suited to birdsfoot trefoil, tall fescue, timothy, big bluestem, switchgrass, and indiangrass. The species that can withstand wetness grow best. Erosion during seedbed preparation is the main management concern. It can be minimized by timely tillage and a quickly established ground cover.

This soil is suitable for building site development if foundations and footings are properly designed and constructed. Using adequately reinforced concrete and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing tile drains around the foundations and footings minimizes the damage caused by excessive wetness.

This soil is not suitable for conventional septic tank absorption fields because of the restricted permeability and the wetness. Properly constructed sewage lagoons can function adequately if the site can be leveled.

This soil is suitable for local roads and streets. Strengthening the subgrade with crushed rock or other suitable material minimizes the damage caused by low strength. Constructing roadside ditches and installing culverts for drainage minimize the damage caused by shrinking and swelling, wetness, and frost action.

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

50—Landes loam, frequently flooded. This well drained soil is adjacent to stream channels and occurs in areas across the entire width of some narrow flood plains. Most areas are subject to flooding for brief periods. Individual areas are relatively narrow and range from about 10 to more than 200 acres in size.

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

Surface layer:
0 to 11 inches, very dark grayish brown, friable loam

Subsoil:
11 to 23 inches, dark brown, friable loam

Substratum:
23 to 35 inches, dark yellowish brown and dark brown, friable loam
35 to 55 inches, dark yellowish brown, friable fine sandy loam
55 to 60 inches, dark brown, mottled, friable silt loam

In places the upper layers are silt loam. In some areas the dark upper layers are more than 24 inches thick. In other areas thin layers of silty clay loam are within a depth of 60 inches.

Included with this soil in mapping are areas of Chequest, Olmitz, Tice, and Zook soils. These soils are commonly in narrow bands adjacent to the uplands. They have more clay and less sand than the Landes soil. Chequest and Zook soils are poorly drained, and Tice soils are somewhat poorly drained. Olmitz soils are gently sloping and moderately sloping. Included soils make up about 10 percent of the unit.

Important properties of the Landes soil—

Permeability: Moderately rapid
Surface runoff: Slow
Available water capacity: Moderate
Organic matter content: Moderately low
Shrink-swell potential: Low
Depth to the water table: 4 to 6 feet

Most areas are used for cultivated crops. A few areas are used for pasture and hay. This soil is suited to corn, soybeans, and grain sorghum. Because of the flooding, planting may be delayed in some years. In some years, however, the flooding is of such brief duration that water damage is not significant.

This soil is well suited to alsike clover, ladino clover, birdsfoot trefoil, bluegrass, red clover, orchardgrass, redtop, tall fescue, timothy, and switchgrass. Flooding is the main management concern. The species most suitable for planting are those that are deep rooted and resistant to flood damage. The flooding should be considered when the grazing system is designed or if hay production is planned.

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

This soil is not suitable for building site development or onsite waste disposal systems because of the flooding.

The land capability classification is IIIw. The woodland ordination symbol is 10A.

51—Chequest silty clay loam, frequently flooded. This nearly level, poorly drained soil is on the larger flood plains. Most areas are subject to flooding for brief periods. Individual areas are irregular in shape and range from about 10 to more than 100 acres in size.

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

Surface layer:
0 to 13 inches, very dark gray, friable silty clay loam

Subsoil:
13 to 60 inches, dark gray, mottled, firm silty clay loam

In places the surface layer is silt loam to a depth of 10 to 15 inches. In some areas the soil has less clay and is a lighter gray in the lower part. In other areas the subsoil has more clay and is lighter gray throughout. In some places the dark upper layers are more than 24 inches thick.

Included with this soil in mapping are small areas of Arbela soils adjacent to the uplands and some soils in small depressional areas. Arbela soils are silty in the upper part and are more clayey in the lower part than the Chequest soil. Also included are areas of Landes soils in narrow bands adjacent to some small channels. Included soils make up about 10 percent of the unit.

Important properties of the Chequest soil—

Permeability: Moderately slow
Surface runoff: Slow
Available water capacity: High
Organic matter content: Moderate
Shrink-swell potential: High
Depth to the water table: 1 to 3 feet

Most areas are used for cultivated crops. This soil is suitable for corn, soybeans, and grain sorghum. The flooding and wetness are the main management concerns. Planting may be delayed in some years. Shallow parallel surface ditches improve surface drainage in most areas. 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 cultivated areas. Tilling in the fall improves tilth in the surface layer and generally allows earlier seeding in the spring.

This soil is moderately suited to ladino clover, alsike clover, bluegrass, and birdsfoot trefoil. Species that are tolerant of flooding and wetness are best suited. The wetness and the flooding should be considered when the grazing system is designed or if hay production is planned.

This soil is suited to trees. The equipment limitation is a management concern. Equipment should be used only when the ground is dry or frozen.

This soil is not suitable for building site development or onsite waste disposal systems because of the flooding.

The land capability classification is IIIw. The woodland ordination symbol is 7W.

53B—Olmitz loam, 2 to 5 percent slopes. This moderately sloping, well drained soil is on foot slopes. Individual areas are somewhat long and narrow and range from about 5 to more than 30 acres in size.

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

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

Subsoil:
8 to 20 inches, black, friable clay loam
20 to 43 inches, very dark brown and dark grayish brown, firm clay loam
43 to 55 inches, dark grayish brown, mottled, firm clay loam

Substratum:
55 to 60 inches, brown, firm clay loam

In a few places the subsoil is grayer. In a few areas the dark upper layers are less than 24 inches thick.

Included with this soil in mapping are areas of Gara and Winnegan soils along the upper edge of the foot slopes on uplands. These soils are steeper than the Olmitz soil and have glacial pebbles. They make up about 10 percent of the unit.

Important properties of the Olmitz soil—

Permeability: Moderate
Surface runoff: Medium
Available water capacity: High
Organic matter content: Moderate
Shrink-swell potential: Moderate
Depth to the water table: More than 6 feet

Most areas are used for cultivated crops. A few areas are used for pasture and hay. This soil is suited to corn, soybeans, grain sorghum, and winter wheat. Diversions help to control erosion in cultivated areas. Contour farming, stripcropping, and a system of conservation tillage that leaves a protective cover of crop residue on the surface help to control erosion, maintain the content of organic matter, improve tilth, increase the rate of water infiltration, and maintain fertility. Most areas of this soil are too narrow to be terraced.

This soil is well suited to alfalfa, birdsfoot trefoil, ladino clover, red clover, orchardgrass, smooth bromegrass, tall fescue, timothy, big bluestem, indiangrass, and switchgrass. Erosion during seedbed preparation is the main management concern. It can be minimized by timely tillage and a quickly established ground cover.

This soil is suitable for building site development if foundations and footings are properly designed and constructed. Using adequately reinforced concrete and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing tile drains around the foundations and footings minimizes damage caused by wet, seepy areas, by poor surface drainage, or by gutter failure.

Septic tank absorption fields can be used for waste disposal if laterals are properly installed. The laterals should be long enough to compensate for the restricted permeability. Sewage lagoons can function adequately if the site can be leveled. Sealing the berms and bottom of the lagoons minimizes seepage.

This soil is suitable for local roads and streets. Strengthening the subgrade with crushed rock or other suitable material minimizes the damage caused by low strength. Constructing roadside ditches and installing culverts for drainage minimize the damage caused by shrinking and swelling, wetness, and frost action.

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

53C—Olmitz loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on foot slopes. Individual areas are somewhat long and narrow and range from about 5 to more than 30 acres in size.

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

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

Subsurface layer:
7 to 16 inches, very dark gray, friable loam
16 to 21 inches, very dark grayish brown, friable clay loam

Subsoil:
21 to 39 inches, dark brown, friable and firm clay loam
39 to 60 inches, dark brown, mottled, firm clay loam

In a few places the subsoil is grayer. In a few areas the dark upper layers are less than 24 inches thick.

Included with this soil in mapping are areas of Gara and Winnegan soils along the upper edge of the foot slopes adjacent to the uplands. These soils are steeper than the Olmitz soil and have dark upper layers that are less than 10 inches thick. They make up about 10 percent of the unit.

Important properties of the Olmitz soil—

Permeability: Moderate
Surface runoff: Medium
Available water capacity: High
Organic matter content: Moderate
Shrink-swell potential: Moderate
Depth to the water table: More than 6 feet

Most areas are used for cultivated crops. A few areas are used for pasture and hay. This soil is suited to corn, soybeans, grain sorghum, and winter wheat. Diversions help to control erosion in cultivated areas. Contour farming, stripcropping, and a system of conservation tillage that leaves a protective cover of crop residue on the surface help to control erosion, maintain the content of organic matter, improve tilth, increase the rate of water infiltration, and maintain fertility. Most areas of this soil are too narrow to be terraced.

This soil is well suited to alfalfa, birdsfoot trefoil, ladino clover, red clover, orchardgrass, smooth bromegrass, tall fescue, timothy, big bluestem, indiangrass, and switchgrass. Erosion during seedbed preparation is the main management concern. It can be minimized by timely tillage and a quickly established ground cover.

This soil is suitable for building site development if foundations and footings are properly designed and constructed. Using adequately reinforced concrete and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing tile drains around the foundations and footings minimizes the damage caused by wet, seepy areas, by poor surface drainage, or by gutter failure.

Septic tank absorption fields can be used for waste disposal if laterals are properly installed. The laterals should be long enough to compensate for the restricted permeability. Sewage lagoons can function adequately if the site can be leveled. Sealing the berms and bottom of the lagoons minimizes seepage.

This soil is suitable for local roads and streets. Strengthening the subgrade with crushed rock or other suitable material minimizes the damage caused by low strength. Constructing roadside ditches and installing culverts for drainage minimize the damage caused by shrinking and swelling and by frost action.

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

56A—Zook silty clay loam, frequently flooded, 0 to 2 percent slopes. This nearly level, poorly drained soil is on the larger flood plains. Most areas are subject to flooding for brief periods. Individual areas are irregular in shape and range from about 10 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 4 inches, black, friable silty clay loam

Subsurface layer:
4 to 13 inches, black, firm silty clay loam
13 to 36 inches, black and very dark gray, mottled, firm silty clay

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

In places the surface layer is silt loam to a depth of 8 to 15 inches. In some areas the soil has less clay or more clay in the lower part. In other areas the dark gray subsoil is at a depth of 10 to 20 inches.

Included with this soil in mapping are small areas of Arbela soils adjacent to the uplands. These soils are silty in the upper layers. They make up about 3 percent of the area.

Important properties of the Zook soil—

Permeability: Slow
Surface runoff: Slow
Available water capacity: High
Organic matter content: High
Shrink-swell potential: High
Seasonal high water table: At the surface to 2 feet below the surface

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, and grain sorghum. Wetness and the flooding are major management concerns. They may delay planting in some years. Shallow parallel surface ditches improve surface drainage in most areas. A system of conservation tillage that leaves a protective cover of crop residue on the surface maintains the content of organic matter, improves tilth, and increases the rate of water infiltration in cultivated areas. Tilling in the fall improves tilth in the surface layer (fig. 7) and generally allows earlier seeding in the spring.

This soil is moderately suited to ladino clover, alsike clover, bluegrass, and birdsfoot trefoil. Species that are tolerant of wetness and flooding are best suited. The wetness and the flooding should be considered when the grazing system is designed or if hay production is planned.

This soil is not suitable for building site development or onsite waste disposal systems because of the flooding.

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

Figure 7.—Fall tillage in an area of Zook silty clay loam, frequently flooded, 0 to 2 percent slopes. Winnegan loam, 9 to 14 percent slopes, eroded, is in the background.

56B—Zook silty clay loam, rarely flooded, 1 to 4 percent slopes. This very gently sloping and gently sloping, poorly drained soil is on flood plains along the smaller streams and in areas adjacent to the uplands along the larger streams. Most areas are subject to flooding for very brief periods. Individual areas are long and narrow and range from about 5 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 11 inches, very dark gray, friable silty clay loam

Subsoil:
11 to 30 inches, black, firm silty clay
30 to 53 inches, very dark gray, firm silty clay
53 to 60 inches, dark gray, mottled, firm silty clay loam

Included with this soil in mapping are small areas of Arbela soils adjacent to the uplands. These soils are silty in the upper layers. Also included are small areas of the loamy Landes soils adjacent to the channels. Included soils make up about 10 percent of the unit.

Important properties of the Zook soil—

Permeability: Slow
Surface runoff: Moderate
Available water capacity: High
Organic matter content: High
Shrink-swell potential: High
Seasonal high water table: At the surface to 2 feet below the surface

Most areas along the smaller streams are used for pasture, but some of the larger areas are used for cultivated crops. This soil is moderately well suited to reed canarygrass and moderately suited to ladino clover, alsike clover, bluegrass, and birdsfoot trefoil. The species that can withstand wetness grow best. The wetness is the main management concern. It should be considered when the grazing system is designed or if hay production is planned.

This soil is suitable for corn, soybeans, grain sorghum, and winter wheat. The wetness is the main management concern. It may delay planting in some years. A system of conservation tillage that leaves a protective cover of crop residue on the surface maintains the content of organic matter, improves tilth, and increases the rate of water infiltration in cultivated areas.

This soil is not suitable for building site development or onsite waste disposal systems because of the flooding.

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

57—Wabash silty clay, frequently flooded. This nearly level, poorly drained soil is on the larger flood plains. Most areas are subject to flooding for brief periods. Individual areas are irregular in shape and range from about 25 to more than 200 acres in size.

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

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

Subsurface layer:
8 to 21 inches, very dark gray, mottled, firm silty clay

Subsoil:
21 to 60 inches, very dark gray and dark gray, mottled, firm clay

In places the depth to the dark gray subsoil is less than 30 inches.

Included with this soil in mapping are some small areas of soils in depressions that are subject to ponding. These soils make up about 3 percent of the unit.

Important properties of the Wabash soil—

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

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, and grain sorghum. Wetness and the flooding are the major management concerns. Because of the very slow runoff rate and the poor internal drainage, it is difficult to remove excess water from cultivated fields. Shallow parallel surface ditches and land grading improve surface drainage. Proper management of crop residue maintains the content of organic matter, improves tilth, and increases the rate of water infiltration. Tilling in the fall improves tilth in the surface layer and generally allows earlier seeding in the spring.

This soil is moderately suited to alsike clover, ladino clover, bluegrass, and birdsfoot trefoil. Species that are tolerant of wetness and flooding are best suited. The wetness and the flooding should be considered when the grazing system is designed or if hay production is planned.

This soil is suited to trees. The equipment limitation, seedling mortality, and the windthrow hazard are the major management concerns. Equipment should be used only when the ground is dry or frozen. Reinforcement planting or planting container-grown nursery stock on ridges improves the seedling survival rate. The stands should be thinned less intensively and more frequently than the stands in areas where windthrow is less likely.

This soil is not suitable for building site development or onsite waste disposal systems because of the flooding.

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

58B—Vigar loam, 2 to 5 percent slopes. This moderately sloping, moderately well drained soil is on low toe slopes. Most areas are subject to flooding for very brief periods. Individual areas are irregular in shape and range from 5 to about 30 acres in size.

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

Surface layer:
0 to 13 inches, very dark grayish brown, very friable and friable loam

Subsoil:
13 to 22 inches, dark brown, firm clay loam
22 to 29 inches, dark yellowish brown, mottled, firm clay loam
29 to 40 inches, dark grayish brown and dark brown, mottled, firm clay loam
40 to 60 inches, mottled dark yellowish brown and grayish brown, firm clay loam

In a few places the soil has less sand. In some areas the soil has thicker dark upper layers.

Important soil properties—

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

Shrink-swell potential: Moderate
Depth to the water table: 2 to 3 feet

Most areas are used for cultivated crops. Some areas are used for pasture and hay. This soil is suited to corn, soybeans, grain sorghum, and winter wheat. Diversions help to control erosion in cultivated areas. Contour farming, stripcropping, and a system of conservation tillage that leaves a protective cover of crop residue on the surface help to control erosion, maintain the content of organic matter, improve tilth, increase the rate of water infiltration, and maintain fertility. Most areas of this soil are too narrow to be terraced.

This soil is well suited to ladino clover and moderately well suited to alsike clover, birdsfoot trefoil, crownvetch, lespedeza, bluegrass, tall fescue, timothy, big bluestem, indiangrass, and switchgrass. Erosion during seedbed preparation is the main management concern. It can be minimized by timely tillage and a quickly established ground cover.

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

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

59—Arbela silt loam, occasionally flooded. This nearly level, poorly drained soil is on high flood plains. Most areas are subject to flooding for brief periods. Individual areas are irregular in shape and range from about 10 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 7 inches, very dark gray, very friable silt loam

Subsurface layer:
7 to 13 inches, very dark gray and dark gray, friable silt loam

Subsoil:
13 to 31 inches, dark gray, firm silty clay loam
31 to 41 inches, dark gray, mottled, firm silty clay
41 to 60 inches, dark gray and grayish brown, mottled, firm clay loam

In places the dark upper layers are less than 10 inches thick. In some areas the subsoil has more clay. In a few other areas the subsoil has less clay.

Included with this soil in mapping are areas of Chequest, Tice, and Zook soils. Chequest and Zook soils are more clayey in the upper part than the Arbela soil. Also, they are closer to the stream channels. Tice soils have a thicker silty upper part than the Arbela soil and have less clay in the lower part. Included soils make up about 20 percent of the unit.

Important properties of the Arbela soil—

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

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, and grain sorghum. Wetness and the flooding are the main management concerns. They may delay planting in some years. Shallow parallel surface ditches improve surface drainage in most areas. A system of conservation tillage that leaves a protective cover of crop residue on the surface maintains the content of organic matter, improves tilth, and increases the rate of water infiltration in cultivated areas. In many areas installing diversions around the base of the adjacent uplands reduces the amount of surface water that flows onto this soil.

This soil is moderately suited to ladino clover, alsike clover, bluegrass, and birdsfoot trefoil. Species that are tolerant of wetness and flooding are best suited. The wetness and the flooding should be considered when the grazing system is designed or if hay production is planned.

This soil is not suitable for building site development or onsite waste disposal systems because of the flooding.

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

67—Tice silt loam, frequently flooded. This nearly level, somewhat poorly drained soil is on the medium or larger flood plains, commonly on alluvial fans where an upland drainageway flows out onto a larger flood plain. Most areas of this soil are subject to flooding for brief periods. Individual areas are relatively narrow and range from about 5 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 13 inches, very dark gray, friable silt loam

Subsoil:
13 to 24 inches, dark grayish brown, mottled, friable silt loam

Substratum:
24 to 60 inches, grayish brown, mottled, friable silt loam and silty clay loam

In places the lower part of the profile is browner. In a few areas the depth to stratified layers is less than 30 inches.

Included with this soil in mapping are areas of the well drained Landes soils adjacent to stream channels and areas of Chequest soils away from the stream channels. Chequest soils are more clayey than the Tice soil. Included soils make up about 15 percent of the unit.

Important properties of the Tice soil—

Permeability: Moderate
Surface runoff: Slow
Available water capacity: High
Organic matter content: Moderate
Shrink-swell potential: Moderate
Depth to the water table: 1.5 to 3.0 feet

Most areas are used for cultivated crops. A few areas are used for pasture and hay. This soil is suited to corn, soybeans, and grain sorghum, but damage caused by wetness and flooding is common. In some years, however, the flooding is of such brief duration that water damage is not significant. Most areas of this soil are too narrow to be managed separately from the soils on the adjacent uplands or high flood plains. In some of the wider areas, installing diversions at the base of the slope minimizes the amount of runoff water from the upland. A system of conservation tillage that leaves a protective cover of crop residue on the surface maintains the content of organic matter, improves tilth, and increases the rate of water infiltration.

This soil is moderately well suited to alsike clover, birdsfoot trefoil, crownvetch, ladino clover, lespedeza, red clover, bluegrass, redtop, tall fescue, timothy, and switchgrass. The species that can withstand flooding are the most suitable. The flooding is the main management concern. It should be considered when the grazing system is designed or if hay production is planned.

This soil is suited to trees. A few areas on narrow flood plains are forested. No major limitations or hazards affect planting or harvesting.

This soil is not suitable for building site development or onsite waste disposal systems because of the flooding.

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

71D—Lenzburg clay loam, 2 to 14 percent slopes. This gently sloping to strongly sloping, well drained soil consists of areas of mine spoil in the uplands. Individual areas are irregular in shape 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 4 inches, dark yellowish brown, friable clay loam

Substratum:
4 to 56 inches, layered dark yellowish brown and dark grayish brown, mottled, firm clay loam
56 to 60 inches, yellowish brown, mottled, firm clay loam

Important soil properties—

Permeability: Moderately slow
Surface runoff: Rapid
Available water capacity: Moderate
Organic matter content: Very low
Shrink-swell potential: Moderate
Depth to the water table: More than 6 feet

Most areas are used for pasture and hay or for trees. Some areas support brush. This soil generally is not used for cultivated crops because of uneven slopes, very low fertility, and, in some places, compacted zones near the surface.

This soil is moderately well suited to crownvetch, lespedeza, tall fescue, big bluestem, switchgrass, and indiangrass. The more shallow rooted species grow best in the reshaped areas. Preparing a good seedbed may be difficult unless moisture conditions are optimum. If possible, a good cover of vegetation should be established before the end of the growing season.

Trees can be grown in areas of this soil. Suitable species include black locust and eastern white pine. Because areas of this soil are different from natural landscapes, special techniques may be required for seeding and planting. Also, because of the irregular slopes, special erosion-control measures may be needed.

This soil is suitable for building site development if the site has been leveled and reshaped. If possible, 1 or 2 years should be allowed between site preparation and construction. Proper design and construction of footings and foundations is important. Using adequately reinforced concrete and backfilling with sand and gravel minimize the damage caused by shrinking and swelling. Installing tile drains around the foundations and footings minimizes the damage caused by excessive wetness.

This soil generally is not used for conventional septic tank absorption fields because of the restricted permeability. Properly constructed sewage lagoons can function adequately if the site can be leveled.

This soil is suitable for local roads and streets. Strengthening the subgrade with crushed rock or other suitable material minimizes the damage caused by low strength. Constructing roadside ditches and installing culverts for drainage minimize the damage caused by shrinking and swelling and by frost action.

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

71F—Lenzburg clay loam, 14 to 45 percent slopes. This moderately steep to very steep, well drained soil consists of areas of mine spoil in the uplands. Individual areas are irregular in shape 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 5 inches, yellowish brown, friable clay loam

Substratum:
5 to 60 inches, multicolored, firm clay loam

Important soil properties—

Permeability: Moderately slow
Surface runoff: Very rapid
Available water capacity: Moderate
Organic matter content: Very low
Shrink-swell potential: Moderate
Depth to the water table: More than 6 feet

Most areas are used for pasture and hay or for trees. Some areas support brush. This soil is not suited to cultivated crops because of uneven slopes, very low fertility, and, in some places, compacted zones near the surface.

This soil is moderately suited to lespedeza, tall fescue, red fescue, big bluestem, switchgrass, and indiangrass. The more shallow rooted species grow best in the reshaped areas. Preparing a good seedbed may be difficult unless moisture conditions are optimum. A good cover of vegetation should be established before the end of the growing season.

Trees can be grown in areas that have not been smoothed or leveled since the spoil was deposited. Suitable species include black locust and eastern white pine. The equipment limitation and the hazard of erosion are the main management concerns. Because areas of this soil are different from natural landscapes, special techniques may be required for seeding and planting. Also, because of the irregular slopes, special erosion-control measures may be needed.

This soil generally is not used for building site development because of the slope. Overcoming the slope is generally not economically feasible.

The land capability classification is VIIe. The woodland ordination symbol is 5R.

74E2—Reger fine sandy loam, 14 to 20 percent slopes, eroded. This moderately steep, moderately deep, well drained soil is on back slopes along upland drainageways. Erosion has removed some of the original surface layer. The remaining surface soil has been mixed with the subsurface layer and the upper part of the subsoil. Individual areas are elongated and range from 10 to 50 acres in size.

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

Surface layer:
0 to 4 inches, brown, friable fine sandy loam

Subsoil:
4 to 21 inches, yellowish brown, friable fine sandy loam

Bedrock:
21 to 60 inches, soft, interbedded sandstone and siltstone

Included with this soil in mapping are areas of the somewhat poorly drained Gorin soils on narrow ridgetops and the moderately well drained Winnegan soils in narrow bands along the upper edge of the mapped areas. Also included, mainly in areas south of Highway 6 along Locust Creek, are soils that have more clay and less sand than the Reger soil. Included soils make up about 15 percent of the unit.

Important properties of the Reger soil—

Permeability: Moderately slow
Surface runoff: Rapid
Available water capacity: Very low
Organic matter content: Low
Shrink-swell potential: Low
Depth to the water table: More than 6 feet

Most areas are used for pasture or timber. This soil is unsuited to cultivated crops and generally unsuited to pasture because of droughtiness and a severe hazard of erosion. If the soil is used for pasture, it is best suited to birdsfoot trefoil, lespedeza, orchardgrass, tall fescue, big bluestem, indiangrass, and little bluestem. Shallow-rooted species that tolerate droughtiness should be selected. Erosion during seedbed preparation is the main management concern. It can be minimized by timely tillage or no-till seeding and a quickly established ground cover. Erosion can be particularly severe if the stands of grasses are depleted by overgrazing. Brush management generally is needed.

This soil is suited to trees. Large areas support native hardwoods. The equipment limitation, the hazard of erosion, and seedling mortality are management concerns. Establishing logging roads and skid trails on the contour helps to overcome the steepness and length of the slopes. Constructing water breaks on haul roads and seeding disturbed areas after harvesting help to control erosion. Because of the slope, the safe use of equipment is a concern. In some areas the logs should be yarded uphill to logging roads or skid trails. Reinforcement planting may be needed to achieve adequate stands. Most existing stands can benefit from selective cutting and thinning of undesirable trees.

This soil generally is not used for building site development because of the slope. Overcoming the slope is generally not economically feasible.

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

74F—Reger very fine sandy loam, 20 to 45 percent slopes. This steep and very steep, moderately deep, well drained soil is on back slopes along upland drainageways. Individual areas are elongated and range from about 15 to more than 120 acres in size.

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

Surface layer:
1 inch to 0, decaying leaves and twigs
0 to 3 inches, dark brown, very friable very fine sandy loam

Subsurface layer:
3 to 7 inches, yellowish brown, friable very fine sandy loam

Subsoil:
7 to 27 inches, yellowish brown, friable and firm very fine sandy loam

Bedrock:
27 to 60 inches, soft, interbedded sandstone and siltstone

Included with this soil in mapping are the moderately well drained Winnegan soils in narrow bands along the upper edge of the mapped areas. Also included, mainly in areas south of Highway 6 along Locust Creek, are soils that have more clay and less sand than the Reger soil. Included soils make up about 15 percent of the unit. In some areas sandstone ledge rock outcrops make up about 5 percent of the unit.

Important properties of the Reger soil—

Permeability: Moderately slow
Surface runoff: Very rapid
Available water capacity: Very low
Organic matter content: Moderately low
Shrink-swell potential: Low
Depth to the water table: More than 6 feet

Nearly all areas support native timber. This soil is not suited to cultivated crops because of the slope, a severe hazard of erosion, and the areas of rock outcrop. It is best suited to trees. The equipment limitation, the hazard of erosion, and seedling mortality are the major management concerns. Establishing logging roads and skid trails on the contour helps to overcome the steepness and length of the slopes. Constructing water breaks on haul roads and seeding disturbed areas after harvesting help to control erosion. Because of the slope, the safe use of equipment is a concern. In some areas the logs should be yarded uphill to logging roads or skid trails. Reinforcement planting may be needed to achieve adequate stands. Most existing stands can benefit from selective cutting and thinning of undesirable trees.

This soil generally is not used for building site development because of the slope. Overcoming the slope is generally not economically feasible.

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

Prime Farmland

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

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban or built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal expenditure of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Natural Resources Conservation Service.

About 27,500 acres in Sullivan County, or about 6.6 percent of the total acreage, meets the requirements for prime farmland. An additional 66,960 acres, or about 16 percent of the total acreage, meets the requirements if the soil has been drained or is not frequently flooded during the growing season, or both. The most extensive areas of prime farmland are on upland ridges near Green City, on many of the upland ridges in the southwestern part of the county, and on the flood plains throughout the county. This prime farmland is used mainly for cultivated crops, pasture, or hay. Some areas on the flood plains support timber.

The map units in the survey area that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

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 in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

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

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

Crops and Pasture

Stuart Lawson, 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.

Approximately 54 percent of the acreage in Sullivan County is cropland. The principal cultivated crops are soybeans, corn, winter wheat, and grain sorghum. Much of the rest of the acreage is used for pasture and hay.

The major management needs on the cropland and pasture in the survey area are measures that control water erosion and flooding, reduce wetness, and help to maintain tilth. A combination of measures is needed in many places.

Water erosion is a major problem on most of the upland soils in Sullivan County. It is a hazard in all cultivated areas where the slope is more than 2 percent. In the steeper areas where the grassland has been converted to cropland, a rapid surface runoff rate increases the potential for severe erosion. These areas are better suited to pasture and hay than to cultivated crops. The soils in the survey area that are best suited to cultivated crops are those on stream terraces and flood plains that are not frequently flooded and those in upland areas that have slopes of less than 5 percent. Erosion-control measures may also be needed in these areas, particularly in the uplands.

Loss of the surface layer through erosion is damaging for several reasons. Productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Erosion results in a deterioration of soil tilth, reduces the available water capacity, decreases the content of organic matter, and reduces the seedling survival rate. Erosion on farmland results in the sedimentation of streams, lakes, and ponds. Erosion control minimizes this pollution and improves the quality of water for municipal and recreational uses and for fish and wildlife. Sediment resulting from erosion can fill roadside ditches and cover rural roads. Cleaning and clearing these areas can be costly.

A number of conservation practices, used alone or in combinations, can minimize soil loss. These practices provide a protective plant cover, reduce the runoff rate, and increase the rate of water infiltration.

Contour stripcropping is an important conservation practice on steep or complex slopes, where the cost of constructing terraces is prohibitive. Strips are planted with grass sod or a close-grown crop that produces a high percentage of ground cover. This ground cover protects the soil from the impact of raindrops. Planting the grass strips on the contour reduces the velocity of the runoff water. Surface runoff moves through the grass strips slowly enough to allow the suspended soil particles to settle out. These grass strips are cut for hay and used for livestock feed.

Terraces reduce the length of slopes and thus reduce the runoff rate and the hazard of erosion. They are most practical and economical on long, smooth upland slopes of less than 8 percent. Terraces with tile outlets store runoff water after rainfall and then allow the water to drain off slowly through the underground tile. Conventional broad-base terraces reduce the length of slopes. Because their construction increases the gradient of the slopes, however, further erosion-control measures, such as crop residue management, are needed. Narrow-based terraces and terraces that have steep, grassed back slopes reduce both the length and the steepness of the slopes. Terraces that have grassed back slopes are normally used on the steeper slopes, but a combination of terrace types can be constructed on an undulating landscape or in areas of diversified topography. As with other conservation practices, additional erosion-control measures may be needed, such as no-till farming, minimum tillage, and crop rotations that include grasses and legumes. In areas where a clayey subsoil is exposed during terracing, increased amounts of lime and fertilizer may be necessary. Planting a drilled crop, such as wheat, increases the content of organic matter in the surface layer.

On some relatively stable landscapes in the southwestern and northeastern parts of the county, a cropping system that keeps a cover of plants or crop residue on the surface can minimize the hazard of erosion. Minimum tillage or no-till farming generally is sufficient in these areas. A crop rotation that includes grasses and legumes improves tilth, provides nitrogen for the subsequent crop, and helps to control erosion.

Flood control is a management concern in areas of bottom land. Levees have been used extensively to control flooding along the streams in some parts of the county. Flood control has increased the acreage of bottom-land soils that meets the requirements for prime farmland.

Surface drainage is a management concern on several bottom-land soils in the county, such as Wabash, Tice, Chequest, and Arbela soils and some Zook soils. Drainage systems normally are not used on upland soils. Shallow ditches, called "W" ditches, and land grading are commonly used in areas of bottom land if the wet areas are several acres or larger in size and if suitable outlets are available.

Soil tilth is an important factor influencing the germination of seeds and the infiltration of water. The uneroded upland soils that are used for crops have a dark surface layer of silt loam or loam that has a moderate content of organic matter. Generally, tillage and compaction weaken the structure of soils that have a surface layer of silt loam. Periods of intense rainfall can result in the formation of a crust on the surface. The crust is hard when dry, and it reduces the rate of water infiltration and increases the runoff rate. Regular additions of crop residue, manure, and other organic material improve soil structure and tilth.

Because the eroded upland soils normally have a higher content of clay in the surface layer than the uneroded soils, the eroded soils have poorer tilth and a slower infiltration rate and lose more water through surface runoff. Effective conservation practices are needed on these eroded soils.

In areas where terraces are built, a common practice is to construct the terrace berm almost entirely from topsoil. This practice generally leaves the terrace channel with a high clay content, poor tilth, low fertility, and the lowest productivity in the entire field. A more effective procedure is to move the topsoil into windrows or piles with a dozer or a scraper, build the terrace berm using the clayey subsoil material, and then spread the topsoil over both the berm and the terrace channel. This method requires more time and expense but is generally more cost effective in the long run.

In some years severely eroded soils and nearly level, poorly drained soils stay wet until late in the spring. Tilling these soils when they are too wet results in the formation of clods. Because of the cloddiness, preparing a good seedbed is difficult. This problem can be minimized on soils that are not subject to erosion by tilling in the fall.

The soils in the county are used largely for row crops, but they are equally well suited to close-growing crops, such as winter wheat, or to legumes grown for hay, such as alfalfa, ladino clover, and red clover. These crops can be grown either in pure stands or in combination with cool-season grasses, such as bromegrass, orchardgrass, timothy, and tall fescue. If properly managed, birdsfoot trefoil yields quality forage for many years. It is more drought resistant than red clover, is less sensitive to poor drainage than alfalfa, and does not cause bloating in livestock.

Good pasture management is a very important aspect of soil conservation. Overgrazing can increase the hazard of sheet and gully erosion. Rotation grazing and restricted grazing during wet periods increase the rate of water infiltration, reduce the runoff rate, and help to control erosion.

Maximum forage production can be obtained by a rotation system that includes both cool-season grasses and warm-season grasses. This system allows livestock to be pastured on the cool-season grasses for about 9 months per year. During the hot summer months, cool-season grasses are dormant and the warm-season grasses grow well. The quality of the midsummer pasture compensates for the limited number of months that the warm-season grasses are productive. The management needs for establishing and grazing warm-season grasses, such as big bluestem, switchgrass, and indiangrass, are different from those for cool-season grasses. Prescribed burning may be needed to control undesirable vegetation, improve forage quality, and increase the quantity of warm-season grasses. Burning generally is needed no more than once every 3 to 5 years. Before proper grazing management practices can be applied, fields of warm-season grasses should be separated from fields of cool-season grasses.

The upland soils that are poorly suited to row crop production because of the slope and the hazard of erosion are well suited to the production of grasses and legumes. Alfalfa stands are maintained for the longest period on the moderately well drained Gara and Winnegan soils. Other legumes and grasses grow well on any of the upland soils, except for the severely eroded soils, which tend to be droughty and low in fertility. In areas of the severely eroded soils, intensive management is required to obtain an adequate stand or produce an acceptable amount of forage.

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 *(20)*. Only class and subclass are used in this survey.

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

Class I soils have few limitations that restrict their use.

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

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

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

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

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

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

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

There are no class I, class V, or class VIII soils in Sullivan County.

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

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

The capability classification of the map units 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.

In 1986, approximately 47,951 acres in Sullivan County, or 11 percent of the total area, was forested *(7)*. Woodland tracts in the uplands are primarily small, private holdings of 10 to 50 acres and are essentially unmanaged. On the flood plains, forested areas are in long, narrow bands bordering streams and rivers. Tree species and growth rates in the county vary, depending on site conditions, soil types, and past management.

The soil 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, texture, structure, and soil depth. Trees grow best on soils whose properties do not fall into the extreme range and that have an effective rooting depth of more than 40 inches.

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. North- and east-facing slopes and low positions on the slope are generally the best upland sites for tree growth because they are cooler and have better moisture conditions than south- and west-facing slopes. The most productive soils on bottom land are generally deep, moderately well drained, and only occasionally flooded.

Management practices can influence woodland productivity. They can minimize the factors that reduce productivity. These practices include thinning young stands, harvesting mature trees, preventing fire, and eliminating the use of woodland for grazing. Fire and grazing have a very negative impact on forest growth and quality. Forest fires are no longer a major problem in the county, but about 50 percent of the woodland is used for grazing. Grazing destroys the leaf layer, compacts the soil, and destroys or damages seedlings. Woodland sites that are not used for grazing and that are protected from fire have the highest potential for production.

The largest acreages of upland forests are in areas of Winnegan, Keswick, and Gorin soils in the northeastern and central parts of the county. Typical species are white oak, northern red oak, black oak, and sugar maple. Northern red oak and black oak are dominant on the moderately deep Reger soils. Undisturbed, forested Winnegan soils are very productive.

Along the major watercourses in the county, Landes, Chequest, and Tice soils support bottom-land hardwoods that are adapted to saturated or flooded soil conditions. Most areas of these soils have been cleared for crop production. The remaining wooded areas typically support silver maple, hackberry, American elm, swamp white oak, sycamore, cottonwood, and pin oak. Bur oak, shellbark hickory, and walnut are common along the smaller streams and on the higher terraces of the major streams. A high potential for excellent forest growth exists on these sites.

Armstrong, Pershing, and Gara soils are primarily transitional soils that formed under both prairie vegetation and woodland. The successful establishment of trees on these soils requires extra care and maintenance.

Plantings of adapted species for Christmas trees, nut trees, and fuelwood trees can be very successful. Christmas tree plantings can be established on any soil that is not poorly drained or very poorly drained. Species of trees best suited to Sullivan County are Scotch pine, Austrian pine, white pine, and Douglas-fir. Nut trees, such as black walnut, are best suited to deep, medium textured, moderately well drained or well drained soils, such as Gara soils in the uplands and Landes soils on the flood plains. Other soils also are suited to these species but may be less productive. Plantings of fast-growing trees for fuelwood can be successful in Sullivan County. The species most suited to this purpose are green ash, black locust, sycamore, 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 *N*, snowpack. The letter *A* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: R, X, W, T, D, C, S, F, and N.

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

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

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

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

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

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

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

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

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

Windbreaks and Environmental Plantings

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

Living plants play an important role in supporting our life and improving its condition. When properly used and maintained, plants help to provide positive solutions to many problems that exist in our contemporary environment. In Sullivan County, windbreaks and environmental plantings can be utilized for a variety of engineering, climatological, and esthetic purposes.

When farmstead, feedlot, and field windbreaks are being planned, important factors include design and layout, species selection, site preparation, seedling handling, weed management, irrigation, and protection from diseases, insects, and livestock.

Farmstead windbreaks make the farmstead area a more comfortable place, reduce energy costs, increase garden and fruit tree yields, enhance wildlife populations, buffer noises, and raise property values *(4)*. Feedlot windbreaks can be used to protect livestock from wind and snow. Windbreaks significantly reduce calf losses, make feeding operations easier, and enable livestock to maintain better weight with less feed.

Farmstead and feedlot windbreaks are generally three or more rows wide and are dense. At least two of the rows should be coniferous trees. The windbreaks should be planted on the windward side of the area and, as much as possible, perpendicular to the prevailing wind. Well designed farmstead and feedlot windbreaks are needed in many areas of Sullivan County, but especially in open areas of prairie-woodland transition soils, such as Gara, Armstrong, Adco, Pershing, and Belinda soils.

Field windbreaks or shelterbelts are designed to protect field crops and bare soil from the effects of strong winds. Field windbreaks reduce soil losses, increase crop yields, retard the spread of weeds between fields, and enhance habitat for wildlife *(13)*. They should be carefully planned. Field boundaries, power lines, and roads should be considered in determining the location of field windbreaks. The windbreaks should be oriented at right angles to the prevailing wind. The typical field windbreak system consists of a series of single rows of trees or shrubs. Field windbreaks can be established throughout Sullivan County. They are most needed in areas of the Armstrong-Pershing-Gara association, which is described under the heading "General Soil Map Units."

Environmental plantings can be used for beautification, visual screens, and control of acoustical, pollution, and climatological problems around buildings. Plants having height, shape, form, color, and texture characteristics that are compatible with the surrounding area, structures, and desired use should be selected *(16)*. Trees and shrubs are easy to establish throughout most of the county if site preparation is adequate and if weeds and other competing plants are controlled.

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

Recreation

Robert D. Miller, wildlife services biologist, Missouri Department of Conservation, helped prepare this section.

Outdoor recreation is an important segment of community development. Skillful planning and management of the available resources, including plants, soils, water, and wildlife, is necessary for the best utilization of recreational areas.

Sullivan County has many natural resources that offer a range of opportunities for development of outdoor recreational areas. State-owned wildlife recreational areas and city reservoirs provide hunting, fishing, swimming, camping, and picnicking opportunities. Such areas include Elmwood Lake (Milan City Reservoir); Locust Creek Wildlife Area; Rocky Ford Access, on Locust Creek; Union Ridge State Forest, north of Greencastle; and Sears Lake, near Milan.

Many of the soils in the county are suitable for the construction of ponds and lakes. Cleared areas and wooded areas are intermingled throughout much of the county. These conditions provide the basis for a variety of scenic recreational developments. Small lakes, camping areas, picnic areas, riding trails, nature trails, golf courses, and hunting areas are examples of recreational facilities that can be built and developed in various parts of the county.

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

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils 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.

This information is not intended to eliminate the need for onsite investigation for specific uses but rather to serve as a guide for screening sites for planning and more detailed investigation.

Wildlife Habitat

Tom Quigley, conservation agent, Missouri Department of Conservation, helped prepare this section.

Sullivan County is one of the nine counties that make up the Green Hills Resource Conservation Area. This area lies within the Iowa-Missouri Heavy Glacial Till Region. The diverse land types in the county provide good habitat for many wildlife species.

The primary big game species in the county are whitetail deer and eastern wild turkey. Both species can be found throughout the county, but populations are higher in the northeastern part of the county and along the Locust Creek drainage area. These areas have more woodland than other parts of the county.

Small game species include ring-neck pheasant, bobwhite quail, cottontail rabbits, red squirrels, and gray squirrels. Populations of these species fluctuate, depending on the severity of weather conditions. In areas where habitat is good, the fluctuations are minor and populations are stable.

Ruffed grouse were reintroduced in the county in

1985, when birds received from Indiana were released in the northeastern part of the survey area. The birds appear to be reproducing in the county.

Ring-neck pheasant are found in the northwestern and north-central parts of the county. Pheasant populations are increasing and are expanding southward. Parts of the county are open to pheasant hunting. Quail, rabbits, and squirrels inhabit areas throughout the county. Populations of these species vary, depending on habitat conditions.

Most of the furbearers that inhabit Missouri are common in Sullivan County. Opossums, raccoon, mink, muskrat, beaver, skunks, coyote, red fox, and gray fox are throughout the county. Bobcats are rarely seen, although an occasional sighting is reported.

Most nongame species of songbirds, small mammals, reptiles, and amphibians common to Missouri inhabit the survey area. Waterfowl use the many farm ponds and city water supply reservoirs during their migration through the area. Wood ducks nest along the streams, and a few mallards and greenwing teal nest on farm ponds. A small population of giant Canada geese nest on farm ponds in the southeastern part of the county.

Three public use areas in the county are owned by the Department of Conservation. The Locust Creek Wildlife Area is about 3,000 acres in size and is southwest of Milan. Sears Community Lake is a 19-acre lake located on 94 acres northeast of Milan. Union Ridge State Forest is 8,377 acres in size. It is in Sullivan, Putnam, and Adair Counties. About half of the acreage of this forest is in Sullivan County, north of Greencastle. All of the areas are open to the public for hunting, fishing, hiking, or other outdoor activities.

Fishing opportunities in the county are numerous. There are many farm ponds, and most have been stocked with fish. A 190-acre water supply lake is north of Milan, and two smaller city reservoirs are in the county. Green City has a 60-acre water supply lake. These lakes are open to the public for fishing. They are stocked with largemouth bass, bluegill, channel catfish, and crappie and are managed for fishing by the Department of Conservation.

Several small streams bisect the county, and most contain fish. The largest of the streams is Locust Creek. Locust Creek is one of the few streams in northern Missouri that are still partially unchannelized. Channel catfish, flatheads, carp, freshwater drum, and crappie inhabit this creek. The portion of the stream extending south of State Route E to the county line is floatable during the spring and early summer.

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

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

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

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

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

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flooding, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are tall fescue, orchardgrass, bromegrass, clover, alfalfa, indiangrass, switchgrass, birdsfoot 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, ragweed, beggarweed, foxtail, and partridge pea.

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

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

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, rushes, sedges, and reeds.

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

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

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

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

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

Engineering

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

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

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

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

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

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

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

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

Building Site Development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

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

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

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

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

Sanitary Facilities

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

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

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

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

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

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

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

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

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

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

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

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

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

Construction Materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

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

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

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

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

Sand and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

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

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

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

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

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

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

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

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

Water Management

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

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

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

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

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

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

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

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

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

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

Soil Properties

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

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

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

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

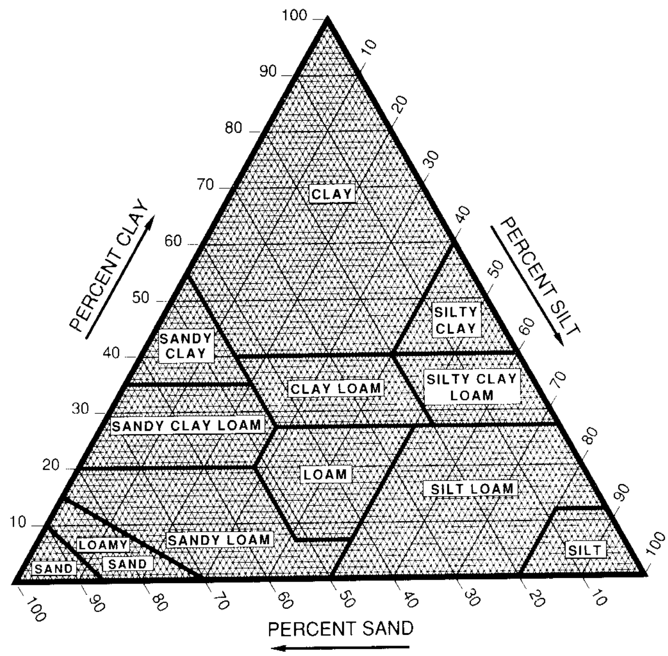

Figure 8.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Engineering Index Properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

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

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 8). "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 *(3)* and the system adopted by the American Association of State Highway and Transportation Officials *(2)*.

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 content of clay of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

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

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at ⅓-bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

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

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

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

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

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

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

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

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

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

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

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

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

4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

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

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

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

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

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

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

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

Soil and Water Features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

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

The four hydrologic soil groups are:

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

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

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

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

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

Flooding, the temporary inundation of an area, is caused by overflowing streams 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. Only saturated zones within a depth of about 6 feet are indicated.

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

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

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

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

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

For concrete, the risk of corrosion also is 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 *(21)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

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

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

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

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. An example is Aquollic 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 fine, montmorillonitic, mesic Aquollic 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" *(22)*. Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" *(21)*. 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."

Adco Series

The Adco series consists of very deep, somewhat poorly drained, very slowly permeable soils on uplands. These soils formed in loess. Slopes range from 1 to 5 percent.

Typical pedon of Adco silt loam, 1 to 5 percent slopes, 900 feet west and 100 feet north of the southeast corner of sec. 17, T. 63 N., R. 18 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; mixed with grayish brown (10YR 5/2) fragments (E); weak thin platy structure parting to moderate very fine granular; friable; many fine roots; slightly acid; abrupt wavy boundary.

E—8 to 13 inches; grayish brown (10YR 5/2) silty clay loam; few medium distinct dark yellowish brown (10YR 4/4) mottles; weak medium platy structure parting to moderate very fine granular; friable; common fine roots; few fine concretions of iron and manganese; moderately acid; abrupt smooth boundary.

Bt1—13 to 21 inches; dark grayish brown (10YR 4/2) silty clay; many medium faint dark brown (10YR 4/3) and common fine faint grayish brown (10YR 5/2) mottles; moderate very fine subangular blocky structure; firm; few fine roots; many prominent clay films on faces of peds; few fine concretions of iron and manganese; moderately acid; clear smooth boundary.

Bt2—21 to 27 inches; brown (10YR 5/3) silty clay; few fine faint dark yellowish brown (10YR 4/4) and few medium faint light brownish gray (10YR 6/2) mottles; moderate fine subangular blocky structure; firm; few fine roots; many prominent clay films on faces of peds; slightly acid; clear smooth boundary.

Btg—27 to 44 inches; light brownish gray (10YR 6/2) silty clay loam; few medium prominent dark brown (7.5YR 4/4) and common fine distinct dark brown (10YR 4/3) mottles; moderate fine subangular blocky structure; firm; few fine roots; common faint clay films on faces of peds; common fine iron and manganese masses; slightly acid; gradual smooth boundary.

BCg—44 to 53 inches; light brownish gray (2.5Y 6/2) silty clay loam; common medium prominent dark yellowish brown (10YR 4/4) and few medium prominent yellowish brown (10YR 5/4) mottles; moderate medium prismatic structure parting to weak fine subangular blocky; firm; many medium iron and manganese masses in the upper part; slightly acid; gradual smooth boundary.

Cg—53 to 60 inches; grayish brown (10YR 5/2) silty clay loam; many coarse distinct dark yellowish brown (10YR 4/4) mottles; weak medium prismatic structure; firm; common fine iron and manganese masses; neutral.

The A horizon has chroma of 1 or 2. The E horizon has value of 4 or 5. The Bt horizon has hue of 7.5YR or 10YR and chroma of 2 to 4. It has mottles with hue of 7.5YR or 10YR and chroma of 2 to 4. It is silty clay or silty clay loam. The Btg horizon has hue of 10YR or 2.5Y and value of 4 to 6. It is silty clay loam or silty clay.

Arbela Series

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

Typical pedon of Arbela silt loam, occasionally flooded, 150 feet west and 200 feet south of the northeast corner of sec. 10, T. 62 N., R. 22 W.

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

A—7 to 10 inches; very dark gray (10YR 3/1) silt loam, grayish brown (10YR 5/2) dry; moderate very fine granular structure; friable; few fine roots; few distinct light gray (10YR 7/2) silt coatings; neutral; clear smooth boundary.

E—10 to 13 inches; dark gray (10YR 4/1) silt loam; moderate thin platy structure; friable; few fine roots; common distinct light gray (10YR 7/1) silt coatings; slightly acid; abrupt smooth boundary.

Btg1—13 to 31 inches; dark gray (10YR 4/1) silty clay loam; moderate fine subangular blocky structure; firm; few very fine and fine roots; many prominent clay films on faces of peds; moderately acid; gradual smooth boundary.

Btg2—31 to 41 inches; dark gray (10YR 4/1) silty clay; common fine faint dark grayish brown (10YR 4/2) mottles; moderate fine subangular blocky structure; firm; many distinct clay films on faces of peds; few fine concretions and masses of iron and manganese; about 5 percent fine sand; moderately acid; gradual smooth boundary.

Btg3—41 to 52 inches; dark gray (10YR 4/1) silty clay loam; common fine distinct dark brown (10YR 4/3) mottles; moderate medium prismatic structure parting to moderate fine subangular blocky; firm; common distinct clay films on faces of peds; few fine concretions of iron and manganese; about 15 percent fine sand; moderately acid; gradual smooth boundary.

BCg—52 to 60 inches; dark gray (10YR 4/1) and grayish brown (10YR 5/2) clay loam; common fine prominent dark yellowish brown (10YR 4/6) mottles; weak medium prismatic structure; firm; prominent clay films in root channels or in pores; few fine concretions of iron and manganese; moderately acid.

The A horizon has chroma of 1 or 2. The B horizon has value of 4 or 5 and chroma of 1 or 2. The content of sand averages more than 5 percent in the control section.

Armstrong Series

The Armstrong series consists of very deep, somewhat poorly drained, slowly permeable soils on uplands. These soils formed in pedisediments and in the underlying paleosol weathered from glacial till. Slopes range from 2 to 14 percent.

Typical pedon of Armstrong clay loam, 5 to 9 percent slopes, eroded, 1,550 feet north and 1,875 feet west of the southeast corner of sec. 32, T. 61 N., R. 21 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) clay loam, grayish brown (10YR 5/2) dry; commonly mixed with dark brown (10YR 4/3) subsoil material; moderate very fine granular structure; friable; many fine and medium roots; moderately acid; clear wavy boundary.

Bt1—8 to 13 inches; dark brown (10YR 4/3) clay loam; few fine distinct dark brown (7.5YR 4/4) mottles; moderate very fine subangular blocky structure; friable; common fine and medium roots; many prominent clay films on faces of peds; common organic coatings in the upper part; moderately acid; clear smooth boundary.

2Bt2—13 to 20 inches; brown (10YR 5/3) clay; common fine faint light brownish gray (10YR 6/2) and common fine prominent red (2.5YR 4/6) and yellowish red (5YR 4/6) mottles; moderate very fine and fine subangular blocky structure; firm; common fine and medium roots; many prominent clay films on faces of peds; common medium concretions of iron and manganese; about 1 percent gravel; slightly acid; gradual smooth boundary.

2Bt3—20 to 27 inches; brown (10YR 5/3) clay; many medium faint light brownish gray (10YR 6/2), common medium prominent yellowish red (5YR 5/6), and common medium faint yellowish brown (10YR 5/4) mottles; moderate fine subangular blocky structure; firm; few fine roots; many distinct clay films on faces of peds; common fine and medium concretions of iron and manganese; about 1 percent gravel; slightly acid; gradual smooth boundary.

2Bt4—27 to 43 inches; yellowish brown (10YR 5/4) clay loam; common coarse distinct light brownish gray (10YR 6/2) and yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to moderate fine subangular blocky; firm; few fine roots; common faint clay films on faces of peds; common medium concretions of iron and manganese; about 1 percent gravel; slightly acid; diffuse smooth boundary.

2Bk1—43 to 57 inches; light yellowish brown (10YR 5/4) clay loam; common medium prominent yellowish brown (10YR 5/8) and common medium distinct light brownish gray (10YR 6/2) mottles; moderate medium prismatic structure; firm; few fine roots; common fine and medium masses of carbonate and few fine masses of iron and manganese; strong effervescence; about 2 percent gravel; slightly alkaline; gradual smooth boundary.

2Bk2—57 to 60 inches; yellowish brown (10YR 5/4) clay loam; few medium distinct yellowish brown (10YR 5/6) and light brownish gray (10YR 6/2) mottles; massive; firm; common fine and medium masses of carbonate and few fine concretions of iron; about 2 percent gravel; strong effervescence; slightly alkaline.

The Ap horizon has chroma of 1 or 2. It is loam or clay loam. The 2Bt horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6. It is clay loam or clay. The 2Bk horizon has value of 4 or 5 and chroma of 4 to 6.

Armstrong clay loam, 5 to 9 percent slopes, severely eroded, and Armstrong clay loam, 9 to 14 percent slopes, severely eroded, have a lighter colored surface layer than is definitive for the series. This difference, however, does not significantly affect the use or management of the soils. The soils in these map units are fine, montmorillonitic, mesic Aquic Hapludalfs.

Belinda Series

The Belinda 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.

Typical pedon of Belinda silt loam, 1,130 feet east and 1,100 feet north of the southwest corner of sec. 10, T. 64 N., R. 19 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; few fine roots; moderately acid (pH 5.6); abrupt wavy boundary.

E1—7 to 10 inches; dark grayish brown (10YR 4/2) silt loam; common fine faint very dark grayish brown (10YR 3/2) mottles; moderate fine granular structure; friable; few fine roots; few fine concretions of iron and manganese; strongly acid; abrupt wavy boundary.

E2—10 to 17 inches; light brownish gray (10YR 6/2) silt loam; few medium faint brown (10YR 5/3) mottles; weak medium platy structure parting to weak fine subangular blocky; friable; few fine roots; common fine concretions of iron and manganese; moderately acid; abrupt wavy boundary.

Btg1—17 to 22 inches; dark grayish brown (10YR 4/2) silty clay; common medium faint dark brown (10YR 4/3) and few fine distinct dark yellowish brown (10YR 4/4) mottles; moderate fine and very fine subangular blocky structure; firm; few fine roots; common prominent clay films on faces of peds; few fine concretions of iron and manganese; few organic coatings; strongly acid; clear smooth boundary.

Btg2—22 to 31 inches; grayish brown (10YR 5/2) silty clay; many medium faint brown (10YR 5/3) and few medium distinct dark yellowish brown (10YR 4/4) mottles; moderate fine and very fine subangular blocky structure; firm; many distinct clay films on faces of peds; few fine roots; few fine concretions of iron and manganese; moderately acid; clear smooth boundary.

Btg3—31 to 43 inches; grayish brown (2.5Y 5/2) silty clay loam; common coarse prominent strong brown (7.5YR 4/6) and common medium prominent yellowish brown (10YR 5/4) mottles; weak medium prismatic structure; firm; common faint clay films on faces of peds; few medium iron and manganese stains; moderately acid; gradual smooth boundary.

BCg—43 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam; few medium prominent dark yellowish brown (10YR 4/6) and few fine prominent strong brown (7.5YR 4/6) mottles; weak medium prismatic structure; firm; few medium iron and manganese stains; moderately acid.

Cantril Series

The Cantril series consists of very deep, somewhat poorly drained, moderately permeable soils on foot slopes. These soils formed in loamy local alluvium. Slopes range from 2 to 5 percent.

Typical pedon of Cantril loam, 2 to 5 percent slopes, 1,950 feet east and 3,650 feet north of the southwest corner of sec. 11, T. 62 N., R. 20 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; moderate very fine granular structure; friable; common fine roots; slightly acid; abrupt wavy boundary.

E—7 to 10 inches; dark grayish brown (10YR 4/2) loam; commonly mixed with very dark gray (10YR 3/1) material; common fine prominent dark yellowish brown (10YR 4/6) and common fine faint dark gray (10YR 4/1) mottles; weak medium platy structure; friable; few fine roots; few fine concretions of iron and manganese; moderately acid; clear smooth boundary.

Bt—10 to 21 inches; dark grayish brown (10YR 4/2) clay loam; many medium prominent yellowish brown (10YR 4/6) and dark yellowish brown (10YR 5/6) and few medium faint grayish brown (10YR 5/2) mottles; moderate very fine subangular blocky structure; firm; few fine roots; few faint clay films on faces of peds; common fine concretions of iron and manganese; moderately acid; clear smooth boundary.

Btg1—21 to 27 inches; dark grayish brown (10YR 4/2) clay loam; many medium prominent yellowish brown (10YR 5/6) and many medium faint dark gray (10YR 4/1) mottles; moderate very fine subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; common fine concretions of iron and manganese; moderately acid; gradual smooth boundary.

Btg2—27 to 42 inches; dark grayish brown (10YR 4/2) clay loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; moderate fine subangular blocky structure; firm; many distinct clay films on faces of peds; few fine stains and concretions of iron and manganese; moderately acid; gradual smooth boundary.

BCg—42 to 60 inches; yellowish brown (10YR 5/4) and gray (10YR 5/1) clay loam; few fine distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; firm; common distinct clay films on vertical faces of peds and in pores; few medium stains and concretions of iron and manganese; slightly acid.

The Ap horizon has chroma of 1 or 2. The E horizon has value of 4 or 5.

Chequest Series

The Chequest series consists of very deep, poorly drained, moderately slowly permeable soils on flood plains. These soils formed in silty alluvial sediments. Slopes range from 0 to 2 percent.

Typical pedon of Chequest silty clay loam, frequently flooded, 450 feet west and 1,950 feet north of the southeast corner of sec. 11, T. 64 N., R. 22 W.

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

A—5 to 13 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; moderate very fine subangular blocky structure; friable; common fine roots; slightly acid; clear smooth boundary.

Bg1—13 to 21 inches; dark gray (10YR 4/1) silty clay loam; common medium distinct dark yellowish brown (10YR 3/4) mottles; moderate very fine subangular blocky structure; firm; few fine roots; common faint organic coatings on vertical faces of peds; moderately acid; clear smooth boundary.

Bg2—21 to 36 inches; dark gray (10YR 4/1) silty clay loam; common fine distinct dark yellowish brown (10YR 3/4) mottles; moderate very fine and fine subangular blocky structure; firm; few fine roots; common faint organic coatings on vertical faces of peds; moderately acid; clear smooth boundary.

Bg3—36 to 60 inches; dark gray (10YR 4/1) silty clay loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; moderate fine subangular blocky structure; firm; few fine roots; many prominent organic coatings on vertical faces of peds; moderately acid.

The Bg horizon has value of 4 or 5. It has mottles with hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 2 to 4.

Gara Series

The Gara series consists of very deep, moderately well drained, moderately slowly permeable soils on uplands. These soils formed in glacial till. Slopes range from 9 to 20 percent.

Typical pedon of Gara clay loam, 9 to 14 percent slopes, eroded, 2,600 feet west and 700 feet north of the southeast corner of sec. 29, T. 61 N., R. 19 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) clay loam, grayish brown (10YR 5/2) dry; mixed with dark yellowish brown (10YR 4/4) fragments of subsoil material; moderate fine subangular blocky structure; friable; many roots; about 2 percent gravel; moderately acid; abrupt wavy boundary.

Bt1—7 to 13 inches; yellowish brown (10YR 5/4) clay loam; few fine faint pale brown (10YR 6/3) mottles; weak medium platy structure parting to moderate very fine and fine subangular blocky; friable; common roots; few faint clay films on faces of peds; about 1 percent gravel; moderately acid; clear smooth boundary.

Bt2—13 to 25 inches; yellowish brown (10YR 5/4) clay loam; common fine faint light yellowish brown (10YR 6/4) mottles; moderate fine subangular blocky structure; firm; common roots; common faint clay films on faces of peds; about 1 percent gravel; moderately acid; clear smooth boundary.

Bt3—25 to 42 inches; yellowish brown (10YR 5/6) clay loam; few medium faint dark yellowish brown (10YR 4/6) and common medium prominent light brownish gray (10YR 6/2) mottles; moderate medium prismatic structure parting to moderate fine subangular blocky; firm; few roots; common faint clay films in root channels or in pores; common dark masses; about 1 percent gravel; moderately acid; gradual smooth boundary.

Bk—42 to 60 inches; yellowish brown (10YR 5/6) clay loam; common medium prominent light brownish gray (10YR 6/2) mottles; massive; firm; few concretions of iron, manganese, and carbonate; about 2 percent gravel; slight effervescence; slightly alkaline.

The Bt horizon has value of 4 or 5 and chroma of 3 to 6. The Bk horizon has value of 4 or 5 and chroma of 4 to 6.

Gara clay loam, 9 to 14 percent slopes, severely eroded, and Gara clay loam, 14 to 20 percent slopes, severely eroded, have a lighter colored surface layer than is definitive for the series. This difference, however, does not significantly affect the use and management of the soils. The soils in these map units are fine-loamy, mixed, mesic Typic Hapludalfs.

Gorin Series

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

Typical pedon of Gorin silt loam, 5 to 9 percent slopes, eroded, 600 feet south and 1,600 feet west of the northeast corner of sec. 12, T. 64 N., R. 18 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, pale brown (10YR 6/3) dry; mixed with yellowish brown (10YR 5/4) fragments of subsoil material; moderate fine granular structure; friable; many fine roots; moderately acid; abrupt wavy boundary.

Bt1—7 to 14 inches; yellowish brown (10YR 5/4) silty clay loam; moderate very fine subangular blocky structure; friable; many distinct clay films on faces of peds; few fine roots; moderately acid; clear smooth boundary.

Bt2—14 to 24 inches; brown (10YR 5/3) silty clay; few medium faint grayish brown (10YR 5/2) mottles; moderate fine subangular blocky structure; firm; many prominent clay films on faces of peds; few fine roots; strongly acid; clear smooth boundary.

Bt3—24 to 37 inches; brown (10YR 5/3) silty clay loam; few coarse prominent strong brown (7.5YR 5/6), common medium faint light brownish gray (10YR 6/2), and few medium prominent reddish brown (5YR 4/4) mottles; weak fine subangular blocky structure; firm; common prominent clay films on faces of peds; few medium concretions of iron and manganese; moderately acid; gradual smooth boundary.

2BC—37 to 43 inches; brown (10YR 5/3) silty clay loam; few medium prominent dark reddish brown (5YR 3/4), common coarse faint light brownish gray (10YR 6/2), and common medium prominent strong brown (7.5YR 5/6) mottles; weak medium prismatic structure; firm; few faint clay films on vertical cleavage planes; about 10 percent very fine sand; moderately acid; abrupt smooth boundary.

2Cg1—43 to 49 inches; dark gray (10YR 4/1), dark yellowish brown (10YR 3/4), and light brownish gray (10YR 6/2) silty clay loam; massive; firm; about 10 percent very fine sand; moderately acid; clear smooth boundary.

2Cg2—49 to 60 inches; light brownish gray (10YR 6/2) loam; few fine distinct yellowish brown (10YR 5/6) mottles; massive; firm; moderately acid.

The Bt horizon has value of 4 or 5 and chroma of 2 to 4. It has mottles with hue of 5YR to 10YR, value of 4 or 5, and chroma of 2 to 6.

Keswick Series

The Keswick series consists of deep, moderately well drained, slowly permeable soils on uplands. These soils formed in pedisediments and in the underlying paleosol weathered from glacial till. Slopes range from 5 to 14 percent.

Typical pedon of Keswick loam, 5 to 9 percent slopes, eroded, 1,200 feet east and 800 feet north of the southwest corner of sec. 21, T. 62 N., R. 20 W.

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

Bt1—4 to 11 inches; dark brown (7.5YR 4/4) clay loam; common medium prominent yellowish brown (10YR 5/6) mottles; moderate very fine subangular blocky structure; firm; common fine roots; common distinct silt coatings on faces of peds; few faint clay films on faces of peds; moderately acid; clear smooth boundary.

2Bt2—11 to 16 inches; reddish brown (5YR 4/4) clay; common medium prominent dark red (2.5YR 3/6) and common fine prominent light brownish gray (10YR 6/2) mottles; moderate fine subangular blocky structure; firm; common fine roots; common distinct clay films on faces of peds; moderately acid; about 2 percent gravel; clear smooth boundary.

2Bt3—16 to 27 inches; strong brown (7.5YR 4/6) clay; common medium prominent light brownish gray (10YR 6/2) mottles; moderate fine subangular blocky structure; firm; few fine roots; many distinct clay films on faces of peds; moderately acid; about 4 percent gravel; clear smooth boundary.

2Bt4—27 to 32 inches; dark yellowish brown (10YR 4/6) clay loam; few medium prominent light brownish gray (10YR 6/2) mottles; moderate fine subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; common stains of manganese or iron and manganese; moderately acid; about 4 percent gravel; clear smooth boundary.

2Bt5—32 to 38 inches; dark yellowish brown (10YR 4/4) clay loam; many medium prominent light brownish gray (10YR 6/2) and common distinct yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; few stains of iron and manganese; slightly acid; about 4 percent gravel; clear smooth boundary.

2Bt6—38 to 46 inches; yellowish brown (10YR 5/6) clay loam; many coarse faint dark yellowish brown (10YR 4/6) and few fine prominent light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; firm; few fine roots; common distinct clay films on vertical faces of peds; common stains of iron and manganese; neutral; about 5 percent gravel; clear smooth boundary.

2Bk—46 to 60 inches; yellowish brown (10YR 5/6) clay loam; common fine, medium, and coarse distinct pale brown (10YR 6/3) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; few fine roots; few distinct clay films in root channels or in pores; common stains of iron and manganese; about 5 percent gravel; common soft masses of carbonate; strong effervescence; slightly alkaline.

The Ap horizon has chroma of 2 or 3. It is loam or clay loam. The upper part of the 2Bt horizon has chroma of 4 to 6. The lower part of the 2Bt horizon and the BC horizon have value of 4 or 5 and chroma of 4 to 6.

Lamoni Series

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

The Lamoni soils in Sullivan County are taxadjuncts because they have a thinner dark surface layer than is defined as the range for the series. This difference, however, does not significantly affect the use and management of the soils. The soils are fine, montmorillonitic, mesic Aquic Hapludalfs.

Typical pedon of Lamoni clay loam, 5 to 9 percent slopes, eroded, 700 feet east and 1,900 feet south of the northwest corner of sec. 15, T. 62 N., R. 22 W.

Ap—0 to 6 inches; very dark gray (10YR 3/1) clay loam, gray (10YR 5/1) dry; mixed with brown (10YR 4/3) fragments of subsoil material; moderate very fine and fine granular structure; friable; common fine roots; moderately acid; abrupt wavy boundary.

Bt1—6 to 10 inches; dark brown (10YR 4/3) clay loam; dark grayish brown (10YR 4/2) on faces of peds; many fine faint yellowish brown (10YR 5/4) and few fine prominent strong brown (7.5YR 4/6) mottles; moderate very fine subangular blocky structure; firm; common fine roots; common faint clay films on faces of peds; few fine concretions of iron and manganese; moderately acid; clear smooth boundary.

2Bt2—10 to 15 inches; yellowish brown (10YR 5/4) clay; few fine prominent strong brown (7.5YR 5/6), common medium faint brown (10YR 5/3), and few medium distinct grayish brown (10YR 5/2) mottles; moderate very fine subangular blocky structure; firm; common fine roots; many distinct clay films; few fine concretions of iron and manganese; about 1 percent gravel; moderately acid; gradual smooth boundary.

2Bt3—15 to 32 inches; yellowish brown (10YR 5/6) clay; common medium distinct brown (10YR 5/3) and few medium prominent grayish brown (10YR 5/2) mottles; weak fine subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; common masses of iron and manganese; about 1 percent gravel; slightly acid; gradual smooth boundary.

2Bt4—32 to 44 inches; yellowish brown (10YR 5/6) clay; common coarse prominent light brownish gray (10YR 6/2) and common fine distinct yellowish brown (10YR 5/4) mottles; weak fine and medium subangular blocky structure; firm; common distinct clay films on faces of peds; about 1 percent gravel; slightly acid; gradual smooth boundary.

2BC—44 to 60 inches; yellowish brown (10YR 5/6) clay loam; common medium prominent light brownish gray (2.5Y 6/2) mottles; moderate medium prismatic structure parting to moderate fine subangular blocky; firm; few distinct clay films on vertical faces of peds; about 2 percent gravel; common masses of iron and manganese; neutral.

The A horizon has chroma of 1 or 2. The 2Bt horizon has value of 4 or 5 and chroma of 3 to 6. It is clay loam or clay.

Landes Series

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

Typical pedon of Landes loam, frequently flooded, 650 feet east and 500 feet south of the northwest corner of sec. 35, T. 62 N., R. 19 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate very fine and fine granular structure; friable; many fine and medium roots; slightly acid; abrupt wavy boundary.

A—7 to 11 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; common fine and medium roots; slightly acid; clear smooth boundary.

Bw—11 to 23 inches; dark brown (10YR 4/3) loam; weak fine subangular blocky structure; friable; common fine and medium roots; slightly acid; clear smooth boundary.

C1—23 to 35 inches; dark yellowish brown (10YR 4/4) and dark brown (10YR 4/3) loam; massive; friable; common fine and medium roots; slightly acid; clear smooth boundary.

C2—35 to 55 inches; dark yellowish brown (10YR 4/4) fine sandy loam; massive; friable; slightly acid; clear smooth boundary.

C3—55 to 60 inches; dark brown (10YR 4/3) silt loam; common medium faint grayish brown (10YR 5/2) mottles; massive; friable; slightly acid.

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

Lenzburg Series

The Lenzburg series consists of very deep, well drained, moderately slowly permeable soils in areas that have been surface mined. These soils formed in excavated material. Slopes range from 2 to 45 percent.

Typical pedon of Lenzburg clay loam, 14 to 45 percent slopes, 1,200 feet east and 1,700 feet north of the southwest corner of sec. 22, T. 63 N., R. 20 W.

A—0 to 5 inches; yellowish brown (10YR 5/4) clay loam, light yellowish brown (10YR 6/4) dry; common medium prominent light gray (10YR 7/1) mottles; moderate fine subangular blocky structure; friable; common roots; strongly effervescent; about 5 percent cobbles and 5 percent gravel; slightly alkaline; clear smooth boundary.

C1—5 to 30 inches; yellowish brown (10YR 5/4) clay loam; intermingled with dark yellowish brown (10YR 4/4) and light gray (10YR 7/1); appears massive but breaks into fine soil fragments; firm; few roots; strong effervescence; about 10 percent cobbles and a few pebbles; slightly alkaline; gradual smooth boundary.

C2—30 to 60 inches; yellowish brown (10YR 5/4) clay loam; intermingled with light gray and gray (10YR 6/1), dark yellowish brown (10YR 4/6), and dark gray (10YR 4/1); appears massive but breaks into fine soil fragments; firm; few carbonate concretions; strong effervescence; about 10 percent cobbles and a few pebbles; slightly alkaline.

The A horizon has chroma of 4 to 6. The content of cobbles ranges from 10 to 20 percent in the C horizon.

Olmitz Series

The Olmitz series consists of very deep, well drained, moderately permeable soils on foot slopes. These soils formed in loamy sediments. Slopes range from 2 to 9 percent.

Typical pedon of Olmitz loam, 5 to 9 percent slopes, 850 feet south and 700 feet west of the northeast corner of sec. 35, T. 64 N., R. 22 W.

Ap—0 to 7 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate fine granular structure; friable; common fine and medium roots; neutral; clear wavy boundary.

A1—7 to 16 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; moderate very fine subangular blocky structure; friable; few fine roots; neutral; clear smooth boundary.

A2—16 to 21 inches; very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) dry; moderate very fine and fine subangular blocky structure; friable; many organic coatings on faces of peds; few fine roots; slightly acid; gradual smooth boundary.

Bw1—21 to 33 inches; dark brown (10YR 3/3) clay loam, brown (10YR 5/3) dry; moderate very fine and fine subangular blocky structure; friable; few fine roots; many organic coatings on faces of peds; slightly acid; gradual smooth boundary.

Bw2—33 to 39 inches; dark brown (10YR 3/3) clay loam, brown (10YR 5/3) dry; moderate very fine and fine subangular blocky structure; firm; few fine roots; many organic coatings on faces of peds and in root channels or pores; slightly acid; gradual smooth boundary.

Bw3—39 to 50 inches; dark brown (10YR 3/3) clay loam, dark brown (10YR 4/3) rubbed, brown (10YR 5/3) dry; few fine distinct brown (10YR 5/3) mottles; moderate fine subangular blocky structure; firm; few fine roots; common organic coatings on faces of peds and in root channels or pores; slightly acid; gradual smooth boundary.

BC—50 to 60 inches; dark brown (10YR 4/3) clay loam; common fine faint brown (10YR 5/3) mottles; moderate medium prismatic structure parting to moderate fine subangular blocky; firm; few fine roots; common organic coatings on faces of peds and in root channels or pores; slightly acid.

The A horizon has value of 2 or 3.

Pershing Series

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

Typical pedon of Pershing silty clay loam, 2 to 5 percent slopes, eroded, 400 feet east and 600 feet south of the northwest corner of sec. 29, T. 61 N., R. 20 W.

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

Bt1—6 to 11 inches; brown (10YR 5/3) silty clay; few fine faint yellowish brown (10YR 5/4) and common medium faint dark brown (10YR 4/3) mottles; moderate very fine subangular blocky structure; friable; common fine roots; few faint clay films on faces of peds; common silt coatings; strongly acid; clear smooth boundary.

Bt2—11 to 23 inches; dark grayish brown (10YR 4/2) and brown (10YR 4/3) silty clay; common medium prominent yellowish brown (10YR 5/6) and common medium distinct yellowish brown (10YR 5/4) mottles; moderate very fine and fine subangular blocky structure; firm; common fine roots; few distinct clay films on faces of peds; few faint silt coatings; few soft masses of iron and manganese; strongly acid; gradual smooth boundary.

Btg—23 to 43 inches; grayish brown (2.5Y 5/2) silty clay loam; common coarse prominent dark brown (7.5YR 4/4) mottles; moderate fine subangular blocky structure; firm; few fine roots; few faint clay films on faces of peds; few masses of iron and manganese; moderately acid; gradual smooth boundary.

BCg—43 to 51 inches; grayish brown (2.5Y 5/2) silty clay loam; few medium prominent red (2.5YR 4/6) and few fine prominent yellowish red (5YR 4/6) mottles; moderate medium prismatic structure; firm; common faint clay films on vertical faces of peds; common masses of iron and manganese; slightly acid; clear smooth boundary.

Cg—51 to 60 inches; grayish brown (10YR 5/2) silt loam; common medium faint dark brown (10YR 4/3) mottles; massive; firm; slightly acid.

The A horizon has chroma of 1 or 2. The Bt horizon has chroma of 2 to 4.

Reger Series

The Reger series consists of moderately deep, well drained, moderately slowly permeable soils on uplands. These soils formed in interbedded, soft sandstone and siltstone. Slopes range from 14 to 45 percent.

Typical pedon of Reger very fine sandy loam, 20 to 45 percent slopes, 350 feet east and 1,700 feet south of the northwest corner of sec. 19, T. 62 N., R. 20 W.

Oi—1 inch to 0; decaying leaves and twigs.

A—0 to 3 inches; dark brown (10YR 4/3) very fine sandy loam, pale brown (10YR 6/3) dry; moderate very fine granular structure; very friable; many coarse roots; moderately acid; abrupt smooth boundary.

E—3 to 7 inches; yellowish brown (10YR 5/4) very fine sandy loam; weak thin platy structure parting to weak fine granular; friable; many roots; about 5 percent soft sandstone and siltstone fragments; moderately acid; clear wavy boundary.

Bw1—7 to 22 inches; yellowish brown (10YR 5/4) very fine sandy loam; moderate fine subangular blocky structure; friable; common fine and medium roots; strongly acid; about 40 percent soft sandstone and siltstone fragments; strongly acid; clear wavy boundary.

Bw2—22 to 27 inches; yellowish brown (10YR 5/4) very fine sandy loam; moderate fine subangular blocky structure; firm; few fine roots; about 50 percent soft sandstone and siltstone fragments; strongly acid; clear wavy boundary.

Cr—27 to 60 inches; interbedded sandstone and siltstone.

The A horizon has value of 4 or 5 and chroma of 2 to 4. The E horizon has value of 4 or 5 and chroma of 3 or 4. The Bw horizon has value of 4 or 5 and chroma of 4 to 6.

Rinda Series

The Rinda series consists of very deep, poorly drained, very slowly permeable soils on uplands. These soils formed in a gray, clayey paleosol weathered from glacial till. Slopes range from 3 to 9 percent.

Typical pedon of Rinda silty clay loam, 5 to 9 percent slopes, eroded, 2,500 feet west and 650 feet south of the northeast corner of sec. 20, T. 63 N., R. 18 W.

Ap—0 to 6 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak thin platy structure parting to moderate very fine granular; friable; many fine and medium roots; neutral; clear wavy boundary.

Bt1—6 to 11 inches; dark grayish brown (10YR 4/2) silty clay loam; few fine prominent dark yellowish brown (10YR 4/6) mottles; moderate very fine subangular blocky structure; firm; common fine and medium roots; common faint clay films on faces of peds; moderately acid; clear smooth boundary.

Bt2—11 to 28 inches; dark grayish brown (10YR 4/2) clay; few fine distinct dark yellowish brown (10YR 4/4) and few medium distinct light brownish gray (2.5Y 6/2) mottles; weak very fine and fine subangular blocky structure; firm; common fine roots; many distinct clay films on faces of peds; few fine concretions of iron and manganese; slightly acid; gradual smooth boundary.

Bt3—28 to 40 inches; dark grayish brown (10YR 4/2) clay; few fine distinct light brownish gray (2.5Y 6/2), common medium prominent dark yellowish brown (10YR 3/6), and common fine distinct yellowish brown (10YR 5/4) mottles; moderate fine subangular blocky structure; firm; common fine roots; common distinct clay films on faces of peds; few fine concretions of iron and manganese; neutral; gradual smooth boundary.

Bt4—40 to 55 inches; dark grayish brown (10YR 4/2) clay; common medium distinct light brownish gray (2.5Y 6/2) and common fine distinct grayish brown (10YR 5/2) mottles; moderate medium prismatic structure parting to moderate fine subangular blocky; firm; few fine roots; common faint clay films on faces of peds; few fine concretions of iron and manganese; neutral; clear smooth boundary.

Bt5—55 to 60 inches; dark grayish brown (2.5Y 4/2) clay; common medium prominent yellowish brown (10YR 5/6) and common coarse distinct pale olive (5Y 6/3) mottles; moderate medium prismatic structure parting to moderate fine subangular blocky; firm; few faint clay films on faces of peds; common fine concretions of iron and manganese; neutral.

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

Shelby Series

The Shelby series consists of very deep, moderately well drained, moderately slowly permeable soils on uplands. These soils formed in glacial till. Slopes range from 9 to 20 percent.

Typical pedon of Shelby clay loam, 9 to 14 percent slopes, eroded, 500 feet east and 950 feet south of the northwest corner of sec. 22, T. 64 N., R. 22 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; many fine and medium roots; about 2 percent gravel; moderately acid; abrupt wavy boundary.

Bt1—7 to 12 inches; dark brown (10YR 3/3) clay loam, dark grayish brown (10YR 4/2) dry; few fine faint dark yellowish brown (10YR 4/4) mottles; moderate fine subangular blocky structure parting to moderate very fine granular; friable; common fine roots; few faint clay films on faces of peds and in root channels; about 1 percent gravel; moderately acid; clear smooth boundary.

Bt2—12 to 21 inches; dark yellowish brown (10YR 4/4) clay loam; common fine distinct dark yellowish brown (10YR 4/6) mottles; moderate fine subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds and in root channels; about 1 percent gravel; moderately acid; clear smooth boundary.

Bt3—21 to 31 inches; dark yellowish brown (10YR 4/6) clay loam; few fine prominent grayish brown (10YR 5/2) mottles; moderate fine subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; few stains of iron and manganese; about 1 percent gravel; moderately acid; gradual smooth boundary.

Bt4—31 to 37 inches; dark yellowish brown (10YR 4/6) clay loam; common medium prominent light brownish gray (2.5Y 6/2) mottles; weak medium subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds and in root channels; few stains of iron and manganese; about 1 percent gravel; slightly acid; gradual smooth boundary.

Bk—37 to 60 inches; dark yellowish brown (10YR 4/6) clay loam; common medium prominent light brownish gray (2.5Y 6/2) mottles; moderate medium prismatic structure; firm; few fine roots; few distinct clay films on vertical faces of peds and in root channels; common fine concretions of iron and manganese; few medium masses of carbonate; about 2 percent gravel; slight effervescence; slightly alkaline.

The Bt horizon has value of 4 or 5 and chroma of 3 to 6.

Shelby clay loam, 14 to 20 percent slopes, eroded, has a thinner dark surface layer than is definitive for the series. This difference, however, does not significantly affect the use or management of the soil. The soil in this map unit is classified as fine-loamy, mixed, mesic Mollic Hapludalfs.

Tice Series

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

Typical pedon of Tice silt loam, frequently flooded, 2,500 feet north and 1,000 feet east of the southwest corner of sec. 26, T. 63 N., R. 19 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; moderate fine subangular blocky structure parting to weak fine granular; friable; many fine roots; slightly acid; abrupt wavy boundary.

A—8 to 13 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; moderate fine granular structure; friable; many fine roots; slightly acid; clear smooth boundary.

Bw—13 to 24 inches; dark grayish brown (10YR 4/2) silt loam; common medium distinct light brownish gray (10YR 6/2) and dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; friable; common roots; moderately acid; gradual smooth boundary.

Cg1—24 to 34 inches; grayish brown (10YR 5/2) silt loam; many fine faint dark grayish brown (10YR 4/2) and few medium distinct dark yellowish brown (10YR 4/4) mottles; massive; friable; few roots; many fine brown concretions; moderately acid; clear smooth boundary.

Cg2—34 to 39 inches; grayish brown (10YR 5/2) silty clay loam; few medium faint light brownish gray (10YR 6/2) and few fine distinct dark yellowish brown (10YR 4/4) mottles; massive; friable; few roots; moderately acid; clear smooth boundary.

Cg3—39 to 60 inches; grayish brown (10YR 5/2) silty clay loam; few medium distinct dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/4) mottles; massive; friable; few roots; moderately acid.

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

Vigar Series

The Vigar series consists of very deep, moderately well drained, moderately slowly permeable soils on low foot slopes. These soils formed in loamy alluvium. Slopes range from 2 to 5 percent.

Typical pedon of Vigar loam, 2 to 5 percent slopes, 2,500 feet west and 400 feet north of the southeast corner of sec. 25, T. 64 N., R. 18 W.

Ap—0 to 5 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate very fine granular structure; very friable; many fine roots; slightly acid; abrupt wavy boundary.

A—5 to 13 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate very fine subangular blocky structure parting to moderate fine granular; friable; common fine roots; slightly acid; clear smooth boundary.

Bt1—13 to 24 inches; dark brown (10YR 3/3) clay loam, brown (10YR 5/2) dry; moderate very fine subangular blocky structure; firm; common fine roots; common faint clay films on faces of peds; slightly acid; clear smooth boundary.

Bt2—24 to 29 inches; dark yellowish brown (10YR 4/4) clay loam; many medium distinct dark gray (10YR 4/1) mottles; moderate very fine subangular blocky structure; firm; few fine roots; common faint clay films on faces of peds; moderately acid; clear smooth boundary.

Bt3—29 to 40 inches; dark grayish brown (10YR 4/2) and dark brown (10YR 4/3) clay loam; common medium distinct dark yellowish brown (10YR 3/4) mottles; moderate fine subangular blocky structure; firm; few fine roots; common faint clay films on faces of peds; moderately acid; gradual smooth boundary.

Bt4—40 to 54 inches; mottled dark yellowish brown (10YR 4/4) and grayish brown (10YR 5/2) clay loam; moderate medium prismatic structure parting to weak medium subangular blocky; firm; few fine roots; common distinct clay films on faces of peds and in pores; common stains of iron and manganese; moderately acid; gradual smooth boundary.

BC—54 to 60 inches; mottled dark yellowish brown (10YR 4/4) and grayish brown (10YR 5/2) clay loam; moderate medium prismatic structure; firm; few fine roots; common distinct clay films in pores; moderately acid.

The A or Ap horizon has value of 2 or 3 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 clayey alluvium. Slopes are less than 1 percent.

Typical pedon of Wabash silty clay, frequently flooded, 2,800 feet north and 1,770 feet east of the southwest corner of sec. 11, T. 62 N., R. 22 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; weak fine granular structure; firm; slightly acid; abrupt wavy boundary.

A—8 to 21 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; few fine distinct dark yellowish brown (10YR 3/4) and common medium prominent yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; firm; few slickensides; strongly acid; clear smooth boundary.

Bg1—21 to 48 inches; very dark gray (10YR 3/1) clay, gray (10YR 5/1) dry; common medium prominent yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few slickensides; strongly acid; clear smooth boundary.

Bg2—48 to 60 inches; dark gray (10YR 4/1) clay; common medium prominent brown (7.5YR 5/4) mottles; moderate medium prismatic structure parting to moderate medium angular blocky; firm; few very dark gray (10YR 3/1) streaks; slightly acid.

These soils have deep, wide cracks during dry summer months. The A horizon has value of 2 or 3 and chroma of 1 or 2. The Bg horizon has value of 2 to 4.

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 9 to 40 percent.

Typical pedon of Winnegan loam, 20 to 40 percent slopes, 1,320 feet west and 20 feet north of the southeast corner of sec. 27, T. 64 N., R. 18 W.

A—0 to 2 inches; dark grayish brown (10YR 4/2) loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; many fine roots; about 1 percent gravel; moderately acid; abrupt smooth boundary.

E—2 to 6 inches; brown (10YR 5/3) loam; weak medium platy structure parting to moderate medium granular; friable; many fine roots; about 1 percent gravel; moderately acid; clear smooth boundary.

Bt1—6 to 12 inches; yellowish brown (10YR 5/6) clay loam; common brown (10YR 5/3) pockets of E material; moderate fine subangular blocky structure; firm; common fine roots; common faint clay films and few light gray (10YR 7/2) silt coatings on faces of peds; about 2 percent gravel; very strongly acid; clear smooth boundary.

Bt2—12 to 18 inches; yellowish brown (10YR 5/6) clay; moderate fine subangular blocky structure; firm; common fine roots; many distinct clay films on faces of peds; about 2 percent gravel; very strongly acid; clear smooth boundary.

Bt3—18 to 27 inches; yellowish brown (10YR 5/6) clay loam; common medium prominent light brownish gray (2.5Y 6/2) and common fine distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; common fine roots; few faint clay films on faces of peds; about 2 percent gravel; moderately acid; abrupt wavy boundary.

Bk—27 to 60 inches; yellowish brown (10YR 5/6) clay loam; common medium faint dark yellowish brown (10YR 4/6) and prominent light brownish gray (10YR 6/2) mottles; massive; firm; few fine roots; common medium masses of carbonate; about 2 percent gravel; strong effervescence; moderately alkaline.

The Bt horizon has hue of 7.5YR or 10YR and chroma of 4 to 6. It is clay or clay loam. The Bk horizon has value of 5 or 6. Masses of calcium carbonate commonly are in the lower part of the solum at a depth of 24 to 40 inches.

Zook Series

The Zook series consists of very deep, poorly drained, slowly permeable soils on flood plains. These soils formed in alluvial sediments. Slopes range from 0 to 4 percent.

Typical pedon of Zook silty clay loam, frequently flooded, 0 to 2 percent slopes, 4,750 feet west and 3,900 feet south of the northeast corner of sec. 25, T. 63 N., R. 22 W.

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

A1—4 to 13 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate very fine subangular blocky structure; firm; few fine roots; moderately acid; clear smooth boundary.

A2—13 to 20 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; few fine faint very dark grayish brown (10YR 3/2) mottles; moderate fine subangular blocky structure; firm; moderately acid; gradual smooth boundary.

A3—20 to 36 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; common fine faint very dark grayish brown (10YR 3/2) mottles; moderate fine subangular blocky structure; firm; moderately acid; gradual smooth boundary.

Bg1—36 to 48 inches; dark gray (10YR 4/1) silty clay; common medium distinct dark yellowish brown (10YR 4/4) and few medium distinct brown (10YR 5/3) mottles; weak fine subangular blocky structure; firm; slightly acid; gradual smooth boundary.

Bg2—48 to 60 inches; gray (10YR 5/1) silty clay; common medium distinct dark brown (10YR 4/3) and brown (10YR 5/3) and few medium prominent dark yellowish brown (10YR 4/4) mottles; moderate medium prismatic structure parting to weak medium subangular blocky; very firm; slightly acid.

The A horizon has hue of 10YR or is neutral in hue. It has value of 2 or 3. The Bg horizon has value of 3 or 4. The Cg horizon has value of 4 or 5.

Formation of the Soils

Soil is the product of soil-forming processes acting on materials accumulated or deposited by geologic action. The characteristics of the soil at any given point are determined by the physical and mineralogical composition of the parent material; the climate under which the soil material has accumulated and existed since accumulation; the plant and animal life on and in the soil; relief, or lay of the land; and the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed to change 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 factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil formation are unknown.

Parent material is the unconsolidated mass in which the soil forms. It determines the limits of the chemical and mineral composition of the soil. The soils in Sullivan County formed in loess, in glacial till, in alluvium, in residual material of Pennsylvanian age, or in a combination of these materials.

The last great continental ice sheet, which never reached Missouri, began to melt approximately 30,000 years ago. Over the next 12,000 to 18,000 years, streams with headwaters farther north overflowed each summer with muddy water from the melting ice *(19)*. In the winter, the water levels dropped and the westerly winds picked up silt from the drying mud flats and deposited it in the uplands of the Midwest. This wind-deposited silty material is called loess. Its primary source in the survey area was the flood plains along the Missouri River, but smaller amounts undoubtedly also came from the flood plains along the Grand and Thompson Rivers and perhaps others. It is possible that at one time loess covered all of the uplands. Loess is very erodible, and all or most of it has been eroded away on the moderately sloping and steeper back slopes and some of the narrow, rounded ridgetops in the county. The thickest remaining deposits of loess are on broad upland ridges.

Belinda and Adco soils are on the most stable loess-covered upland landscapes in the survey area. The loess is less than 20,000 years old, and the soils must be younger than the material in which they formed. These soils have a considerable amount of profile development and have leached subsurface horizons and a clayey subsoil, even though they formed in silty loess material *(18)*, because the slopes are so gentle that runoff is slow and most of the precipitation leaches through the soils.

The soils on the narrower ridges and the upper back slopes formed in a different kind of parent material than those on broad upland ridges. The loess has been removed from these parts of the landscape by geologic erosion, and an old erosional surface that rests on glacial till is exposed *(8)*. The glacial till, called Kansan till, is probably at least 350,000 years old. The erosional surface is associated with a soil-forming period called the Sangamon interglacial episode, which began approximately 120,000 years ago. Armstrong and Keswick soils formed in an old soil that had formed in the Sangamon erosional surface prior to 20,000 years ago *(14, 15)*.

The steeper back slopes have a different kind of erosional surface. In these areas, geologic erosion has removed the Sangamon erosional surface. In most places, the present soils, such as Gara and Winnegan soils, formed in the glacial till that underlies the present erosional surface. These soils have not been altered from the parent material as much as the soils on broad ridgetops, such as Belinda and Adco soils, primarily because more water has run off the surface of the steeper soils and less water has leached through the

Figure 9.—Interbedded sandstone and siltstone of Pennsylvanian age.

soil profile. In a few places, primarily along the three forks of Locust Creek and along Spring Creek, the glacial till has been entirely removed by erosion on some slopes and the underlying Pennsylvanian-age bedded sandstone and siltstone are exposed (fig. 9). Reger soils formed in this material.

The youngest soils in the survey area are the alluvial soils on flood plains. The more sandy soils, such as Landes soils, were deposited by rapidly moving floodwater. The more clayey soils, such as Wabash and Zook soils, settled out of slack-water areas of floodwater.

Sullivan County presently has a subhumid midcontinental climate that probably has changed little, except for minor fluctuations, in the past 8,000 years. Seasonal temperature changes are distinct. The average annual air temperature is about 54 degrees F; therefore, this county is in the mesic temperature zone. Rainfall averages about 36 inches per year, and the seasonal distribution is predictable. There is an adequate amount of precipitation to leach bases, reduce natural fertility, and increase acidity in the upper several feet of the soils within a period of a few hundred years; therefore, the county is in a udic moisture zone.

Plants, burrowing animals, insects, bacteria, and fungi affect the content of organic matter and its distribution in the soil profile, plant nutrients, structure, and porosity *(9)*. During the early days of settlement, the survey area supported a mixture of prairie and forest vegetation *(17)*. Human activity has altered the processes of soil formation by replacing trees and warm-season prairie grasses with other crops. Intensive cultivation, erosion, and the use of chemicals and fertilizers have reduced the content of organic matter in the soil and affected the population and activity of worms, burrowing animals, bacteria, and fungi. Cultivation has reduced tilth in the plow layer, decreased the stability of soil structure, and, in many places, increased the rate of runoff and erosion. In much of the uplands, erosion has removed all or part of the original surface layer, thereby lowering the fertility and productivity of the soils.

Soils that formed under forest vegetation have an accumulation of organic matter on and near the surface. When these soils are cleared for farming, this organic material is mixed into the plow layer. It is oxidized in a relatively short period of time. Therefore, cultivated soils that formed under forest vegetation characteristically have a gray or light brown surface layer and a very low content of organic matter. Soils in Sullivan County that formed under forest vegetation include Gorin, Keswick, Reger, and Winnegan soils on uplands.

Soils that formed under prairie vegetation have a higher content of organic matter in the upper few feet of the profile than soils that formed under forest vegetation. Cultivation lowers the organic matter content somewhat in the plow layer, but the organic matter content of cultivated soils that formed under prairie vegetation remains much higher in and below the plow layer than it does in cultivated soils that formed under forest vegetation. Therefore, the prairie soils have a darker surface layer. Soils in Sullivan County that formed under prairie vegetation include Lamoni and Shelby soils on uplands and Wabash and Zook soils on flood plains.

Most of the soils in the survey area are thought to have formed under a mixture of prairie and forest vegetation. After cultivation, these soils have more organic matter in the plow layer than cultivated soils that formed only under woodland but less than cultivated soils that formed under prairie vegetation. Also, the organic matter extends deeper into the soil profile than it does in the forested soils but not as deep as it does in the prairie soils. A possible vegetation pattern for these soils is a cyclic shift back and forth from trees to prairie grasses. These cycles may have lasted for varying periods of time, perhaps as long as several hundred years in some instances. The vegetation changes might have been triggered by natural events, such as prairie fires, or by minor climatic changes. Another possible vegetation pattern is one of scattered trees with a prairie grass understory that remained virtually unchanged over a long period of time. Soils in Sullivan County that formed under a mixture of prairie and forest vegetation include Armstrong and Gara soils.

Relief refers to the general unevenness of the land surface. It takes into account the difference in elevation from the ridgetops to the valley floors and the nature of the slopes in between. It affects soil formation mostly through its influence on water infiltration, runoff, and geologic erosion. Geologic erosion is the erosion that occurs independently of human activity. Its rate depends primarily on the degree of slope, the aspect or direction of the slope, the kind of material at the surface, and the type of vegetation. Erosion that results from human activity is called accelerated erosion. Its rate depends on tillage practices, the length and degree of slope, the texture of the surface layer, and the kinds of crops that are grown. If all other conditions are equal, soils on the steeper slopes show less profile development than soils in the more nearly level areas. The runoff rate is more rapid in the steeper areas, and less water is leached downward through the soil. The formation of clay occurs more slowly in these areas, and soluble minerals break down and leach out of the soil more slowly.

Aspect exerts an influence on the development of upland soils. In the northern hemisphere, south- and west-facing slopes receive more solar energy than north- and east-facing slopes. Therefore, the soils on south- and west-facing slopes are more droughty, produce less vegetation or thinner vegetation, and are more susceptible to geologic erosion. The rate of geologic erosion increases in proportion to the increase in slope gradient. Also, studies have shown that silty and loamy soil material on the surface erodes more rapidly than clayey soil material *(22)*.

Time is important only as it allows climate, living organisms, and relief to exert their influence on the parent material. The amount of profile development in a soil is reflected by the length of time that the parent material has been in place and subject to weathering and to the slope of the landscape. Young soils show little profile development or horizon differentiation. Old soils show the effects of clay movement and leaching, and they have distinct horizons.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep, rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Back slope. The geomorphic component that forms the steepest inclined surface and principal element of many hill slopes. Back slopes in profile typically *range from gently sloping to very steep, are linear,* and descend to a foot slope. In terms of gradational process, back slopes are erosional forms produced mainly by mass wasting and running water.

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, K), expressed as a percentage of the total cation-exchange capacity.

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Bedding system. A drainage system made by plowing, grading, or otherwise shaping the surface of a flat field. It consists of a series of low ridges separated by shallow, parallel dead furrows.

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

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on the contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Bisequum. Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

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

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

California bearing ratio (CBR). The load-supporting capacity of a soil as compared to that of standard crushed limestone, expressed as a ratio. First standardized in California. A soil having a CBR of 16 supports 16 percent of the load that would be supported by standard crushed limestone, per unit area, with the same degree of distortion.

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.

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

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Colluvium. Soil material, 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.

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

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

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

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, or clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 38 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

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 (geology). 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 outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glacial till (geology). 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 and mottles.

Graded stripcropping. Growing crops in strips that grade toward a protected waterway.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of the material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Head slope. The concave surface at the head of a drainageway where the flow of water converges downward toward the center and contour lines form concave curves.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and are less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration 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

Interfluve. The relatively undissected upland or ridge between two adjacent valleys containing streams flowing in the same general direction, or any elevated area between two drainageways that sheds water to them.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by the wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nose slope. The projecting end of an interfluve, where contour lines connecting the opposing side slopes form convex curves around the projecting end and lines perpendicular to the contours diverge downward. Overland flow of water is divergent.

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.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3

Slightly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Ridge. A long, narrow elevation of the land surface, usually sharp crested with steep sides forming an extended upland between valleys.

Rill. A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 drawbar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shoulder. The geomorphic component that forms the uppermost inclined surface at the top of a hill slope. It comprises the transition zone from back slope to summit of an upland. The surface is dominantly convex in profile and erosional in origin.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Side slope. The slope bounding a drainageway and lying between the drainageway and the adjacent interfluve. It is generally linear along the slope width. Overland flow is parallel down the slope.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silica-sesquioxide ratio. The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

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
Nearly level and very gently sloping	0 to 3 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 30 percent
Very steep	more than 30 percent

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the substratum. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediments of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to 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).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Breaking up a compact subsoil by pulling a special chisel through the soil.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). A layer of otherwise suitable soil material that is too thin for the specified use.

Till plain. An extensive area of nearly level to undulating soils underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded 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 breaks (or water bars). Humps or small dike-like surface drainage structures, properly used only in closing retired roads to traffic, on firelines, and on abandoned skid trails.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 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
	°F	°F	°F	°F	°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---	105	-23	---	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
12	Belinda silt loam	900	0.2
16B2	Pershing silty clay loam, 2 to 5 percent slopes, eroded	17,800	4.2
17C	Gorin silt loam, bench, 3 to 9 percent slopes	500	0.1
17C2	Gorin silt loam, 5 to 9 percent slopes, eroded	7,300	1.7
21B	Cantril loam, 2 to 5 percent slopes	560	0.1
27B	Adco silt loam, 1 to 5 percent slopes	1,400	0.3
30D2	Shelby clay loam, 9 to 14 percent slopes, eroded	1,350	0.3
30E2	Shelby clay loam, 14 to 20 percent slopes, eroded	200	*
31D2	Gara clay loam, 9 to 14 percent slopes, eroded	63,500	15.2
31E2	Gara clay loam, 14 to 20 percent slopes, eroded	42,500	10.2
32D3	Gara clay loam, 9 to 14 percent slopes, severely eroded	11,800	2.8
32E3	Gara clay loam, 14 to 20 percent slopes, severely eroded	9,900	2.4
34D2	Winnegan loam, 9 to 14 percent slopes, eroded	7,800	1.9
34E2	Winnegan loam, 14 to 20 percent slopes, eroded	19,400	4.7
34F	Winnegan loam, 20 to 40 percent slopes	25,750	6.2
35D3	Winnegan clay loam, 9 to 14 percent slopes, severely eroded	1,700	0.4
35E3	Winnegan clay loam, 14 to 20 percent slopes, severely eroded	4,150	1.0
41C2	Rinda silty clay loam, 3 to 9 percent slopes, eroded	1,250	0.3
43C2	Keswick loam, 5 to 9 percent slopes, eroded	17,600	4.2
43D2	Keswick loam, 9 to 14 percent slopes, eroded	3,650	0.9
43D3	Keswick clay loam, 9 to 14 percent slopes, severely eroded	640	0.2
44B	Armstrong loam, 2 to 5 percent slopes	4,500	1.1
44C2	Armstrong clay loam, 5 to 9 percent slopes, eroded	87,000	20.9
44D2	Armstrong clay loam, 9 to 14 percent slopes, eroded	3,500	0.8
45C3	Armstrong clay loam, 5 to 9 percent slopes, severely eroded	710	0.2
45D3	Armstrong clay loam, 9 to 14 percent slopes, severely eroded	660	0.2
48C2	Lamoni clay loam, 5 to 9 percent slopes, eroded	1,450	0.3
50	Landes loam, frequently flooded	33,250	8.0
51	Chequest silty clay loam, frequently flooded	5,700	1.4
53B	Olmitz loam, 2 to 5 percent slopes	2,500	0.6
53C	Olmitz loam, 5 to 9 percent slopes	1,000	0.2
56A	Zook silty clay loam, frequently flooded, 0 to 2 percent slopes	4,800	1.2
56B	Zook silty clay loam, rarely flooded, 1 to 4 percent slopes	8,700	2.1
57	Wabash silty clay, frequently flooded	3,200	0.8
58B	Vigar loam, 2 to 5 percent slopes	1,300	0.3
59	Arbela silt loam, ocasionally flooded	4,700	1.1
67	Tice silt loam, frequently flooded	5,150	1.2
71D	Lenzburg clay loam, 2 to 14 percent slopes	103	*
71F	Lenzburg clay loam, 14 to 45 percent slopes	323	0.1
74E2	Reger fine sandy loam, 14 to 20 percent slopes, eroded	1,900	0.5
74F	Reger very fine sandy loam, 20 to 45 percent slopes	6,800	1.6
	Water areas larger than 40 acres in size	262	0.1
	Total	417,158	100.0

* Less than 0.1 percent.

TABLE 5.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
12	Belinda silt loam (where drained)
16B2	Pershing silty clay loam, 2 to 5 percent slopes, eroded
21B	Cantril loam, 2 to 5 percent slopes (where drained)
27B	Adco silt loam, 1 to 5 percent slopes
44B	Armstrong loam, 2 to 5 percent slopes
50	Landes loam, frequently flooded (where protected from flooding or not frequently flooded during the growing season)
51	Chequest silty clay loam, frequently flooded (where drained and either protected from flooding or not frequently flooded during the growing season)
53B	Olmitz loam, 2 to 5 percent slopes
56A	Zook silty clay loam, frequently flooded, 0 to 2 percent slopes (where drained and either protected from flooding or not frequently flooded during the growing season)
56B	Zook silty clay loam, rarely flooded, 1 to 4 percent slopes (where drained)
57	Wabash silty clay, frequently flooded (where drained and either protected from flooding or not frequently flooded during the growing season)
58B	Vigar loam, 2 to 5 percent slopes
59	Arbela silt loam, ocasionally flooded (where drained)
67	Tice silt loam, frequently flooded (where protected from flooding or not frequently flooded during the growing season)

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE

(Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability	Corn	Soybeans	Grain sorghum	Winter wheat	Bromegrass-alfalfa hay	Alfalfa hay	Tall fescue
		Bu	Bu	Bu	Bu	Tons	Tons	AUM*
12------------- Belinda	IIIw	102	34	81	41	3.4	---	5.3
16B2----------- Pershing	IIIe	102	34	81	41	3.4	3.0	5.3
17C------------ Gorin	IIIe	93	31	72	37	3.1	2.9	4.9
17C2----------- Gorin	IIIe	87	29	70	35	3.0	2.5	4.6
21B------------ Cantril	IIe	96	32	76	38	3.2	---	5.0
27B------------ Adco	IIe	108	36	85	43	3.6	---	5.6
30D2----------- Shelby	IIIe	108	36	85	43	3.6	3.2	6.0
30E2----------- Shelby	IVe	98	33	77	39	3.3	3.0	5.2
31D2----------- Gara	IVe	87	29	70	35	3.0	2.8	4.8
31E2----------- Gara	VIe	---	---	---	---	2.6	2.5	4.0
32D3----------- Gara	VIe	---	---	---	---	2.7	2.5	4.0
32E3----------- Gara	VIe	---	---	---	---	2.3	---	3.8
34D2----------- Winnegan	IVe	79	26	63	33	2.7	2.5	4.0
34E2----------- Winnegan	VIe	---	---	---	---	2.3	---	3.8
34F------------ Winnegan	VIIe	---	---	---	---	---	---	3.0
35D3----------- Winnegan	VIe	---	---	---	---	2.5	---	4.0
35E3----------- Winnegan	VIe	---	---	---	---	2.2	---	3.7
41C2----------- Rinda	IVe	81	27	64	32	2.7	---	4.0
43C2----------- Keswick	IIIe	93	31	73	37	3.1	---	5.0

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Grain sorghum	Winter wheat	Bromegrass-alfalfa hay	Alfalfa hay	Tall fescue
		Bu	Bu	Bu	Bu	Tons	Tons	AUM*
43D2------------ Keswick	IVe	75	25	59	30	2.5	---	3.9
43D3------------ Keswick	VIe	---	---	---	---	2.0	---	3.5
44B------------- Armstrong	IIe	102	34	81	41	3.5	---	5.5
44C2------------ Armstrong	IIIe	93	31	73	37	3.1	---	4.9
44D2------------ Armstrong	IVe	81	27	64	32	2.6	---	4.0
45C3------------ Armstrong	IVe	79	25	62	31	2.6	---	4.0
45D3------------ Armstrong	VIe	---	---	---	---	2.5	---	3.8
48C2------------ Lamoni	IIIe	98	32	78	40	3.3	---	5.2
50-------------- Landes	IIIw	108	36	85	23	3.6	---	5.9
51-------------- Chequest	IIIw	113	37	89	---	3.8	---	6.0
53B------------- Olmitz	IIe	129	43	101	52	4.4	4.0	7.0
53C------------- Olmitz	IIIe	120	40	94	48	4.0	3.5	6.5
56A------------- Zook	IIIw	96	32	76	---	---	---	5.0
56B------------- Zook	IIw	96	32	76	38	3.2	---	5.0
57-------------- Wabash	IVw	69	30	71	28	3.0	---	4.9
58B------------- Vigar	IIe	120	40	94	48	4.0	4.0	7.0
59-------------- Arbela	IIw	112	37	88	45	3.8	---	6.5
67-------------- Tice	IIIw	110	34	85	---	3.6	---	6.0
71D------------- Lenzburg	IVe	73	22	75	24	3.0	---	5.0
71F------------- Lenzburg	VIIe	---	---	---	---	---	---	3.5

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Grain sorghum	Winter wheat	Bromegrass-alfalfa hay	Alfalfa hay	Tall fescue
		Bu	Bu	Bu	Bu	Tons	Tons	AUM*
74E2------------ Reger	VIIe	---	---	---	---	---	---	1.6
74F------------- Reger	VIIe	---	---	---	---	---	---	2.0

* 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. Absence of an entry indicates that information was not available)

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
12---------------- Belinda	2W	Slight	Severe	Moderate	Moderate	White oak-----------	45	30	Eastern cottonwood, silver maple, American sycamore, green ash.
16B2------------ Pershing	3C	Slight	Slight	Severe	Severe	White oak-----------	55	38	Eastern white pine, white oak.
17C, 17C2------- Gorin	3C	Slight	Slight	Moderate	Severe	White oak----------- Black oak----------- Northern red oak----	53 61 62	36 44 45	White oak, northern red oak, black oak.
21B------------- Cantril	4A	Slight	Slight	Slight	Slight	White oak-----------	75	57	White oak, northern red oak.
31D2------------ Gara	3A	Slight	Slight	Slight	Slight	White oak----------- Northern red oak---- Black oak-----------	55 55 59	38 38 41	Eastern white pine, white oak, northern red oak.
31E2------------ Gara	3R	Moderate	Moderate	Slight	Slight	White oak----------- Northern red oak---- Black oak-----------	55 55 59	38 38 41	Eastern white pine, white oak, northern red oak.
32D3------------ Gara	3A	Slight	Slight	Slight	Slight	White oak----------- Northern red oak---- Black oak-----------	55 55 59	38 38 41	Eastern white pine, white oak, northern red oak
32E3------------ Gara	3R	Moderate	Moderate	Slight	Slight	White oak----------- Northern red oak---- Black oak-----------	55 55 59	38 38 41	Eastern white pine, white oak, northern red oak.
34D2------------ Winnegan	3A	Slight	Slight	Slight	Slight	White oak----------- Post oak------------ Black oak-----------	60 --- ---	43 --- ---	White oak, black oak, northern red oak.
34E2, 34F------- Winnegan	3R	Moderate	Moderate	Slight	Slight	White oak----------- Post oak------------ Black oak-----------	60 --- ---	43 --- ---	White oak, black oak, northern red oak.

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Volume*	Trees to plant
35D3------------ Winnegan	3A	Slight	Slight	Slight	Slight	White oak-----------	60	43	White oak, black oak, northern red oak.
						Post oak------------	---	---	
						Black oak-----------	---	---	
35E3------------ Winnegan	3R	Moderate	Moderate	Slight	Slight	White oak-----------	60	43	White oak, black oak, northern red oak.
						Post oak------------	---	---	
						Black oak-----------	---	---	
41C2------------ Rinda	2W	Slight	Severe	Moderate	Moderate	White oak-----------	45	30	Pin oak, green ash, eastern redcedar.
						Northern red oak----	45	---	
43C2, 43D2, 43D3----------- Keswick	3C	Slight	Slight	Moderate	Severe	White oak-----------	55	38	Black oak.
						Northern red oak----	55	38	
						Post oak------------	---	---	
44B, 44C2, 44D2, 45C3, 45D3----- Armstrong	3C	Slight	Slight	Moderate	Severe	White oak-----------	55	38	Black oak.
						Northern red oak----	55	38	
						Post oak------------	---	---	
50-------------- Landes	10A	Slight	Slight	Slight	Slight	Eastern cottonwood--	105	141	Eastern cottonwood, American sycamore, green ash, black walnut, pecan.
						Yellow-poplar-------	95	96	
						American sycamore---	---	---	
						Sweetgum------------	---	---	
						Green ash-----------	---	---	
51-------------- Chequest	7W	Slight	Severe	Moderate	Moderate	Eastern cottonwood--	90	103	Silver maple, eastern cottonwood, American sycamore, green ash.
						Silver maple--------	80	34	
57-------------- Wabash	4W	Slight	Severe	Severe	Moderate	Pin oak-------------	75	57	Pin oak, pecan, eastern cottonwood.
67-------------- Tice	5A	Slight	Slight	Slight	Slight	Pin oak-------------	96	75	Eastern cottonwood, American sycamore, green ash.
						Eastern cottonwood--	---	---	
						White ash-----------	---	---	
71D------------- Lenzburg	5A	Slight	Slight	Slight	Slight	Black walnut--------	73	70	Black walnut, eastern cottonwood, green ash.
						Eastern cottonwood--	---	---	
71F------------- Lenzburg	5R	Moderate	Moderate	Slight	Slight	Black walnut--------	73	70	Black walnut, eastern cottonwood, green ash.
						Eastern cottonwood--	---	---	

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	Volume*	
74E2, 74F: Reger	3R	Moderate	Moderate	Moderate	Slight	Northern red oak	57	40	Northern red oak, white oak, black oak.
						White oak	---	---	
						Black oak	59	40	

* Volume is the yield in cubic feet per acre per year calculated at the age of culmination of mean annual increment for fully stocked natural stands.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
12. Belinda	---	Amur privet, silky dogwood, Amur honeysuckle, American cranberrybush.	Austrian pine, Norway spruce, blue spruce, northern whitecedar, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
16B2. Pershing	---	Eastern redcedar, American cranberrybush, Washington hawthorn, Amur privet, arrowwood, gray dogwood.	Austrian pine, Osage-orange, green ash.	Eastern white pine, pin oak.	---
17C, 17C2. Gorin	Fragrant sumac	Washington hawthorn, Amur maple.	Hackberry, eastern redcedar, Norway spruce.	Pin oak, Austrian pine, honeylocust.	---
21B. Cantril	---	Silky dogwood, American cranberrybush, Amur privet, gray dogwood.	Washington hawthorn, northern whitecedar, blue spruce, white fir, Austrian pine.	Norway spruce	Pin oak, eastern white pine.
27B. Adco	---	American cranberrybush, Amur privet, arrowwood, Washington hawthorn, eastern redcedar.	Austrian pine, green ash, Osage-orange.	Eastern white pine, pin oak.	---
30D2, 30E2. Shelby	---	Silky dogwood, American cranberrybush, Amur privet, gray dogwood.	Washington hawthorn, northern whitecedar, blue spruce, white fir.	Norway spruce, Austrian pine.	Pin oak, eastern white pine.
31D2, 31E2, 32D3, 32E3. Gara	---	Amur honeysuckle, American cranberrybush, Amur privet, silky dogwood.	Northern whitecedar, white fir, Washington hawthorn, blue spruce.	Austrian pine, Norway spruce.	Eastern white pine, pin oak.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
34D2, 34E2, 34F, 35D3, 35E3: Winnegan	---	American cranberrybush, Amur privet, arrowwood, Washington hawthorn, eastern redcedar.	Austrian pine, green ash, Osage-orange.	Pin oak, eastern white pine.	---
41C2: Rinda	---	American cranberrybush, eastern redcedar, Washington hawthorn, arrowwood, Amur privet.	Green ash, Austrian pine, Osage-orange.	Eastern white pine, pin oak.	---
43C2, 43D2, 43D3: Keswick	---	Eastern redcedar, American cranberrybush, Washington hawthorn, arrowwood, Amur privet.	Austrian pine, green ash, Osage-orange.	Eastern white pine, pin oak.	---
44B, 44C2, 44D2, 45C3, 45D3: Armstrong	---	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, American cranberrybush.	Austrian pine, green ash, Osage-orange.	Eastern white pine, pin oak.	---
48C2: Lamoni	---	Eastern redcedar, Washington hawthorn, arrowwood, Amur privet, American cranberrybush.	Austrian pine, green ash, Osage-orange.	Eastern white pine, pin oak.	---
50: Landes	---	Silky dogwood, Amur privet, American cranberrybush.	Austrian pine, white fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce	Eastern white pine, pin oak.
51: Chequest	---	Amur privet, silky dogwood, American cranberrybush, gray dogwood.	Norway spruce, Austrian pine, northern whitecedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
53B, 53C: Olmitz	---	Amur privet, silky dogwood, American cranberrybush.	White fir, blue spruce, northern whitecedar, Washington hawthorn.	Austrian pine, Norway spruce.	Pin oak, eastern white pine.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
56A, 56B-----------Zook	---	Silky dogwood, American cranberrybush, Amur privet.	Norway spruce, northern whitecedar, Austrian pine, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
57-----------------Wabash	---	Silky dogwood, Amur privet, American cranberrybush.	Norway spruce, Austrian pine, northern whitecedar, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
58B----------------Vigar	---	Amur privet, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce-----	Eastern white pine, pin oak.
59-----------------Arbela	---	American plum, silky dogwood, gray dogwood.	Nannyberry viburnum, Washington hawthorn, white fir.	Green ash, eastern white pine, Norway spruce, sweetgum.	Pin oak.
67-----------------Tice	---	Silky dogwood, Amur privet, American cranberrybush.	Austrian pine, white fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce-----	Eastern white pine, pin oak.
71D, 71F-----------Lenzburg	Siberian peashrub	Eastern redcedar, jack pine, Russian-olive, Washington hawthorn, Osage-orange.	Honeylocust, northern catalpa.	---	---
74E2, 74F----------Reger	Siberian peashrub	Gray dogwood, lilac, radiant crabapple, Washington hawthorn, eastern redcedar.	Austrian pine, eastern white pine, red pine.	---	---

TABLE 9.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe")

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
12 Belinda	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.
16B2 Pershing	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Severe: erodes easily.	Slight.
17C, 17C2 Gorin	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: slope.	Severe: erodes easily.	Slight.
21B Cantril	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight	Slight.
27B Adco	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Slight	Slight.
30D2 Shelby	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.
30E2 Shelby	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
31D2 Gara	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight	Moderate: slope.
31E2 Gara	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
32D3 Gara	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
32E3 Gara	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
34D2 Winnegan	Moderate: slope, wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Severe: slope.	Slight	Moderate: slope.
34E2 Winnegan	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
34F Winnegan	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
35D3 Winnegan	Moderate: slope, wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Severe: slope.	Slight	Moderate: slope.
35E3 Winnegan	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
41C2 Rinda	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: slope, wetness, percs slowly.	Severe: erodes easily.	Moderate: wetness.
43C2 Keswick	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: slope, wetness.	Severe: erodes easily.	Moderate: wetness.
43D2 Keswick	Severe: wetness.	Moderate: slope, wetness, percs slowly.	Severe: slope, wetness.	Severe: erodes easily.	Moderate: wetness, slope.
43D3 Keswick	Severe: wetness.	Moderate: slope, wetness.	Severe: slope, wetness.	Severe: erodes easily.	Moderate: wetness, slope.
44B Armstrong	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
44C2 Armstrong	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.
44D2 Armstrong	Severe: wetness.	Moderate: slope, wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness, slope.
45C3 Armstrong	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: slope, wetness.	Severe: erodes easily.	Moderate: wetness.
45D3 Armstrong	Severe: wetness.	Moderate: slope, wetness, percs slowly.	Severe: slope, wetness.	Severe: erodes easily.	Moderate: wetness, slope.
48C2 Lamoni	Severe: wetness, percs slowly.	Severe: percs slowly.	Severe: slope, wetness, percs slowly.	Severe: erodes easily.	Moderate: wetness.
50 Landes	Severe: flooding.	Moderate: flooding.	Slight	Moderate: flooding.	Severe: flooding.
51 Chequest	Severe: flooding, wetness.	Moderate: flooding, wetness, percs slowly.	Severe: wetness, flooding.	Moderate: wetness, flooding.	Severe: flooding.
53B Olmitz	Slight	Slight	Moderate: slope.	Slight	Slight.
53C Olmitz	Slight	Slight	Severe: slope.	Slight	Slight.
56A Zook	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
56B------------------- Zook	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
57-------------------- Wabash	Severe: flooding, wetness, percs slowly.	Severe: wetness, too clayey, percs slowly.	Severe: too clayey, wetness, flooding.	Severe: wetness, too clayey.	Severe: wetness, flooding, too clayey.
58B------------------- Vigar	Severe: flooding.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Slight----------	Slight.
59-------------------- Arbela	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
67-------------------- Tice	Severe: flooding.	Moderate: flooding, wetness.	Severe: flooding.	Moderate: wetness, flooding.	Severe: flooding.
71D------------------- Lenzburg	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: large stones, slope.
71F------------------- Lenzburg	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.	Severe: slope.
74E2------------------ Reger	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
74F------------------- Reger	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.	Severe: slope.

TABLE 10.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor")

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
12: Belinda	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
16B2: Pershing	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
17C, 17C2: Gorin	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
21B: Cantril	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
27B: Adco	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
30D2: Shelby	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
30E2: Shelby	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Fair	Very poor.
31D2: Gara	Fair	Good	Fair	Good	Good	Very poor.	Poor	Fair	Good	Poor.
31E2: Gara	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
32D3: Gara	Fair	Good	Fair	Good	Good	Very poor.	Poor	Fair	Good	Poor.
32E3: Gara	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
34D2: Winnegan	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
34E2: Winnegan	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
34F: Winnegan	Very poor.	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
35D3: Winnegan	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
35E3: Winnegan	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
41C2: Rinda	Poor	Fair	Poor	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.
43C2, 43D2, 43D3: Keswick	Fair	Good	Fair	Good	Fair	Very poor.	Poor	Fair	Good	Very poor.
44B: Armstrong	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Very poor.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	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
44C2, 44D2, 45C3, 45D3 Armstrong	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
48C2 Lamoni	Fair	Good	Fair	Fair	Fair	Poor	Poor	Good	Fair	Poor.
50 Landes	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
51 Chequest	Good	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good.
53B Olmitz	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
53C Olmitz	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
56A, 56B Zook	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
57 Wabash	Poor	Poor	Poor	Poor	Poor	Poor	Good	Poor	Poor	Fair.
58B Vigar	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
59 Arbela	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
67 Tice	Poor	Fair	Fair	Good	Good	Fair	Fair	Fair	Good	Fair.
71D Lenzburg	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
71F Lenzburg	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
74E2, 74F Reger	Very poor.	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.

TABLE 11.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
12----------------- Belinda	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
16B2--------------- Pershing	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength, frost action.	Slight.
17C, 17C2---------- Gorin	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength, frost action.	Slight.
21B---------------- Cantril	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness.	Severe: low strength, frost action.	Slight.
27B---------------- Adco	Moderate: too clayey, wetness.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength, frost action.	Slight.
30D2--------------- Shelby	Moderate: wetness, slope.	Moderate: shrink-swell, slope.	Moderate: wetness, slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
30E2--------------- Shelby	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
31D2--------------- Gara	Moderate: wetness, slope.	Moderate: shrink-swell, slope.	Moderate: wetness, slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
31E2--------------- Gara	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
32D3--------------- Gara	Moderate: wetness, slope.	Moderate: shrink-swell, slope.	Moderate: wetness, slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
32E3--------------- Gara	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
34D2--------------- Winnegan	Severe: wetness.	Severe: shrink-swell.	Severe: wetness.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.	Moderate: slope.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
34E2, 34F Winnegan	Severe: wetness, slope.	Severe: shrink-swell, slope.	Severe: wetness, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength, slope.	Severe: slope.
35D3 Winnegan	Severe: wetness.	Severe: shrink-swell.	Severe: wetness.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.	Moderate: slope.
35E3 Winnegan	Severe: wetness, slope.	Severe: shrink-swell, slope.	Severe: wetness, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength, slope.	Severe: slope.
41C2 Rinda	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, frost action.	Moderate: wetness.
43C2 Keswick	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength.	Moderate: wetness.
43D2, 43D3 Keswick	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell, slope.	Severe: shrink-swell, low strength.	Moderate: wetness, slope.
44B, 44C2 Armstrong	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength.	Moderate: wetness.
44D2 Armstrong	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell, slope.	Severe: shrink-swell, low strength.	Moderate: wetness, slope.
45C3 Armstrong	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength.	Moderate: wetness.
45D3 Armstrong	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell, slope.	Severe: shrink-swell, low strength.	Moderate: wetness, slope.
48C2 Lamoni	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength.	Moderate: wetness.
50 Landes	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
51 Chequest	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, flooding.	Severe: flooding.
53B Olmitz	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
53C---------------- Olmitz	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
56A---------------- 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.
56B---------------- 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.
57----------------- 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, flooding, too clayey.
58B---------------- Vigar	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength, frost action.	Slight.
59----------------- Arbela	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness.
67----------------- Tice	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength, flooding, frost action.	Severe: flooding.
71D---------------- Lenzburg	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: large stones, slope.
71F---------------- Lenzburg	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.	Severe: slope.
74E2, 74F---------- Reger	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

TABLE 12.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "fair," and other terms. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
12----------------- Belinda	Severe: wetness, percs slowly.	Moderate: seepage.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
16B2--------------- Pershing	Severe: wetness, percs slowly.	Moderate: slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
17C---------------- Gorin	Severe: wetness, percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
17C2--------------- Gorin	Severe: wetness, percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
21B---------------- Cantril	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
27B---------------- Adco	Severe: wetness, percs slowly.	Moderate: slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
30D2--------------- Shelby	Severe: wetness, percs slowly.	Severe: slope.	Moderate: wetness, slope, too clayey.	Moderate: slope.	Fair: too clayey, slope, wetness.
30E2--------------- Shelby	Severe: wetness, percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
31D2--------------- Gara	Severe: wetness, percs slowly.	Severe: slope.	Moderate: wetness, slope, too clayey.	Moderate: slope.	Fair: too clayey, slope, wetness.
31E2--------------- Gara	Severe: wetness, percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
32D3--------------- Gara	Severe: wetness, percs slowly.	Severe: slope.	Moderate: wetness, slope, too clayey.	Moderate: slope.	Fair: too clayey, slope, wetness.
32E3--------------- Gara	Severe: wetness, percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
34D2---------------- Winnegan	Severe: wetness, percs slowly.	Severe: slope.	Moderate: wetness, slope, too clayey.	Moderate: wetness, slope.	Fair: too clayey, slope, wetness.
34E2, 34F----------- Winnegan	Severe: wetness, percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
35D3---------------- Winnegan	Severe: wetness, percs slowly.	Severe: slope.	Moderate: wetness, slope, too clayey.	Moderate: wetness, slope.	Fair: too clayey, slope, wetness.
35E3---------------- Winnegan	Severe: wetness, percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
41C2---------------- Rinda	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
43C2, 43D2, 43D3---- Keswick	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness.	Severe: wetness.	Poor: wetness.
44B----------------- Armstrong	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
44C2, 44D2, 45C3, 45D3--------------- Armstrong	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
48C2---------------- Lamoni	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
50------------------ Landes	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage.	Poor: seepage, too sandy.
51------------------ Chequest	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
53B----------------- Olmitz	Moderate: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
53C----------------- Olmitz	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
56A----------------- Zook	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
56B----------------- Zook	Severe: wetness, percs slowly.	Moderate: seepage, slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
57------------------ Wabash	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
58B----------------- Vigar	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
59------------------ Arbela	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
67------------------ Tice	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack.
71D----------------- Lenzburg	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, small stones, slope.
71F----------------- Lenzburg	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
74E2, 74F----------- Reger	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: depth to rock, small stones, slope.

TABLE 13.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "good," "fair," and other terms. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
12-------------------- Belinda	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
16B2------------------ Pershing	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
17C, 17C2------------- Gorin	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
21B------------------- Cantril	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
27B------------------- Adco	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
30D2------------------ Shelby	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
30E2------------------ Shelby	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
31D2------------------ Gara	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
31E2------------------ Gara	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
32D3------------------ Gara	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
32E3------------------ Gara	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
34D2------------------ Winnegan	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
34E2------------------ Winnegan	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
34F------------------- Winnegan	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
35D3------------------ Winnegan	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
35E3: Winnegan	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
41C2: Rinda	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
43C2, 43D2, 43D3: Keswick	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
44B, 44C2, 44D2, 45C3, 45D3: Armstrong	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
48C2: Lamoni	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
50: Landes	Good	Probable	Improbable: too sandy.	Fair: small stones, thin layer.
51: Chequest	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
53B, 53C: Olmitz	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
56A, 56B: Zook	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
57: Wabash	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
58B: Vigar	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
59: Arbela	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
67: Tice	Fair: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
71D: Lenzburg	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
71F: Lenzburg	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
74E2------------------ Reger	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
74F------------------- Reger	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.

TABLE 14.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
12 Belinda	Slight	Severe: wetness.	Percs slowly	Wetness, percs slowly, erodes easily.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
16B2 Pershing	Moderate: slope.	Moderate: hard to pack, wetness.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Erodes easily, wetness.	Erodes easily, percs slowly.
17C, 17C2 Gorin	Moderate: slope.	Moderate: thin layer, hard to pack, wetness.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Erodes easily, wetness.	Erodes easily, percs slowly.
21B Cantril	Moderate: seepage, slope.	Moderate: wetness.	Frost action, slope.	Slope, wetness, rooting depth.	Wetness	Rooting depth.
27B Adco	Slight	Severe: hard to pack.	Percs slowly, frost action.	Wetness, percs slowly, slope.	Erodes easily, wetness, percs slowly.	Erodes easily, percs slowly.
30D2, 30E2 Shelby	Severe: slope.	Slight	Deep to water	Slope	Slope	Slope.
31D2, 31E2 Gara	Severe: slope.	Slight	Deep to water	Slope, rooting depth.	Slope	Slope, rooting depth.
32D3, 32E3 Gara	Severe: slope.	Slight	Deep to water	Slope, rooting depth, erodes easily.	Slope, erodes easily.	Slope, erodes easily, rooting depth.
34D2, 34E2, 34F, 35D3, 35E3 Winnegan	Severe: slope.	Moderate: wetness.	Percs slowly, slope.	Slope, wetness, percs slowly.	Slope, wetness.	Slope, percs slowly.
41C2 Rinda	Moderate: slope.	Severe: hard to pack.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Erodes easily, wetness.	Wetness, erodes easily.
43C2 Keswick	Moderate: slope.	Moderate: wetness.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Erodes easily, wetness.	Wetness, erodes easily.
43D2 Keswick	Severe: slope.	Moderate: wetness.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Slope, erodes easily, wetness.	Wetness, slope, erodes easily.
43D3 Keswick	Severe: slope.	Moderate: wetness.	Percs slowly, frost action, slope.	Slope, wetness.	Slope, erodes easily, wetness.	Wetness, slope, erodes easily.
44B, 44C2 Armstrong	Moderate: slope.	Severe: hard to pack.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
44D2: Armstrong	Severe: slope.	Severe: hard to pack.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Slope, wetness, percs slowly.	Wetness, slope, percs slowly.
45C3: Armstrong	Moderate: slope.	Severe: hard to pack.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Erodes easily, wetness.	Wetness, erodes easily.
45D3: Armstrong	Severe: slope.	Severe: hard to pack.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Slope, erodes easily, wetness.	Wetness, slope, erodes easily.
48C2: Lamoni	Moderate: slope.	Moderate: hard to pack, wetness.	Percs slowly, slope.	Slope, wetness, percs slowly.	Erodes easily, wetness.	Wetness, erodes easily.
50: Landes	Severe: seepage.	Severe: seepage, piping.	Deep to water	Favorable	Too sandy	Favorable.
51: Chequest	Slight	Severe: wetness.	Flooding, frost action.	Wetness, flooding.	Erodes easily, wetness.	Wetness, erodes easily.
53B, 53C: Olmitz	Moderate: seepage, slope.	Slight	Deep to water	Slope	Favorable	Favorable.
56A: Zook	Slight	Severe: hard to pack, wetness.	Percs slowly, flooding, frost action.	Wetness, percs slowly.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
56B: Zook	Slight	Severe: hard to pack, wetness.	Percs slowly, frost action.	Wetness, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly.
57: Wabash	Slight	Severe: hard to pack, wetness.	Percs slowly, flooding.	Wetness, droughty, slow intake.	Wetness, percs slowly.	Wetness, droughty, percs slowly.
58B: Vigar	Moderate: slope.	Moderate: wetness.	Frost action, slope.	Slope, wetness.	Wetness	Favorable.
59: Arbela	Moderate: seepage.	Severe: wetness.	Flooding, frost action.	Wetness, flooding.	Erodes easily, wetness.	Wetness, erodes easily.
67: Tice	Moderate: seepage.	Severe: wetness.	Flooding, frost action.	Wetness	Wetness	Favorable.
71D, 71F: Lenzburg	Severe: slope.	Moderate: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
74E2, 74F: Reger	Severe: slope.	Severe: seepage.	Deep to water	Slope, droughty, soil blowing.	Slope, depth to rock, erodes easily.	Slope, erodes easily, droughty.

TABLE 15.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 10 inches	Fragments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
12------------ Belinda	0-7	Silt loam-----	CL, ML	A-4, A-6	0	0	100	100	100	95-100	30-40	5-15
	7-17	Silt loam-----	CL-ML, CL, ML	A-4	0	0	100	100	100	95-100	25-35	5-10
	17-43	Silty clay, silty clay loam.	CH	A-7	0	0	100	100	100	95-100	40-55	20-30
	43-60	Silty clay loam.	CH	A-7	0	0	100	100	100	95-100	50-65	25-35
16B2---------- Pershing	0-6	Silty clay loam.	CL, CH	A-7	0	0	100	100	100	95-100	40-55	15-30
	6-43	Silty clay loam, silty clay.	CH, CL	A-7	0	0	100	100	100	95-100	40-65	20-40
	43-60	Silty clay loam, silt loam.	CH, CL	A-7, A-6	0	0	100	100	100	95-100	35-55	20-35
17C----------- Gorin	0-13	Silt loam-----	CL, CL-ML	A-4, A-6	0	0	100	100	90-100	70-90	25-40	5-18
	13-20	Silty clay loam, silty clay.	CL	A-6, A-7	0	0	100	100	95-100	90-100	35-50	15-30
	20-36	Silty clay, silty clay loam.	CH	A-7	0	0	100	100	95-100	90-100	50-65	30-40
	36-60	Silty clay loam, clay loam.	CL	A-6, A-7	0	0	100	100	80-95	70-90	30-50	12-30
17C2---------- Gorin	0-7	Silt loam-----	CL, CL-ML	A-4, A-6	0	0	100	100	90-100	70-90	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
	14-37	Silty clay, silty clay loam.	CH	A-7	0	0	100	100	95-100	90-100	50-65	30-40
	37-49	Silty clay loam, clay loam.	CL	A-6, A-7	0	0	100	100	80-95	70-90	30-50	12-30
	49-60	Loam, silt loam.	CL	A-4, A-6	0	0	100	95-100	85-100	65-90	25-35	8-15
21B----------- Cantril	0-10	Loam----------	CL	A-6	0	0	100	100	85-95	65-75	30-40	11-20
	10-60	Clay loam-----	CL	A-6, A-7	0	0	100	100	90-100	70-88	35-45	15-25
27B----------- Adco	0-8	Silt loam-----	CL	A-6, A-7	0	0	100	100	100	95-100	30-45	13-25
	8-13	Silt loam, silty clay loam.	CL	A-6, A-7	0	0	100	100	100	95-100	30-45	13-25
	13-27	Silty clay----	CH	A-7	0	0	100	100	100	95-100	66-76	41-49
	27-53	Silty clay loam, silty clay.	CL, CH	A-7	0	0	100	100	100	90-100	43-66	22-41
	53-60	Silt loam, silty clay loam, clay loam.	CL	A-6, A-7	0	0	100	100	95-100	75-100	31-51	13-29

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 10 inches	Fragments 3-10 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
30D2, 30E2---- Shelby	0-7	Clay loam-----	CL	A-6, A-7	0	0	90-95	85-95	75-90	55-70	35-45	15-25
	7-12	Clay loam-----	CL	A-6, A-7	0	0	90-95	85-95	75-90	55-70	35-45	15-25
	12-37	Clay loam-----	CL	A-6, A-7	0	0-5	90-95	85-95	75-90	55-70	30-45	15-25
	37-60	Clay loam-----	CL	A-6, A-7	0	0-5	90-95	85-95	75-90	55-70	30-45	15-25
31D2, 31E2---- Gara	0-7	Clay loam-----	CL	A-6, A-7	0	0	90-95	85-95	70-85	55-75	35-45	15-25
	7-42	Clay loam, loam.	CL	A-6	0	0-5	90-95	85-95	70-85	55-75	30-40	15-25
	42-60	Clay loam, loam.	CL	A-6	0	0-5	90-95	85-95	70-85	55-75	30-40	15-25
32D3, 32E3---- Gara	0-4	Clay loam-----	CL	A-6, A-7	0	0	90-95	85-95	70-85	55-75	35-45	15-25
	4-22	Clay loam, loam.	CL	A-6	0	0-5	90-95	85-95	70-85	55-75	30-40	15-25
	22-60	Loam, clay loam.	CL	A-6	0	0-5	90-95	85-95	70-85	55-75	30-40	15-25
34D2, 34E2, 34F---------- Winnegan	0-6	Loam----------	CL-ML, CL	A-4, A-6	0	0	95-100	95-100	80-90	60-80	20-30	5-15
	6-27	Clay loam, clay.	CL	A-7	0	0	95-100	95-100	85-95	65-85	40-50	20-30
	27-60	Clay loam, loam.	CL	A-6	0	0	95-100	95-100	85-95	60-80	25-40	10-20
35D3, 35E3---- Winnegan	0-3	Clay loam-----	CL	A-6	0	0	95-100	95-100	80-90	65-80	25-40	11-20
	3-27	Clay loam, clay.	CL	A-7	0	0	95-100	95-100	85-95	65-85	40-50	20-30
	27-60	Clay loam, loam.	CL	A-6	0	0	95-100	95-100	85-95	60-80	25-40	10-20
41C2---------- Rinda	0-6	Silty clay loam.	CL	A-7	0	0	100	95-100	90-100	85-100	40-50	20-30
	6-11	Silty clay loam.	CH	A-7	0	0	100	95-100	90-100	85-100	45-55	20-30
	11-60	Clay, silty clay.	CH, CL	A-7	0	0	95-100	95-100	80-95	75-90	55-70	35-45
43C2, 43D2---- Keswick	0-4	Loam----------	CL, CL-ML	A-6, A-4	0	0-5	90-100	80-100	75-90	60-80	20-30	5-15
	4-32	Clay loam, clay.	CH, CL	A-7	0	0-5	90-100	80-100	70-90	55-80	40-70	20-40
	32-60	Clay loam-----	CL	A-6	0	0-5	90-100	80-100	70-90	55-80	30-40	15-25
43D3---------- Keswick	0-4	Clay loam-----	CL	A-6, A-7	0	0-5	90-100	80-100	75-90	60-80	35-50	15-25
	4-22	Clay loam, clay.	CH, CL	A-7	0	0-5	90-100	80-100	70-90	55-80	40-70	20-40
	22-60	Clay loam-----	CL	A-6	0	0-5	90-100	80-100	70-90	55-80	30-40	15-25
44B----------- Armstrong	0-8	Loam----------	CL, CL-ML	A-6, A-4	0	0-5	90-100	80-95	75-90	55-80	20-30	5-15
	8-45	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
	45-60	Clay loam-----	CL	A-6	0	0-5	90-100	80-95	70-90	55-80	30-40	15-20
44C2, 44D2---- Armstrong	0-8	Clay loam-----	CL	A-6, A-7	0	0-5	90-100	80-95	75-90	55-80	35-45	15-25
	8-43	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
	43-60	Clay loam-----	CL	A-6	0	0-5	90-100	80-95	70-90	55-80	30-40	15-20

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 10 inches	Frag- ments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct	Pct					Pct	
45C3, 45D3: Armstrong	0-5	Clay loam	CL	A-6, A-7	0	0-5	90-100	80-95	75-90	55-80	35-45	15-25
	5-44	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
	44-60	Clay loam	CL	A-6	0	0-5	90-100	80-95	70-90	55-80	30-40	15-20
48C2: Lamoni	0-6	Clay loam	CL	A-6, A-7	0	0	95-100	95-100	80-95	70-95	35-45	15-25
	6-44	Clay loam, clay.	CH	A-7	0	0	95-100	95-100	90-100	85-100	50-60	25-35
	44-60	Clay loam	CL	A-6, A-7	0	0	95-100	95-100	70-90	55-85	35-50	15-30
50: Landes	0-11	Loam	CL, CL-ML	A-4, A-6	0	0	100	90-100	85-95	50-75	25-35	5-15
	11-55	Fine sandy loam, loam, loamy fine sand.	SM, ML, CL-ML, SC-SM	A-2, A-4	0	0	100	85-100	70-95	20-70	<25	NP-10
	55-60	Stratified sand to silt loam.	SM, ML, SP-SM, SC	A-2, A-4	0	0	100	95-100	60-95	10-70	<30	NP-10
51: Chequest	0-13	Silty clay loam.	CL	A-7	0	0	100	100	95-100	95-100	40-50	15-25
	13-60	Silty clay loam, silty clay.	CL, CH	A-7	0	0	100	100	95-100	90-100	45-60	20-30
53B, 53C: Olmitz	0-16	Loam	CL	A-6	0	0	100	90-100	85-95	60-80	30-40	11-20
	16-50	Loam, clay loam.	CL	A-6	0	0	100	90-100	85-95	60-80	30-40	11-20
	50-60	Clay loam	CL	A-6, A-7	0	0	100	90-100	85-95	60-80	35-45	15-25
56A: Zook	0-13	Silty clay loam.	CH, CL	A-7	0	0	100	100	95-100	95-100	45-65	20-35
	13-36	Silty clay, silty clay loam.	CH	A-7	0	0	100	100	95-100	95-100	60-85	35-55
	36-60	Silty clay loam, silty clay, silt loam.	CH, CL, ML, MH	A-7, A-6	0	0	100	100	95-100	95-100	35-80	10-50
56B: Zook	0-11	Silty clay loam.	CH, CL	A-7	0	0	100	100	95-100	95-100	45-65	20-35
	11-60	Silty clay, silty clay loam.	CH	A-7	0	0	100	100	95-100	95-100	60-85	35-55
57: Wabash	0-21	Silty clay	CH	A-7	0	0	100	100	100	95-100	50-75	30-50
	21-60	Silty clay, clay.	CH	A-7	0	0	100	100	100	95-100	52-78	30-55
58B: Vigar	0-13	Loam	CL-ML, CL	A-4, A-6	0	0	95-100	90-100	85-95	60-75	20-30	5-15
	13-60	Clay loam, silty clay loam, loam.	CL	A-6	0	0	95-100	90-100	70-95	60-90	30-40	15-25

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification Unified	Classification AASHTO	Frag- ments > 10 inches	Frag- ments 3-10 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct	Pct					Pct	
59------------ Arbela	0-10	Silt loam-----	CL-ML, CL	A-4, A-6	0	0	100	100	95-100	90-100	25-40	5-15
	10-13	Silt loam, silty clay loam.	CL-ML, CL	A-4, A-6	0	0	100	100	95-100	90-100	25-35	5-15
	13-41	Silty clay loam, silty clay.	CL	A-6, A-7	0	0	100	100	95-100	90-100	35-50	20-30
	41-60	Silty clay loam, clay loam.	CL	A-6	0	0	100	100	90-100	70-95	30-40	15-25
67------------ Tice	0-13	Silt loam-----	CL	A-6, A-7	0	0	100	100	90-100	80-95	30-45	10-20
	13-34	Silty clay loam, silt loam.	CL, CH	A-7	0	0	100	100	95-100	85-95	40-55	15-30
	34-60	Stratified silty clay loam to loam.	CL-ML, CL	A-4, A-6, A-7	0	0	100	100	60-95	55-80	25-45	5-20
71D, 71F------ Lenzburg	0-5	Clay loam-----	CL	A-6, A-7	0-1	2-10	80-100	75-100	65-95	55-85	35-50	15-25
	5-30	Silty clay loam, clay loam, gravelly loam.	CL	A-6, A-7	0-2	5-15	75-95	70-95	65-95	60-90	25-45	10-25
	30-60	Silty clay, silty clay loam, clay loam.	CL, CH	A-6, A-7	0-5	5-25	70-95	60-90	55-90	50-90	30-55	15-30
74E2---------- Reger	0-3	Fine sandy loam.	ML, SM, SC-SM	A-2, A-4	0	0	95-100	95-100	60-85	30-55	11-20	NP-5
	3-7	Very fine sandy loam, loam, fine sandy loam.	ML, CL-ML, SM	A-2, A-4	0	0-5	90-100	90-100	50-85	30-75	11-20	NP-5
	7-27	Very fine sandy loam, fine sandy loam, loam.	ML, CL-ML, SM	A-2, A-4	0	0-10	30-60	25-50	15-50	5-45	11-20	NP-5
	27-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---	---
74F----------- Reger	0-3	Very fine sandy loam.	ML, CL-ML	A-4	0	0	95-100	90-100	80-95	50-90	11-20	NP-5
	3-7	Very fine sandy loam, loam, fine sandy loam.	ML, CL-ML, SM	A-2, A-4	0	0-5	90-100	90-100	50-85	30-75	11-20	NP-5
	7-27	Very fine sandy loam, fine sandy loam, loam.	ML, CL-ML, SM	A-2, A-4	0	0-10	30-60	25-50	15-50	5-45	11-20	NP-5
	27-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---	---

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
12---------------- Belinda	0-7	16-22	1.35-1.40	0.6-2.0	0.22-0.24	5.6-7.3	Low----------	0.37	3	6	2-3
	7-17	18-27	1.30-1.35	0.6-2.0	0.20-0.22	4.5-6.0	Low----------	0.43			
	17-43	28-52	1.30-1.45	<0.06	0.12-0.14	4.5-6.5	High---------	0.32			
	43-60	28-40	1.40-1.50	0.06-0.6	0.18-0.20	5.1-6.0	High---------	0.43			
16B2-------------- Pershing	0-6	27-38	1.30-1.40	0.2-0.6	0.22-0.24	4.5-7.3	Moderate-----	0.37	3	7	2-3
	6-43	35-48	1.35-1.45	0.06-0.2	0.18-0.20	5.1-6.0	High---------	0.43			
	43-60	24-40	1.35-1.50	0.2-0.6	0.18-0.20	5.1-6.5	High---------	0.43			
17C--------------- Gorin	0-13	12-27	1.30-1.50	0.6-2.0	0.22-0.24	5.1-7.3	Moderate-----	0.43	3	6	.5-1
	13-20	27-42	1.30-1.45	0.06-0.6	0.18-0.20	4.5-6.5	Moderate-----	0.32			
	20-36	35-60	1.30-1.40	0.06-0.2	0.11-0.16	4.5-6.0	High---------	0.32			
	36-60	27-40	1.30-1.45	0.2-0.6	0.18-0.20	4.5-6.5	Moderate-----	0.32			
17C2-------------- Gorin	0-7	12-27	1.30-1.50	0.6-2.0	0.22-0.24	5.1-7.3	Moderate-----	0.43	3	6	.5-1
	7-14	27-42	1.30-1.45	0.06-0.6	0.18-0.20	4.5-6.5	Moderate-----	0.32			
	14-37	35-60	1.30-1.40	0.06-0.2	0.11-0.16	4.5-6.0	High---------	0.32			
	37-49	27-40	1.30-1.45	0.2-0.6	0.18-0.20	4.5-6.5	Moderate-----	0.32			
	49-60	20-27	1.30-1.45	0.2-0.6	0.17-0.20	4.5-6.5	Moderate-----	0.32			
21B--------------- Cantril	0-10	14-27	1.40-1.45	0.6-2.0	0.17-0.19	5.1-7.3	Low----------	0.28	5	6	2-3
	10-60	27-35	1.45-1.75	0.6-2.0	0.14-0.16	5.1-6.5	Moderate-----	0.32			
27B--------------- Adco	0-8	15-27	1.20-1.40	0.6-2.0	0.20-0.24	4.5-7.3	Low----------	0.32	3	6	2-4
	8-13	15-30	1.20-1.40	0.6-2.0	0.16-0.20	4.5-6.5	Low----------	0.32			
	13-27	50-60	1.20-1.40	<0.06	0.09-0.11	5.1-6.5	High---------	0.43			
	27-53	32-50	1.25-1.45	0.06-0.2	0.12-0.18	5.1-7.3	High---------	0.43			
	53-60	15-35	1.30-1.50	0.06-0.2	0.14-0.18	5.6-7.3	Moderate-----	0.43			
30D2, 30E2-------- Shelby	0-7	27-35	1.50-1.55	0.2-0.6	0.16-0.18	5.1-7.3	Moderate-----	0.32	5	6	2-3
	7-12	30-35	1.50-1.55	0.2-0.6	0.16-0.18	5.1-7.3	Moderate-----	0.28			
	12-37	30-35	1.55-1.65	0.2-0.6	0.16-0.18	5.1-7.3	Moderate-----	0.28			
	37-60	30-35	1.55-1.65	0.2-0.6	0.16-0.18	6.6-8.4	Moderate-----	0.37			
31D2, 31E2-------- Gara	0-7	27-35	1.50-1.55	0.2-0.6	0.16-0.18	5.6-7.3	Moderate-----	0.32	5	6	2-3
	7-42	25-38	1.55-1.75	0.2-0.6	0.16-0.18	4.5-6.5	Moderate-----	0.32			
	42-60	24-38	1.65-1.75	0.2-0.6	0.16-0.18	5.6-8.4	Moderate-----	0.37			
32D3, 32E3-------- Gara	0-4	27-35	1.50-1.55	0.2-0.6	0.16-0.18	5.6-7.3	Moderate-----	0.37	4	6	.5-1
	4-22	25-38	1.55-1.75	0.2-0.6	0.16-0.18	4.5-6.5	Moderate-----	0.32			
	22-60	24-38	1.65-1.75	0.2-0.6	0.16-0.18	5.6-8.4	Moderate-----	0.37			
34D2, 34E2, 34F-- Winnegan	0-6	18-27	1.20-1.40	0.6-2.0	0.20-0.24	4.5-7.3	Low----------	0.32	3	6	.5-1
	6-27	35-45	1.35-1.55	0.06-0.2	0.09-0.15	4.5-6.5	High---------	0.32			
	27-60	20-35	1.40-1.60	0.2-0.6	0.09-0.15	7.4-8.4	Moderate-----	0.32			
35D3, 35E3-------- Winnegan	0-3	27-35	1.20-1.40	0.2-0.6	0.17-0.19	4.5-7.3	Moderate-----	0.32	3	6	.5-1
	3-27	35-45	1.35-1.55	0.06-0.2	0.09-0.15	4.5-6.5	High---------	0.32			
	27-60	20-35	1.40-1.60	0.2-0.6	0.09-0.15	7.4-8.4	Moderate-----	0.32			
41C2-------------- Rinda	0-6	27-35	1.45-1.50	0.2-0.6	0.20-0.22	5.6-7.3	Moderate-----	0.43	3	7	2-3
	6-11	30-40	1.45-1.50	0.2-0.6	0.18-0.20	5.1-6.5	High---------	0.43			
	11-60	40-60	1.45-1.60	<0.06	0.14-0.16	5.1-7.3	High---------	0.32			
43C2, 43D2-------- Keswick	0-4	22-27	1.45-1.50	0.6-2.0	0.17-0.22	4.5-7.3	Moderate-----	0.37	3	6	.5-1
	4-32	35-60	1.45-1.60	0.06-0.2	0.11-0.15	4.5-6.0	High---------	0.37			
	32-60	30-40	1.60-1.75	0.2-0.6	0.12-0.16	4.5-7.8	Moderate-----	0.37			

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
43D3------------- Keswick	0-4	27-40	1.45-1.50	0.2-0.6	0.17-0.19	4.5-7.3	Moderate-----	0.37	2	4	.5-1
	4-22	35-60	1.45-1.60	0.06-0.2	0.11-0.15	4.5-6.0	High---------	0.37			
	22-60	30-40	1.60-1.75	0.2-0.6	0.12-0.16	4.5-7.8	Moderate-----	0.37			
44B-------------- Armstrong	0-8	22-27	1.45-1.50	0.6-2.0	0.20-0.22	5.6-7.3	Moderate-----	0.32	3	6	2-3
	8-45	36-60	1.45-1.55	0.06-0.2	0.11-0.16	4.5-6.5	High---------	0.32			
	45-60	30-36	1.55-1.70	0.2-0.6	0.14-0.16	5.1-7.8	Moderate-----	0.32			
44C2, 44D2------- Armstrong	0-8	35-40	1.45-1.50	0.2-0.6	0.18-0.20	5.6-7.3	Moderate-----	0.32	3	4	2-3
	8-43	36-60	1.45-1.55	0.06-0.2	0.11-0.16	4.5-6.5	High---------	0.32			
	43-60	30-36	1.55-1.70	0.2-0.6	0.14-0.16	5.1-7.8	Moderate-----	0.32			
45C3, 45D3------- Armstrong	0-5	35-40	1.45-1.50	0.2-0.6	0.18-0.20	5.6-7.3	Moderate-----	0.37	2	4	1-2
	5-44	36-60	1.45-1.55	0.06-0.2	0.11-0.16	4.5-6.5	High---------	0.32			
	44-60	30-36	1.55-1.70	0.2-0.6	0.14-0.16	5.1-7.8	Moderate-----	0.32			
48C2------------- Lamoni	0-6	27-40	1.45-1.50	0.2-0.6	0.17-0.21	5.1-7.3	Moderate-----	0.37	3	7	2-3
	6-44	38-50	1.55-1.65	<0.2	0.13-0.17	5.1-6.5	High---------	0.37			
	44-60	32-40	1.60-1.70	0.06-0.2	0.14-0.18	5.6-7.3	High---------	0.37			
50--------------- Landes	0-11	8-22	1.20-1.40	0.6-2.0	0.20-0.22	5.6-8.4	Low----------	0.28	4	5	1-2
	11-55	5-18	1.45-1.70	2.0-6.0	0.10-0.15	5.6-8.4	Low----------	0.20			
	55-60	5-18	1.60-1.70	6.0-20	0.05-0.15	5.6-8.4	Low----------	0.20			
51--------------- Chequest	0-13	30-35	1.30-1.35	0.2-0.6	0.18-0.20	5.1-7.3	High---------	0.32	5	7	3-4
	13-60	35-42	1.35-1.45	0.2-0.6	0.14-0.18	5.1-6.0	High---------	0.43			
53B, 53C--------- Olmitz	0-16	24-27	1.40-1.45	0.6-2.0	0.19-0.21	5.6-7.3	Moderate-----	0.24	5	6	3-4
	16-50	24-30	1.40-1.45	0.6-2.0	0.19-0.21	5.6-7.3	Moderate-----	0.28			
	50-60	27-34	1.45-1.55	0.6-2.0	0.15-0.17	5.1-6.5	Moderate-----	0.28			
56A-------------- Zook	0-13	35-40	1.30-1.35	0.2-0.6	0.21-0.23	5.6-7.3	High---------	0.37	5	7	4-6
	13-36	36-45	1.30-1.45	0.06-0.2	0.11-0.13	5.6-7.8	High---------	0.28			
	36-60	20-45	1.30-1.45	0.06-0.6	0.11-0.22	5.6-7.8	High---------	0.28			
56B-------------- Zook	0-11	35-40	1.30-1.35	0.2-0.6	0.21-0.23	5.6-7.3	High---------	0.28	5	4	4-6
	11-60	35-45	1.30-1.45	0.06-0.2	0.11-0.13	5.6-7.3	High---------	0.28			
57--------------- Wabash	0-21	40-46	1.25-1.45	<0.06	0.12-0.14	5.1-7.3	Very high----	0.28	5	4	2-4
	21-60	40-60	1.20-1.45	<0.06	0.08-0.12	5.1-7.8	Very high----	0.28			
58B-------------- Vigar	0-13	15-27	1.25-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.24	5	5	2-4
	13-60	24-35	1.20-1.40	0.2-0.6	0.14-0.16	5.6-7.3	Moderate-----	0.32			
59--------------- Arbela	0-10	20-27	1.30-1.50	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.32	5	6	2-4
	10-13	18-30	1.35-1.55	0.6-2.0	0.20-0.22	5.1-6.5	Low----------	0.43			
	13-41	35-45	1.30-1.40	0.2-0.6	0.18-0.20	4.5-6.0	Moderate-----	0.43			
	41-60	27-36	1.30-1.40	0.2-0.6	0.16-0.20	5.6-6.5	Moderate-----	0.43			
67--------------- Tice	0-13	22-27	1.25-1.45	0.6-2.0	0.21-0.24	6.1-7.8	Moderate-----	0.32	5	6	2-3
	13-34	24-35	1.30-1.50	0.6-2.0	0.18-0.20	5.6-7.8	Moderate-----	0.32			
	34-60	15-30	1.40-1.60	0.6-2.0	0.11-0.18	5.6-7.8	Moderate-----	0.32			
71D, 71F--------- Lenzburg	0-5	27-35	1.30-1.60	0.6-2.0	0.17-0.22	6.6-8.4	Moderate-----	0.37	5	4L	<0.5
	5-30	20-35	1.40-1.70	0.2-0.6	0.11-0.17	7.4-8.4	Moderate-----	0.37			
	30-60	25-45	1.40-1.70	0.2-0.6	0.08-0.18	7.4-8.4	High---------	0.32			
74E2------------- Reger	0-3	5-15	1.30-1.50	2.0-6.0	0.12-0.15	5.1-7.3	Low----------	0.24	4	3	.5-1
	3-7	5-15	1.25-1.45	0.6-2.0	0.12-0.17	5.1-6.5	Low----------	0.43			
	7-27	5-15	1.30-1.50	0.6-2.0	0.06-0.09	5.1-7.3	Low----------	0.17			
	27-60	---	---	0.2-0.6	---	---	--------------	----			

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
74F-------------- Reger	0-3	5-15	1.20-1.40	0.6-2.0	0.18-0.22	5.1-7.3	Low----------	0.37	4	3	1-2
	3-7	5-15	1.25-1.45	0.6-2.0	0.12-0.17	5.1-6.5	Low----------	0.43			
	7-27	5-15	1.30-1.50	0.6-2.0	0.06-0.09	5.1-7.3	Low----------	0.17			
	27-60	---	---	0.2-0.6	---	---	-------------	----			

TABLE 17.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
12 Belinda	D	None	---	---	0.5-2.0	Perched	Nov-May	>60	---	Moderate	High	Moderate.
16B2 Pershing	C	None	---	---	2.0-4.0	Perched	Nov-May	>60	---	High	High	Moderate.
17C, 17C2 Gorin	C	None	---	---	2.0-4.0	Perched	Nov-Apr	>60	---	High	High	Moderate.
21B Cantril	B	None	---	---	2.0-4.0	Apparent	Nov-May	>60	---	High	Moderate	Low.
27B Adco	D	None	---	---	2.0-4.0	Perched	Nov-May	>60	---	High	High	Moderate.
30D2, 30E2 Shelby	B	None	---	---	3.0-5.0	---	---	>60	---	Moderate	Moderate	Moderate.
31D2, 31E2, 32D3, 32E3 Gara	C	None	---	---	3.0-5.0	---	---	>60	---	Moderate	Moderate	Moderate.
34D2, 34E2, 34F, 35D3, 35E3 Winnegan	C	None	---	---	2.0-3.5	Perched	Nov-Apr	>60	---	Moderate	High	High.
41C2 Rinda	D	None	---	---	1.0-3.0	Perched	Nov-May	>60	---	High	High	Moderate.
43C2, 43D2, 43D3 Keswick	C	None	---	---	1.0-3.0	Perched	Nov-May	>60	---	High	High	Moderate.
44B, 44C2, 44D2, 45C3, 45D3 Armstrong	C	None	---	---	1.0-3.0	Perched	Nov-May	>60	---	High	High	Moderate.
48C2 Lamoni	C	None	---	---	1.0-3.0	Perched	Nov-Apr	>60	---	Moderate	High	Moderate.
50 Landes	B	Frequent	Brief	Nov-May	4.0-6.0	Apparent	Nov-May	>60	---	Moderate	Low	Low.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
51----------------- Chequest	C	Frequent----	Brief-----	Nov-May	1.0-3.0	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.
53B, 53C---------- Olmitz	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
56A--------------- Zook	C/D	Frequent----	Brief-----	Nov-May	0-2.0	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.
56B--------------- Zook	C	Rare--------	---	---	0-2.0	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.
57---------------- Wabash	D	Frequent----	Brief-----	Nov-May	0-1.0	Apparent	Nov-May	>60	---	Moderate	High-----	Moderate.
58B--------------- Vigar	C	Rare--------	---	---	2.0-3.0	Apparent	Nov-Apr	>60	---	High-----	High-----	Moderate.
59---------------- Arbela	C	Occasional	Brief-----	Nov-Apr	0-1.5	Apparent	Nov-May	>60	---	High-----	High-----	Moderate.
67---------------- Tice	B	Frequent----	Very brief or brief.	Nov-May	1.5-3.0	Apparent	Nov-May	>60	---	High-----	High-----	Low.
71D, 71F---------- Lenzburg	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
74E2, 74F--------- Reger	B	None--------	---	---	>6.0	---	---	20-40	Soft	Moderate	Moderate	High.

TABLE 18.--CLASSIFICATION OF THE SOILS

(An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series)

Soil name	Family or higher taxonomic class
Adco	Fine, montmorillonitic, mesic Albaquic Hapludalfs
Arbela	Fine, montmorillonitic, mesic Argiaquic Argialbolls
Armstrong	Fine, montmorillonitic, mesic Aquollic Hapludalfs
Belinda	Fine, montmorillonitic, mesic Mollic Albaqualfs
Cantril	Fine-loamy, mixed, mesic Udollic Ochraqualfs
Chequest	Fine, montmorillonitic, mesic Typic Haplaquolls
Gara	Fine-loamy, mixed, mesic Mollic Hapludalfs
Gorin	Fine, montmorillonitic, mesic Aquic Hapludalfs
Keswick	Fine, montmorillonitic, mesic Aquic Hapludalfs
*Lamoni	Fine, montmorillonitic, mesic Aquic Argiudolls
Landes	Coarse-loamy, mixed, mesic Fluventic Hapludolls
Lenzburg	Fine-loamy, mixed (calcareous), mesic Typic Udorthents
Olmitz	Fine-loamy, mixed, mesic Cumulic Hapludolls
Pershing	Fine, montmorillonitic, mesic Aquollic Hapludalfs
Reger	Coarse-loamy, mixed, mesic Dystric Eutrochrepts
Rinda	Fine, montmorillonitic, mesic, sloping Mollic Ochraqualfs
Shelby	Fine-loamy, mixed, mesic Typic Argiudolls
Tice	Fine-silty, mixed, mesic Fluvaquentic Hapludolls
Vigar	Fine-loamy, mixed, mesic Aquic Argiudolls
Wabash	Fine, montmorillonitic, mesic Vertic Haplaquolls
Winnegan	Fine, mixed, mesic Typic Hapludalfs
Zook	Fine, montmorillonitic, mesic Cumulic Haplaquolls

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