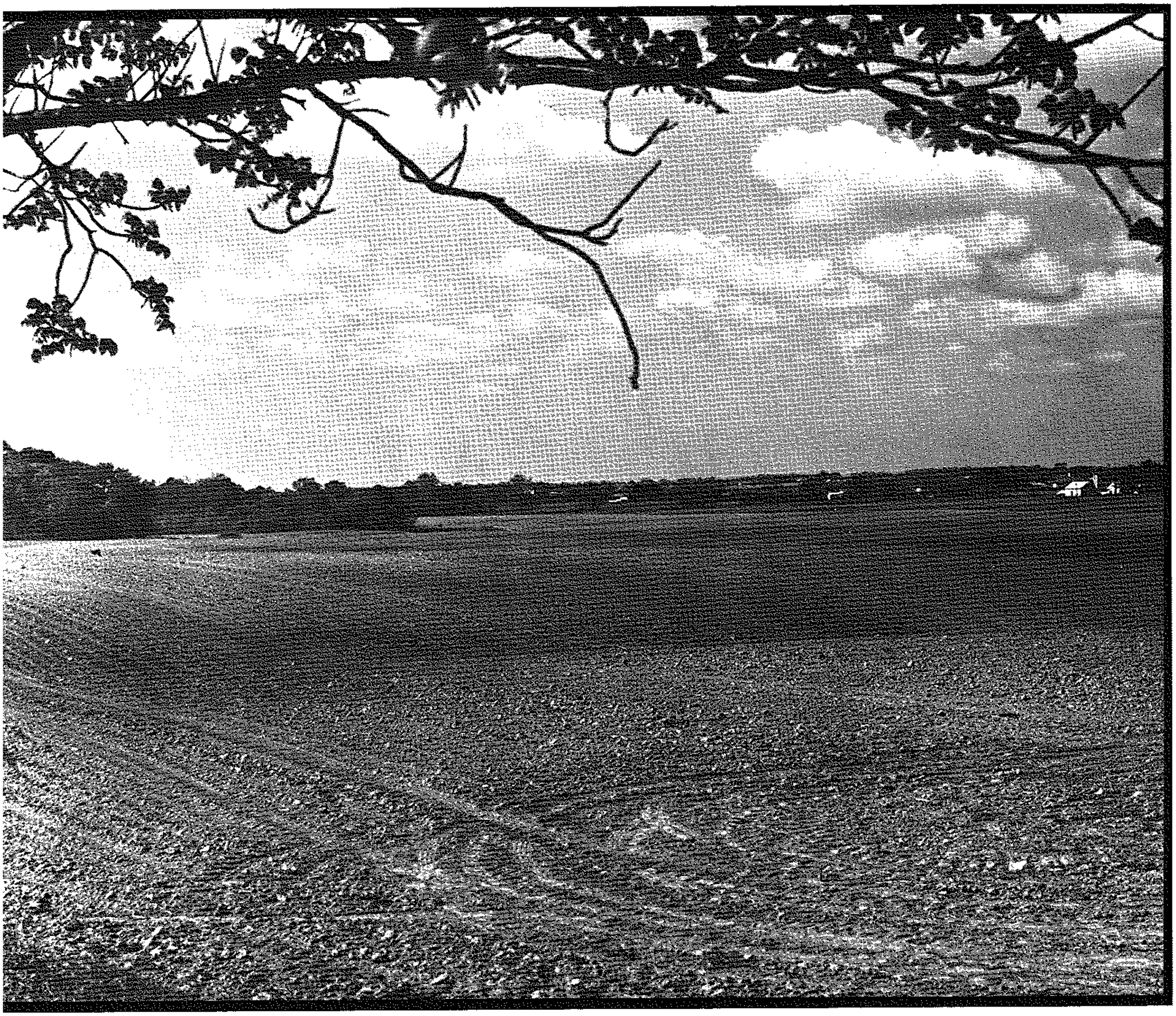
L SURVEY OF

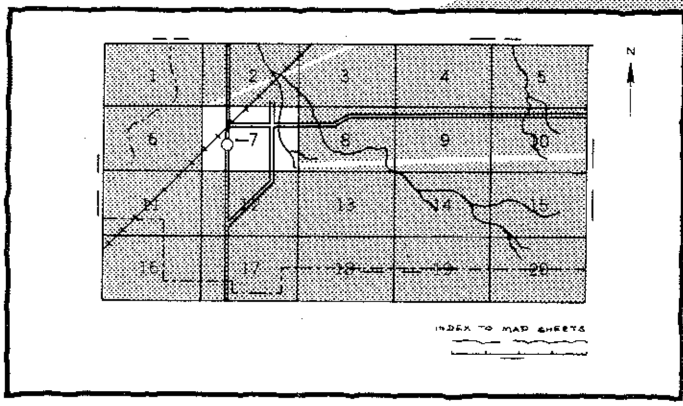
PICKAWAY COUNTY, OHIO

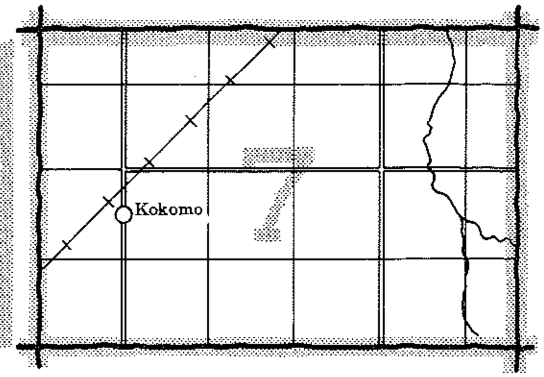


United States Department of Agriculture,
Soil Conservation Service, in cooperation with
Ohio Department of Natural Resources,
Division of Lands and Soil, and
Ohio Agricultural Research and Development Center

HOW TO USE

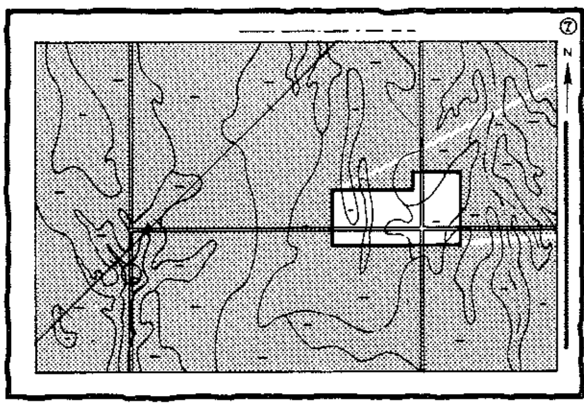
1. Locate your area of interest on the "Index to Map Sheets" (the last page of this publication).

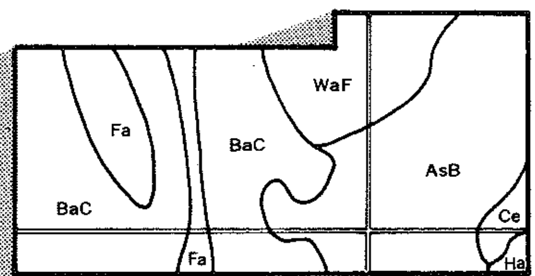




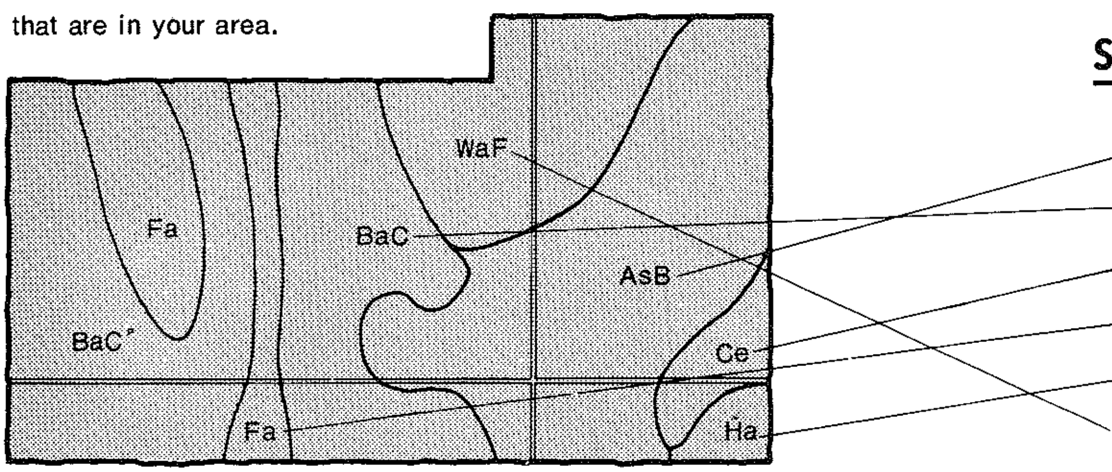
2. Note the number of the map sheet and turn to that sheet.

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





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



Symbols

AsB
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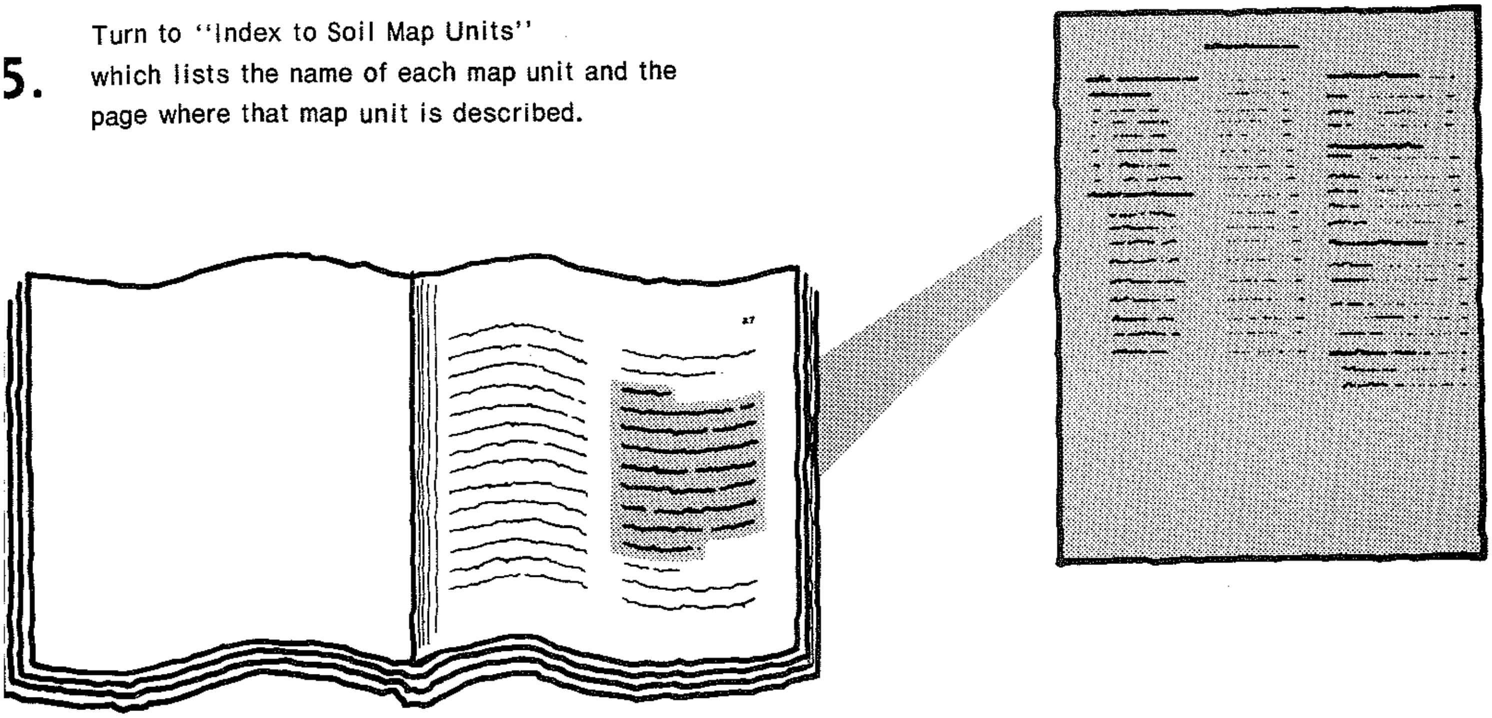
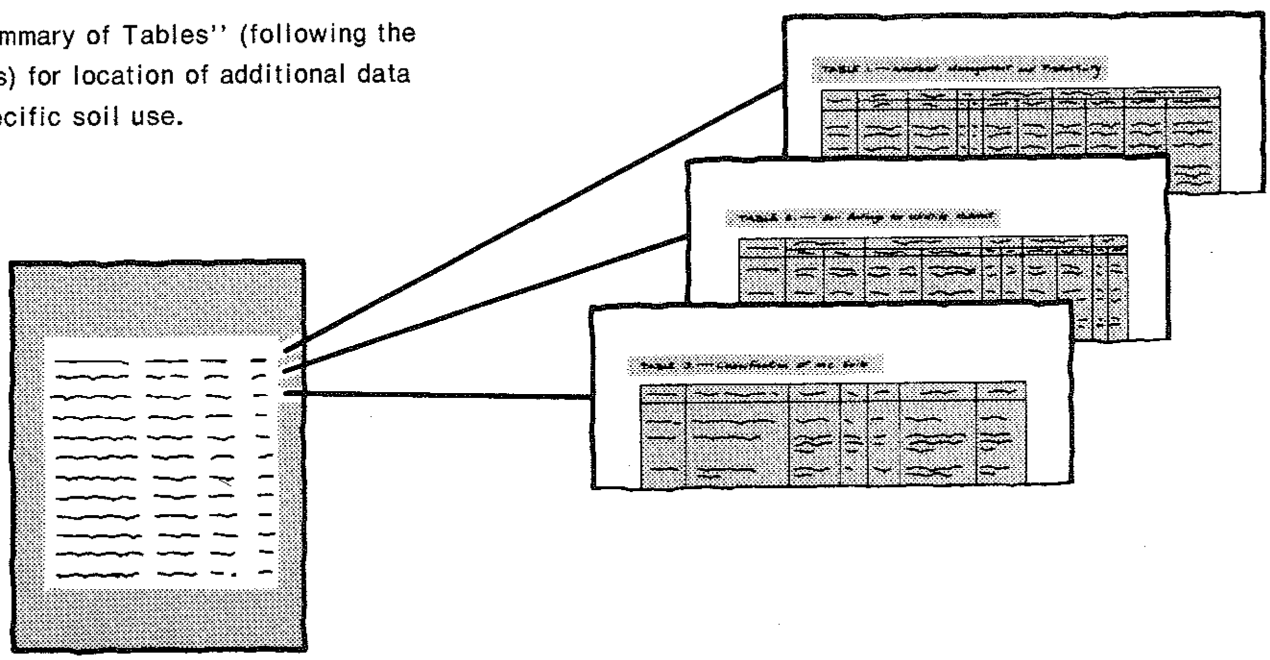
HIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

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

Major fieldwork for this soil survey was performed in the period 1969-76. Soil names and descriptions were approved in 1977. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1976. This survey was made cooperatively by the Soil Conservation Service and the Ohio Department of Natural Resources, Division of Lands and Soil, and the Ohio Agricultural Research and Development Center. It is part of the technical assistance furnished to the Pickaway Soil and Water Conservation District. The survey was materially aided by funds provided by the Pickaway County Commissioners.

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

Cover: The soils in Pickaway County are mainly used for farming. Miamian soils are in the foreground. The darker colored soils in the background are Westland and Patton.

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Issued February 1980

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Foreword

We introduce the Soil Survey of Pickaway County. You will find, herein, basic information useful for any land planning program. Of prime importance are the predictions of soil behavior for selected land uses. Also highlighted are limitations or hazards to land uses that are inherent in the soil, improvements needed to overcome these limitations, and the impact that selected land use will have on the environment.

This soil survey has been prepared to fit the needs of different users. Farmers, ranchers, foresters, or agronomists can use it to determine the potential of the soil and the management practices required for food and fiber production. Planners, community decisionmakers, engineers, developers, builders, or homebuyers can use it to plan use of land, select sites for construction, develop soil resources, and identify special practices that may be needed to assure proper performance. Conservationists, recreationists, teachers, students, or specialists in wildlife management, waste disposal, or pollution control can use the soil survey to help understand, protect, and enhance the environment.

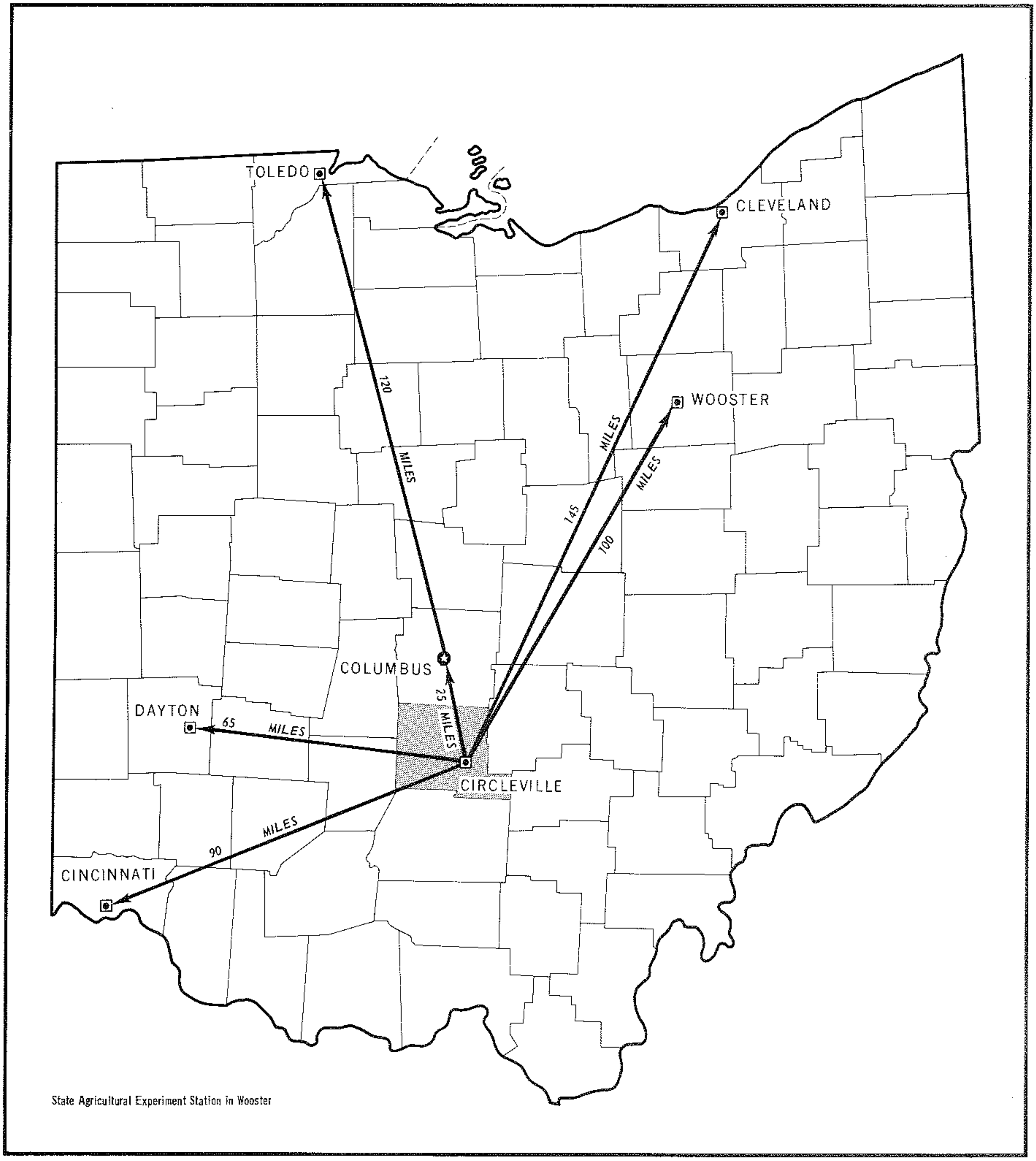
Many people assume that soils are all somewhat alike. They are unaware that great differences in soil properties can occur even within short distances. Soils may be seasonally wet or subject to flooding. They may be shallow to bedrock. They may be too unstable to be used as a foundation for buildings or roads. Very 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. This publication also shows, on the general soil map, the location of broad areas of soils; the location of each kind of soil is shown on detailed soil maps at the back. It provides descriptions of each kind of soil in the survey area and gives much information about each soil for specific uses. If you need additional information or assistance in using this publication, please call your local office of the Soil Conservation Service or the Cooperative Extension Service.

We believe that this soil survey will help us have a better environment and a better life. The widespread use of this information can greatly assist us in the conservation, development, and productive use of our soil, water, and related resources.

Robert E. Quilliam

Robert E. Quilliam
State Conservationist
Soil Conservation Service



Location of Pickaway County in Ohio.

SOIL SURVEY OF PICKAWAY COUNTY, OHIO

By J. W. Kerr and R. L. Christman, Ohio Department of Natural Resources, Division of Lands and Soil

Fieldwork by J. W. Kerr, N. L. Williams, L. A. Jones, and W. Lindauer, Ohio Department of Natural Resources, Division of Lands and Soil; and N. A. McLoda, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service, in cooperation with Ohio Department of Natural Resources, Division of Lands and Soil, and Ohio Agricultural Research and Development Center

General nature of the county

Pickaway County is in the south-central part of Ohio. It occupies about 507 square miles or 322,560 acres. Circleville, the county seat and only city, is about 25 miles south of Columbus, Ohio. In 1970 the total population of the county was 40,071.

Cash grain and livestock farming are the major landuses in the county. Corn, soybeans, wheat, oats, and hay are grown on many farms, particularly in the flatter western part and on the flood plains and terraces along the Scioto River. Much of the remaining woodland is on dissected, gently sloping to very steep soils along streams.

Poor natural drainage is the major management limitation on soils in flatter areas in the county. Erosion is a major hazard on sloping to very steep soils. If artificial drainage is adequate and erosion control and other good management practices are used, most soils in Pickaway County are highly productive.

Pickaway County is on the edge of the expanding metropolitan Columbus area. Nonfarm development, particularly residential and commercial development, is constantly taking place. This development is evident in the northern part of the county and in the vicinity of Circleville (fig. 1).

Climate

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

Pickaway County is cold in winter and uncomfortably warm in summer. Winter precipitation, frequently snow, accumulates enough moisture in most soils by spring to minimize drought during summer. Normal annual precipitation is adequate for all crops that are adapted to the temperature and length of growing season in the survey area.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Circleville, Ohio, for the period 1951-75. 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 33 degrees F, and the average daily minimum temperature is 24 degrees. The lowest temperature on record for the period, which occurred at Circleville on January 28, 1963, is -17 degrees. In summer the average temperature is 73 degrees, and the average daily maximum temperature is 85 degrees. The highest recorded temperature, which occurred on July 14, 1954, is 103 degrees.

Growing degree days are shown in table 3. 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 of 50 degrees F. The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

Sixty percent of the total annual precipitation generally falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 18 inches. The heaviest 1-day rainfall during the period of record was 4.8 inches at Circleville on May 24, 1968. Thunderstorms occur on about 40 days each year, and most occur in summer.

Average seasonal snowfall is 13 inches. The greatest snow depth at any one time during the period of record was 10 inches. On an average of 9 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 65 percent of the time possible in summer and 35 percent in winter. The prevailing wind is from the south-southwest. Average windspeed is highest, 11 miles per hour, in March.

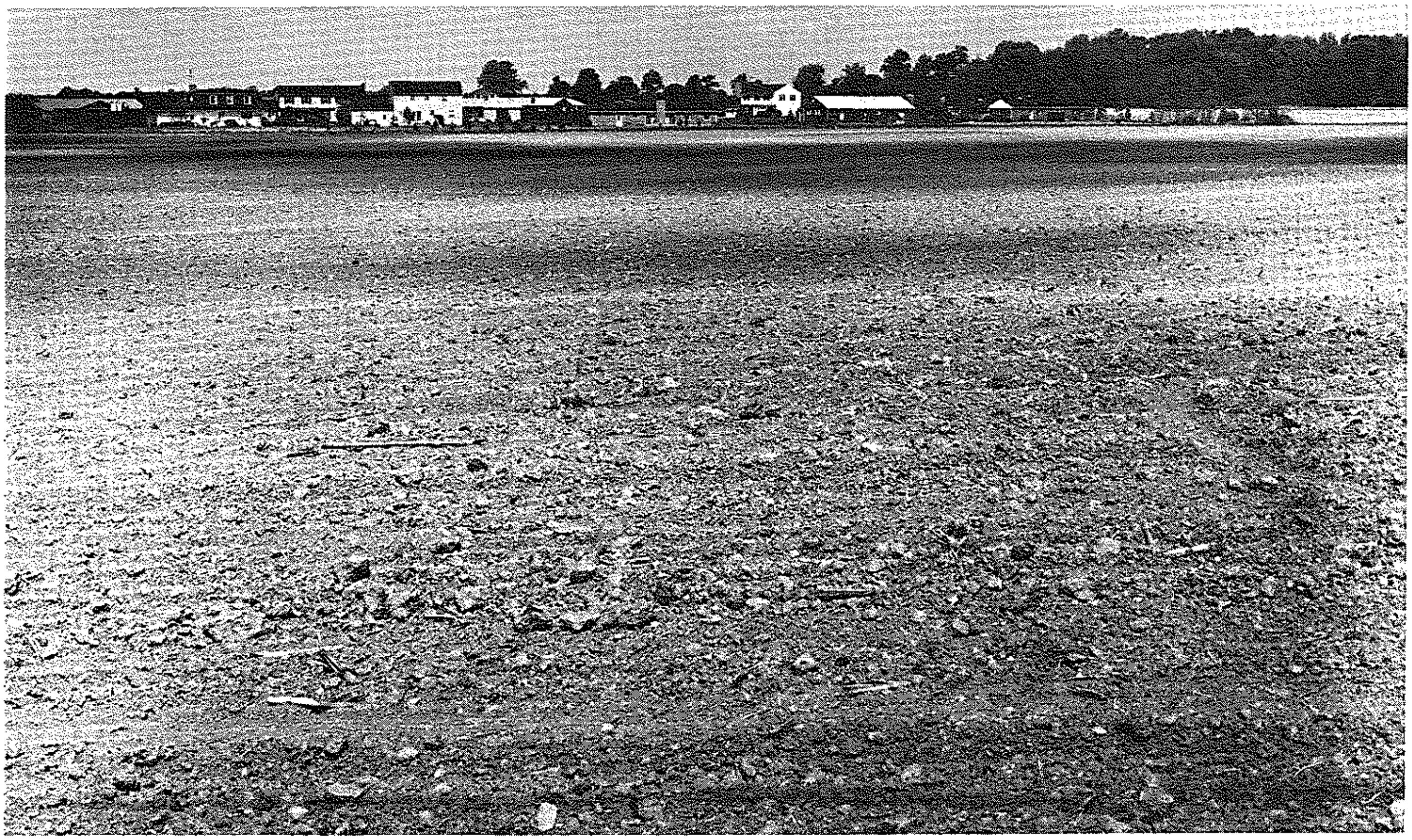


Figure 1.—Urban development encroaching on prime farmland. The soils are Crosby and Kokomo.

Tornadoes and severe thunderstorms occur occasionally. These storms generally are local and of short duration and cause damage in a variable pattern.

History and development

Bernice Allen, Keystone, Ohio, assisted in preparing this section.

The land in Pickaway County has been highly prized by various people from the time of the Mound Builders to today's farmers (*13, 2*). The Mound Builders left their mark upon the land with their burial mounds and earthworks.

The name Pickaway was derived from the Indian name Picqua. A group of Shawnee Indians farmed the land in the 1600's and 1700's. They built permanent villages such as Old Chillicothe, and surrounded them with cornfields. The Indians hunted in the surrounding territory.

Pickaway County was established in 1810 from Ross, Franklin, and Fairfield Counties. For a few years, the county seat was Jefferson, just south of Circleville. In 1814, Circleville was designated the county seat.

All of the territory east of the Scioto River was Congress Lands; that west of the river was within the Virginia Military District reserved for Virginians who held bounty claims for service in the Revolution. Claims for service in the Revolution were filled first, so the lands west of the river were settled earlier than Congress Lands, although a few scattered settlements were made in the Congress Lands before 1800.

The early farmers produced surplus farm products that could not be marketed in Pickaway County. This surplus was fed to livestock which were driven to eastern markets, or it was shipped on flatboats on the Scioto River to New Orleans. These methods provided a limited outlet for potential production. Much growth and agricultural prosperity can be attributed to the construction of the Ohio Canal, expansion of the B&O Railroad, and construction of highways.

Farming

Pickaway County is one of the top ten farming areas in Ohio. According to the Census of Agriculture in 1969, approximately 96.7 percent of the total land area in the county was in farms. In 1976 there were 1,240 farms in the county with an average size of 240 acres.

The Ohio Crop Reporting Service reported that Pickaway County, in 1976, was third in the production of corn, seventeenth in the production of soybeans, and twentieth in the production of wheat (*12*).

In 1976 the major commodities that produced cash receipts were: corn, 26 percent; soybeans, 24 percent; cattle, 16 percent; hogs, 15 percent; wheat, 7 percent; dairy products, 6 percent; greenhouse and nursery products, 3 percent; and miscellaneous other products, 3 percent (*5*).

How this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; the lime content of the glacial till (fig. 2); and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units that have different levels of detail in this survey area are described under "General soil map for broad land use planning" and "Soil maps for detailed planning."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, woodland managers, engineers, planners, developers and builders, home buyers, and others.

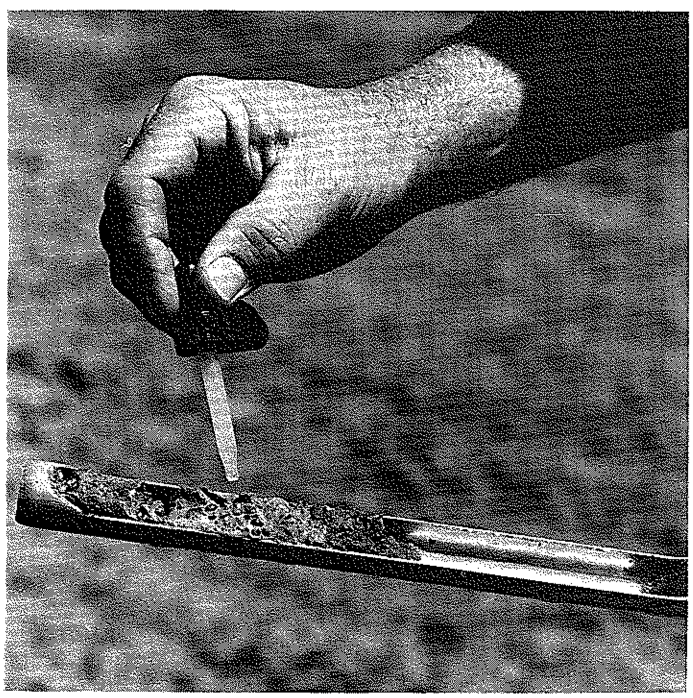


Figure 2.—Testing for free carbonates in glacial till.

General soil map for broad land use planning

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

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

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

Soils on uplands

The six associations in this group make up about 78 percent of the county. The well drained to very poorly drained soils formed mainly in glacial till that has a medium or high content of lime. In one association the soils formed in glacial outwash. The nearly level to very steep soils are on broad flats and dissected undulating areas along drainageways. Farming is the main land use. Seasonal wetness, ponding, slow or moderately slow permeability, slope, and the hazard of erosion are the main land-use limitations.

1. Kokomo-Crosby-Miamian association

Nearly level to sloping, very poorly drained, somewhat poorly drained, and well drained soils formed in medium textured and moderately fine textured glacial till

This association consists of broad flats with depressions, low knolls, and rises. Elevation ranges from about 5 to 10 feet. Steeper areas are along drainageways. When freshly tilled, the soils have a striking pattern of dark and light colors.

This association makes up about 37 percent of the county. It is about 40 percent Kokomo soils, 30 percent Crosby soils, 20 percent Miamian soils, and 10 percent soils of minor extent.

Kokomo soils are in low positions on flats and in depressions. They are nearly level, very poorly drained, and moderately slowly permeable. These soils have a surface layer of silty clay loam and high available water capacity. They have a seasonal high water table near the surface and are subject to ponding.

Crosby soils are in intermediate positions on flats and slight rises. They are nearly level and gently sloping, somewhat poorly drained, and slowly permeable. These soils have a surface layer of silt loam, moderate available water capacity, and a seasonal high water table between a depth of 12 and 36 inches.

Miamian soils are on low knolls, rises, and side slopes along waterways. They are gently sloping and sloping, well drained, and have moderately slow permeability. These soils have a surface layer of silt loam or clay loam and low available water capacity.

Of minor extent in this association are Lewisburg and Celina soils on slight rises and foot slopes. Corwin soils are on long, gentle slopes and at the heads of waterways. Narrow strips of Eel, Medway, Shoals, and Sloan soils are on flood plains.

Most areas of this association are used for cash grain crops. Some areas are used for small farm woodlots or pasture. The potential for farming is high. The potential for development of building sites and sanitary facilities is low on the Kokomo and Crosby soils and medium to high on the Miamian soils. The potential for recreational uses is low on the Kokomo soils and medium on the Crosby and Lewisburg soils.

Soil wetness, slow or moderately slow permeability, low strength, and the hazard of erosion are the main limitations for land use on the Miamian and Crosby soils. Surface and subsurface drains help improve drainage. Maintaining tilth is also a management concern. The Miamian soils are better suited to buildings than the Kokomo and Crosby soils.

2. Crosby-Kokomo-Celina association

Nearly level and gently sloping, somewhat poorly drained, very poorly drained, and moderately well drained soils formed in medium textured and moderately fine textured glacial till

This association consists of broad flats with depressions, knolls, and ridges. Elevation ranges from about 5 to 15 feet. When freshly tilled, the soils have a striking pattern of light and dark colors. (fig. 3).

This association makes up about 5 percent of the county. It is about 45 percent Crosby soils, 25 percent Kokomo soils, 15 percent Celina soils, and 15 percent soils of minor extent.

Crosby soils are on flats, low knolls, and ridges. They are nearly level and gently sloping, somewhat poorly drained, and slowly permeable. These soils have a surface layer of silt loam, moderate available water capacity, and a seasonal high water table between a depth of 12 and 36 inches.

Kokomo soils are in depressions and along waterways. They are nearly level, very poorly drained, and moderately slowly permeable. These soils have a surface layer of silty clay loam and high available water capacity. They

Figure 3.—Crosby-Kokomo-Celina association. Light colored areas are Crosby and Celina soils. Dark colored areas are Kokomo soils.

have a seasonal high water table near the surface and are subject to ponding.

Celina soils are on flats, low knolls, ridges, and side slopes along waterways. They are nearly level and gently sloping and moderately well drained. These soils have moderately slow permeability and a seasonal high water table between a depth of 18 and 36 inches. They have a surface layer of silt loam and moderate available water capacity.

Of minor extent in this association are Kendallville and Miamian soils on knolls, ridges, and side slopes. Narrow strips of Eel, Shoals, Genesee, and Sloan soils are on flood plains.

Most areas of this association are used for cash grain crops. A few areas are used for specialty crops. Some areas have residential, commercial, and other uses. The potential for farming is high. The potential for development of building sites and sanitary facilities is low on the Crosby and Kokomo soils and medium on the Celina soils. The potential for recreational uses is medium on the Crosby and Celina soils and poor on the Kokomo soils.

Seasonal wetness, slow or moderately slow permeability, low strength, and the hazard of erosion are the main limitations for land use on the Crosby and Celina soils. Surface and subsurface drains help improve drainage. The Celina soils are better suited to buildings than the Kokomo or Crosby soils. Sanitary facilities need to be connected to central sewers and treatment facilities.

3. Miamian-Lewisburg association

Nearly level to very steep, well drained and moderately well drained soils formed in medium textured glacial till

This association is in dissected areas on side slopes of valleys, in drainageways, on knolls, and on narrow to broad ridges. Elevation ranges from 10 to 60 feet.

This association makes up about 9 percent of the county. It is about 45 percent Miamian soils, 35 percent Lewisburg soils, and 20 percent soils of minor extent.

Miamian soils are on high knolls and sides of ridges and valleys. They are nearly level to very steep and are well drained. These soils have moderately slow permeability, moderate to low available water capacity, and a surface layer of silt loam or clay loam. Lewisburg soils are in a complex pattern with Miamian soils on broad ridgetops and low knolls. They are nearly level and gently sloping and moderately well drained. These soils have moderate or moderately slow permeability in the subsoil and slow permeability in the substratum. They have a surface layer of silt loam, moderate available water capacity, and a seasonal high water table between a depth of 24 and 48 inches.

Of minor extent in this association are the steep and very steep Hennepin soils and sloping to very steep Cana Variant soils on sides of ridges and valleys. Crosby, Corwin, and Celina soils are on broad ridges and near the heads of drainageways.

Most areas of this association are used for cropland, pasture, and woodland. The nearly level and gently sloping soils have high potential for cropland and medium or high potential for most building sites, sanitary facilities, and recreational uses. The moderately steep to very steep soils have low potential for these uses.

Slopes and the hazard of erosion are the main limitations for use. Tilth is a problem on some Miamian soils that have a clay loam surface layer. These soils have a narrower range of moisture content for good workability than the Miamian soils that have a surface layer of silt loam. Some scenic building sites are in this association. The moderately slow or slow permeability is a severe limitation for septic tank absorption fields. Plant cover needs to be maintained on the site during construction.

4. Miamian-Kendallville-Eldean association

Nearly level to sloping, well drained soils formed in medium textured glacial till and moderately fine to coarse textured glacial outwash

This association consists of broad, gently rolling, convex ridgetops with knolls and short, uneven side slopes. Elevation ranges from 5 to 30 feet. Some steeper areas are along drainageways and in hummocky areas.

This association makes up about 10 percent of the county. It is about 35 percent Miamian soils, 25 percent Kendallville soils, 15 percent Eldean soils, and 25 percent soils of minor extent.

Kendallville soils are mainly in an intermediate position between Miamian soils in areas with uniform slopes and Eldean soils along waterways in hummocky areas with short, uneven slopes. These soils are well drained and nearly level to sloping. Miamian soils have moderately slow permeability and a surface layer of silt loam or clay loam. They have moderate to low available water capacity. Kendallville soils have moderately slow permeability and a surface layer of silt loam. They have moderate available water capacity. Eldean soils have moderate or moderately slow permeability in the subsoil and rapid or very rapid permeability in the substratum. They have low or moderate available water capacity and a surface layer of loam or gravelly loam.

Of minor extent in this association are Celina and Crosby soils on slight rises, knolls, and flats in areas that have fairly uniform slopes. Casco, Ockley, and Princeton soils are intermingled with Eldean soils in the better drained positions and with Westland soils in depressions.

Most areas of this association are used for farming. Potential for cultivated crops, building sites, and recreational uses is medium or high.

These soils are well suited to cultivated crops, hay, and pasture. Slopes, the hazard of erosion, and seepage in the Eldean soils are the main limitations for use. Tilth is a problem on the sloping Miamian soils that have a surface layer of clay loam. These soils have a narrower range of moisture content for good workability. The Miamian and Kendallville soils are better suited to most sanitary facilities than the Eldean soils. Movement of effluent through the rapidly or very rapidly permeable sand and gravel in the substratum of the Eldean soils is a possible pollution hazard to underground water supplies.

5. Miamian-Celina-Crosby association

Nearly level to moderately steep, well drained, moderately well drained, and somewhat poorly drained soils formed in medium textured and moderately fine textured glacial till

This association consists of moderately broad ridges and undulating areas that have occasional broad flats and dissected areas along drainageways. Elevation ranges from 20 to 60 feet.

This association makes up about 13 percent of the county. It is about 35 percent Miamian soils, 20 percent Celina soils, 15 percent Crosby soils, and 30 percent soils of minor extent.

Miamian soils are on high knolls and sides of ridges and valleys. They are well drained and gently sloping to moderately steep. These soils have moderately slow permeability, moderate to low available water capacity, and a surface layer of silt loam or clay loam. Celina and Crosby soils are on broad ridgetops, foot slopes, and low knolls and in undulating areas (fig. 4). Celina soils are nearly level and gently sloping and moderately well drained. They have moderately slow permeability and a seasonal high water table between a depth of 18 and 36 inches. These soils have a surface layer of silt loam and moderate available water capacity. Crosby soils are nearly level and gently sloping, somewhat poorly drained, and slowly permeable. They have a surface layer of silt loam, moderate available water capacity, and a seasonal high water table between a depth of 12 and 36 inches.

Of minor extent in this association are Kokomo soils in depressions and along small waterways, Corwin soils at the heads of waterways and on foot slopes, and Kendallville soils on complex slopes and along drainageways.

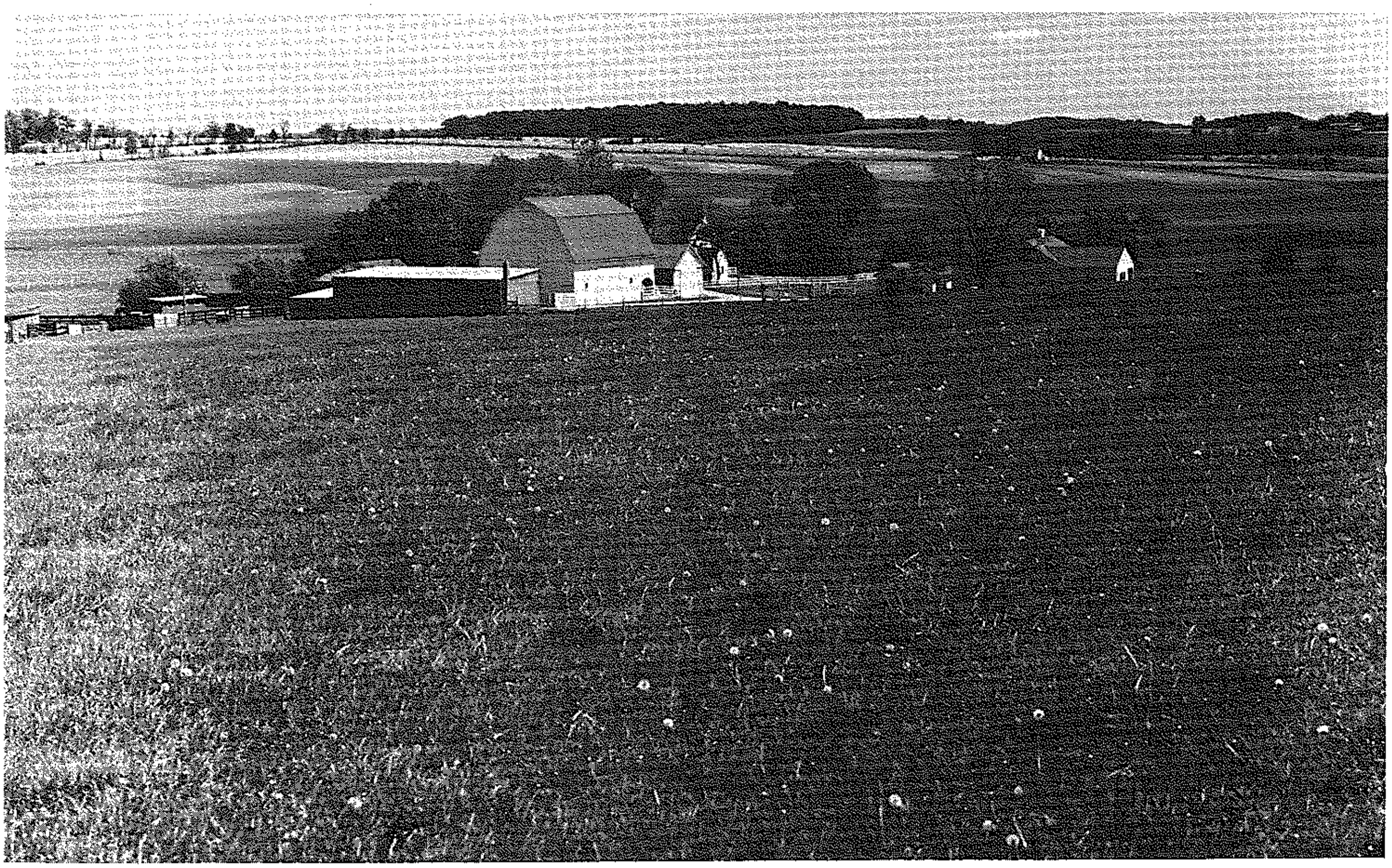


Figure 4.—Typical landscape of Miamian-Celina-Crosby association. Miamian soils are on higher knolls and side slopes. Celina and Crosby soils are on broad ridgetops, on foot slopes, and in undulating areas.

Loudonville and Celina Variant soils are on bedrock-controlled landforms, and Eel, Shoals, Genesee, and Sloan soils are on narrow flood plains.

Most areas of this association are used for farming. Cash grain crops and livestock are the main enterprises. The nearly level and gently sloping soils have high potential for cultivated crops, pasture, and hay. The moderately steep soils have low potential for cultivated crops. The nearly level and gently sloping Miamian and Celina soils have better potential for development of building sites, sanitary facilities, and recreational uses than the Crosby soils.

The hazard of erosion, seasonal wetness, and slow or moderately slow permeability are the main limitations for use. Tilth is a problem on some Miamian soils that have a clay loam surface layer. These soils have a narrower range of moisture content for good workability. Using crop rotation, minimizing tillage, and planting cover crops are good management methods. Artificial drainage is needed in the Crosby soils. Plant cover needs to be maintained on the site during construction.

6. Cardington-Alexandria association

Gently sloping to very steep, moderately well drained and well drained soils formed in medium textured and moderately fine textured glacial till

This association consists of gently rolling hills and valleys with some broad, undulating ridge crests. Elevation ranges from 20 to 120 feet.

This association makes up about 4 percent of the county. It is about 40 percent Cardington soils, 30 percent Alexandria soils, and 30 percent soils of minor extent.

The Cardington soils are on knolls and ridges. They are moderately well drained, gently sloping and sloping soils that have a seasonal high water table between a depth of 24 and 36 inches. The Alexandria soils are on hillsides and side slopes along drainageways. They are well drained and gently sloping to very steep. Both the Cardington soils and the Alexandria soils have moderately slow permeability. They have a surface layer of silt loam and moderate available water capacity.

Of minor extent in this association are Bennington soils on flats and slight rises, Corwin soils on foot slopes and at the heads of some drainageways, and Loudonville soils on side slopes along streams. Eel, Shoals, Sloan, and Genesee soils are on narrow flood plains.

Most of this association is used for cropland, pasture, and woodland. The main enterprises are cash grain and livestock farming. The gently sloping and sloping soils have medium to high potential for cultivated crops and development of building sites. These soils have high potential for hay and pasture and medium or low potential for sanitary facilities. The moderately steep to very steep soils have high potential for woodland and for woodland wildlife habitat.

Slope, moderately slow permeability, and the seasonal wetness of the Cardington soils are the main limitations for use. Minimizing tillage, planting cover crops, and using crop rotation are good management methods. The gently sloping and sloping Alexandria soils are better suited to buildings than the Cardington soils. Plant cover needs to be maintained on the site during construction. Artificial drainage is needed in the wetter soils.

Soils on stream terraces, outwash plains, and flood plains

The two associations in this group make up about 22 percent of the county. The well drained and very poorly drained soils formed in glacial outwash and alluvium on relatively broad, flat to undulating stream terraces, outwash plains, and flood plains. Narrow strips of sloping soils are on slope breaks between terrace levels and between terraces and flood plains. A few hummocky areas are on outwash terraces. The soils are used mainly for farming. Flooding, the hazard of erosion and seepage, moderately slow permeability, wetness, and ponding are the main limitations for land use.

7. Eldean-Genesee-Warsaw association

Nearly level to sloping, well drained soils formed in moderately fine textured to coarse textured glacial outwash and alluvium

This association consists of broad, flat to undulating stream terraces, outwash plains, and flood plains. Short, rather steep slope breaks are between flood plains and terraces and between terrace levels. Elevation ranges from 5 to 30 feet.

This association makes up about 18 percent of the county. It is about 20 percent Eldean soils, 15 percent Genesee soils, 10 percent Warsaw soils, and 55 percent soils of minor extent.

Eldean and Warsaw soils are on broad flats, slight rises, and slope breaks on stream terraces. The Genesee soils are on broad flats on flood plains. All of these soils are well drained. Eldean soils are nearly level to sloping. They have moderate or moderately slow permeability in the subsoil and rapid or very rapid permeability in the substratum. These soils have a surface layer of gravelly loam or loam and low or moderate available water capacity. Genesee soils are nearly level, moderately permeable, and occasionally flooded. They have a surface layer of silt loam and high available water capacity. Warsaw soils are nearly level and gently sloping. They have moderate permeability over very rapid permeability. They have a surface layer of loam and low or moderate available water capacity.

Of minor extent in this association are Ockley, Wea, Tippecanoe, and Westland soils on stream terraces and Stonelick, Medway, Eel, Ross, and Sloan soils on flood plains.

Most areas of this association are used for cultivated crops, specialty crops, and nursery stock. Some of the specialty crops are sweet corn, tomatoes, and melons.

Potential is high for cultivated crops, pasture, and hay. The Eldean and Warsaw soils have high potential for development of building sites and most recreational uses. Genesee soils have low potential for development of building sites and some recreational uses.

This association is well suited to corn, soybeans, hay, pasture, and specialty crops. Droughtiness and the hazard of erosion on Eldean and Warsaw soils and the hazard of flooding on Genesee soils are the main management concerns. The nearly level and gently sloping soils are well suited to irrigation. The Warsaw and Eldean soils are well suited to planting and grazing early in spring. They are good for building sites; however, there is a possible hazard of pollution to underground water supplies if the soils are used for sanitary facilities. These soils are also good sources of sand and gravel.

8. Westland association

Nearly level, very poorly drained soils formed in moderately fine textured to moderately coarse textured glacial outwash and alluvium

This association consists of flat to depressional areas on stream terraces and outwash plains. Elevation ranges from 2 to 8 feet.

This association makes up about 4 percent of the county. It is about 40 percent Westland soils and 60 percent soils of minor extent.

Westland soils are nearly level and very poorly drained and have a surface layer of silty clay loam. They have moderately slow permeability in the subsoil and very rapid permeability in the substratum. These soils have a seasonal high water table near the surface and are subject to ponding. They have high available water capacity.

Of minor extent in this association are Montgomery and Patton soils that formed in lake bed sediment and Linwood and Carlisle soils that formed in organic materials in depressions. Sleeth, Tippecanoe, Algiers, and Thackery soils are on stream terraces and outwash plains, and Sloan and Algiers soils are on narrow flood plains.

Most areas of this association are used for cash grain crops. A few wet, undrained areas are used for pasture and for wetland wildlife habitat. Potential for cultivated crops, hay, pasture, and trees is high. Potential is low for development of building sites, sanitary facilities, and recreational uses.

If artificially drained, this association is well suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. Most areas used for cropland have subsurface drains and open ditches. Seasonal wetness, ponding, seepage, and moderately slow permeability are severe limitations for development of building sites, sanitary facilities, and recreational uses.

Soil maps for detailed planning

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

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

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil, a brief description of the soil profile, and a listing of the principal hazards and limitations to be considered in planning management.

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

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, 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, Eldean loam, 2 to 6 percent slopes, is one of several phases in the Eldean series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Casco-Kendallville complex, 12 to 18 percent slopes is an example.

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

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, gravel is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

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

AdB2—Alexandria silt loam, 2 to 6 percent slopes, eroded. This deep, gently sloping, well drained soil is mainly on convex ridgetops. Erosion has removed part of the original surface layer. Most areas are long and narrow or irregular in shape and are 3 to 40 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsoil is about 35 inches thick. It is yellowish brown and brown, firm silty clay loam in the upper part and mottled, yellowish brown and brown, firm clay loam in the lower part. The substratum to a depth of about 60 inches is mottled, yellowish brown, firm loam and clay loam glacial till.

Included with this soil in mapping are narrow strips of the very poorly drained Kokomo soils in depressions and along waterways. Also included are small areas of the somewhat poorly drained Bennington soils on the lower parts of slopes and in flatter areas. The included soils make up about 10 percent of most areas.

Permeability is moderately slow, and runoff is medium. The root zone is moderately deep to compact glacial till. Available water capacity and organic matter content are moderate. Tilth is good. Reaction in the subsoil is very strongly acid to medium acid in the upper part and medium acid to mildly alkaline in the lower part. The shrink-swell potential in the subsoil is moderate.

Most areas are used for farmland. This soil has high potential for cultivated crops, pasture, hay, development of building sites, and recreational uses. It has medium to high potential for most sanitary facilities.

This soil is suited to row crops and small grain. The hazard of erosion is the main limitation for row crops. The surface layer crusts after hard rains. Minimum tillage and use of cover crops and grassed waterways help reduce soil loss. Incorporating crop residue or other organic matter into the surface layer helps improve tilth, increase the rate of water infiltration, and reduce crusting.

The use of this soil for pasture or hay helps control erosion. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Rotation of pasture and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees and shrubs. Native hardwoods are in a few small areas. Seedlings grow well if competing vegetation is controlled or removed by cutting, spraying, girdling, or mowing.

This soil is suited to building sites and some sanitary facilities, if proper design and installation procedures are used. Maintaining soil cover helps reduce runoff and erosion during construction. Use of a suitable base material helps improve local roads. Increasing the size of the absorption area helps overcome the moderately slow permeability that limits the performance of septic tank absorption fields.

This soil is in capability subclass IIe and woodland suitability subclass 2o.

AdC2—Alexandria silt loam, 6 to 12 percent slopes, eroded. This deep, sloping, well drained soil is mainly on side slopes along waterways. Erosion has removed part of the original surface layer. Tillage has mixed subsoil material with a higher clay content and more coarse fragments into the present surface layer. Most areas are long and narrow or irregular in shape and are 6 to 24 acres.

Typically, the surface layer is brown, friable silt loam about 7 inches thick. The subsoil is about 35 inches thick. It is yellowish brown and brown, friable silt loam and firm silty clay loam in the upper part; brown, firm clay in the next part; and mottled, yellowish brown, firm clay loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown, firm loam and clay loam.

Included with this soil in mapping are narrow strips of the somewhat poorly drained Bennington soils on foot slopes and small areas of severely eroded soils that have a thinner subsoil and a silty clay loam or clay loam surface layer on back slopes. Also included are the moderately deep Loudonville soils at the base of slopes and in dissected areas along drainageways. The included soils make up 5 to 10 percent of most areas.

Permeability is moderately slow, and runoff is rapid. The root zone is mainly moderately deep to compact glacial till. Available water capacity is moderate, and organic matter content is moderately low. Tilth is good. Reaction in the subsoil is very strongly acid to medium acid in the upper part and medium acid to mildly alkaline in the lower part. The shrink-swell potential in the subsoil is moderate.

Most areas of this soil are used for farmland. Some areas are used for woodland. This soil has medium potential for cultivated crops and high potential for hay, pasture, and trees. It has medium potential for most building sites, recreational uses, and sanitary facilities.

This soil is suited to row crops and small grain. The hazard of erosion is severe in cultivated areas. Including grasses and legumes in the cropping system helps control erosion. The surface layer crusts after hard rains. If plowed when wet and sticky, the soil is cloddy. Minimum tillage and use of cover crops and grassed waterways help reduce runoff and soil loss. Incorporating crop residue or other organic matter into the surface layer helps maintain tilth, increase the rate of water infiltration, and reduce crusting.

This soil is suited to pasture and hay. Surface compaction, poor tilth, reduced growth, and increased runoff result from overgrazing or grazing when the soil is wet. Proper stocking rates, selection of plants, rotation of pasture, timely deferment of grazing, and control of weeds help keep the pasture and soil in good condition.

This soil is well suited to trees and shrubs. Seedlings grow well if competing vegetation is controlled or removed by cutting, spraying, girdling, or mowing.

This soil is suited to building sites and sanitary facilities if proper design and installation procedures are used. Slope, moderately slow permeability, low strength, and moderate shrink-swell potential are the main limitations. Maintaining soil cover helps reduce runoff and erosion during construction. Increasing the size of the absorption area helps improve septic tank absorption fields. Leach lines should be installed on the contour to reduce seepage. Use of a suitable base material helps improve local roads. This soil is suitable for pond enbankments.

This soil is in capability subclass IIIe and woodland suitability subclass 2o.

AdD2—Alexandria silt loam, 12 to 18 percent slopes, eroded. This deep, moderately steep, well drained soil is on hillsides and on side slopes along drainageways. Erosion has removed part of the original surface layer. Tillage has mixed subsoil material with a higher clay content and more coarse fragments into the present surface layer. Most areas are long and narrow or irregular in shape and are 5 to 25 acres.

Typically, the surface layer is brown, friable silt loam about 7 inches thick. The subsoil to a depth of about 38 inches is dark yellowish brown and yellowish brown, firm silty clay loam and clay loam. The substratum to a depth of about 60 inches is yellowish brown, firm loam and clay loam glacial till.

Included with this soil in mapping are narrow strips of the moderately deep Loudonville soils and outcroppings of shale bedrock at the base of slopes and in dissected areas along drainageways. Also included are small areas of severely eroded soils on back slopes that have a thinner subsoil and a silty clay loam or clay loam surface layer. The included soils make up less than 5 percent of most areas.

Permeability is moderately slow, and runoff is very rapid. The root zone is mainly moderately deep to compact glacial till. Available water capacity is moderate, and organic matter content is moderately low. Tilth is good. Reaction in the subsoil is very strongly acid to medium acid in the upper part and medium acid to mildly alkaline in the lower part. The shrink-swell potential in the subsoil is moderate.

Most areas of this soil are used for permanent pasture and woodland. This soil has low potential for cultivated crops and medium to high potential for pasture. It has low potential for most building sites, sanitary facilities, and recreational uses.

Slope and the severe hazard of erosion are limitations for cultivated crops. Row crops can be grown if erosion is controlled and good management is applied. The soil is cloddy, if it is plowed when sticky and wet. It puddles and crusts easily. Minimum tillage, cover crops, and grassed waterways help reduce runoff and soil loss. Incorporating crop residue or other organic matter into the surface layer helps improve tilth and fertility, increase the rate of water infiltration, and reduce crusting.

The use of this soil for pasture also helps control erosion. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Reseeding can be done by cover crops, companion crops, or by the trash-mulch or no-till seeding methods.

This soil is well suited to trees and shrubs. Slope limits the use of equipment. Seedlings grow well if competing vegetation is controlled or removed by cutting, spraying, girdling, or mowing. Logging roads and skid trails should be protected against erosion and established across the slope. This soil has good potential for woodland wildlife habitat.

Slope, moderately slow permeability, and low strength are severe limitations for development of building sites, sanitary facilities, and recreational uses. Proper design and installation procedures help overcome the slope. Plant cover needs to be maintained on the site during construction to reduce the hazard of erosion. Trails in recreational areas need to be laid out on the contour and protected against erosion.

This soil is in capability subclass IVe and woodland suitability subclass 2r.

AdE—Alexandria silt loam, 18 to 35 percent slopes. This deep, steep and very steep, well drained soil is on hillsides and on side slopes along well defined waterways. Most areas are long and narrow or irregular in shape and are 3 to 8 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 6 inches thick. The subsoil is about 24 inches thick. It is dark yellowish brown, firm silty clay loam in the upper part and yellowish brown, firm silty clay loam and clay loam in the lower part. The substratum to a depth of about 60 inches is brown, firm, clay loam glacial till.

Included with this soil in mapping are narrow strips of the moderately deep Loudonville soils and outcroppings of sandstone and shale bedrock at the base of slopes and along dissected drainageways. Also included are small areas of severely eroded soils on back slopes that have a thinner subsoil and a silty clay loam or clay loam surface layer. The included soils make up 5 to 10 percent of most areas.

Permeability is moderately slow, and runoff is very rapid. The root zone is moderately deep to compact glacial till. Available water capacity is moderate, and organic matter content is moderately low. Tilth is good. Reaction in the subsoil is very strongly acid to medium acid in the upper part and medium acid to mildly alkaline in the lower part. The shrink-swell potential in the subsoil is moderate.

Most areas of this soil are used for woodland. A few areas are used for permanent pasture. This soil has low potential for cultivated crops and medium or low potential for pasture. It has low potential for most building sites, sanitary facilities, and recreational uses. This soil has high potential for woodland and woodland wildlife habitat.

This soil is too steep for cultivated crops. A few areas that have 18 to 25 percent slopes can be used for permanent pasture of grasses and legumes. If pasture is reseeded, the hazard of erosion is severe unless adequate plant cover is maintained. The no-till seeding method reduces the risk of erosion. Grazing should be regulated to maintain enough vegetation to control erosion. The growth of pasture plants is limited during dry periods in summer.

This soil is suited to trees and shrubs. Slope limits the use of equipment. Seedlings grow well if competing vegetation is controlled or removed by cutting, spraying, or girdling. Logging roads and skid trails should be constructed on the contour to protect against erosion.

Slope, moderately slow permeability, and low strength are severe limitations for buildings, sanitary facilities, and most recreational uses. Plant cover should be maintained on the site during construction. Trails in recreational areas should be laid out on the contour and protected against erosion.

This soil is in capability subclass VIe and woodland suitability subclass 2r.

Ag—Algiers silt loam. This deep, nearly level, somewhat poorly drained soil is on flood plains, terraces, and in upland depressions. It has recent alluvium over an older soil that has a darker colored surface layer. This soil is frequently flooded for very brief periods in winter and spring from streambank overflow or runoff from adjacent higher lying soils. Slope is 0 to 2 percent. Most areas are 2 to 80 acres.

Typically, this soil has a layer of dark grayish brown, friable silt loam about 22 inches thick over an older, buried soil. The buried soil has a surface layer of black, firm silty clay loam about 13 inches thick. The buried subsoil is about 27 inches thick. It is dark gray, firm silty clay loam in the upper part and mottled, yellowish brown, firm clay loam in the lower part. The substratum to a depth of about 72 inches is mottled, yellowish brown, firm clay loam.

Included with this soil in mapping are small areas of the very poorly drained Sloan soils in depressions and the moderately well drained Eel soils in slightly higher positions on flood plains. Also included along waterways are small areas of the very poorly drained Kokomo soils on uplands and the very poorly drained Westland soils on terraces. The included soils make up about 20 percent of most areas.

A seasonal high water table is near the surface in winter, spring, and other extended wet periods. Permeability is moderate, and runoff is very slow. The root zone is deep. Available water capacity is high, and organic matter content is moderate. The surface layer is easily tilled through a fairly wide range in moisture content. Reaction in the root zone is mainly neutral or mildly alkaline.

Most of the acreage is used for farmland. This soil has high potential for cultivated crops and woodland and low potential for development of building sites, sanitary facilities, and most recreational uses.

The major limitations for farming are seasonal wetness and flooding. Wetness and flooding delay planting and limit the choice of crops. Undrained areas can be used for hay and pasture. Maintaining soil tilth and desirable forage stands is difficult unless the soil is drained and grazing is controlled. Drained areas are suited to cultivated crops. Open ditches and subsurface drains help lower the water table. Diversions on adjacent soils intercept runoff and reduce wetness and siltation. Planting cover crops, incorporating crop residue, rotating crops, and tilling at proper moisture levels improve tilth, reduce crusting, and increase organic matter content.

Undrained areas of this soil are suited to woodland and vegetation for wildlife habitat. Species that are tolerant of some wetness should be selected for reforestation. Spraying, mowing, and disking help reduce plant competition. Harvesting equipment is limited during wet seasons.

The seasonal high water table and hazard of flooding are severe limitations for building sites and sanitary facilities. This soil has potential for such recreational uses as hiking during the drier part of the year. Diking to control flooding is difficult. Local roads can be improved by use of fill and a suitable base material from outside the areas.

This soil is in capability sublcass IIw and woodland suitability subclass 2o.

BnA—Bennington silt loam, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is on broad flats and in slightly concave areas on broad ridgetops. Most areas are irregular in shape. Areas are commonly 3 to 16 acres, but some range to 50 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 9 inches thick. The subsurface layer is mottled, grayish brown, friable silt loam about 6 inches thick. The subsoil is mottled, yellowish brown and is about 29 inches thick. It is friable, silty clay loam in the upper part; firm silty clay in the middle part; and firm clay loam in the lower part. The substratum to a depth of about 60 inches is mottled, brown, firm clay loam and loam glacial till.

Included with this soil in mapping are moderately well drained Corwin soils at the heads of waterways and very poorly drained Kokomo soils in depressions and along waterways. The included soils make up 5 to 10 percent of most areas.

A perched seasonal high water table is near the surface in winter, spring, and other extended wet periods. Permeability and runoff are slow. The root zone is mainly moderately deep to compact glacial till. Available water capacity and organic matter content are moderate. Tilth is good. Reaction in the subsoil ranges from very strongly acid in the upper part to mildly alkaline in the lower part. The shrink-swell potential in the subsoil is moderate.

Most of the acreage is used for farmland. Drained areas have high potential for cultivated crops, hay, and pasture. This soil has low potential for most building sites and sanitary facilities. It has medium potential for most recreational uses.

This soil is suited to row crops and small grain. Wetness delays planting and limits the choice of crops. Surface drains and land smoothing help remove surface water. Subsurface drains help lower the seasonal high water table. Tilling or harvesting when this soil is wet causes compaction. Minimum tillage, incorporating crop residue or other organic matter into the surface layer, and tilling at the proper moisture level improve tilth and fertility, increase the rate of water infiltration, and reduce crusting.

This soil is not well suited to grazing early in spring. Overgrazing or grazing when the soil is wet causes surface compaction and poor tilth.

This soil is well suited to trees and shrubs that tolerate some wetness. A few areas produce native hardwoods. Seedlings of adapted species grow well if competing vegetation is controlled or removed by cutting, spraying, girdling, or mowing.

Slow permeability, seasonal wetness, and low strength are severe limitations for buildings, sanitary facilities, and most recreational uses. Building sites should be landscaped for good surface drainage away from the foundations. Artificial drainage and use of a suitable base material improve local roads.

This soil is in capability subclass IIw and woodland suitability subclass 2o.

BnB—Bennington silt loam, 2 to 6 percent slopes. This deep, gently sloping, somewhat poorly drained soil is on foot slopes, low knolls, and at the heads of waterways. Most areas are long and narrow or irregular in shape and are 5 to 20 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 8 inches thick. The subsoil is about 28 inches thick. It is mottled, yellowish brown, firm silty clay loam and silty clay in the upper part and mottled, brown, firm clay loam in the lower part. The substratum to a depth of about 60 inches is mottled, brown, firm, clay loam and loam glacial till.

Included with this soil in mapping are very poorly drained Kokomo soils in depressions and in narrow strips along waterways. The included soils make up 5 to 10 percent of most areas.

A perched seasonal high water table is near the surface in winter, spring, and other extended wet periods. Permeability is slow, and runoff is medium. The root zone is moderately deep to compact glacial till. Available water capacity and organic matter content are moderate. Tilth is good. Reaction in the subsoil ranges from very strongly acid in the upper part to mildly alkaline in the lower part. The shrink-swell potential in the subsoil is moderate.

Most of the acreage is used for farmland. Drained areas have high potential for cultivated crops, hay, pasture, and openland and woodland wildlife habitat. This soil has low potential for most building sites and sanitary facilities. It has medium potential for most recreational uses.

This soil is suited to row crops and small grain. Wetness, surface crusting, and control of erosion are main management concerns. Subsurface drains help lower the water table. Minimum tillage and incorporating crop residue or other organic matter into the surface layer improve tilth and fertility, increase the rate of water infiltration, and reduce crusting. Leaving crop residue on the surface in fall and not plowing until spring help protect the soil against erosion.

This soil is well suited to pasture and hay. Overgrazing or grazing when this soil is wet results in compaction of the silt loam surface layer, poor tilth, and damage to pasture plants.

This soil is well suited to trees and shrubs that tolerate some wetness. A few areas produce native hardwoods. Seedlings of adapted species grow well if competing vegetation is controlled or removed by cutting, spraying, girdling, or mowing.

The slow permeability, seasonal wetness, and low strength of this soil are severe limitations for buildings and sanitary facilities and are moderate limitations for most recreational uses. Foundation drains and protective exterior wall coatings help prevent wet basements. Artificial drainage and use of a suitable base material improve local roads. Plant cover should be maintained on the site during construction to reduce runoff and erosion.

This soil is in capability subclass IIe and woodland suitability subclass 2o.

CaB—Cana Variant silt loam, 2 to 6 percent slopes. This moderately deep, gently sloping, moderately well drained soil is on convex ridgetops. Most areas are long and narrow, but some are broad, oval, or irregular in shape. Areas are mainly 3 to 15 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 8 inches thick. The subsurface layer is light yellowish brown, friable silt loam about 3 inches thick. The subsoil is about 26 inches thick. It is brown and yellowish brown, firm silty clay loam in the upper part; mottled, yellowish brown, firm clay and silty clay in the middle part; and mottled, strong brown, firm shaly silty clay loam in the lower part. Rippable shale bedrock is at a depth of about 37 inches.

Included with this soil in mapping are small areas of the somewhat poorly drained Crosby soils on foot slopes. The included soils make up 5 to 10 percent of most areas.

A seasonal high water table is perched between a depth of 24 and 42 inches late in winter, in spring, and in other extended wet periods. Permeability is slow, and runoff is medium. The root zone is moderately deep to shale bedrock. Available water capacity is low, and organic matter content is moderate. Tilth is good. Reaction in the subsoil ranges from strongly acid to slightly acid in the upper part of the subsoil and extremely acid or very strongly acid in the lower part. The shrink-swell potential is moderate.

Most of the acreage is used for cropland. Corn, soybeans, and small grain are the main crops. This soil has high potential for cropland, pastureland, woodland, and openland or woodland wildlife habitat. It has low or medium potential for development of building sites and sanitary facilities. This soil has medium potential for most recreational uses.

This soil is suited to row crops and small grain. The hazard of erosion and low available water capacity are the main limitations for cultivated crops. The surface layer crusts and puddles after hard rains. Minimum tillage, planting cover crops, incorporating crop residue, and using grassed waterways increase the rate of water infiltration and reduce crusting and the hazard of erosion. Subsurface drains are needed in the wetter soils.

The use of this soil for pasture or hay helps control erosion. Overgrazing when this soil is wet causes surface compaction, excessive runoff, and poor tilth. Rotation of pasture and restrictive use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees and shrubs. Native hardwoods are in a few small areas. Seedlings grow well if competing vegetation is controlled or removed by cutting, spraying, mowing, or girdling.

Rippable bedrock between a depth of 20 to 40 inches, seasonal wetness, slow permeability, and low strength are limitations for building sites, sanitary facilities, and recreational uses. This soil is better suited to houses without basements than to houses with basements. Artificial drainage and use of a suitable base material for local roads help overcome the hazard of frost action and low strength. Maintaining soil cover on building sites during construction reduces the hazard of erosion.

This soil is in capability subclass IIe and woodland suitability subclass 2o.

CaD—Cana Variant silt loam, 6 to 18 percent slopes. This moderately deep, sloping and moderately steep, moderately well drained soil is on ridgetops and the lower part of convex side slopes. Most areas are long and narrow or oval and are 3 to 15 acres.

Typically, the surface layer is brown, friable silt loam about 6 inches thick. The subsoil is about 26 inches thick. It is yellowish brown, firm silty clay loam in the upper part and mottled, brown and yellowish brown, firm silty clay and shaly silty clay loam in the lower part. Rippable shale bedrock is at a depth of about 32 inches.

Included with this soil in mapping are small areas of the well drained Miamian soils in concave positions on the lower part of slopes. The included soils make up 5 to 10 percent of most areas.

A seasonal high water table is perched between a depth of 24 and 42 inches late in winter, in spring, and in other extended wet periods. Permeability is slow, and runoff is rapid. The root zone is moderately deep to shale bedrock. Available water capacity is low, and organic matter content is moderately low. Tilth is good. Reaction in the subsoil ranges from strongly acid to slightly acid in the upper part and extremely acid or very strongly acid in the lower part. The shrink-swell potential is moderate.

Most of the acreage is used for pasture or woodland. This soil has medium to low potential for cultivated crops and medium to high potential for pasture. It has low potential for most building sites and sanitary facilities and medium potential for most recreational uses. Areas that have 6 to 12 percent slopes have greater potential for most uses than areas that have 12 to 18 percent slopes.

Slope and low available water capacity are limitations for cultivated crops. If erosion is controlled, row crops can be grown. The cropping system should include close growing crops and grasses and legumes that provide large amounts of crop residue. The steeper slopes cause some problems in the operation of machinery and in the installation of erosion-control methods. Minimum tillage, planting cover crops, using grassed waterways, and tilling at a proper moisture level improve tilth, increase the rate of water infiltration, and reduce the hazard of erosion.

The use of this soil for pasture helps control erosion. Surface compaction, poor tilth, and increased runoff result from overgrazing or grazing when this soil is wet. Reseeding with cover crops, companion crops, or by the trash-mulch or no-till seeding methods reduces erosion.

This soil is well suited to trees. Native hardwoods are in some areas. Spraying, mowing, or disking helps reduce plant competition. Logging roads and skid trails should be protected against erosion and established across the slope. This soil has high potential for woodland wildlife habitat.

Rippable bedrock between a depth of 20 to 40 inches, seasonal wetness, slope, slow permeability, and soil strength are limitations for building sites, sanitary facilities, and recreational uses. This soil is better suited to houses without basements than to houses with basements. Artificial drainage and use of a suitable base material for local roads help overcome the hazard of frost action and low strength. Plant cover should be maintained on the site to reduce erosion. Trails in recreational areas should be protected against erosion and laid out on the contour.

This soil is in capability subclass IVe and woodland suitability subclass 2o.

CaF—Cana Variant silt loam, 18 to 50 percent slopes. This moderately deep, steep and very steep, moderately well drained soil is on sides of valleys and ravines in dissected uplands. Most areas are long and narrow and are 3 to 35 acres.

Typically, the surface layer is brown, friable silt loam about 4 inches thick. The subsoil is about 20 inches thick. It is brown, firm silty clay loam in the upper part and brown and yellowish brown, firm shaly silty clay and shaly silty clay loam in the lower part. Rippable shale bedrock is at a depth of about 24 inches.

Included with this soil in mapping are areas of the moderately well drained Celina Variant soils in the eastern part of the county and narrow strips of the well drained Miamian and Alexandria soils on the lower parts of slopes.

A seasonal high water table is perched between a depth of 24 and 42 inches during extended wet periods. Permeability is slow, and runoff is very rapid. The root zone is moderately deep to shale bedrock. Available water capacity and organic matter content are low. Tilth is good. Reaction in the subsoil ranges from strongly acid to slightly acid in the upper part and is extremely acid or very strongly acid in the lower part.

Most of the acreage is used for permanent vegetation. Some areas that have less sloping soils are used for farmland. This soil has low potential for cultivated crops, development of building sites, and sanitary facilities. It has high potential for woodland and woodland wildlife habitat. Areas that have 18 to 25 percent slopes have medium potential for pasture.

Slope is a severe limitation for cultivated crops, but areas that have 18 to 25 percent slopes are suited to permanent pasture. The hazard of erosion is serious, when adequate vegetative cover is not maintained. Reseeding pasture with cover crops, companion crops, or by the trash-mulch or no-till seeding methods reduces erosion. Rotation of pasture and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is suited to woodland. Slope limits the use of logging and planting equipment. Logging roads and skid trails should be protected against erosion and laid out on the contour.

Steep and very steep slope, slow permeability, some wetness, and bedrock at a depth of 20 to 40 inches are severe limitations for buildings, sanitary facilities, and recreational uses. Plant cover should be maintained on the site during construction to reduce the hazard of erosion. Trails in recreational areas should be protected against erosion and established across the slope.

This soil is in capability subclass VIe and woodland suitability subclass 2r.

CdB—Cardington silt loam, 2 to 6 percent slopes. This deep, gently sloping, moderately well drained soil is on long slopes and broad ridgetops. Most areas generally are 10 to 80 acres but some areas range to 250 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 9 inches thick. The subsurface layer is faintly mottled, pale brown, friable silt loam about 3 inches thick. The subsoil is about 21 inches thick. It is yellowish brown, firm silty clay loam in the upper part and mottled, dark yellowish brown and yellowish brown, firm clay loam in the middle and lower parts. The substratum to a depth of about 60 inches is mottled, yellowish brown and brown, firm, clay loam and loam glacial till.

Included with this soil in mapping are narrow strips of the very poorly drained Kokomo soils along waterways. The included soils make up about 5 to 10 percent of most areas.

A perched seasonal high water table is between a depth of 24 and 36 inches in winter, spring, and other extended wet periods. Permeability is moderately slow, and runoff is medium. The root zone is moderately deep to compact glacial till. Available water capacity and organic matter content are moderate. Tilth is good. Reaction in the subsoil ranges from very strongly acid in the upper part to neutral in the lower part. The shrink-swell potential in the subsoil is moderate.

Most areas of this soil are used for farmland. This soil has high potential for cultivated crops, hay, pasture, and recreational uses. It has medium potential for most building sites and medium or low potential for sanitary facilities.

This soil is well suited to row crops and small grain. The hazard of erosion and surface crusting are the main concerns, if the soil is cultivated. Minimum tillage and use of cover crops and grassed waterways help reduce soil loss. Incorporating crop residue or other organic matter into the surface layer helps improve tilth, increase the rate of water infiltration, and reduce crusting. Subsurface drains are needed in the wetter soils.

The use of this soil for pasture or hay helps control erosion. Surface compaction, poor tilth, and increased runoff result from overgrazing or grazing when this soil is wet.

This soil is well suited to trees and shrubs. Spraying, mowing, or disking help reduce plant competition.

Seasonal wetness, moderately slow permeability, and the shrink-swell potential are limitations for buildings and sanitary facilities. This soil is better suited to houses without basements than to houses with basements. Foundation drains and protective exterior wall coatings help prevent wet basements. Artificial drainage and use of a suitable base material for local roads help overcome the hazard of frost action and low strength. This soil is suited to recreational uses, such as picnic areas and paths and trails.

This soil is in capability subclass IIe and woodland suitability subclass 2o.

CdC2—Cardington silt loam, 6 to 12 percent slopes, eroded. This deep, sloping, well drained soil is on side slopes along waterways and on the upper and lower parts of hillsides. Erosion has removed part of the original surface layer. Tillage has mixed subsoil material that has a higher clay content and more coarse fragments into the present surface layer. Most areas are long and narrow or irregular. Areas are mainly 5 to 45 acres but some areas range to 70 acres.

Typically, the surface layer is brown, friable silt loam about 7 inches thick. The subsoil is about 20 inches thick. It is yellowish brown, firm silty clay loam in the upper part and mottled, dark yellowish brown, firm clay loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown and brown, firm clay loam and loam glacial till.

Included with this soil in mapping are narrow strips of the very poorly drained Kokomo soils along drainageways. The included soils make up about 3 percent of most areas.

A perched seasonal high water table is between a depth of 24 and 36 inches in winter, spring, and other extended wet periods. Permeability is moderately slow, and runoff is rapid. The root zone is mainly moderately deep to compact glacial till. Available water capacity is moderate, and organic matter content is moderately low. Tilth is good. Reaction in the subsoil ranges from very strongly acid in the upper part to neutral in the lower part. The shrink-swell potential in the subsoil is moderate.

Most areas are used for farmland. Some areas are used for permanent pasture or woodland. This soil has medium potential for cultivated crops and for most building sites and recreational uses. It has low or medium potential for sanitary facilities and high potential for hay and pasture.

This soil is suited to row crops and small grain. The hazard of erosion is the main limitation for row crops. It reduces the range of moisture content for tillage. Minimum tillage and use of cover crops and grassed waterways help reduce soil loss. Incorporating crop residue or other organic matter into the surface layer improves tilth and fertility, increases the rate of water infiltration, reduces crusting, and improves soil-seed contact.

The use of this soil for pasture or hay helps control erosion. Surface compaction, reduced growth, poor tilth, and increased runoff result from overgrazing or grazing when this soil is wet. Proper stocking rates, selection of plants, rotation of pasture, and timely deferment of grazing, along with weed control, help keep the pasture and soil in good condition.

This soil is well suited to trees and shrubs. Seedlings grow well if competing vegetation is controlled or removed by cutting, spraying, girdling, or mowing.

This soil is moderately well suited to most buildings, sanitary facilities, and recreational uses. Slope, seasonal wetness, moderately slow permeability, and shrink-swell potential are the main limitations. Artificial drainage and use of a suitable base material for local roads help reduce the hazard of frost action and low soil strength. Foundation drains and protective exterior wall coatings help prevent wet basements. Increasing the size of the absorption area and placing leach lines on the contour to reduce seepage to the soil surface help improve septic tank absorption fields. Maintaining soil cover helps reduce increased runoff and erosion during construction.

This soil is in capability subclass IIIe and woodland suitability subclass 2o.

Cf—Carlisle muck. This deep, nearly level, very poorly drained soil is in low-lying swampy areas, in kettle holes on terraces, and in depressions on uplands. The microrelief is uneven in uncultivated areas because of clumps of grass. This soil is frequently flooded. Slope is 0 to 2 percent. Most areas are long and narrow or oval.

Typically, the surface layer is black, very friable muck about 8 inches thick. Below this to a depth of about 62 inches are layers of black, dark brown, and dark reddish brown, friable muck.

Included with this soil in mapping are narrow strips of the very poorly drained Linwood, Montgomery, Kokomo, and Westland soils and the poorly drained Patton soils on the periphery of areas. The included soils make up 2 to 10 percent of most areas.

Water is near the surface or ponded on the surface for long periods. Permeability ranges from moderately slow to moderately rapid. Runoff is very slow. The root zone is deep, but the root depth is influenced by the water table. Available water capacity is high and organic matter content is very high. Tilth is good. Reaction in the root zone is slightly acid to mildly alkaline.

Most areas are used for wetland vegetation. This soil has high potential for wetland wildlife habitat. Drained areas have high potential for cropland, pasture, and some specialty crops. The potential for development of building sites, sanitary facilities, and recreational uses is very low.

Very poor natural drainage and flooding are limitations for agricultural uses. This soil is too wet for crops, unless it is drained. Surface and subsurface drains help remove excess water. In some areas, suitable outlets are difficult to establish. Subsidence or shrinkage occurs after draining because of oxidation of the organic material. Controlled drainage helps reduce shrinkage in areas where the water table can be raised or lowered. During dry periods, fire is a hazard. Use of cover crops, crop residue, irrigation, and windbreaks are good management methods. Frost damage is a concern because of the low-lying position.

Water-tolerant species of grass used for hay and pasture are suited to drained areas of this soil. Overgrazing and grazing when the soil is wet damage plants.

This soil is not well suited to woodland, unless it is drained. Undrained areas support water-tolerant trees and some cattails, reeds, or sedges. Wetness seriously limits the use of logging equipment.

Flooding, wetness, low strength, and seepage are severe limitations for development of building sites, sanitary facilities, and recreational uses. Replacing the organic material with suitable base material and providing drainage help improve local roads. This soil is a source of peat for lawns and landscaping. Undrained areas provide good habitat for ducks, muskrat, and other wetland wildlife.

This soil is in capability subclass IIIw and woodland suitability subclass 4w.

CgC—Casco gravelly loam, 6 to 12 percent slopes. This deep, sloping, well drained to somewhat excessively drained soil is on kames and side slopes along waterways. Most areas are long and narrow or irregular and are 5 to 20 acres.

Typically, the surface layer is brown, friable gravelly loam about 7 inches thick. The subsoil is dark yellowish brown and dark brown, firm gravelly clay loam about 7 inches thick. The substratum to a depth of about 60 inches is dark yellowish brown and brown, loose, stratified very gravelly sand and gravelly sand.

Included with this soil in mapping are small areas of the more droughty Rodman soils on the upper part of slopes. The included soils make up 5 to 10 percent of most areas.

Permeability is moderate in the subsoil and very rapid in the substratum. Runoff is medium, and the root zone is mainly shallow to sand and gravel. Available water capacity and organic matter content are low. Reaction in the subsoil is medium acid to mildly alkaline. The shrink-swell potential in the subsoil is moderate.

This soil is used mainly for row crops, woodland, pasture, and hay. It has low potential for cultivated crops and medium potential for pasture, hay, development of building sites, and recreational uses.

Droughtiness and the hazard of erosion are limitations for cultivated crops, small grain, hay, and pasture. This soil is better suited to early maturing crops than to crops that mature late in summer. It is well suited to grazing early in spring. Gravel in the surface layer interferes with tillage. Plant nutrients are leached from this soil at a moderately rapid rate. Response is generally better to smaller but more frequent or timely applications of plant nutrients than to one large application. Including grasses and legumes in the cropping system and the use of minimum tillage help control erosion and maintain tilth in cultivated areas.

This soil is well suited to deep-rooted trees. Seedlings are difficult to establish during dry periods. Spraying, mowing, or disking helps reduce plant competition.

Slope and gravel in the surface layer are limitations for building sites and recreational uses. This soil is droughty for lawns during dry periods. Seedlings should be mulched and watered. Sloughing is a hazard during excavations. Underground water supplies can be polluted because of seepage from sanitary facilities. Plant cover should be maintained on the site to reduce the hazard of erosion. This soil is a good source of sand and gravel.

This soil is in capability subclass IVe and woodland suitability subclass 3s.

ChD—Casco-Kendallville complex, 12 to 18 percent slopes. This complex consists of a well drained to somewhat excessively drained Casco soil and a well drained Kendallville soil on kames and terraces. These soils are deep and moderately steep. Areas are mainly 5 to 35 acres. They are made up of about 55 percent Casco gravelly loam and 25 percent Kendallville silt loam. The Casco soil is on the convex part of knolls and on sharp slope breaks on terraces. The Kendallville soil is near the base of kames and on the upper part of slopes on terraces. The two soils are so intricately mixed, or areas are so small in size, that it is not practical to separate them in mapping.

Typically, the Casco soil has a surface layer of brown, friable gravelly loam about 7 inches thick. The substratum to a depth of about 60 inches is brown, loose very gravelly sand.

Typically, the Kendallville soil has a surface layer of brown, friable silt loam about 8 inches thick. The subsoil is about 26 inches thick. It is brown, firm clay loam in the upper part, and dark yellowish brown, firm gravelly clay loam and gravelly sandy clay loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown, firm loam glacial till.

Included with these soils in mapping are small areas of the droughty Rodman soils on the most convex part of slopes. The included soils make up 5 to 10 percent of most areas.

Permeability of the Casco soil is moderate in the subsoil and very rapid in the substratum. The root zone is shallow to sand and gravel. Available water capacity and organic matter content are low. Reaction in the subsoil is medium acid to mildly alkaline.

Permeability of the Kendallville soil is moderately slow. The root zone is moderately deep to compact glacial till. Available water capacity is moderate, and organic matter content is moderately low. Reaction in the subsoil is medium acid or strongly acid in the upper part and neutral or mildly alkaline in the lower part.

In both of these soils runoff is very rapid, tilth is good, and the shrink-swell potential of the subsoil is moderate.

Most of the acreage is used for permanent pasture and woodland. These soils have low potential for row crops, small grain, development of building sites, sanitary facilities, and most recreational uses. The potential is medium or high for woodland and medium or low for pasture.

The moderately steep slope, hazard of erosion, and low and moderate available water capacity are limitations for farming. The hazard of erosion is serious when pasture is reseeded or adequate plant cover is not maintained. Seeding pasture by the trash-mulch or no-till methods reduces the hazard of erosion and conserves moisture. During dry periods, it is difficult to establish seedings, especially on the Casco soil.

The Kendallville soil is better suited to woodland than the Casco soil. Slope limits the use of logging equipment. Logging roads and skid trails should be protected against erosion and established across the slope.

The moderately steep slope is a severe limitation for building sites. Plant cover should be maintained on the site during construction to reduce the hazard of erosion. Roads and streets should be laid out on the contour. Seepage from sanitary facilities in the Casco soil is a possible hazard of pollution to underground water supplies. The Casco soil is droughty for lawns. Trails in recreational areas should be protected against erosion.

These soils are in capability subclass VIe. The Casco soil is in woodland suitability subclass 3s and the Kendallville soil is in woodland suitability subclass 1r.

ChE—Casco-Kendallville complex, 18 to 35 percent slopes. This complex consists of a well drained to somewhat excessively drained Casco soil and a well drained Kendallville soil on kames, eskers, terraces, and end moraines. These soils are deep and steep and very steep. Most areas are 5 to 35 acres and contain about 55 percent Casco gravelly loam and 30 percent Kendallville silt loam. The Casco soil is mainly on the convex part of slopes. The Kendallville soil is near the base of slopes. The two soils are so intricately mixed, or areas are so small in size, that it is not practical to separate them in mapping.

Typically, the Casco soil has a surface layer of brown, friable gravelly loam about 5 inches thick. The subsoil is dark brown, firm gravelly clay loam about 7 inches thick. The substratum to a depth of about 60 inches is brown, loose very gravelly sand.

Typically, the Kendallville soil has a surface layer of brown, friable silt loam about 6 inches thick. The subsoil is about 22 inches thick. It is brown, firm clay loam in the upper part, and is dark yellowish brown, firm gravelly sandy clay loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown, firm loam glacial till.

Included with these soils in mapping are about 15 percent small areas of the droughty Rodman soils on side slopes.

Permeability of the Casco soil is moderate in the subsoil and very rapid in the substratum. The root zone is shallow to sand and gravel, and available water capacity is low or very low. Reaction in the subsoil is medium acid to mildly alkaline.

Permeability of the Kendallville soil is moderately slow. The root zone is moderately deep to compact glacial till, and available water capacity is moderate. Reaction in the subsoil is medium acid or strongly acid in the upper part and neutral or mildly alkaline in the lower part.

In both of these soils runoff is very rapid, tilth is good, and organic matter content is low.

Most of the acreage is used for woodland and permanent pasture. These soils have low potential for most uses other than woodland, woodland wildlife habitat, and some recreational uses.

These soils are too steep for cultivated crops or hay and have limited use for permanent pasture. The hazard of erosion is very severe, if the plant cover is removed. Seeding pasture by the trash-mulch or no-till methods reduces the hazard of erosion and conserves moisture. During dry periods it is difficult to establish seedings, especially on the Casco soil.

The Kendallville soil is better suited to woodland than the Casco soil. Slope limits the use of planting and harvesting equipment. Logging roads and skid trails should be protected against erosion and established across the slope. Spraying and cutting reduce plant competition.

The steep and very steep slope is a severe limitation for building sites, sanitary facilities, and most recreational uses. Plant cover should be maintained on the site during construction to reduce the hazard of erosion. Trails in recreational areas should be protected against erosion and laid out on the contour.

These soils are in capability subclass VIIe. The Casco soil is in woodland suitability subclass 3s, and the Kendallville soil is in woodland suitability subclass 1r.

CkD—Casco-Rodman gravelly loams, 12 to 18 percent slopes. This complex consists of a well drained to somewhat excessively drained Casco soil and an excessively drained Rodman soil on terraces, kames, and eskers. These soils are deep and moderately steep. Areas on terraces are long and narrow, and those on kames and eskers are irregular. Most areas are 5 to 35 acres and contain about 65 percent Casco gravelly loam and 25 percent Rodman gravelly loam. The Casco soil is mainly on less sloping areas. The Rodman soil is on convex knolls and steeper side slopes. The two soils are so intricately mixed, or areas are so small in size, that it is not practical to separate them in mapping.

Typically, the Casco soil has a surface layer of brown, friable gravelly loam about 7 inches thick. The subsoil is dark brown, firm gravelly clay loam about 7 inches thick. The substratum to a depth of about 60 inches is brown, loose very gravelly sand.

Typically, the Rodman soil has a surface layer of very dark grayish brown, friable gravelly loam about 7 inches thick. The subsoil is brown, friable gravelly loam about 7 inches thick. The substratum to a depth of about 60 inches is brown and dark grayish brown, loose gravelly coarse sand.

Permeability of the Casco soil is moderate in the subsoil. Available water capacity and organic matter content are low. Reaction in the subsoil is medium acid to mildly alkaline.

Permeability of the Rodman soil is moderately rapid in the subsoil. Available water capacity is very low, and organic matter content is moderate. Reaction in the subsoil is neutral to moderately alkaline.

In both of these soils, permeability is very rapid in the substratum, runoff is rapid, the root zone is shallow to sand and gravel (fig. 5), and tilth is good.

Most of the acreage is used for permanent pasture and woodland. These soils have low potential for row crops, small grain, development of building sites, sanitary facilities, and most recreational uses. The potential is medium for woodland and medium or low for pasture.

The moderately steep slope, droughtiness, and hazard of erosion are limitations for farming. These soils are suited to permanent pasture (fig. 6). The hazard of erosion is serious if pasture is reseeded or if adequate plant cover is not maintained. Seeding pasture by the trash-mulch or no-till methods reduces the hazard of erosion

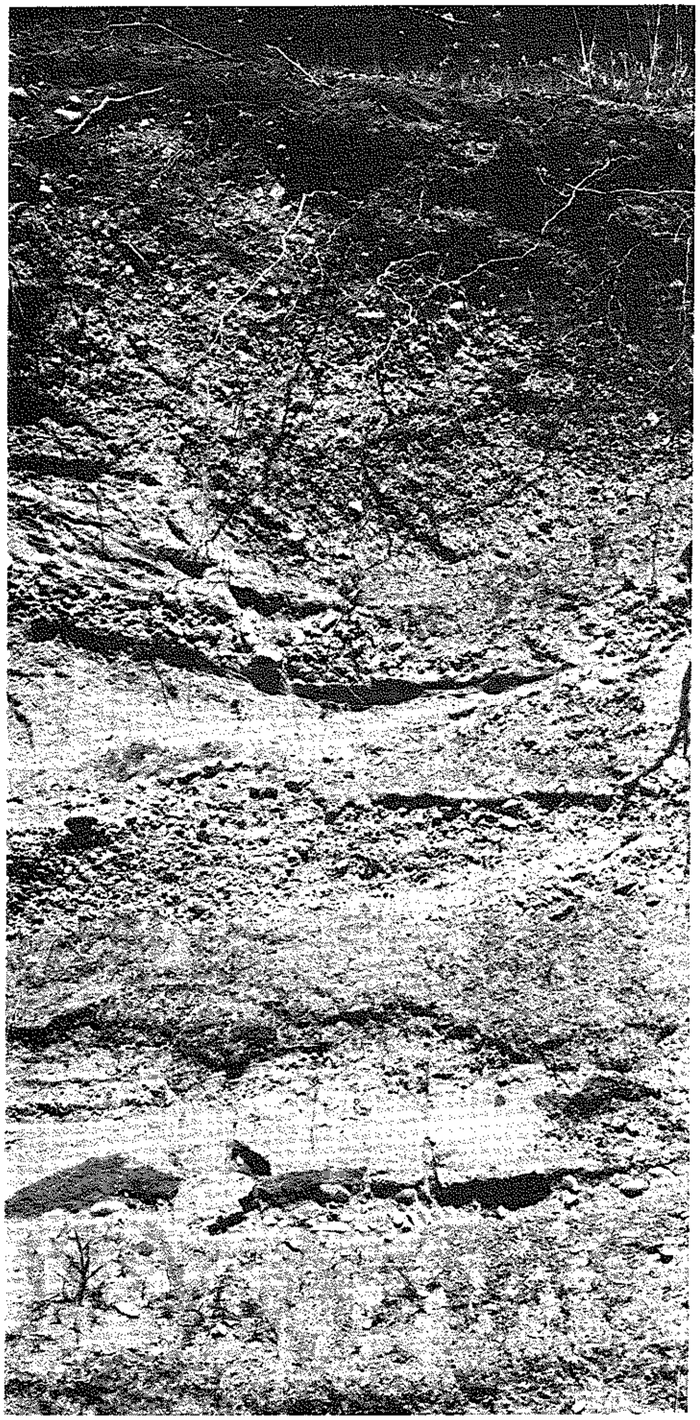


Figure 5.—Casco-Rodman gravelly loams, 12 to 18 percent slopes, have a shallow root zone over stratified sand and gravel.

and conserves moisture. It is difficult to establish seedings during dry periods. Some plants have nutrient deficiencies because of the shallow depth to material that has a high content of lime. Fertilizer is leached from these soils at a rapid rate. Response is generally better to smaller but more frequent or timely applications of nutrients than to one large application.

The low or very low available water capacity reduces woodland growth. Species adapted to dry sites should be selected for new plantings. Slope limits the use of logging equipment. Logging roads and skid trails should be protected against erosion and established across the slope.

The moderately steep slope is a severe limitation for building sites. Plant cover should be maintained on the site during construction to reduce the hazard of erosion. These soils are droughty for lawns. Roads and streets should be laid out on the contour. Seepage from sanitary facilities is a possible hazard of pollution to underground water supplies. Trails in recreational areas should be protected against erosion.

These soils are in capability subclass VIe and woodland suitability subclass 3s.

CkE—Casco-Rodman gravelly loams, 18 to 35 percent slopes. This complex consists of a well drained to somewhat excessively drained Casco soil and an excessively drained Rodman soil on terraces, kames, and eskers. These soils are deep and steep and very steep. Most areas are long and narrow and contain about 55 percent Casco gravelly loam and 35 percent Rodman gravelly loam. The Casco soil is mainly on foot slopes and the less sloping part of areas. The Rodman soil is on convex knolls and steeper side slopes. These soils are so intricately mixed, or areas are so small in size, that it is not practical to separate them in mapping.

Typically, the Casco soil has a surface layer of brown, friable gravelly loam about 5 inches thick. The subsoil is brown, firm gravelly clay loam about 7 inches thick. The substratum to a depth of about 60 inches is brown, loose very gravelly sand.

Typically, the Rodman soil has a surface layer of very dark brown, friable gravelly loam about 5 inches thick. The subsoil is brown, friable gravelly loam about 7 inches thick. The substratum to a depth of about 60 inches is dark grayish brown, loose gravelly coarse sand.

Permeability of the Casco soil is moderate in the subsoil, and runoff is very rapid. Organic matter content is low. Reaction in the subsoil is medium acid to mildly alkaline.

Permeability of the Rodman soil is moderately rapid in the subsoil, and runoff is rapid. Organic matter content is moderate. Reaction in the subsoil is neutral to moderately alkaline.

In both of these soils permeability in the substratum is very rapid. The root zone is shallow, available water capacity is very low, and tilth is good.

Most of the acreage is used for woodland and permanent pasture. These soils have low potential for most

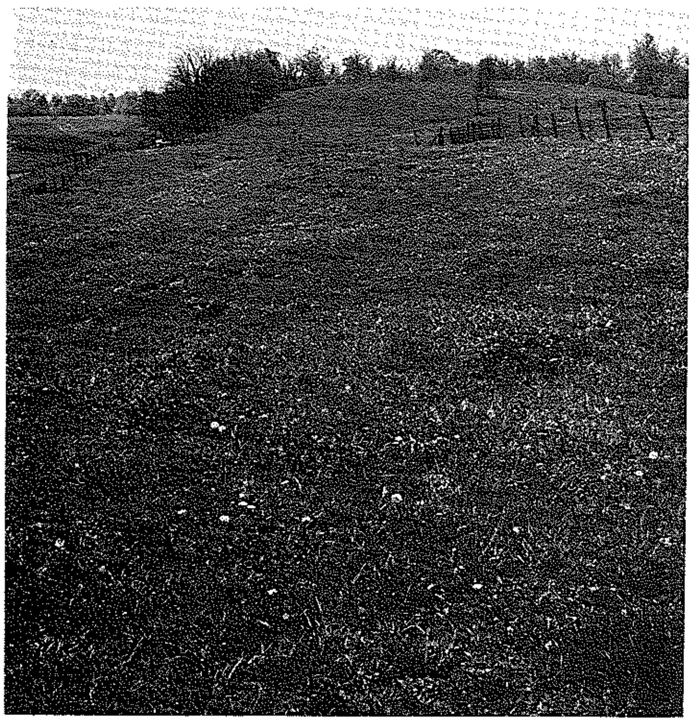


Figure 6.—Casco-Rodman gravelly loams, 12 to 18 percent slopes, are suited to permanent pasture.

uses other than woodland, woodland wildlife habitat, and some recreational uses.

These droughty soils are too steep for cultivated crops or hay and have limitations for permanent pasture. The hazard of erosion is very severe, if the plant cover is removed. Seeding pasture by the trash-mulch or no-till methods reduces the hazard of erosion and conserves moisture. It is difficult to establish seedings during dry periods. Some plants have nutrient deficiencies because of the shallow depth to material that has a high content of lime.

The very low available water capacity reduces woodland growth. Species adapted to dry sites should be selected for new plantings. Slope limits the use of logging and planting equipment. Logging roads and skid trails should be protected against erosion and established across the slope. Spraying and cutting reduce plant competition.

The steep and very steep slope is a severe limitation for building sites, sanitary facilities, and most recreational uses. Plant cover should be maintained on the site during construction to reduce the hazard of erosion. Trails in recreational areas should be protected against erosion and laid out on the contour.

These soils are in capability subclass VIIe and woodland suitability subclass 3s.

ClA—Celina silt loam, 0 to 2 percent slopes. This deep, nearly level, moderately well drained soil is on convex ridges and slight rises. Most areas are circular or irregular in shape and are 3 to 14 acres.

Typically, the surface layer is brown, friable silt loam about 9 inches thick. The subsurface layer is yellowish brown and pale brown, friable silt loam about 4 inches thick. The subsoil is mottled, yellowish brown, firm silty clay loam and clay loam about 24 inches thick. The substratum to a depth of about 60 inches is mottled, yellowish brown, firm loam glacial till.

Included with this soil in mapping are narrow strips of the very poorly drained Kokomo soils along drainageways and small areas of the somewhat poorly drained Crosby soils in slight depressions. The included soils make up 2 to 8 percent of most areas.

A seasonal high water table is perched between a depth of 18 to 36 inches late in winter, in spring, and in other extended wet periods. Permeability is moderately slow, and runoff is slow. The root zone is moderately deep to compact glacial till. Available water capacity and organic matter content are moderate. Tilth is good. Reaction in the subsoil ranges from strongly acid in the upper part to neutral in the lower part. The shrink-swell potential in the subsoil is moderate.

Most of the acreage is used for farmland. This soil has high potential for cultivated crops, hay, pasture, woodland, and openland and woodland wildlife habitat. The potential is low or medium for development of building sites and sanitary facilities. This soil has medium potential for most recreational uses.

This soil is well suited to corn, soybeans, small grain, hay, and pasture. Cultivated crops can be grown frequently, if management is good. Maintaining good tilth and a high fertility level are main management concerns. Soil compaction is a problem if this soil is tilled when wet. Minimum tillage, planting cover crops, incorporating crop residue, and tilling at proper moisture levels increase the rate of water infiltration and reduce crusting and the hazard of erosion. Randomly spaced subsurface drains are needed in the wetter soils.

Overgrazing or grazing when this soil is wet causes soil compaction and poor tilth. Rotation of pasture and restricted grazing during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees and shrubs. Seedlings grow well if competing vegetation is controlled or removed by spraying, cutting, girdling, or mowing.

Seasonal wetness, moderately slow permeability, soil strength, and the shrink-swell potential are limitations for building sites and sanitary facilities. Artificial drainage and storm sewers reduce wetness. This soil is better suited to houses without basements than to houses with basements. Building sites should be landscaped for good surface drainage away from the foundations. Foundation drains and protective exterior wall coatings help prevent wet basements. Artificial drainage and suitable base material for local roads help overcome the hazards of frost action and low strength.

This soil is in capability class I and woodland suitability subclass 1o.

ClB—Celina silt loam, 2 to 6 percent slopes. This deep, moderately well drained, gently sloping soil is on broad convex ridgetops and on knolls and side slopes along waterways. Most areas are 3 to 30 acres.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsurface layer is light yellowish brown and yellowish brown, friable silt loam about 4 inches thick. The subsoil is mottled, yellowish brown, firm silty clay loam and clay loam about 24 inches thick. The substratum to a depth of about 60 inches is mottled, yellowish brown, firm, loam glacial till.

Included with this soil in mapping are narrow strips of the very poorly drained Kokomo soils along waterways and the somewhat poorly drained Crosby soils on toe slopes and foot slopes. The included soils make up about 5 percent of most areas.

A seasonal high water table is perched between a depth of 18 to 36 inches late in winter, in spring, and in other extended wet periods. Permeability is moderately slow, and runoff is medium. The root zone is moderately deep to compact glacial till. Available water capacity and organic matter content are moderate. Tilth is good. Reaction in the subsoil ranges from strongly acid to neutral in the upper part and slightly acid to mildly alkaline in the lower part. The shrink-swell potential in the subsoil is moderate.

Most of the acreage is used for farmland. This soil has high potential for cultivated crops, hay, pasture, woodland, and openland and woodland wildlife habitat. The potential is medium for most recreational uses. This soil has medium or low potential for development of building sites and sanitary facilities.

This soil is well suited to row crops, small grain, and hay. The hazard of erosion and surface crusting are the main limitations if this soil is farmed. Use of meadow crops in the cropping system and grassed waterways help control erosion. Use of minimum tillage, incorporating crop residue, planting cover crops, and tilling at proper moisture levels increase the rate of water infiltration and reduce crusting and the hazard of erosion. Subsurface drains are needed in the wetter soils.

The use of this soil for pasture helps control erosion. Surface compaction, poor tilth, and increased runoff result from overgrazing or grazing when the soil is wet.

This soil is well suited to trees and shrubs. Native hardwoods are in a few areas. Seedlings grow well if competing vegetation is controlled or removed by spraying, mowing, disking, or girdling.

Seasonal wetness, moderately slow permeability, soil strength, and the shrink-swell potential are limitations for building sites and sanitary facilities. This soil is better suited to houses without basements than to houses with basements. Artificial drainage and storm sewers reduce wetness. Foundation drains and protective exterior wall coatings help prevent wet basements. Artificial drainage and use of a suitable base material for local roads help overcome the hazards of frost action and low strength. Maintaining soil cover on the site during construction reduces the hazard of erosion. This soil is suited to recreational uses, such as picnic areas and paths and trails.

This soil is in capability subclass IIe and woodland suitability subclass 1o.

CnC—Celina Variant silt loam, 6 to 15 percent slopes. This moderately deep, sloping and moderately steep, moderately well drained soil is on hillsides. Most areas are 4 to 10 acres. Some areas are eroded, and some have slopes of 2 to 6 percent.

Typically, the surface layer is dark grayish brown, friable silt loam about 6 inches thick. The subsoil is about 28 inches thick. It is yellowish brown, firm, silty clay loam in the upper part; mottled, yellowish brown, firm clay loam in the middle part; and mottled, dark gray and gray, firm clay in the lower part. Very dark grayish brown, rippable shale bedrock is at a depth of about 34 inches.

Included with this soil in mapping are deep Celina soils on the lower part of slopes. The included soils make up 5 to 15 percent of most areas.

A seasonal high water table is perched between a depth of 24 and 42 inches late in winter, in spring, and in other extended wet periods. Permeability is slow, and runoff is rapid. The root zone is moderately deep to shale bedrock. Available water capacity is low, and organic matter content is moderate. Tilth is good. Reaction in the subsoil is strongly acid to slightly acid in the upper part and neutral to moderately alkaline in the lower part. The shrink-swell potential in the subsoil is moderate.

Most of the acreage is used for farmland. Some areas are used for permanent pasture and woodland. This soil has medium potential for cultivated crops and most recreational uses. It has low potential for most building sites and sanitary facilities. This soil has high potential for pasture and woodland.

This soil is suited to row crops and small grain. The hazard of erosion is severe in cultivated areas, especially if plowing is in fall. Grasses and legumes in the cropping system reduce soil loss and improve tilth. The surface layer crusts after hard rains. The soil is cloddy if plowed when wet and sticky. Minimum tillage, planting cover crops, incorporating crop residue, and tilling at proper moisture levels increase the rate of water infiltration and reduce crusting, soil compaction, and the hazard of erosion.

The use of this soil for pasture helps control erosion. Overgrazing or grazing when this soil is wet causes surface compaction, excessive runoff, and poor tilth. Reseeding can be done by cover crops or companion crops or by using the trash-mulch or no-till seeding method. Rotation of pasture and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees. Spraying, mowing, or disking help reduce plant competition. Logging roads and skid trails should be protected against erosion.

Bedrock between a depth of 20 and 40 inches, seasonal wetness, slope, slow permeability, and soil strength are limitations for building sites and sanitary facilities. This soil is better suited to houses without basements than to houses with basements. Artificial drainage and use of a suitable base material for local roads help overcome the hazard of frost action and low strength.

This soil is in capability subclass IIIe and woodland suitability subclass 2o.

CoA—Corwin silt loam, 0 to 2 percent slopes. This deep, nearly level, moderately well drained soil is near the heads of waterways. Most areas are oval, fan-shaped, or irregular in shape. Areas are generally 3 to 10 acres, but some areas range to 30 acres.

Typically, the surface layer is very dark grayish brown, friable silt loam about 8 inches thick. The subsurface layer is very dark grayish brown, friable silty clay loam about 6 inches thick. The subsoil is about 22 inches thick. It is yellowish brown, firm silty clay loam in the upper part and mottled, yellowish brown, firm clay loam in the lower part. The substratum to a depth of about 60 inches is mottled, yellowish brown and dark yellowish brown, firm, loam glacial till. In some areas, there is 6 to 12 inches of local alluvial sediment on the surface layer.

Included with this soil in mapping are narrow strips of the very poorly drained Kokomo soils along waterways. The included soils make up 5 to 15 percent of most areas.

A seasonal high water table is perched between a depth of 36 and 72 inches in spring and other extended wet periods. Permeability is moderately slow, and runoff is slow. The root zone is moderately deep to compact glacial till. Available water capacity is moderate or high, and organic matter content is high. Tilth is good. Reaction in the subsoil is slightly acid or medium acid in the upper part and neutral in the lower part. The shrink-swell potential in the subsoil is moderate.

Most of the acreage is used for cropland. This soil has high potential for cropland, pasture, and woodland. It has low or medium potential for development of building sites and sanitary facilities. It has medium or high potential for recreational uses.

This soil is well suited to corn, soybeans, small grain, hay, and pasture. Cultivated crops can be grown frequently, if management is good. Maintaining good tilth and a high level of fertility are main management concerns. Tilling or harvesting when the soil is wet causes compaction. Minimum tillage, planting cover crops, incorporating crop residue, and tilling at proper moisture levels increase the rate of water infiltration and reduce crusting and the hazard of erosion. Randomly spaced subsurface drains are needed in the wetter soils.

Overgrazing or grazing when this soil is wet causes compaction and poor tilth. Rotation of pasture and restricted grazing during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees and shrubs. Seedlings grow well if competing vegetation is controlled or removed by spraying, cutting, girdling, or mowing.

Seasonal wetness, moderately slow permeability, the shrink-swell potential, and soil strength are limitations for building sites and sanitary facilities. This soil is better suited to houses without basements than to houses with basements. Artificial drainage and storm sewers reduce wetness. Building sites should be landscaped for good surface drainage away from the foundations. Foundation drains and protective exterior wall coatings help prevent wet basements. Use of a suitable base material helps improve local roads. Increasing the size of the absorption area helps improve septic tank absorption fields.

This soil is in capability class I. It was not assigned a woodland suitability subclass.

CoB—Corwin silt loam, 2 to 6 percent slopes. This deep, gently sloping, moderately well drained soil is on the lower third of long, gentle slopes and at the heads of waterways. Most areas are fan-shaped, oval, or irregular in shape. Areas are generally 3 to 10 acres, but some areas range to 40 acres.

Typically, the surface layer is very dark grayish brown, friable silt loam about 8 inches thick. The subsurface layer is very dark grayish brown, friable silt loam about 6 inches thick. The subsoil is about 22 inches thick. It is yellowish brown, firm silty clay loam in the upper part and mottled, yellowish brown, firm clay loam in the lower part. The substratum to a depth of about 60 inches is mottled, yellowish brown and dark yellowish brown, firm, loam glacial till.

Included with this soil in mapping are small areas of the well drained Miamian soils on knolls and on the middle and upper parts of slopes. Also included are narrow strips of the very poorly drained Kokomo soils along waterways. The included soils make up 5 to 15 percent of most areas.

A seasonal high water table is perched between a depth of 36 and 72 inches in spring and other extended wet periods. Permeability is moderately slow, and runoff is medium. The root zone is moderately deep to compact glacial till. Available water capacity is moderate or high, and organic matter content is high. Tilth is good. Reaction in the subsoil is slightly acid or medium acid in the upper part and neutral in the lower part. The shrink-swell potential in the subsoil is moderate.

Most of the acreage is used for farmland. This soil has high potential for cultivated crops, hay, pasture, and woodland. It has medium potential for most building sites and medium or low potential for sanitary facilities. This soil has high potential for most recreational uses.

This soil is suited to row crops, small grain, hay, and specialty crops. The hazard of erosion is the main concern for row crops. Minimum tillage, planting cover crops, and using grassed waterways help reduce soil loss. Incorporating crop residue or other organic matter into the surface layer improves tilth, increases the rate of water infiltration, and reduces crusting.

The use of this soil for pasture helps control erosion. Surface compaction, poor tilth, and increased runoff result from overgrazing or grazing when this soil is wet.

This soil is well suited to trees. Seedlings grow well if competing vegetation is controlled or removed by spraying, mowing, disking, or girdling.

Seasonal wetness, moderately slow permeability, the shrink-swell potential, and soil strength are limitations for building sites and sanitary facilities. This soil is better suited to houses without basements than to houses with basements. Artificial drainage and storm sewers reduce wetness. Foundation drains and protective exterior wall coatings help prevent wet basements. Use of a suitable base material on local roads helps overcome the hazard of low strength. Maintaining soil cover on the site during construction reduces the hazard of erosion. Increasing the size of the absorption area helps improve septic tank absorption fields. This soil is well suited to such recreational uses as picnic areas, golf fairways, and paths and trails.

This soil is in capability subclass IIe. It was not assigned a woodland suitability subclass.

CrA—Crosby silt loam, 0 to 2 percent slopes. This deep nearly level, somewhat poorly drained soil is in narrow to broad areas on very slight rises. Areas are fan-shaped at the heads of waterways and in narrow strips along waterways. Most areas are 2 to 30 acres, but some areas range to more than 100 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 8 inches thick. The subsurface layer is mottled, brown, friable silt loam about 4 inches thick. The subsoil is mottled, yellowish brown and dark yellowish brown, firm silty clay loam, clay, and clay loam about 24 inches thick. The substratum to a depth of about 60 inches is mottled, yellowish brown, firm, loam glacial till. In some areas east of the Scioto River, the surface layer is loam.

Included with this soil in mapping are small areas of the very poorly drained Kokomo soils in depressions and along waterways. The included soils make up 5 to 15 percent of most areas.

A seasonal high water table is between a depth of 12 and 36 inches late in winter, in spring, and in other extended wet periods. Permeability and runoff are slow. The root zone is moderately deep to compact glacial till. Available water capacity and organic matter content are moderate. Tilth is good. Reaction in the subsoil ranges from medium acid in the upper part to mildly alkaline in the lower part. The shrink-swell potential in the subsoil is moderate.

Most of the acreage is used for farmland. This soil has high potential for cultivated crops, hay, and pasture. It has low potential for development of building sites and sanitary facilities. This soil has medium or low potential for recreational uses.

This soil is suited to corn, soybeans, small grain, hay, and pasture. Wetness and surface crusting are main management concerns for farming. Surface drains help remove excess surface water. Subsurface drainage systems help lower the water table. Tilling or harvesting when this soil is wet causes compaction. Incorporating crop residue, tilling at proper moisture levels, incorporating crop residue, and planting cover crops reduce crusting and improve tilth.

Overgrazing or grazing when this soil is wet causes surface compaction and poor tilth. Rotation of pasture and restricted grazing during wet periods help keep the pasture and the soil in good condition.

This soil is suited to woodland and to openland and woodland wildlife habitat. Species that are tolerant of some wetness should be selected for new plantings. Reforestation of desirable species is difficult because of plant competition. Good site preparation and spraying, mowing, or disking after the seedlings are established help improve survival and growth.

The seasonal high water table, slow permeability, and low strength are severe limitations for building sites and sanitary facilities. Surface and subsurface drains help reduce wetness. Building sites should be landscaped for good surface drainage away from the foundations. Sanitary facilities should be connected to central sewers. Artificial drainage and use of a suitable base material help improve local roads. Wetness is a limitation for recreational uses.

This soil is in capability subclass IIw and woodland suitability subclass 3o.

CrB—Crosby silt loam, 2 to 6 percent slopes. This deep, gently sloping, somewhat poorly drained soil is on narrow to broad upland areas between Celina soils on knolls and low ridges and Kokomo soils in depressions and along waterways. Areas are fan-shaped at the heads of waterways and in bands along small waterways. Most areas are 5 to 30 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 8 inches thick. The subsoil is about 22 inches thick. It is mottled, dark yellowish brown, firm silty clay in the upper part and mottled, yellowish brown, firm clay loam in the lower part. The substratum to a depth of about 60 inches is mottled, yellowish brown, firm, clay loam and loam glacial till.

Included with this soil in mapping are narrow strips and small, irregular areas of the very poorly drained Kokomo soils along waterways and in depressions. The included soils make up 5 to 10 percent of most areas.

A seasonal high water table is between a depth of 12 and 36 inches late in winter, in spring, and in other extended wet periods. Permeability is slow, and runoff is medium. The root zone is mainly deep to compact glacial till. Available water capacity and organic matter content are moderate. Tilth is good. Reaction in the subsoil ranges from medium acid in the upper part to mildly alkaline in the lower part. The shrink-swell potential is moderate.

Most of the acreage is used for cropland. This soil has high potential for cropland, pasture, woodland, and openland and woodland wildlife habitat. It has medium or low potential for recreational uses and low potential for development of building sites and sanitary facilities.

This soil is well suited to corn, soybeans, small grain, hay, and pasture (fig. 7). Control of erosion, wetness, and surface crusting are main management concerns. Subsurface drains help lower the water table. Sod or meadow crops in the cropping system, use of grassed waterways, and returning large amounts of crop residue help increase infiltration and reduce the hazards of erosion and surface crusting. Leaving crop residue on the surface in fall and not plowing until spring protect the soil against erosion. Tilling or harvesting if the soil is wet causes compaction. Incorporating crop residue, tilling at proper moisture levels, and planting cover crops reduce crusting and improve tilth.

Overgrazing or grazing when this soil is wet causes compaction of the silt loam surface layer and results in poor tilth and damage to pasture.

This soil is suited to woodland and to openland and woodland wildlife habitat. Species that are tolerant of some wetness should be selected for new plantings. Spraying, mowing, disking or girdling help reduce plant competition.

The seasonal high water table, slow permeability, and low strength are severe limitations for building sites and sanitary facilities. Building sites should be landscaped for good surface drainage away from the foundations. Foundation drains and protective exterior wall coatings help prevent wet basements. Sanitary facilities should be connected to central sewers. Artificial drainage and use of a suitable base material help improve local roads. Plant cover needs to be maintained on the site during construction to reduce runoff and erosion. Wetness is a limitation for recreational uses.

This soil is in capability subclass IIe and woodland suitability subclass 3o.

Figure 7.—Crosby silt loam, 2 to 6 percent slopes, is well suited to cultivated crops. Dark colored Kokomo silty clay loam is in depressions.

CuA—Crosby-Urban land complex, nearly level. This complex consists of a deep, somewhat poorly drained Crosby soil and areas of Urban land on broad upland areas between drainageways. Areas commonly have straight boundaries with distinct corners and range from 40 to several hundred acres. Slope is 0 to 2 percent. Most areas contain about 40 percent Crosby silt loam and 30 percent Urban land. The Crosby soil and the Urban land are in such a complex pattern that it is not practical to separate them in mapping.

Typically, the Crosby soil has a surface layer of dark grayish brown, friable silt loam about 8 inches thick. The subsurface layer is mottled, brown, friable silt loam about 4 inches thick. The subsoil is about 24 inches thick. It is mottled, yellowish brown, firm silty clay loam and clay loam in the upper part and is mottled, dark yellowish brown, firm clay and clay loam in the lower part. The substratum to a depth of about 60 inches is mottled yellowish brown, firm, loam glacial till.

Urban land areas are mainly covered by buildings and pavement. The buildings are mostly used for housing and include single family units and apartment complexes. Some areas have industrial or commercial uses.

Included with this complex in mapping are areas that are altered by cutting and filling. More filling than excavating has occurred in most of these areas because of the need to change natural drainage. Also included are narrow strips of the very poorly drained Kokomo soils along waterways. The included areas make up about 30 percent of most areas.

Most areas are artificially drained by sewer systems, gutters, and subsurface drains. Areas of Crosby soils that are not drained have a seasonal high water table between a depth of 12 and 36 inches late in winter, in spring, and in other extended wet periods. Permeability and runoff are slow. The organic matter content, available water capacity, and shrink-swell potential in the subsoil are moderate. Tilth is good.

The Crosby soil is used for parks, openland, building sites, lawns, and gardens. It has high potential for lawns, gardens, trees, and shrubs. This soil has low potential for most building sites and sanitary facilities and medium potential for most recreational uses.

If excess water is removed, the Crosby soil is well suited to grasses, flowers, vegetables, trees, and shrubs. Several methods of artificial drainage can be used. Perennial plants selected for planting should be tolerant of some wetness. The hazard of erosion is not a major problem unless the soil is disturbed or left in a bare, exposed condition for a considerable period of time. The included small areas of cut and fill land are not well suited to lawns and gardens. Subsoil material, exposed on the surface, has very poor tilth. It is sticky when wet and hard when dry.

The Crosby soil has severe limitations for development of building sites and sanitary facilities because of slow permeability, seasonal wetness, and low strength. Building sites should be landscaped for good surface drainage away from the foundations. Covering or replacing the upper layer of the Crosby soil with a suitable base material helps improve local roads and streets. Most sanitary facilities are connected to central sewage disposal systems.

The Crosby soil is in capability subclass IIw and is not assigned to a woodland suitability subclass. Urban land is not assigned to a capability subclass or a woodland suitability subclass.

Ee—Eel silt loam, occasionally flooded. This deep, nearly level, moderately well drained soil is on flood plains of major streams and larger tributaries. It is occasionally flooded for brief periods in fall, winter, and spring. Most areas are long and narrow and are about 5 to 100 acres. Slope is 0 to 2 percent.

Typically, the surface layer is dark grayish brown, friable silt loam about 9 inches thick. The subsoil is about 29 inches thick. It is brown, friable silt loam in the upper part and mottled, dark yellowish brown and yellowish brown, firm silt loam and loam in the middle and lower parts. The substratum to a depth of about 60 inches is mottled, brown, friable sandy loam. In some areas, the surface layer is darker colored, and in other areas, the surface layer is loam.

Included with this soil in mapping are small areas of the very poorly drained Sloan soils near breaks to stream terraces or uplands and the well drained Genesee soils on slightly higher areas. The included soils make up 15 to 20 percent of most areas.

A seasonal high water table is at a depth of 36 to 72 inches in winter and spring. Permeability is moderate, and runoff is slow. The root zone is deep. Available water capacity is high, and organic matter content is moderate. The surface layer is easily tilled through a fairly wide range in moisture content. Reaction in the subsoil is mainly neutral to moderately alkaline.

This soil is mainly used for row crops, small grain, and hay. Some areas are used for pasture and woodland. This soil has high potential for cropland, pasture, and woodland and low potential for development of building sites and sanitary facilities.

If this soil is farmed, flooding is a hazard. This soil is well suited to corn and soybeans. Flooding late in winter and in spring can severely damage winter grain crops. Planting cover crops and using crop residue maintain organic matter content, reduce crusting, and protect the surface in areas subject to scouring during floods. Randomly spaced subsurface drains are needed in some of the included areas of wetter soils.

This soil is suited to grasses and legumes for pasture. Overgrazing or grazing if this soil is wet causes compaction and poor tilth. Rotation of pasture and deferment of grazing during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees and other vegetation grown for wildlife habitat. Spraying, mowing, and disking reduce plant competition.

The hazard of flooding and the seasonal high water table are severe limitations for buildings and sanitary facilities. This soil has potential for such recreational uses as picnic areas, hiking trails, and golf fairways. Diking to control flooding is difficult. This soil is a good source of topsoil.

This soil is in capability subclass IIw and woodland suitability subclass 1o.

ElA—Eldean loam, 0 to 2 percent slopes. This deep, nearly level, well drained soil is on outwash terraces along streams. Most areas are broad or long and narrow and are 5 to 100 acres.

Typically, the surface layer is dark brown, friable loam about 8 inches thick. The subsoil is about 22 inches thick. It is brown, firm clay loam in the upper part; reddish brown, firm, gravelly clay loam in the next part; and dark brown, friable, gravelly sandy loam in the lower part. The substratum to a depth of about 60 inches is light yellowish brown and pale brown, loose, gravelly and very gravelly loamy sand and gravelly sand. In some small areas, the subsoil is thicker than typical and sand and gravel are at a depth of 40 to 50 inches.

Included with this soil in mapping and in similar landscape positions are small areas of droughty Casco soils that have sand and gravel at a depth of 12 to 20 inches. Also included in slight depressions are the moderately well drained Sleeth soils that receive runoff and seepage from adjacent soils. The included soils make up 10 to 20 percent of most areas.

Permeability is moderate or moderately slow in the subsoil and rapid or very rapid in the substratum. Runoff is slow. The root zone is mainly moderately deep to sand and gravel. Available water capacity is low or moderate, and organic matter content is moderate. The surface layer is easily tilled through a fairly wide range in moisture content. Reaction in the subsoil is medium acid or slightly acid in the upper part and slightly acid to mildly alkaline in the lower part. The shrink-swell potential in the subsoil is moderate.

Most of the acreage is used for farmland. A few areas are used for sand and gravel. This soil has high potential for cultivated crops, hay, pasture, development of building sites, and recreational uses. It has low potential for impoundment of water because of the rapidly or very rapidly permeable substratum.

This soil is suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. Droughtiness is the main limitation for cropland. Crops can be seeded early because this soil warms and dries early in spring. Row crops can be grown continuously if a high level of management is used. This soil is well suited to irrigation. Minimum tillage and returning crop residue or regular additions of other organic material to the soil help reduce crusting and increase water intake.

This soil is well suited to grazing early in spring. Proper stocking rates, selection of plants, rotation of pasture, and timely deferment of grazing, along with weed control, help keep the pasture and soil in good condition.

This soil is well suited to use as woodland, but only a small area is used for this purpose. Spraying, mowing, or disking helps reduce plant competition.

This soil is well suited to building sites. Low strength and the shrink-swell potential are moderate limitations. Extending building foundations to the substratum helps overcome the low strength. Replacing the subsoil with a suitable base material helps improve local roads. The possible pollution of underground water supplies is a limitation for sanitary facilities. During dry periods, this soil is droughty for lawns. It is a good source of sand and gravel.

This soil is in capability subclass IIs and woodland suitability subclass 2o.

EIB—Eldean loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on outwash terraces along streams and on low kames. Most areas are long and narrow or irregular in shape and are 3 to 100 acres.

Typically, the surface layer is dark brown, friable loam about 8 inches thick. The subsoil is about 22 inches thick. It is reddish brown, firm clay loam and gravelly clay loam in the upper part and dark brown, firm, gravelly clay and friable gravelly sandy loam in the lower part. The substratum to a depth of about 60 inches is light yellowish brown and pale brown, loose gravelly loamy sand and gravelly sand. In some small areas the surface layer is sandy loam or silt loam.

Included with this soil in mapping are areas of the moderately well drained Sleeth soils on foot slopes and toe slopes and the very poorly drained Westland soils in depressions and along waterways. The included soils make up 5 to 10 percent of most areas.

Permeability is moderate or moderately slow in the subsoil and rapid or very rapid in the substratum. Runoff is medium. The root zone is mainly moderately deep to sand and gravel. Available water capacity is low or moderate, and organic matter content is moderate. The surface layer is easily tilled through a fairly wide range in moisture content. Reaction in the subsoil is slightly acid or medium acid in the upper part and slightly acid to mildly alkaline in the lower part. The shrink-swell potential in the subsoil is moderate.

Most of the acreage is used for farmland. This soil has high potential for cultivated crops, hay, pasture, trees, development of building sites and recreational uses. It has low potential for impoundment of water because of the rapidly or very rapidly permeable substratum.

This soil is well suited to corn, soybeans, small grain, nursery stock, and grasses and legumes for hay or pasture (fig. 8). Droughtiness and control of erosion are main management concerns. This soil is better suited to early maturing crops than to crops that mature late in summer. This soil is well suited to irrigation. Minimum tillage, planting cover crops, and using grassed waterways help prevent excessive soil loss. Use of crop residue or regular additions of other organic material improves fertility, reduces crusting, and increases water intake.

This soil is well suited to grazing early in spring. Rotation of pasture, timely deferment of grazing, and restricted use during wet periods help keep the pasture and soil in good condition. This soil is well suited to woodland, but only a small area is used for this purpose. Spraying, mowing, or disking help reduce plant competition.

This soil is well suited to building sites. Low strength and the shrink-swell potential are moderate limitations. Extending building foundations to the substratum helps overcome the low strength. Replacing the subsoil with a suitable base material helps improve local roads. Pollution of underground water supplies is a possible hazard for sanitary facilities. During dry periods this soil is droughty for lawns. It is a good source of sand and gravel.

This soil is in capability subclass IIe and woodland suitability subclass 2o.

EIC2—Eldean loam, 6 to 12 percent slopes, eroded. This deep, sloping, well drained soil is on short, irregular slope breaks on terraces, kames, and side slopes of valleys. Most areas are long and narrow and are 3 to 15 acres.

Typically, the surface layer is brown, friable loam about 6 inches thick. The subsoil is about 22 inches thick. It is reddish brown, firm gravelly clay loam in the upper and middle parts and dark brown, friable gravelly sandy loam in the lower part. The substratum to a depth of about 60 inches is pale brown, loose gravelly sand.

Included with this soil in mapping are small areas of the Kendallville soils on kames and side slopes of valleys in the transition area between glacial outwash and glacial till. Also included are small areas of severely eroded soils that have shallow gullies and a gravelly sandy loam, gravelly loam, or clay loam surface layer. The included soils make up 5 to 10 percent of most areas.

Permeability is moderate or moderately slow in the subsoil and rapid or very rapid in the substratum. Runoff is rapid. The root zone is mainly moderately deep to sand and gravel. Available water capacity is low, and organic matter content is moderately low. Reaction in the subsoil is slightly acid or medium acid in the upper part and slightly acid to mildly alkaline in the lower part. The shrink-swell potential in the subsoil is moderate.

Most of the acreage is used for farmland. This soil has medium potential for cultivated crops, development of

Figure 8.—Eldean loam, 2 to 6 percent slopes, is well suited to nursery stock.

building sites, and recreational uses. It has high potential for hay and pasture.

This soil is moderately well suited to cultivated crops and small grain and is well suited to hay and pasture. The hazard of erosion is the main limitation for cultivated crops. During extended dry periods, this soil is droughty. This soil is better suited to early maturing crops than to crops that mature late in summer. Minimum tillage, planting cover crops, and using grassed waterways reduce runoff and soil loss. The surface layer can be worked through a fairly wide range of moisture content. Incorporating crop residue or other organic matter into the surface layer improves tilth, increases the rate of water infiltration, and reduces crusting.

This soil is well suited to grazing early in spring. Proper stocking rates, selection of plants, rotation of pasture, and timely deferment of grazing, along with weed control, help keep the pasture and soil in good condition.

This soil is well suited to trees. Native hardwoods are in a few areas. It is difficult to establish seedlings during dry periods. Spraying, mowing, or disking reduce plant competition.

Slope, low strength, the shrink-swell potential, and the possible pollution of underground water supplies are limitations for building sites, sanitary facilities, and most recreational uses. If this soil is used for construction, development should be on the contour. Extending building foundations to the substratum helps overcome the low strength. Replacing the subsoil with a suitable base material helps improve local roads. During dry periods this soil is droughty for lawns. Trails in recreational areas should be protected against erosion and established across the slope. This soil is a good source of sand and gravel.

This soil is in capability subclass IIIe and woodland suitability subclass 2o.

EnA—Eldean gravelly loam, 0 to 2 percent slopes. This deep, nearly level, well drained soil is mainly on outwash terraces along streams. Most areas are oblong or circular and are 3 to 15 acres.

Typically, the surface layer is brown, friable gravelly loam about 8 inches thick. The subsoil is about 24 inches thick. It is reddish brown, firm gravelly clay loam in the upper and middle parts and is reddish brown, friable gravelly sandy loam in the lower part. The substratum to a depth of about 60 inches is pale brown, loose gravelly sand. In some areas, the surface layer is darker colored than typical.

Included with this soil in mapping and in similar landscape positions are small areas of droughty Casco soils that have sand and gravel at a depth of 12 to 20 inches. Included soils make up 5 to 15 percent of most areas.

Permeability is moderate or moderately slow in the subsoil and rapid or very rapid in the substratum. Runoff is slow. The root zone is mainly moderately deep to sand and gravel. Available water capacity is low, and organic matter content is moderate or moderately low. The surface layer is easily tilled through a fairly wide range in moisture content. Reaction in the subsoil is medium acid or slightly acid in the upper part and slightly acid to mildly alkaline in the lower part. The shrink-swell potential in the subsoil is moderate.

Most of the acreage is used for farmland. This soil has high potential for cultivated crops, hay, pasture, trees, and development of building sites. It has medium potential for recreational uses and low potential for impoundment of water because of the rapidly or very rapidly permeable substratum.

This soil is suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. Droughtiness is the main limitation for cropland. Crops can be seeded early, because this soil warms and dries early in spring. Row crops can be grown continuously if a high level of management is used. This soil is well suited to irrigation. Gravel in the surface layer interferes with tillage. Use of crop residue or regular additions of other organic material and minimum tillage reduce crusting and increase water intake.

This soil is well suited to grazing early in spring. Proper stocking rates, selection of plants, rotation of pasture, and timely deferment of grazing, along with weed control, help keep the pasture and soil in good condition.

This soil is well suited to woodland, but only a few areas are used for this purpose. Spraying, mowing, or disking reduce plant competition.

This soil is well suited to building sites. Low soil strength and the shrink-swell potential are moderate limitations. Extending the building foundations to the substratum helps overcome the low strength. Replacing the subsoil with suitable base material helps improve local roads. The possible pollution of underground water supplies limits sanitary facilities. During dry periods, this soil is droughty for lawns. It is a good source of sand and gravel. Applying a layer of stone-free loamy material over the gravelly loam surface layer improves the suitability for most recreational uses.

This soil is in capability subclass IIs and woodland suitability subclass 2o.

EnB2—Eldean gravelly loam, 2 to 6 percent slopes, eroded. This deep, gently sloping, well drained soil is mainly on stream terraces and kames. Some areas are on uplands. Most areas are long and narrow to broad and are 3 to 20 acres.

Typically, the surface layer is brown, friable gravelly loam about 6 inches thick. The subsoil is about 22 inches thick. It is reddish brown, firm clay loam and gravelly clay in the upper and middle parts and reddish brown, friable gravelly sandy loam in the lower part. The substratum to a depth of about 60 inches is pale brown, loose gravelly sand.

Included with this soil in mapping and in similar landscape positions are small areas of the droughty Casco soils that have sand and gravel at a depth of 12 to 20 inches. Also included are the very poorly drained Westland soils in depressions and along waterways. The included areas make up 5 to 10 percent of most areas.

Permeability is moderate or moderately slow in the subsoil and rapid or very rapid in the substratum. Runoff is medium. The root zone is mainly moderately deep to sand and gravel. Available water capacity is low, and organic matter content is moderate or moderately low. The surface layer is easily tilled through a fairly wide range in moisture content. Reaction in the subsoil is medium acid or slightly acid in the upper part and slightly acid to mildly alkaline in the lower part. The shrink-swell potential in the subsoil is moderate.

Most of the acreage is used for farmland. This soil has high potential for cultivated crops, hay, pasture, trees, and development of building sites. It has medium potential for recreational uses and low potential for impoundment of water because of the rapidly or very rapidly permeable substratum.

This soil is well suited to corn, soybeans, small grain, and grasses and legumes for hay or pasture. Droughtiness and control of erosion are main management concerns. Because of the limited available water capacity this soil is better suited to early maturing crops than to crops that mature late in summer. Gravel in the surface layer interferes with tillage. Minimum tillage, planting cover crops, and using grassed waterways help prevent excessive soil loss. Use of crop residue and regular additions of other organic material improve fertility, reduce crusting, and increase water intake.

This soil is well suited to grazing early in spring. Grasses and legumes grow poorly during dry periods in summer. Proper stocking rates, selection of plants, rotation of pasture, and timely deferment of grazing, along with weed control, help keep the pasture and soil in good condition.

This soil is well suited to woodland, but only a small acreage is used for this purpose. Seedlings are difficult to establish during dry periods in summer. Spraying, mowing, or disking reduce plant competition.

This soil is well suited to building sites. Low soil strength and the shrink-swell potential are moderate limitations. Extending building foundations to the substratum helps overcome the low strength. Replacing the subsoil with a suitable base material helps improve local roads.

Possible pollution of underground water supplies is a hazard for sanitary facilities. During dry periods, this soil is droughty for lawns. Applying a layer of stone-free loamy material over the gravelly loam surface layer improves suitability for most recreational uses. This soil is a good source of sand and gravel.

This soil is in capability subclass IIe and woodland suitability subclass 2o.

EpA—Eldean-Kendallville loams, 0 to 2 percent slopes. This complex consists of deep, nearly level, well drained soils that are mainly on a transitional landscape position between outwash terraces and uplands. Most areas are 5 to 50 acres and are made up of about 55 percent Eldean loam and 35 percent Kendallville loam. The Eldean soil is on higher positions than the Kendallville soil. The soils are so intricately mixed, or areas are so small in size, that it is not practical to separate them in mapping.

Typically, the Eldean soil has a surface layer of dark brown, friable loam about 9 inches thick. The subsoil is about 26 inches thick. It is brown and reddish brown, firm gravelly clay loam in the upper part and dark brown, firm gravelly clay and friable gravelly sandy loam in the lower part. The substratum to a depth of about 60 inches is pale brown, loose gravelly loamy sand. In some areas, the subsoil is thicker than typical and has sand and gravel at a depth of 40 to 50 inches.

Typically, the Kendallville soil has a surface layer of brown, friable loam about 9 inches thick. The subsoil is about 30 inches thick. It is brown, friable loam in the upper part and dark yellowish brown, firm clay loam and gravelly clay loam in the middle and lower parts. The substratum to a depth of about 60 inches is yellowish brown, firm, loam glacial till.

Included with these soils in mapping are the somewhat poorly drained Crosby and Sleeth soils in slight depressions and along waterways. The included soils make up about 10 percent of most areas.

Permeability of the Eldean soil is moderate or moderately slow in the subsoil and rapid or very rapid in the substratum. The root zone is mainly moderately deep to sand and gravel, and available water capacity is low or moderate. Reaction in the subsoil is medium acid or slightly acid in the upper part and slightly acid to mildly alkaline in the lower part.

Permeability of the Kendallville soil is moderately slow. The root zone is mainly moderately deep to compact glacial till, and available water capacity is moderate. Reaction in the subsoil is medium acid or strongly acid in the upper part and neutral or mildly alkaline in the lower part.

In both of these soils runoff is slow, organic matter content is moderate, and the shrink-swell potential is moderate in the subsoil. The surface layer is easily tilled through a fairly wide range in moisture content.

Most of the acreage is used for farmland. These soils have high potential for cultivated crops, small grain, hay, pasture, trees, development of building sites and recreational uses.

These soils are well suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. Droughtiness of the Eldean soil is the main limitation for cropland. The Eldean soil dries earlier in spring than the Kendallville soil. Row crops can be grown continuously on both soils if a high level of management is used. These soils are well suited to irrigation. Use of crop residue or regular additions of other organic material and minimum tillage reduce crusting and increase water intake.

These soils are well suited to deep-rooted grasses and legumes for hay and pasture. Rotation of pasture and timely deferment of grazing help keep the pasture and soils in good condition.

These soils are well suited to woodland, but only a small acreage is used for this purpose.

These soils are well suited to building sites. Low strength and the shrink-swell potential are moderate limitations. Extending building foundations to the substratum of the Eldean soil helps overcome the low strength. Replacing the subsoil of the Eldean soil with a suitable base material helps improve local roads. The Eldean soil is better suited to septic tank absorption fields than the Kendallville soil. Movement of unfiltered effluent through the rapidly or very rapidly permeable sand and gravel in the substratum is a possible hazard of pollution to underground water supplies. The moderately slow permeability of the Kendallville soil is a limitation for septic tank absorption fields. Increasing the size of the absorption area helps overcome this problem. During dry periods the Eldean soil is droughty for lawns.

These soils are in capability subclass IIs. The Eldean soil is in woodland suitability subclass 2o, and the Kendallville soil is in woodland suitability subclass 1o.

EpB—Eldean-Kendallville loams, 2 to 6 percent slopes. This complex consists of deep, gently sloping, well drained soils in moderately broad to long and narrow areas on stream terraces and in circular or irregular areas on kames and eskers. Most areas are 2 to 50 acres and are made up of about 55 percent Eldean loam and 30 percent Kendallville loam. The Eldean soil is mainly on terraces and the tops and sides of kames and eskers. The Kendallville soil is on the lower part of slopes on kames and eskers and in the transition zone between soils on terraces and uplands. These soils are so intricately mixed, or areas are so small in size, that it is not practical to separate them in mapping.

Typically, the Eldean soil has a surface layer of dark brown, friable loam about 9 inches thick. The subsoil is about 24 inches thick. It is brown and reddish brown, firm gravelly clay loam in the upper and middle parts and dark brown, friable gravelly sandy loam in the lower part. The substratum to a depth of about 60 inches is pale brown, loose gravelly sand. In some areas, the subsoil is thicker than typical and has sand and gravel at a depth of 40 to 50 inches.

Typically, the Kendallville soil has a surface layer of brown, very friable loam about 10 inches thick. The subsoil is about 29 inches thick. It is brown, friable loam and firm clay loam in the upper part and yellowish brown, firm gravelly clay loam and gravelly sandy clay loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown, firm, loam glacial till.

Included with these soils in mapping are small areas of the somewhat poorly drained Crosby and Sleeth soils on foot slopes and some small areas of soils that have a sandy loam surface layer and are droughty. The included soils make up 10 to 15 percent of most areas.

Permeability of the Eldean soil is moderate or moderately slow in the subsoil and rapid or very rapid in the substratum. The root zone is mainly moderately deep to sand and gravel, and available water capacity is low or moderate. Reaction in the subsoil is medium acid or slightly acid in the upper part and slightly acid to mildly alkaline in the lower part.

Permeability of the Kendallville soil is moderately slow. The root zone is mainly moderately deep to compact glacial till, and available water capacity is moderate. Reaction in the subsoil is medium acid or strongly acid in the upper part and neutral or mildly alkaline in the lower part.

In both of these soils runoff is medium, organic matter content is moderate, and the shrink-swell potential is moderate in the subsoil. The surface layer is easily tilled through a fairly wide range in moisture content.

Most of the acreage is used for farmland. These soils have high potential for cultivated crops, small grain, hay, pasture, trees, development of building sites, and recreational uses.

These soils are well suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. The hazard of erosion on both soils and the droughtiness of the Eldean soil are the main limitations for cropland. The Eldean soil dries earlier in spring than the Kendallville soil and is better suited to early maturing crops than to crops that mature late in summer. Both soils are suited to irrigation. Minimum tillage, planting cover crops, and using grassed waterways help reduce erosion. Use of crop residue or regular additions of other organic material reduces crusting and increases water intake.

These soils are well suited to deep-rooted grasses and legumes for hay and pasture. Rotation of pasture and timely deferment of grazing help keep the pasture and the soils in good condition.

These soils are well suited to woodland, but only a small area is used for this purpose. Spraying, mowing, or disking reduces plant competition.

These soils are well suited to building sites. Low strength and shrink-swell potential are moderate limitations. Extending the building foundation to the substratum of the Eldean soil helps overcome the low strength. Replacing the subsoil of the Eldean soil with a suitable base material helps improve local roads. The Eldean soil is better suited to septic tank absorption fields than the Kendallville soil. In the Eldean soil, the movement of unfiltered effluent through the rapidly or very rapidly permeable sand and gravel in the substratum is a possible hazard of pollution to underground water supplies. The moderately slow permeability of the Kendallville soil is a limitation for septic tank absorption fields. Increasing the size of the absorption area helps overcome this problem. During dry periods, the Eldean soil is droughty for lawns. Plant cover should be maintained on the site during construction to reduce the hazard of erosion.

These soils are in capability subclass IIe. The Eldean soil is in woodland suitability subclass 2o, and the Kendallville soil is in woodland suitability subclass 1o.

EpC2—Eldean-Kendallville loams, 6 to 12 percent slopes, eroded. This complex consists of deep, sloping, well drained soils in long, narrow areas on short slope breaks on terraces and in circular or irregular areas on kames and eskers. Most areas are 2 to 30 acres and make up about 55 percent Eldean loam and 30 percent Kendallville loam. The Eldean soil is mainly on the tops and sides of kames and eskers. The Kendallville soil is on the lower part of slopes. The Eldean and Kendallville soils are so intricately mixed, or areas are so small in size, that it is not practical to separate them in mapping.

Typically, the Eldean soil has a surface layer of brown, friable loam about 8 inches thick. The subsoil is about 22 inches thick. It is reddish brown, firm clay loam and gravelly clay loam in the upper and middle parts and dark brown, friable gravelly sandy loam in the lower part. The substratum to a depth of about 60 inches is pale brown, loose gravelly sand.

Typically, the Kendallville soil has a surface layer of brown, friable loam about 6 inches thick. The subsoil is about 28 inches thick. It is dark yellowish brown, firm clay loam in the upper part and gravelly clay loam in the lower part. The substratum to a depth of about 60 inches is yellowish brown, firm, loam glacial till.

Included with these soils in mapping are small areas of the more droughty Casco and Rodman soils on the upper part of convex slopes. The included soils make up 10 to 15 percent of most areas.

Permeability of the Eldean soil is moderate or moderately slow in the subsoil and rapid or very rapid in the substratum. The root zone is mainly moderately deep to sand and gravel, and available water capacity is low. Reaction in the subsoil is medium acid or slightly acid in the upper part and slightly acid to mildly alkaline in the lower part.

Permeability of the Kendallville soil is moderately slow. The root zone is mainly moderately deep to compact glacial till, and available water capacity is moderate. Reaction in the subsoil is medium acid or strongly acid in the upper part and neutral or mildly alkaline in the lower part.

In both soils runoff is rapid, organic matter content is moderately low, and tilth is good. The shrink-swell potential is moderate in the subsoil.

Most of the acreage is used for farmland. These soils have medium potential for cultivated crops, development of building sites and recreational uses. They have high potential for hay, pasture, and woodland.

These soils are moderately well suited to cultivated crops and small grain and well suited to hay and pasture. The hazard of erosion on both soils and the droughtiness of the Eldean soil are the main limitations for cropland. The Eldean soil dries earlier in spring than the Kendallville soil and is better suited to early maturing crops than to crops that mature late in summer. Minimum tillage, cover crops, and grassed waterways reduce runoff and soil loss. Incorporating crop residue or other organic matter into the surface layer improves tilth, increases the rate of water infiltration, and reduces crusting.

These soils are well suited to deep-rooted grasses and legumes for hay and pasture. Rotation of pasture and timely deferment of grazing help keep the pasture and the soils in good condition.

These soils are well suited to trees and shrubs. During dry periods seedlings are difficult to establish on the Eldean soil.

These soils are fairly well suited to building sites. Low strength, shrink-swell potential, and slope are moderate limitations. Development should be on the contour. Extending the building foundation to the substratum of the Eldean soil helps overcome the low strength. Use of suitable base material helps improve local roads on the Eldean soil. The Eldean soil is better suited as a site for septic tank absorption fields than the Kendallville soil. In the Eldean soil, the movement of unfiltered effluent through the rapidly or very rapidly permeable sand and gravel in the substratum is a possible hazard of pollution to underground water supplies. The moderately slow permeability of the Kendallville soil is a limitation for septic tank absorption fields. Increasing the size of the absorption area helps overcome this problem. Leach lines should be placed on the contour. The Eldean soil is droughty for lawns, especially during dry periods.

These soils are in capability subclass IIIe. The Eldean soil is in woodland suitability subclass 2o, and the Kendallville soil is in woodland suitability subclass 1o.

EuA—Eldean-Urban land complex, nearly level. This complex consists of a deep, well drained Eldean soil and Urban land on terraces. Most areas are 10 to 100 acres or more and contain about 55 percent Eldean loam and 35 percent Urban land. The Eldean soil and the Urban land areas are so intricately mixed, or areas are so small in size, that it is not practical to separate them in mapping. Slope ranges from 2 to 6 percent.

Typically, the Eldean soil has a surface layer of dark brown, friable loam about 9 inches thick. The subsoil is about 26 inches thick. It is brown and reddish brown, firm gravelly clay loam in the upper and middle parts and dark brown, friable gravelly sandy loam in the lower part. The substratum to a depth of about 60 inches is pale brown, loose gravelly sand. In some areas, the subsoil is thicker than typical and has sand and gravel at a depth of 40 to 50 inches. In other areas, the surface layer is darker colored.

The Urban land areas are covered by streets, parking lots, buildings, and other structures that alter the soil so that identification is not feasible.

Included in mapping are areas radically altered by cutting and filling. The inclusions make up about 10 percent of most areas.

The permeability of the Eldean soil is moderate or moderately slow in the subsoil and rapid or very rapid in the substratum. Runoff is slow, available water capacity is low or moderate, and organic matter content is moderate. The root zone is moderately deep to sand and gravel. Reaction in the subsoil is medium acid or slightly acid in the upper part and slightly acid to mildly alkaline in the lower part. The shrink-swell potential is moderate in the subsoil.

The Eldean soil is used for parks, openland, building sites, lawns, and gardens. It has high potential for lawns, vegetable and flower gardens, trees, shrubs, recreational areas, and building sites. This soil has low potential for impoundment of water because of the rapidly or very rapidly permeable substratum.

The Eldean soil is well suited to grasses, flowers, vegetables, trees, and shrubs. During dry periods, supplemental irrigation is needed for good growth. Soil erosion generally is not a major problem unless the soil is disturbed and left unprotected. The included small areas of cut and fill land are not well suited to lawns and gardens. Subsoil material, exposed on the surface, has poor tilth. It is sticky when wet and hard when dry.

The Eldean soil is well suited to building sites. Low strength and the shrink-swell potential are moderate limitations. Extending building foundations to the substratum helps overcome the low strength. Replacing the subsoil with a suitable base material helps improve local roads and streets. If the Eldean soil is used for sanitary facilities, there is a possible hazard of pollution of underground water supplies.

The Eldean soil is in capability subclass IIs and is not assigned to a woodland suitability subclass. Urban land is not assigned to a capability subclass or a woodland suitability subclass.

EuB—Eldean-Urban land complex, gently sloping. This complex consists of a deep, well drained Eldean soil and Urban land on terraces. Most areas are 10 to 70 acres or more and are made up of about 55 percent Eldean loam and 35 percent Urban land. The Eldean soil and the Urban land areas are so intricately mixed, or areas are so small in size, that it is not practical to separate them in mapping. Slope is 0 to 2 percent.

Typically, the Eldean soil has a surface layer of dark brown, friable loam about 8 inches thick. The subsoil is about 22 inches thick. It is brown and reddish brown, firm gravelly clay loam in the upper and middle parts and dark brown, friable gravelly sandy loam in the lower part. The substratum to a depth of about 60 inches is pale brown, loose gravelly sand.

The Urban land areas are covered by streets, parking lots, buildings, and other structures that alter the soil so that identification is not feasible.

Included in mapping are areas radically altered by cutting and filling and small areas of the more droughty Casco soils on the upper part of convex slopes. Small areas of the Kendallville soils that have glacial till in the substratum are in transitional areas between terraces and uplands. The included soils make up about 10 percent of most areas.

Permeability of the Eldean soil is moderate or moderately slow in the subsoil and rapid or very rapid in the substratum. Runoff is medium, and organic matter content is moderate. The root zone is mainly moderately deep to sand and gravel, and available water capacity is low or moderate. Reaction in the subsoil is medium acid or slightly acid in the upper part and slightly acid to mildly alkaline in the lower part. The shrink-swell potential is moderate in the subsoil.

The Eldean soil is used for parks, openland, building sites, lawns, and gardens. It has high potential for lawns, vegetable and flower gardens, trees, shrubs, recreational areas, and building sites. This soil has low potential for impoundment of water because of the rapidly or very rapidly permeable substratum.

The Eldean soil is suited to grasses, flowers, vegetables, trees, and shrubs. During dry periods, supplemental irrigation is needed for good growth. Soil erosion generally is not a major problem unless the soil is disturbed and left unprotected. The included small areas of cut and fill land are not well suited to lawns and gardens. Subsoil material, exposed on the surface, has poor tilth. It is sticky when wet and hard when dry.

The Eldean soil is well suited to building sites. Low strength and the shrink-swell potential are moderate limitations. Extending building foundations to the substratum helps overcome the low strength. Replacing the subsoil with a suitable base material helps improve local roads and streets. If the Eldean soil is used for sanitary facilities, the pollution of underground water supplies is a possible hazard.

The Eldean soil is in capability subclass IIe and is not assigned to a woodland suitability subclass. Urban land is not assigned to a capability subclass or a woodland suitability subclass.

Gn—Genesee silt loam, occasionally flooded. This deep, nearly level, well drained soil is in the highest position on flood plains of major streams and larger tributaries. It is occasionally flooded for brief periods in fall, winter, and spring. Most areas are long and narrow and are 5 to 200 acres or more. Slope is 0 to 2 percent.

Typically, the surface layer is dark grayish brown, friable silt loam about 9 inches thick. The subsoil is dark brown, friable silt loam and loam about 29 inches thick. The substratum to a depth of about 60 inches is dark brown and brown, friable silt loam. In some areas the surface layer is loam. In other areas, the surface layer is darker than typical.

Included with this soil in mapping are narrow strips of the somewhat poorly drained Shoals soils in lower positions on the flood plain and areas of the more sandy Stonelick soils adjacent to the streams. Also included are small areas of soils that are droughty and have a sandy loam surface layer that is 10 to 15 percent gravel. The included soils make up about 15 to 25 percent of most areas.

Permeability is moderate, and runoff is slow. The root zone is deep. Available water capacity is high, and organic matter content is moderate. The surface layer is easily tilled through a fairly wide range in moisture content. Reaction in the subsoil is neutral to moderately alkaline.

Most of the acreage is used for cropland, mainly row crops, small grain, and truck crops. Truck crops are grown along smaller streams. A few areas are used for pasture and woodland. This soil has high potential for cropland, pasture, and woodland. It has low potential for development of building sites and sanitary facilities.

Flooding is the main hazard for cropland. Although the choice of crops is limited, this soil is well suited to continuous crops such as corn and soybeans. Crops such as winter wheat are severely damaged by floodwater in winter and early in spring. Row crops can be planted and harvested during the nonflooding period in most years. Use of cover crops and crop residue help maintain organic matter, reduce crusting, and protect the surface during floods.

This soil is suited to grasses and legumes for pasture. Overgrazing or grazing when this soil is wet causes compaction and poor tilth. Rotation of pasture and deferment of grazing during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees and other vegetation grown for wildlife habitat. Tree seedlings grow well if competing vegetation is controlled or removed by spraying, mowing, and disking.

Flooding is a severe limitation for most building sites and sanitary facilities. This soil has potential for such recreational uses as picnic areas, hiking trails, and golf fairways. Diking to control flooding is difficult in many areas.

This soil is in capability subclass IIw and woodland suitability subclass 1o.

HeE—Hennepin-Miamian silt loams, 18 to 25 percent slopes. These deep, steep, well drained soils are on side slopes along well defined drainageways on uplands. Most areas are 5 to 30 acres and are made up of about 50 percent Hennepin silt loam and 35 percent Miamian silt loam. The Hennepin soil is mainly on back slopes, and the Miamian soil is on shoulder slopes and foot slopes. The soils are so intricately mixed, or areas are so small in size, that it is not practical to separate them in mapping.

Typically, the Hennepin soil has a surface layer of brown, friable silt loam about 6 inches thick. The subsoil is dark yellowish brown and yellowish brown, friable loam about 11 inches thick. The substratum to a depth of about 60 inches is brown, firm loam glacial till.

Typically, the Miamian soil has a surface layer of brown, friable silt loam about 6 inches thick. The subsoil is dark yellowish brown, firm clay loam about 19 inches thick. The substratum to a depth of about 60 inches is yellowish brown, firm, loam glacial till.

Included with these soils in mapping are narrow strips of the Eldean soils formed in glacial outwash on foot slopes of valley sides. Also included are narrow strips of soils that have slopes of 35 to 60 percent. The included soils make up about 15 percent of most areas.

Permeability of the Hennepin soil is slow or moderately slow. The root zone is mainly shallow to compact calcareous glacial till, and the shrink-swell potential in the subsoil is low. Reaction in the subsoil is slightly acid to moderately alkaline.

Permeability of the Miamian soil is moderately slow. The root zone is mainly moderately deep, and the shrink-swell potential is moderate. Reaction in the subsoil is strongly acid to neutral in the upper part and slightly acid to mildly alkaline in the lower part.

In both soils runoff is very rapid, available water capacity is moderate, and organic matter content is low.

Most areas of these soils are used for woodland. A few areas are used for permanent pasture. These soils have low potential for cultivated crops, development of building sites, and sanitary facilities. They have medium potential for woodland and woodland wildlife habitat.

Slope is a severe limitation for cropland. These soils are suited to adapted grasses and legumes for hay and pasture. The hazard of erosion is severe, if adequate plant cover is not maintained. Surface compaction, poor tilth, reduced growth, and increased runoff result from overgrazing or grazing when these soils are wet. Proper stocking rates, selection of plants, rotation of pasture, and timely deferment of grazing, along with control of weeds help keep the pasture and soils in good condition. Reseeding pasture by the trash-mulch or no-till seeding method helps control erosion.

These soils are well suited to trees and shrubs. Some deep-rooted plants may have nutrient deficiencies, if their roots encounter the calcareous glacial till in the substratum. Seedlings grow well if competing vegetation is controlled or removed by cutting, spraying, or girdling. Logging roads and skid trails should be protected against erosion and constructed on the contour.

Slope and the slow or moderately slow permeability are severe limitations for development of building sites, sanitary facilities, and most recreational uses. Plant cover should be maintained on the site during construction to reduce the hazard of erosion. Trails in recreational areas should be protected against erosion and established across the slope.

These soils are in capability subclass VIe and woodland suitability subclass 1r.

HeF—Hennepin-Miamian silt loams, 25 to 50 percent slopes. These deep, very steep, well drained soils are on hillsides and on side slopes along well defined drainageways on uplands. Most areas are 5 to 30 acres and are made up of about 55 percent Hennepin silt loam and 30 percent Miamian silt loam. The Hennepin soil is mainly on back slopes, and the Miamian soil is on shoulder slopes and foot slopes. These soils are so intricately mixed, or areas are so small in size, that it is not practical to separate them in mapping.

Typically, the Hennepin soil has a surface layer of brown, friable silt loam about 6 inches thick. The subsoil is dark yellowish brown and yellowish brown, friable loam about 11 inches thick. The substratum to a depth of about 60 inches is brown, friable and firm, loam glacial till.

Typically, the Miamian soil has a surface layer of brown, friable silt loam about 6 inches thick. The subsoil is dark yellowish brown, firm clay loam about 16 inches thick. The substratum to a depth of about 60 inches is yellowish brown, firm, loam glacial till.

Included with these soils in mapping are narrow strips of the Eldean soils formed in glacial outwash on foot slopes of valley sides. Also included are narrow, short, nearly vertical escarpments. The included areas make up about 15 percent of most areas.

Permeability of the Hennepin soil is slow or moderately slow. The root zone is mainly shallow to compact calcareous glacial till, and the shrink-swell potential in the subsoil is low. Reaction in the subsoil is slightly acid to moderately alkaline.

Permeability of the Miamian soil is moderately slow. The root zone is mainly moderately deep, and the shrink-swell potential is moderate. Reaction in the subsoil is strongly acid to neutral in the upper part and slightly acid to mildly alkaline in the lower part.

In both soils runoff is very rapid, available water capacity is moderate, and organic matter content is low.

Most areas of these soils are used for woodland. A few areas are used for permanent pasture. These soils have low potential for cropland, pasture, development of building sites, sanitary facilities, and recreational uses. They have high potential for woodland and woodland wildlife habitat.

Slopes are too steep for the safe operation of modern farm machinery. The hazard of erosion is severe, if adequate plant cover is not maintained. Surface compaction, poor tilth, reduced growth, and increased runoff result from overgrazing or grazing when these soils are wet. Proper stocking rates, rotation of pasture, and timely deferment of grazing help keep the pasture and soils in good condition.

These soils are well suited to trees and shrubs. Some deep-rooted plants may have nutrient deficiencies, if their roots encounter the calcareous glacial till in the substratum. Seedlings grow well if competing vegetation is controlled or removed by cutting, spraying, or girdling. The very steep slope severely limits the use of logging equipment. Logging roads should be protected against erosion and laid out on the contour.

Construction for recreational and urban uses is very difficult. The hazard of erosion is very severe when vegetation is removed. Trails in recreational areas should be protected against erosion and established across the slope.

These soils are in capability subclass VIIe and woodland suitability subclass 1r.

HnA—Henshaw silt loam, 0 to 4 percent slopes. This deep, nearly level and gently sloping, somewhat poorly drained soil is on slight rises and in narrow strips along waterways on low terraces and in shallow basinlike areas on uplands. Most areas are long and narrow or irregular in shape and are 5 to 15 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 8 inches thick. The subsoil is about 34 inches thick. It is mottled, brown and grayish brown, friable and firm silt loam in the upper part; mottled, yellowish brown, firm silty clay loam in the middle part; and mottled, olive brown, friable silt loam in the lower part. The substratum to a depth of about 62 inches is mottled, yellowish brown and grayish brown, friable silt loam. In some areas in the subsoil, the content of clay is higher than typical.

Included with this soil in mapping are small areas of the poorly drained Patton soils in depressions and areas of soils that have slopes of 4 to 12 percent. The included soils make up about 10 to 20 percent of most areas.

A seasonal high water table is between a depth of 12 and 24 inches in winter, spring, and other extended wet periods. Permeability is moderately slow, and runoff is slow and medium. The root zone is mainly deep. Available water capacity is high, and organic matter content is moderate. The surface layer crusts after heavy rains. Reaction in the subsoil is strongly acid to mildly alkaline. The shrink-swell potential is low.

Most of the acreage is used for farmland. This soil has high potential for cultivated crops, hay, pasture, and trees. The potential for development of building sites and sanitary facilities is low.

Drained areas of this soil are well suited to corn, soybeans, small grain, and grasses and legumes for hay or pasture. Seasonal wetness is the main limitation for cropland. If not drained, this soil warms slowly and dries late in spring. Most areas of cropland are drained. Subsurface drainage systems help remove excess water from the root zone. Surface drains are used in some areas. Planting cover crops and use of crop residue or additions of other organic material improve tilth, reduce crusting, and help control erosion.

Overgrazing or grazing when this soil is wet causes poor tilth and compaction of the silt loam surface layer. This soil is poorly suited to grazing early in spring. Rotation of pasture and restricted grazing during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees that are tolerant of some wetness. Competing vegetation can be controlled or removed by spraying, mowing, and disking.

Seasonal wetness, moderately slow permeability, and low strength are limitations for buildings and most sanitary facilities. Landscaping on building sites helps keep surface water away from the foundations. Subsurface drains and open ditches help improve drainage. Dwellings and small buildings should be constructed with foundations designed to prevent structural damage caused by frost action. Wetness limits excavations in winter and spring. Artificial drainage and use of a suitable base material help improve local roads.

This soil is in capability subclass IIw and woodland suitability subclass 2o.

Ko—Kokomo silty clay loam. This deep, nearly level, very poorly drained soil is in broad depressions and in narrow strips along waterways on uplands. It receives runoff from adjacent, higher lying soils and is subject to ponding. Slope is 0 to 2 percent. Most areas are 2 to 50 acres, but some areas are as much as 2,000 acres.

Typically, the surface layer is very dark brown, friable silty clay loam about 8 inches thick. The subsurface layer is very dark brown, friable, silty clay loam about 10 inches thick. The subsoil is mottled, dark gray and dark grayish brown, firm silty clay and clay loam about 22 inches thick. The substratum to a depth of about 60 inches is mottled, yellowish brown, firm, clay loam and loam glacial till.

Included with this soil in mapping are small areas of somewhat poorly drained Crosby soils on slight convex rises and the well drained Miamian soils and the moderately well drained Lewisburg soils on knolls. The included soils make up 5 to 10 percent of most areas.

A seasonal high water table is near the surface in winter, spring, and other extended wet periods. Permeability is moderately slow, and runoff is very slow. This soil is subject to ponding. The root zone is moderately deep or deep to compact glacial till. Available water capacity and organic matter content are high. This soil puddles and clods easily. Throughout the subsoil reaction is mainly neutral. The shrink-swell potential in the subsoil is moderate.

Most of the acreage is used for farmland. This soil has high potential for cultivated crops, hay, pasture, and woodland. It has low potential for development of building sites, sanitary facilities, and recreational uses.

The very poor natural drainage is the main limitation for farming. Drained areas are well suited to corn, soybeans, wheat, oats, hay, and pasture (fig. 9). Stands of wheat and oats, in inadequately drained areas, are poor in most years. A combination of surface and subsurface drains helps improve drainage. This soil becomes compacted and cloddy, if it is worked when wet and sticky. Grazing when this soil is dry helps prevent compaction.

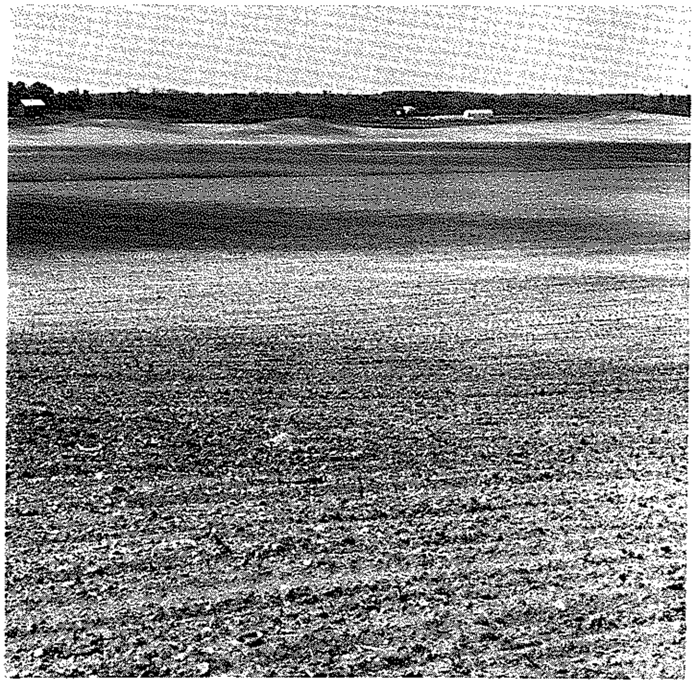


Figure 9.—Dark colored Kokomo soils in center are well suited to cultivated crops. Kendallville soils are on hummocky hills in background.

Incorporating crop residue or other organic matter into the surface layer and planting cover crops help maintain tilth and increase the rate of water infiltration.

This soil is suited to trees that are tolerant of wetness. Spraying, mowing, and disking help reduce plant competition. Wetness limits tree planting and the use of harvesting equipment in winter and spring.

Prolonged wetness, ponded water, low strength, and moderately slow permeability are severe limitations for building sites and sanitary facilities. Surface drains and storm sewers remove surface water. Artificial drainage and use of a suitable base material help improve local roads. Extensive drainage is needed for intensive recreational uses, such as ball diamonds and tennis courts.

This soil is in capability subclass IIw and woodland suitability subclass 2w.

Ln—Linwood muck. This deep, nearly level, very poorly drained soil is in bogs and swales on terraces and uplands. It is frequently flooded. Slope is 0 to 2 percent. Most areas are circular and are 2 to 10 acres.

Typically, the surface layer is black, friable muck about 12 inches thick. Below this to a depth of about 45 inches is black, dark reddish brown, and dark brown, friable muck. The substratum to a depth of about 60 inches is dark gray, firm silty clay loam.

Included with this soil in mapping are small areas of the Carlisle soils formed in organic deposits more than 60 inches thick and areas of soils that have clayey or sandy material at a depth of 36 to 48 inches. Also included are areas of soils that have 14 to 30 inches of silt loam over muck. The included soils make up about 20 percent of most areas.

Water is near the surface and ponds for long periods. Runoff is very slow, and permeability is moderate. The root zone is deep, available water capacity is very high, and organic matter content is very high. Tilth is good. Reaction in the root zone is strongly acid to neutral.

Most areas are used for cropland and pasture. Some areas have natural vegetation and are used for wetland wildlife habitat. This soil has high potential for cropland, pasture, and wetland wildlife habitat. The potential for development of building sites, sanitary facilities, and recreational uses is low.

The very poor natural drainage and flooding are the main limitations for cultivated crops. Drained areas are well suited to cultivated crops but are poorly suited to wheat, because ponding causes a loss of stand. Surface drains remove ponded water. Subsurface drains are also used. Some areas are difficult to drain because of inadequate outlets. Subsidence or shrinkage is a result of oxidation of organic material after draining. Controlled drainage reduces shrinkage in areas where the water table can be raised or lowered. During dry periods the hazard of fire is a concern. Irrigation, windbreaks, and cover crops reduce the hazard of erosion.

Drained areas of this soil are suited to adapted grasses for hay and pasture. Water-tolerant grasses, such as reed canarygrass, grow well on this soil. Overgrazing and grazing when this soil is wet damages plants.

This soil is not well suited to woodland because of wetness and unstable soil conditions. Undrained areas support water-tolerant trees and some cattails, reeds, or sedges. Seedlings are difficult to establish on this soil, and larger trees are subject to tree throw. Wetness severely limits the use of logging equipment.

Wetness, flooding, low strength, and seepage are severe limitations for development of building sites, sanitary facilities, and recreational uses. Undrained areas provide good habitat for ducks, muskrats, and other wetland wildlife.

This soil is in capability subclass IIw and woodland suitability subclass 4w.

LoB—Loudonville silt loam, 2 to 6 percent slopes. This moderately deep, gently sloping, well drained soil is on ridgetops and knolls on uplands. Most areas are 10 to 30 acres.

Typically, the surface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsoil is about 28 inches thick. It is yellowish brown, firm clay loam in the upper part and yellowish brown, firm channery clay loam in the lower part. Hard sandstone bedrock is at a depth of about 39 inches.

Included with this soil in mapping are small areas of the deep Alexandria and Miamian soils that have bedrock at a depth of more than 40 inches on foot slopes. Also included are areas of somewhat poorly drained soils on broad ridgetops. The included soils make up 5 to 10 percent of most areas.

Permeability is moderate. The root zone is moderately deep to sandstone bedrock. Available water capacity is low, runoff is medium, and organic matter content is moderate. Tilth is good. Reaction in the subsoil is medium acid to very strongly acid. The shrink-swell potential in the subsoil is moderate.

Most of the acreage is used for farmland. This soil has high potential for cultivated crops, hay, pasture, and recreational uses. It has medium to low potential for most building sites and low potential for sanitary facilities.

This soil is suited to row crops and small grain. The hazard of erosion and low available water capacity are the main limitations for cultivated crops. The surface layer crusts and puddles after hard rains. Minimum tillage, planting cover crops, incorporating crop residue, and using grassed waterways increase the rate of water infiltration and reduce crusting and the hazard of erosion.

The use of this soil for pasture or hay helps control erosion. Overgrazing or grazing when this soil is wet causes surface compaction, excessive runoff, and poor tilth. Rotation of pasture and restrictive use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees and shrubs. Native hardwoods are in a few small areas. Seedlings grow well if competing vegetation is controlled or removed by cutting, spraying, mowing, or girdling.

Hard bedrock at a depth of 20 to 40 inches, moderate shrink-swell potential, and soil strength are limitations for building sites and sanitary facilities. The soil is better suited to houses without basements because blasting of bedrock is generally necessary for basements. Replacing the surface layer and subsoil with a suitable base material helps improve local roads. This soil is well suited to such recreational uses as camp areas, picnic areas, and paths and trails.

This soil is in capability subclass IIe and woodland suitability subclass 2o.

LoC—Loudonville silt loam, 6 to 18 percent slopes. This moderately deep, sloping and moderately steep, well drained soil is on the sides of hills and ridges. Most areas are long and narrow or irregular in shape and are 3 to 20 acres.

Typically, the surface layer is dark grayish brown, very friable silt loam about 6 inches thick. The subsoil is about 28 inches thick. It is yellowish brown, firm silt loam in the upper part; brown, firm clay loam in the middle part; and yellowish brown, firm channery clay loam in the lower part. The substratum is strong brown and yellowish brown fractured sandstone bedrock over hard sandstone bedrock at a depth of about 38 inches.

Included with this soil in mapping are small areas of the Alexandria and Miamian soils that are on foot slopes and have bedrock at a depth of more than 40 inches. The included soils make up 5 to 10 percent of most areas.

Permeability is moderate. The root zone is moderately deep to sandstone bedrock. Available water capacity is low, runoff is rapid, and organic matter content is moderately low. Tilth is good. Reaction in the subsoil is medium acid to very strongly acid. The shrink-swell potential in the subsoil is moderate.

Most of the acreage is used for farmland. The steeper areas are used for pasture or woodland. This soil has medium to low potential for cultivated crops and medium to high potential for permanent pasture and most recreational uses. It has low potential for development of building sites and sanitary facilities. Areas that have 6 to 12 percent slopes have greater potential for most uses than areas that have 12 to 18 percent slopes.

The slope and low available water capacity are limitations for cultivated crops. Row crops can be grown, if erosion is controlled. The cropping system should include close-growing crops and grasses and legumes that provide large amounts of crop residue. Steeper slope limits the operation of machinery and the installation of erosion-control practices. Minimum tillage, planting cover crops, using grassed waterways, and tilling at proper moisture levels improve tilth, increase the rate of water infiltration, and reduce the hazard of erosion.

The use of this soil for pasture helps control erosion. Surface compaction, poor tilth, and increased runoff result from overgrazing or grazing when this soil is wet. Reseeding with cover crops or companion crops or using the trash-mulch or no-till seeding method reduces erosion.

This soil is well suited to trees. Native hardwoods are in some areas. Spraying, mowing, or disking helps reduce plant competition. Logging roads and skid trails should be protected against erosion and established across the slope. This soil has high potential for woodland wildlife habitat.

Slope and bedrock at a depth of 20 to 40 inches are severe limitations for building sites and sanitary facilities. Blasting of bedrock is generally necessary for basements. Replacing the surface layer and subsoil with a suitable base material improves local roads. Plant cover should be maintained on the site to reduce erosion. Trails in recreational areas should be protected against erosion and laid out on the contour.

This soil is in capability subclass IVe and woodland suitability subclass 2o.

LoF—Loudonville silt loam, 18 to 50 percent slopes. This moderately deep, steep and very steep, well drained soil is on the sides of valleys and ravines in dissected uplands. Most areas are long and narrow or irregular in shape and are 10 to 30 acres.

Typically, the surface layer is brown, friable silt loam about 4 inches thick. The subsoil is about 24 inches thick. It is dark yellowish brown, firm clay loam in the upper part and dark yellowish brown, friable channery loam in the lower part. Hard sandstone bedrock is at a depth of about 28 inches. Some areas are stony.

Included with this soil in mapping are small areas of the well drained Alexandria and Miamian soils that are on foot slopes and have bedrock at a depth of more than 40 inches. The included soils make up about 5 percent of most areas.

Permeability is moderate. The root zone is moderately deep to sandstone bedrock. Available water capacity is low, runoff is very rapid, and organic matter content is moderate. Tilth is good. Reaction in the subsoil is medium acid to very strongly acid. The shrink-swell potential in the subsoil is moderate.

Most of the acreage is used for woodland. Some areas that have 18 to 35 percent slopes are used for pasture. This soil has low potential for cultivated crops, development of building sites and sanitary facilities. It has high potential for woodland and woodland wildlife habitat. Areas that have 18 to 25 percent slopes have medium potential for pasture.

Slope is a severe limitation for cultivated crops. Areas that have 18 to 25 percent slopes are suited to permanent pasture. The hazard of erosion is severe when adequate vegetation is not maintained. Reseeding pasture by cover crops, companion crops, or the trash-mulch or no-till seeding method reduces erosion. Rotation of pasture and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is suited to woodland. Slope limits the use of logging and planting equipment. Logging roads and skid trails should be protected against erosion and laid out on the contour.

The steep and very steep slope and bedrock at a depth of 20 to 40 inches are severe limitations for building sites, sanitary facilities, and recreational uses. Plant cover should be maintained on the site during construction to reduce the hazard of erosion. Trails in recreational areas need to be protected against erosion and established across the slope.

This soil is in capability subclass VIe and woodland suitability subclass 2r.

Md—Medway silt loam, occasionally flooded. This deep, nearly level, moderately well drained soil is commonly near slope breaks to terraces or uplands on flood plains and low stream terraces. Flooding is common in winter and spring. Slope is 0 to 2 percent. Most areas are long and narrow and are 5 to 100 acres.

Typically, the surface layer is very dark brown, friable silt loam about 7 inches thick. The subsurface layer is black and very dark grayish brown, friable silt loam about 11 inches thick. The subsoil is mottled, brown and yellowish brown, friable loam about 20 inches thick. The substratum to a depth of 60 inches is mottled brown, yellowish brown, and grayish brown, friable sandy loam, clay loam, and gravelly loam. In some areas, the surface layer is fine sandy loam. In other areas, the surface layer is lighter colored than typical.

Included with this soil in mapping are 5 to 15 percent small areas of the somewhat poorly drained Shoals soils in depressions.

A seasonal high water table is between a depth of 18 and 36 inches in winter, early in spring, and in other extended wet periods. Permeability is moderate, and runoff is slow. The root zone is deep. Available water capacity and organic matter content are high. This soil has good tilth and can be worked through a fairly wide range of moisture content. Reaction in the subsoil is slightly acid to mildly alkaline.

This soil is mainly used for row crops, small grain, and hay. A few areas are used for pasture. This soil has high potential for cropland, pasture, and woodland. It has low potential for most building sites and sanitary facilities and has medium potential for most recreational uses.

This soil is suited to continuous row crops and to hay and pasture. Flooding in winter and spring severely damages winter grain crops, if they are not protected. Minimum tillage, incorporating crop residue, and planting cover crops help maintain tilth, reduce crusting, and protect the surface in areas subject to scouring during floods. Randomly spaced subsurface drains are needed in some of the wetter soils.

This soil is well suited to trees and shrubs. Spraying, mowing, or disking reduces plant competition.

The hazard of flooding and wetness are severe limitations for building sites and sanitary facilities. This soil is suited to such recreational uses as picnic areas and paths and trails. It is also a good source of topsoil.

This soil is in capability subclass IIw and woodland suitability subclass 1o.

MfB2—Miamian silt loam, 2 to 6 percent slopes, eroded. This deep, gently sloping, well drained soil is on knolls and short, uneven side slopes. Erosion has removed part of the original surface layer. Tillage has mixed material from the subsoil, which has a higher clay content and more coarse fragments than the original surface, into the present surface layer. Slope is mainly 4 to 6 percent. Most areas are 2 to 15 acres.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsoil is yellowish brown and dark yellowish brown, firm clay loam and clay about 22 inches thick. The substratum to a depth of about 60 inches is yellowish brown, firm, loam glacial till.

Included with this soil in mapping are small areas of the somewhat poorly drained Crosby and the very poorly drained Kokomo soils along waterways and on foot slopes and toe slopes. The included soils make up about 5 percent of most areas.

Permeability is moderately slow, and runoff is medium. The root zone is mainly moderately deep to compact glacial till. Available water capacity and organic matter content are moderate. Tilth is good. Reaction in the subsoil is strongly acid to neutral in the upper part and slightly acid to mildly alkaline in the lower part. The shrink-swell potential in the subsoil is moderate.

Most of the acreage is used for farmland. This soil has high potential for cultivated crops, hay, pasture, and trees. The potential is high for development of building sites and medium or high for sanitary facilities (fig. 10).

This soil is suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. If this soil is used for cultivated crops, there is a hazard of erosion. The surface layer crusts after hard rains. Minimum tillage, planting cover crops, incorporating crop residue, and using grassed waterways increase the rate of water infiltration, and reduce crusting and the hazard of erosion. A few areas that have long, smooth slopes can be farmed on the contour.

The use of this soil for pasture or hay helps control erosion. Overgrazing or grazing when this soil is wet causes surface compaction, excessive runoff, and poor tilth. Rotation of pasture and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees. Native hardwoods are in a few small areas. Spraying, mowing, or disking reduces plant competition.

This soil is suited to building sites and some sanitary facilities, if proper design and installation procedures are used. It does not have sufficient strength and stability to support heavy vehicular traffic, especially during wet periods. Use of a suitable base material helps improve local roads. The moderately slow permeability limits the use of septic tank absorption fields. Increasing the size of the absorption area helps overcome this problem. Some areas are good sites for ponds. Plant cover should be maintained on the site during construction to reduce soil loss.

Figure 10.—Miamian silt loam, 2 to 6 percent slopes, eroded, has high potential for building site development.

This soil is in capability subclass IIe and woodland suitability subclass 1o.

MfC2—Miamian silt loam, 6 to 12 percent slopes, eroded. This deep, sloping, well drained soil is on side slopes at heads of drainageways and on knolls and ridges. Erosion has removed part of the original surface layer. Tillage has mixed material from the subsoil, which has a higher clay content and more coarse fragments than the original surface layer, into the present surface layer. Most areas are 3 to 20 acres.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsoil is yellowish brown and dark yellowish brown, firm clay loam about 19 inches thick. The substratum to a depth of about 60 inches is yellowish brown, firm loam glacial till.

Included with this soil in mapping are narrow bands of the very poorly drained Kokomo soils along drainageways. The included soils make up about 5 percent of most areas.

Permeability is moderately slow, and runoff is rapid. The root zone is mainly moderately deep to compact glacial till. Available water capacity is moderate, but it has been reduced by erosion. Organic matter content is moderately low, and tilth is good. Reaction of the subsoil is strongly acid to neutral in the upper part and slightly acid to mildly alkaline in the lower part. The shrink-swell potential in the subsoil is moderate.

Most of the acreage is used for farmland. Some areas are used for permanent pasture and woodland. This soil has medium potential for cultivated crops and high potential for hay, pasture, and trees. The potential is medium for development of building sites and most sanitary facilities.

This soil is suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. The hazard of erosion is severe in cultivated areas. Including grasses and legumes in the cropping system helps control erosion and maintain tilth. The surface layer crusts after hard rains. If plowed when wet and sticky, the soil is cloddy. Minimum tillage, planting cover crops, incorporating crop residue, and tilling at proper moisture levels increase the rate of water infiltration and reduce crusting and the hazard of erosion. Use of grassed waterways is a good management method. Some areas that have long, smooth slopes can be farmed on the contour.

The use of this soil for pasture helps control erosion. Overgrazing or grazing when this soil is wet causes surface compaction, excessive runoff, and poor tilth. Rotation of pasture and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is suited to trees and shrubs. Native hardwoods are in some areas. Spraying, mowing, or disking reduces plant competition. Logging roads should be protected against erosion.

The soil is suited to bulding sites and most sanitary facilities, if proper design and installation procedures are used. Slope, moderately slow permeability, and the moderate shrink-swell potential and strength are the main limitations. Increasing the size of the absorption area helps improve septic tank absorption fields. Use of a suitable base material helps improve local roads. This soil is suitable for pond embankments. Erosion is a hazard during construction.

This soil is in capability subclass IIIe and woodland suitability subclass 1o.

MfD2—Miamian silt loam, 12 to 18 percent slopes, eroded. This deep, moderately steep, well drained soil is on side slopes parallel to well defined waterways and on hillsides and convex ridgetops. Erosion has removed part of the original surface layer. Tillage has mixed material from the subsoil, which has a higher clay content and more coarse fragments than the original surface layer, into the present surface layer. Most areas are 4 to 10 acres but some areas range to more than 40 acres.

Typically, the surface layer is brown, friable silt loam about 7 inches thick. The subsoil is dark yellowish brown and yellowish brown, firm clay loam about 17 inches thick. The substratum to a depth of about 60 inches is yellowish brown, firm, loam glacial till.

Included with this soil in mapping are narrow strips of the Eldean soils formed in glacial outwash on the lower part of slopes. The included soils make up about 10 percent of most areas.

Permeability is moderately slow, and runoff is very rapid. The root zone is mainly moderately deep to compact glacial till. Available water capacity is moderate. This soil is droughty during extended dry periods because of runoff. Organic matter content is moderately low, and tilth is good. This soil has a narrower range of moisture content for good workability because of past erosion. Reaction in the subsoil is strongly acid to neutral in the upper part and slightly acid to mildly alkaline in the lower part. The shrink-swell potential in the subsoil is moderate.

Most areas of this soil are used for permanent pasture and woodland. Some areas are used for farmland. This soil has high potential for pasture and woodland. It has low potential for cultivated crops, development of building sites, and sanitary facilities.

Slope is a limitation for cropland. If this soil is used for cultivated crops, there is a severe hazard of erosion. Row crops can be grown occasionally, if erosion is controlled. Slope is a problem for operation of machinery and installation of erosion-control methods. If plowed when sticky and wet, this soil is cloddy. It puddles and crusts easily. Minimum tillage, planting cover crops, returning crop residue, and tilling and harvesting at a proper moisture level help control erosion, increase the rate of water infiltration, and reduce surface crusting. Use of grassed waterways is a good management method.

The use of this soil for pasture helps control erosion. Overgrazing or grazing when this soil is wet causes surface compaction, excessive runoff, and poor tilth. Rotation of pasture and restricted use during wet periods help keep the pasture and soil in good condition. Reseeding can be done by use of cover crops or companion crops or by the trash-mulch or no-till seeding method.

This soil is suited to trees. Spraying, mowing or disking reduces plant competition. Slope limits the use of equipment. Logging roads and skid trails should be protected against erosion and etablished across the slope. This soil has high potential for woodland wildlife habitat.

Slope, moderately slow permeability, and low strength are severe limitations for most building sites and sanitary facilities. Proper design and installation procedures help overcome slope. Plant cover should be maintained on the site during construction to reduce the hazard of erosion. Trails in recreational areas should be protected against erosion and laid out on the contour.

This soil is in capability subclass IVe and woodland suitability subclass 1r.

MhC3—Miamian clay loam, 6 to 12 percent slopes, severely eroded. This deep, sloping, well drained soil is along well defined waterways and on ridges and hillsides on uplands. Because of erosion, the surface layer mainly consists of material from the subsoil. Shallow, short gullies are common in some areas. Most areas are 3 to 10 acres.

Typically, the surface layer is brown, firm clay loam about 7 inches thick. The subsoil is dark yellowish brown, firm clay loam and clay about 13 inches thick. The substratum to a depth of about 60 inches is yellowish brown, firm, loam glacial till. In some narrow strips on the lower part of slopes, erosion is not severe. In other areas on slope breaks, slope is 12 to 15 percent.

Included with this soil in mapping are small spots where erosion is so severe that calcareous glacial till is exposed. The included soils make up about 10 percent of most areas.

Permeability is moderately slow, and runoff is very rapid. The root zone is mainly moderately deep to compact glacial till. Available water capacity is moderate to low, and the soil is droughty during extended dry periods because of runoff. Organic matter content is low. Tilth is fair. Reaction in the subsoil is strongly acid to neutral in the upper part and slightly acid to mildly alkaline in the lower part. The shrink-swell potential in the subsoil is moderate.

Most of the acreage is used for cropland and pasture. This soil has low potential for cultivated crops. It has medium potential for hay, pasture, sanitary facilities, recreational uses, and most building sites.

This soil is poorly suited to cultivated crops but can be used for permanent pasture and hay. The hazard of erosion is severe in cultivated areas. Maintenance of good tilth is very difficult because of subsoil material in the plow layer. This soil can be worked within a narrow range of moisture content. It crusts and puddles after hard rains. If plowed when wet and sticky, the soil is very cloddy. Minimum tillage, planting cover crops, and using grassed waterways help reduce runoff and soil loss. Incorporating crop residue or other organic matter into the surface layer helps improve tilth, increase the rate of water infiltration, and reduce crusting.

Drought-resistant grasses and legumes can be grown for pasture and hay. Pasture does not grow well during dry periods in summer. Surface compaction, reduced growth, and increased runoff result from overgrazing or grazing when this soil is wet. Reseeding by using companion crops or the trash-mulch or no-till seeding method helps reduce soil loss.

This soil is suited to trees and other vegetation grown for wildlife habitat. Seedlings are difficult to establish during dry periods in summer. Some species do not grow well in areas that have calcareous glacial till in the surface layer.

This soil is suited to building sites if proper design and installation procedures are used. Slope, moderate shrink-swell potential, and low strength are the main limitations. Plant cover should be maintained during construction. Lawns are difficult to establish and maintain in the severely eroded clay loam surface layer. Lawn seedings should be mulched. Stickiness of the surface layer limits recreational uses. Increasing the size of the absorption area and constructing leach lines on the contour help to overcome the moderately slow permeability which limits the use of septic tank absorption fields. Sanitary facilities need to be connected to commercial sewer and treatment facilities. Use of a suitable base material helps improve local roads and streets. This soil is suitable for pond embankments.

This soil is in capability subclass IVe and woodland suitability subclass 1o.

MhD3—Miamian clay loam, 12 to 18 percent slopes, severely eroded. This deep, moderately steep, well drained soil is mainly on side slopes along well defined waterways. Because of erosion, the surface layer mainly consists of material from the subsoil. Most areas are 4 to 10 acres.

Typically, the surface layer is brown, firm clay loam about 6 inches thick. The subsoil is dark yellowish brown, firm clay loam about 14 inches thick. The substratum to a depth of about 60 inches is yellowish brown, firm, loam glacial till. In narrow strips on the lower part of some slopes, erosion is not severe.

Included with this soil in mapping are narrow strips of the very poorly drained Kokomo soils along drainageways. The included soils make up about 5 percent of most areas.

Permeability is moderately slow, and runoff is very rapid. The root zone is mainly moderately deep to compact glacial till. Available water capacity is moderate to low, and the soil is droughty during extended dry periods because of runoff. Organic matter content is low. Tilth is fair. Reaction in the subsoil is strongly acid to neutral in the upper part and slightly acid to mildly alkaline in the lower part. The shrink-swell potential in the subsoil is moderate.

Most areas of this soil are used for permanent pasture and woodland. Some areas are used for cultivated crops. This soil has low potential for cultivated crops, development of building sites, and sanitary facilities. It has high potential for woodland.

This soil is poorly suited to cultivated crops because of slope, past erosion, and a continuing hazard of erosion. The hazard of erosion is serious when areas are reseeded or adequate plant cover is not maintained. Grazing should be regulated to reduce soil compaction and maintain enough vegetation to control erosion. If plowed when sticky and wet, this soil is cloddy. Reseeding by using companion crops or the trash-mulch or no-till seeding method reduces soil loss. Pasture does not grow well during dry periods in summer. Applications of barnyard manure improve tilth and water-holding capacity.

This soil is suited to trees and other vegetation grown for wildlife habitat. Seedlings are difficult to establish during dry periods in summer.

Slope, moderately slow permeability, and low strength are severe limitations for building sites, sanitary facilities, and recreational uses. Plant cover should be maintained on the site during construction to reduce the hazard of erosion. Trails in recreational areas should be protected against erosion and laid out on the contour.

This soil is in capability subclass VIe and woodland suitability subclass 1r.

MkA—Miamian-Kendallville silt loams, 0 to 2 percent slopes. This complex consists of deep, nearly level, well drained Miamian and Kendallville soils on flat areas parallel to major streams. Most areas are dissected by shallow waterways. They are 3 to 35 acres in size and contain about 55 percent Miamian silt loam and 25 percent Kendallville silt loam. The Miamian soil is on flats, and the Kendallville soil is on convex, slight rises. These soils are so intricately mixed, or areas are so small in size, that it is not practical to separate them in mapping.

Typically, the Miamian soil has a surface layer of dark grayish brown, friable silt loam about 9 inches thick. The subsoil is dark yellowish brown, firm clay loam and clay about 27 inches thick. The substratum to a depth of about 60 inches is yellowish brown, firm, loam glacial till.

Typically, the Kendallville soil has a surface layer of dark grayish brown, friable silt loam about 9 inches thick. The subsoil is dark yellowish brown, firm gravelly clay loam and sandy clay loam about 30 inches thick. The substratum to a depth about 60 inches is yellowish brown, firm, loam glacial till.

Included with these soils in mapping are narrow strips of the very poorly drained Kokomo soils along waterways and small areas of the somewhat poorly drained Crosby soils on broad flats and along waterways. The included soils make up 5 to 10 percent of most areas.

In both soils permeability is moderately slow, and runoff is slow. The root zone is mainly moderately deep to compact glacial till. Available water capacity and organic matter content are moderate. Tilth is good. Reaction in the subsoil of the Miamian soil is strongly acid to neutral in the upper part and slightly acid to mildly alkaline in the lower part. Reaction in the subsoil of the Kendallville soil increases with depth from medium acid or strongly acid in the upper part to neutral or mildly alkaline in the lower part. The shrink-swell potential is moderate in the subsoil of both soils.

Most areas of these soils are used for farmland. The soils have high potential for cultivated crops, hay, pasture, development of building sites, and recreational uses. The potential is medium or high for sanitary facilities.

These soils are well suited to row crops, small grain, pasture, and hay. The surface layer crusts after hard rains. Minimum tillage, planting cover crops, incorporating crop residue, and using grassed waterways increase the rate of water infiltration and reduce crusting and the hazard of erosion. These soils are well suited to irrigation.

These soils are well suited to trees. Native hardwoods are in a few small areas. Spraying, mowing, or disking helps reduce plant competition.

These soils are suited to building sites and some sanitary facilities, if proper design and installation procedures are used. Use of a suitable base material helps improve local roads. Increasing the size of the absorption area helps overcome moderately slow permeability that limits the use of septic tank absorption fields. Blanketing the sides of sewage lagoons and ponds with a fairly impervious material helps reduce seepage in the Kendallville soils.

These soils are in capability class I and woodland suitability subclass 1o.

MkB—Miamian-Kendallville silt loams, 2 to 6 percent slopes. This complex consists of deep, gently sloping, well drained Miamian and Kendallville soils on knolls and side slopes along streams. Some areas are dissected by drainageways. Most areas are long and narrow or irregular in shape. They are 5 to 100 acres and contain about 50 percent Miamian silt loam and 35 percent Kendallville silt loam soils. The Miamian soil is on smooth slopes, and the Kendallville soil is on convex, complex slopes on slight rises and knolls. The two soils are so intricately mixed, or areas are so small in size, that it is not practical to separate them in mapping.

Typically, the Miamian soil has a surface layer of dark grayish brown, friable silt loam about 8 inches thick. The subsoil is dark yellowish brown, firm clay loam and clay about 26 inches thick. The substratum to a depth of about 60 inches is yellowish brown, firm, loam glacial till.

Typically, the Kendallville soil has a surface layer of dark grayish brown, friable silt loam about 8 inches thick. The subsoil is dark yellowish brown, firm gravelly clay loam and sandy clay loam about 29 inches thick. The substratum to a depth of about 60 inches is yellowish brown, firm, loam glacial till.

Included with these soils in mapping are narrow strips of the very poorly drained Kokomo soils along waterways and small areas of the somewhat poorly drained Crosby soils on concave slopes adjacent to drainageways. The included soils make up 5 to 10 percent of most areas.

In both soils permeability is moderately slow, and runoff is medium. The root zone is mainly moderately deep to compact till. Available water capacity and organic matter content are moderate. Tilth is good. Reaction in the subsoil of the Miamian soil is strongly acid to neutral in the upper part and slightly acid to mildly alkaline in the lower part. Reaction in the subsoil of the Kendallville soil increases with depth from medium acid or strongly acid in the upper part to neutral or mildly alkaline in the lower part. The shrink-swell potential is moderate in the subsoil of both soils.

Most areas of these soils are used for farmland. The soils have high potential for cultivated crops, hay, pasture, development of building sites, and recreational uses. The potential is medium or high for sanitary facilities.

These soils are suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. If they are used for cultivated crops, there is a hazard of erosion. The surface layer crusts after hard rains. Minimum tillage, planting cover crops, incorporating crop residue, and using grassed waterways increase the rate of water infiltraton and reduce crusting and the hazard of erosion.

The use of these soils for pasture or hay helps control erosion. Overgrazing or grazing when these soils are wet causes surface compaction, excessive runoff, and poor tilth. Rotation of pasture and restricted use during wet periods help keep the pasture and soils in good condition.

These soils are well suited to trees. Native hardwoods are in a few small areas. Spraying, mowing, or disking helps reduce plant competition.

These soils are suited to building sites and some sanitary facilities, if proper design and installation procedures are used. Use of a suitable base material helps improve local roads. Increasing the size of the absorption area helps overcome moderately slow permeability that limits the use of septic tank absorption fields. Blanketing the sides of sewage lagoons and ponds with a fairly impervious material helps reduce seepage in the Kendallville soil. Plant cover should be maintained on the site during construction to reduce erosion.

These soils are in capability subclass IIe and woodland suitability subclass 1o.

MkC2—Miamian-Kendallville silt loams, 6 to 12 percent slopes, eroded. This complex consists of deep, sloping, well drained Miamian and Kendallville soils on knolls and side slopes parallel to streams. Erosion has removed part of the original surface layer. Tillage has mixed material from the subsoil, which has a higher clay content and more coarse fragments than the original surface layer, into the present surface layer. Slope ranges from 6 to 12 percent, but it is mainly 8 to 12 percent. Most areas are oblong or long and narrow. They are 3 to 35 acres and contain about 50 percent Miamian silt loam and 25 percent Kendallville silt loam soils. The Kendallville soil is commonly on the upper part of convex slopes. These soils are so intricately mixed, or areas are so small in size, that it is not practical to separate them in mapping.

Typically, the Miamian soil has a surface layer of brown, friable silt loam about 6 inches thick. The subsoil is yellowish brown, firm clay loam about 20 inches thick. The substratum to a depth of about 60 inches is yellowish brown, firm loam glacial till. Some areas on the upper part of slopes have a clay loam surface layer.

Typically, the Kendallville soil has a brown, friable silt loam surface layer about 6 inches thick. The subsoil is dark yellowish brown, firm, gravelly sandy clay loam about 26 inches thick. The substratum to a depth of about 60 inches is yellowish brown, firm, loam glacial till. Some areas on the upper part of slopes have a gravelly loam surface layer.

Included with these soils in mapping are long narrow strips of the very poorly drained Kokomo soils along waterways. The included soils make up about 7 percent of most areas.

In both soils permeability is moderately slow, and runoff is rapid. The root zone is mainly moderately deep to compact glacial till. Available water capacity is moderate, and organic matter content is moderately low. Tilth is good. Reaction in the subsoil of the Miamian soil is strongly acid to neutral in the upper part and slightly acid to mildly alkaline in the lower part. Reaction in the subsoil of the Kendallville soil increases with depth from medium acid or strongly acid in the upper part to neutral or mildly alkaline in the lower part. The shrink-swell potential is moderate in the subsoil of both soils.

Most of the acreage is used for farmland. Some areas are used for permanent pasture and woodland. These soils have medium potential for cultivated crops and high potential for pasture and trees. The potential is medium for development of building sites and most sanitary facilities.

These soils are suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. The hazard of erosion is severe in cultivated areas. Including grasses and legumes in the cropping system helps control erosion and maintain tilth in cultivated areas. The surface layer crusts after hard rains. If plowed when wet and sticky, these soils are cloddy. Minimum tillage, planting cover crops, incorporating crop residue, and tilling at a proper moisture level increase the rate of water infiltration and reduce crusting and the hazard of erosion. Use of grassed waterways helps reduce erosion.

The use of these soils for pasture helps control erosion. Overgrazing or grazing when these soils are wet causes surface compaction, excessive runoff, and poor tilth. Rotation of pasture and restricted use during wet periods help keep the pasture and soils in good condition.

These soils are suited to trees and shrubs. Native hardwoods are in some areas. Spraying, mowing, or disking help reduce plant competition. Logging roads should be protected against erosion.

These soils are suited to building sites and most sanitary facilities, if proper design and installation procedures are used. Slope, moderately slow permeability, and the moderate shrink-swell potential and strength are the main limitations. Increasing the size of the absorption area helps improve septic tank absorption fields. Use of a suitable base material helps improve local roads. Blanketing the sides of sewage lagoons and ponds with a fairly impervious material helps reduce seepage in the Kendallville soil. Plant cover needs to be maintained on the site during construction to reduce erosion.

These soils are in capability subclass IIIe and woodland suitability subclass 1o.

MkD2—Miamian-Kendallville silt loams, 12 to 18 percent slopes, eroded. This complex consists of deep, moderately steep, well drained Miamian and Kendallville soils on hillsides, convex ridgetops, and on side slopes along waterways. Erosion has removed part of the original surface layer. Subsoil material, which has a higher clay content and more coarse fragments than the original surface layer, has been mixed into the present surface layer. Most areas are 3 to 20 acres and contain about 50 percent Miamian silt loam and 30 percent Kendallville silt loam. The Miamian soil is mainly on the upper part of slopes, and the Kendallville soil on the lower part. These soils are so intricately mixed, or areas are so small in size, that it is not practical to separate them in mapping.

Typically, the Miamian soil has a surface layer of brown, friable silt loam about 5 inches thick. The subsoil is yellowish brown, firm clay loam about 18 inches thick. The substratum to a depth of about 60 inches is yellowish brown, loam glacial till.

Typically, the Kendallville soil has a surface layer of brown, friable silt loam about 5 inches thick. The subsoil is yellowish brown, firm gravelly sandy clay loam about 23 inches thick. The substratum to a depth of about 60 inches is yellowish brown, firm, loam glacial till.

Included with these soils in mapping are small areas of the Hennepin soils that have slopes of 16 to 20 percent and are on side slopes adjacent to streams. These soils have less depth to compact glacial till than the major soils. Some severely eroded soils are on abrupt slope breaks and have calcareous glacial till exposed on the soil surface or are gullied. The included soils make up 5 to 10 percent of most areas.

Permeability of these soils is moderately slow, and runoff is very rapid. The root zone is mainly moderately deep to compact glacial till. Available water capacity is moderate. These soils are droughty during extended dry periods because of runoff. Organic matter content is moderately low, and tilth is good. Reaction in the subsoil of the Miamian soil is strongly acid to neutral in the upper part and slightly acid to mildly alkaline in the lower part. Reaction in the subsoil of the Kendallville soil increases with depth from medium acid or strongly acid in the upper part to neutral or mildly alkaline in the lower part. The shrink-swell potential is moderate in the subsoil of both soils.

Most areas of these soils are used for permanent pasture and woodland. Some areas are used for farmland. These soils have high potential for pasture and woodland. They have low potential for cultivated crops, development of building sites, and sanitary facilities.

Slope is a limitation for cropland. If these soils are used for cultivated crops, the hazard of erosion is severe. Row crops can be grown occasionally, if erosion is controlled and good management is applied. Slope causes some problems for the operation of machinery and the installation of erosion-control methods. If plowed when sticky and wet, these soils are cloddy. They puddle and crust easily. Minimum tillage, planting cover crops, returning crop residue, and tilling and harvesting at proper moisture levels help control erosion, increase the rate of water infiltration, and reduce surface crusting. Use of grassed waterways also helps control erosion.

The use of these soils for pasture helps control erosion. Overgrazing or grazing when these soils are wet causes surface compaction, excessive runoff, and poor tilth. Rotation of pasture and restricted use during wet periods help keep the pasture and soils in good condition. Reseeding can be done by using cover crops or companion crops or by using the trash-mulch or no-till seeding method.

These soils are suited to trees. Spraying, mowing, or disking helps reduce plant competition. Slope moderately limits the use of equipment. Logging roads and skid trails should be protected against erosion and established across the slope. These soils have high potential for woodland wildlife habitat.

Slope and the moderately slow permeability are severe limitations for building sites and sanitary facilities. Proper design and installation procedures help overcome the slope limitation. Plant cover should be maintained on the site during construction to reduce the hazard of erosion. Trails in recreational areas should be protected against erosion and laid out on the contour.

These soils are in capability subclass IVe and woodland suitability subclass 1r.

MIA—Miamian-Lewisburg silt loams, 0 to 2 percent slopes. This complex consists of a well drained Miamian soil and a moderately well drained Lewisburg soil on low knolls and slight rises on uplands. The Lewisburg soil is commonly at a higher elevation than the Miamian soil. Areas of these deep, nearly level soils are mainly 2 to 10 acres, but some areas range to 40 acres. Most areas contain about 55 percent Miamian silt loam and 30 percent Lewisburg silt loam. These soils are so intermingled that it is not practical to separate them in mapping.

Typically, the Miamian soil has a surface layer of dark grayish brown, friable silt loam about 8 inches thick. The subsoil is dark yellowish brown, firm clay loam and clay about 27 inches thick. The substratum to a depth of about 60 inches is yellowish brown, firm, loam glacial till.

Typically, the Lewisburg soil has a surface layer of brown, friable silt loam about 7 inches thick. The subsoil is yellowish brown, firm clay loam and clay about 11 inches thick. The substratum to a depth of about 60 inches is mottled, yellowish brown, firm, loam glacial till.

Included with these soils in mapping are small areas of the somewhat poorly drained Crosby soils on flats and narrow strips of the very poorly drained Kokomo soils along waterways. The included soils make up 10 to 15 percent of most areas.

Permeability of the Miamian soil is moderately slow, and the root zone is mainly moderately deep to compact glacial till. Permeability of the Lewisburg soil is moderate or moderately slow in the subsoil and slow in the substratum. The root zone is mainly shallow, and a perched seasonal high water table is at a depth of 24 to 48 inches.

In both the Miamian and Lewisburg soils, runoff is slow, and tilth is good. Available water capacity and organic matter content are moderate. Reaction in the subsoil is strongly acid to neutral in the upper part and slightly acid to mildly alkaline in the lower part. The shrink-swell potential is moderate in the subsoil.

Most of the acreage is used for farmland. These soils have high potential for cultivated crops, hay, and pasture. They have medium or high potential for development of building sites, sanitary facilities, and recreational uses. The Miamian soil has higher potential for most uses than the Lewisburg soil.

These soils are suited to row crops, small grain, hay, and pasture. The surface layer crusts after hard rains. Because of the shallow root zone of the Lewisburg soil, crops are more susceptible to drought and crop yields are lower than on the Miamian soil. Artificial drainage is needed in most areas of the included wetter soils. Minimum tillage, planting cover crops, incorporating crop residue, and using grassed waterways increase the rate of water infiltration and reduce crusting and the hazard of erosion.

These soils are well suited to trees and shrubs. Native hardwoods are in a few areas. Spraying, mowing, or disking helps reduce plant competition. Shallow-rooted species should be selected for planting on Lewisburg soil.

The Miamian soil is better suited to building sites and sanitary facilities than the Lewisburg soil, because it is more permeable, better drained, and has a thicker zone favorable to root development. Both soils can be used for these purposes, if proper design and installation procedures are used. Use of a suitable base material helps improve local roads. Building sites should be landscaped for good surface drainage away from the foundations. Increasing the size of the absorption area helps overcome the moderately slow or slow permeability that limits the uses of septic tank absorption fields.

These soils are in capability class I. The Miamian soil is in woodland suitability subclass 1o, and the Lewisburg soil is in woodland suitability subclass 2o.

MIB—Miamian-Lewisburg silt loams, 2 to 6 percent slopes. This complex consists of a well drained Miamian soil and a moderately well drained Lewisburg soil on low knolls and ridges on uplands. Slopes are 2 to 4 percent. These deep, nearly level soils are dominantly in areas that are 6 to 50 acres but range from 2 to 100 acres. Most areas contain about 50 percent Miamian silt loam and 30 percent Lewisburg silt loam. The Lewisburg soil is mainly on the upper part of convex slopes and on tops of knolls and ridges. The Miamian soil is on smooth back slopes and foot slopes. These soils are so intricately mixed, or areas are so small in size, that it is not practical to separate them in mapping.

Typically, the Miamian soil has a surface layer of brown, friable silt loam about 9 inches thick. The subsoil is brown, yellowish brown, and dark yellowish brown, firm silty clay loam, clay loam, and clay about 23 inches thick. The substratum to a depth of about 60 inches is mottled, yellowish brown, firm, loam glacial till.

Typically, the Lewisburg soil has a surface layer of brown, friable silt loam about 7 inches thick. The subsoil is yellowish brown, firm clay loam and clay about 11 inches thick. The substratum to a depth of about 60 inches is mottled, yellowish brown, firm, loam glacial till.

Included with these soils in mapping are small areas of the somewhat poorly drained Crosby soils on toe slopes and flats and narrow strips of the very poorly drained Kokomo soils along waterways. The included soils make up 10 to 15 percent of most areas.

The permeability of the Miamian soil is moderately slow, and the root zone is mainly moderately deep to compact glacial till. Permeability of the Lewisburg soil is moderate or moderately slow in the subsoil and slow in the substratum. The root zone is mainly shallow, and a perched seasonal high water table is at a depth of 24 to 48 inches.

In both soils, runoff is medium and tilth is good. Available water capacity and organic matter content are moderate. Reaction in the subsoil is strongly acid to neutral in the upper part and slightly acid to mildly alkaline in the lower part. The shrink-swell potential is moderate in the subsoil.

Most of the acreage is used for farmland. These soils have high potential for cultivated crops, hay, pasture, and trees. They have medium or high potential for development of building sites, sanitary facilities, and recreational uses. The Miamian soil has higher potential for most uses than the Lewisburg soil.

These soils are suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. If they are used for cultivated crops, there is a hazard of erosion. The surface layer crusts after hard rains. Because of the shallow root zone of the Lewisburg soil, crops are more susceptible to drought and crop yields are lower than on the Miamian soil. In most areas, artificial drainage is needed in the included wetter soils. Minimum tillage, planting cover crops, incorporating crop residue, and using grassed waterways increase the rate of water infiltration and reduce crusting and the hazard of erosion.

These soils are well suited to trees and shrubs. Native hardwoods are in a few areas. Spraying, mowing, or disking helps reduce plant competition.

The Miamian soil is better suited to building sites and sanitary facilities than the Lewisburg soil because it is more permeable, better drained, and has a thicker zone favorable to root development. Both soils can be used for these purposes, if proper design and installation procedures are used. Use of a suitable base material improves local roads. Increasing the size of the absorption area helps overcome the moderately slow or slow permeability that limits the use of septic tank absorption fields. Plant cover should be maintained on the site during construction to reduce erosion. Some areas are good sites for ponds.

These soils are in capability subclass IIe. The Miamian soil is in woodland suitability subclass 1o, and the Lewisburg soil is in woodland suitability subclass 2o.

MmB—Miamian-Urban land complex, gently undulating. This complex consists of a deep, well drained Miamian soil on knolls, ridges, and side slopes on uplands and areas of Urban land. Slope ranges from 1 to 6 percent. Most areas are 10 to 40 acres and are made up of about 55 percent Miamian silt loam and 30 percent Urban land. The Miamian soil and the Urban land areas are so intricately mixed, or areas are so small in size, that it is not practical to separate them in mapping.

Typically, the Miamian soil has a surface layer of brown, friable silt loam about 9 inches thick. The subsoil is dark yellowish brown, firm clay loam and clay about 23 inches thick. The substratum to a depth of about 60 inches is yellowish brown, firm, loam glacial till.

The Urban land areas are covered by streets, parking lots, buildings, and other structures that obscure or alter the soil so that identification is not feasible.

Included with this complex in mapping are areas radically altered by cutting and filling. Also included are narrow strips of the very poorly drained Kokomo soils along waterways and in depressions and small areas of the somewhat poorly drained Crosby soils on foot slopes, toe slopes, and flats. The included soils make up about 15 percent of most areas.

Permeability is moderately slow in the Miamian soil, and runoff is medium. The root zone is mainly moderately deep to compact glacial till. Available water capacity and organic matter content are moderate. Tilth is good.

Reaction in the subsoil ranges from strongly acid to neutral in the upper part and from slightly acid to mildly alkaline in the lower part. The shrink-swell potential in the subsoil is moderate.

The Miamian soil is used for parks, openland, building sites, lawns, and gardens. It has high potential for lawns, vegetable and flower gardens, trees, and shrubs. The potential is high for building site development and recreational uses and medium or high for most sanitary facilities.

The Miamian soil is well suited to grasses, flowers, vegetables, trees, and shrubs. Soil erosion is a hazard if the soil is disturbed or left in a bare, exposed condition. The surface layer crusts after hard rains. Regular additions of organic material increase the rate of water infiltration and reduce crusting and the hazard of erosion. The included small areas of cut and fill land are not well suited to lawns and gardens. Subsoil material, exposed on the surface, has poor tilth. It is sticky when wet and hard when dry.

The Miamian soil is suited to buildings and most sanitary facilities if proper design and installation procedures are used. The moderately slow permeability and moderate shrink-swell potential and strength are the main limitations. Dwellings and small buildings need their foundations and footings designed to prevent structural damage caused by the moderate strength and the shrinking and swelling of the soil. Use of a suitable base material helps improve local roads. Where possible, sanitary facilities should be connected to community sewers and treatment facilities. Plant cover should be maintained on the site during construction to reduce the hazard of erosion.

The Miamian soil is in capability subclass IIe and is not assigned to a woodland suitability subclass. Urban land is not assigned to a capability subclass or to a woodland suitability subclass.

Mt—Montgomery silty clay loam. This deep, nearly level, very poorly drained soil is in flat or depressional areas in slackwater basins. It is subject to ponding in the lower part of depressions because of runoff from adjacent, higher lying soils. Slope is 0 to 2 percent. Most areas are circular or irregular in shape and are 3 to 40 acres.

Typically, the surface layer is black, firm silty clay loam about 8 inches thick. The subsurface layer is black, firm, silty clay loam about 8 inches thick. The subsoil is mottled, dark gray, firm silty clay about 24 inches thick. The substratum to a depth of about 66 inches is mottled, grayish brown, calcareous, firm silty clay.

Included with this soil in mapping are small areas of the somewhat poorly drained Henshaw soils on slight rises and the very poorly drained Westland soils that have sand and gravel in the substratum and are on outwash plains. The included soils make up 2 to 12 percent of most areas.

A seasonal high water table is near the surface in winter, spring, and other extended wet periods. Permeability is slow or very slow, and runoff is very slow or ponded. The root zone is deep, and available water capacity is high. This soil can be tilled only within a narrow range of moisture content. Organic matter content is high. Reaction in the subsoil is neutral or mildly alkaline. The shrink-swell potential in the subsoil is high.

Most of the acreage is used for farmland. This soil has high potential for cropland, pasture, woodland, and wetland wildlife habitat. The potential for development of building sites, sanitary facilities, and recreational uses is poor.

If artificially drained, this soil is well suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. If management is optimum, row crops can be grown continuously. Seasonal wetness is the main limitation for cropland. Most areas used for cropland are drained. Subsurface drains and open ditches provide drainage. This soil becomes compact and cloddy, if it is tilled when wet. Incorporating crop residue or other organic matter into the surface layer and planting cover crops improve tilth and increase the rate of water infiltration.

This soil is suited to pasture and hay, but it is poorly suited to grazing early in spring. Surface compaction, poor tilth, reduced growth, and decreased infiltration rates result from overgrazing when the soil is wet. Selection of plants, rotation of pasture, and timely deferment of grazing help keep the pasture and soil in good condition.

This soil is suited to trees adapted to wet sites. Seedlings grow well if competing vegetation is controlled or removed by spraying, mowing, and disking. Good site preparation increases survival and growth. Logging can be done during the drier part of the year.

Wetness, ponding, slow or very slow permeability, and the high shrink-swell potential are severe limitations for building sites and sanitary facilities. Surface drains and storm sewers help remove surface water. Artificial drainage and a suitable base material from outside the area improve local roads.

This soil is in capability subclass IIIw and woodland suitability subclass 2w.

OcA—Ockley silt loam, 0 to 2 percent slopes. This deep, nearly level, well drained soil is in broad areas on stream terraces and outwash plains. A few small areas are on tops of low rises and long, narrow ridges. Most areas are 5 to 30 acres.

Typically, the surface layer is dark brown, friable silt loam about 9 inches thick. The subsoil is about 43 inches thick. It is brown and dark brown, friable and firm silt loam and loam in the upper part; brown and strong brown, firm clay loam in the middle part; and strong brown, brown, and dark brown, firm sandy clay loam and gravelly sandy clay loam in the lower part. The substratum to a depth of about 66 inches is pale brown and brown, loose gravelly loamy sand and gravelly sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Sleeth soils in slight depressions and the very poorly drained Westland soils in depressions and along waterways. The included soils make up 5 to 10 percent of most areas.

Permeability is moderate in the subsoil and very rapid in the substratum. Runoff is slow. The root zone is deep, available water capacity is high, and organic matter content is moderate. The surface layer is easily tilled through a fairly wide range in moisture content, even though it crusts after hard rains. Reaction in the subsoil is strongly acid to slightly acid, and acidity generally decreases as depth increases. The shrink-swell potential in the subsoil is moderate.

Most of the acreage is used for farmland. This soil has high potential for cultivated crops, hay, pasture, trees, building sites and recreational uses.

This soil is suited to corn, soybeans, small grain, and hay. It is well suited to specialty crops. Row crops can be grown year after year. This soil can be tilled and grazed early in spring and is well suited to irrigation. The main management concerns are maintaining high fertility and good soil tilth. Minimum tillage, planting cover crops, and incorporating crop residue or other organic matter into the surface layer help maintain tilth, increase the rate of water infiltration, and reduce crusting.

This soil is well suited to pasture. Surface compaction, poor tilth, and decreased infiltration rate result from overgrazing or grazing when this soil is wet. Rotation of pasture and timely deferment of grazing are used to keep the pasture and soil in good condition.

This soil is well suited to trees. Seedlings are easy to establish, if competing vegetation is controlled or removed by cutting, spraying, girdling, or mowing.

This soil is well suited to building sites. The shrink-swell potential and low strength are moderate limitations. Extending foundations to underlying sand and gravel and backfilling with a suitable base material help overcome these limitations. Use of a suitable base material improves local roads. The possible contamination of ground water is a limitation to some sanitary facilities. This soil is well suited to recreational uses. It is poorly suited to water impoundment because of the very rapid permeability in the substratum. This soil is a good source of sand and gravel.

This soil is in capability class I and woodland suitability subclass 1o.

OcB—Ockley silt loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on outwash plains and stream terraces. Most areas are long and narrow or irregular in shape and are 3 to 15 acres.

Typically, the surface layer is brown, friable silt loam about 9 inches thick. The subsoil is about 41 inches thick. It is brown, friable silt loam and firm silty clay loam in the upper part; brown and reddish brown, firm clay loam in the middle part; and dark reddish brown, firm gravelly sandy clay loam in the lower part. The substratum to a depth of about 60 inches is brown, loose gravelly loamy sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Sleeth soils in slight depressions and along waterways. The included soils make up 5 to 10 percent of most areas.

Permeability is moderate in the subsoil and very rapid in the substratum. Runoff is medium. The root zone is deep, available water capacity is high, and organic matter content is moderate. The surface layer is easily tilled through a fairly wide range in moisture content, even though it crusts after hard rains. Reaction in the subsoil is strongly acid to slightly acid, and acidity generally decreases as depth increases. The shrink-swell potential in the subsoil is moderate.

Most of the acreage is used for farmland. This soil has high potential for cultivated crops, hay, pasture, trees, development of building sites, and recreational uses.

This soil is suited to corn, soybeans, wheat, and oats. Row crops can be grown year after year if erosion is controlled. The soil dries early in spring. It is suited to irrigation and minimum tillage. The major management concern is control of erosion, especially on long slopes. Managing crop residue and planting cover crops help reduce the hazard of erosion, conserve moisture, and maintain organic matter content and tilth.

The use of this soil for pasture or hay helps control erosion. This soil is well suited to grazing early in spring. Overgrazing or grazing when this soil is wet causes surface compaction, excessive runoff, and poor tilth. Rotation of pasture and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is well suited to trees. Native hardwoods are in only a few areas. Seedlings are easy to establish, if competing vegetation is controlled or removed. Spraying, mowing, or disking helps reduce plant competition.

This soil is well suited to building sites. The shrink-swell potential and low strength are moderate limitations. Extending foundations to underlying sand and gravel and backfilling with a suitable material help overcome these limitations. Use of a suitable base material improves local roads. The possible contamination to ground water is a limitation to some sanitary facilities. This soil is well suited to most recreational uses. It is a good source of sand and gravel. It is poorly suited to water impoundment because of the very rapid permeability in the substratum.

This soil is in capability subclass IIe and woodland suitability subclass 1o.

Pa—Patton silty clay loam. This deep, nearly level, poorly drained soil is in depressional areas in the basins of former lakes. It receives runoff from adjacent, higher lying soils and is subject to ponding. Slope is 0 to 2 percent. Most areas are 2 to 100 acres or more.

Typically, the surface layer is black, friable silty clay loam about 9 inches thick. The subsurface layer is very dark gray, firm silty clay loam about 5 inches thick. The subsoil is mottled, dark gray and gray, firm silty clay loam about 23 inches thick. The substratum to a depth of about 62 inches is mottled, gray and dark gray, calcareous, firm silt loam and silty clay loam. In some areas, there is a higher clay content in the subsoil than typical.

Included with this soil in mapping are small areas of the very poorly drained Kokomo soils on uplands and the somewhat poorly drained Algiers soils on terraces and uplands. The included soils have better soil strength in the substratum than this Patton soil. They make up 15 to 20 percent of most areas.

A seasonal high water table is near the soil surface during extended wet periods. Permeability is moderate, and organic matter content is high. Runoff is very slow or ponded. The root zone is moderately deep to the compact substratum, and available water capacity is high. Tilth is fair. Reaction in the subsoil is slightly acid to mildly alkaline. The shrink-swell potential is moderate.

Most areas are used for cultivated crops and pasture. This soil has high potential for cultivated crops, hay, pasture, and woodland. It has low potential for development sites, sanitary facilities, and recreational uses.

Where artificially drained, this soil is well suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. Most areas used for cropland have been drained. Seasonal wetness is the main limitation for farming. Subsurface drains and open ditches are commonly used to provide drainage. This soil can be continuously cultivated, if optimum management is used. Careful management is needed to maintain good tilth. This soil becomes compact and cloddy, if tilled when wet. Managing crop residue and planting cover crops improve tilth and increase the rate of water infiltration.

This soil is poorly suited to grazing early in spring. Overgrazing or grazing when this soil is wet causes compaction and poor tilth. Rotation of pasture and restricted use during wet periods help keep the pasture and soil in good condition.

This soil is suited to trees that are tolerant of wetness. Seedlings grow well when vegetation is controlled or removed by spraying, mowing, and disking. Wetness limits the use of tree planting and harvesting equipment during winter and spring.

Wetness, ponding, and low strength are severe limitations for building sites, sanitary facilities, and recreational uses. Artificial drainage is needed to help overcome these limitations. Artificial drainage and use of a suitable base material help improve local roads.

This soil is in capability subclass IIw and woodland suitability subclass 2w.

Pg—Pits, gravel. This map unit consists of surface-mined areas from which sand and gravel has been removed for use in construction. Pits commonly are on kames and terraces and in areas of Casco, Eldean, Ockley, and other soils that are underlain by glacial outwash. Most pits have a high wall on one or more sides. Areas are 2 to 170 acres. Actively mined pits are continually being enlarged.

The mined material consists of stratified layers of gravel and sand of varying thickness and orientation. The kind and grain size of the aggregates are uniform within any one layer but commonly differ from layer to layer. Some layers contain a significant amount of silt and sand.

Nearly all the large aggregates are rounded quartz, granite, and other siliceous materials, but limestone pebbles are dominant. Most areas also contain dolomite, but the amount is variable from place to place.

Because of the nature of the operations, soil material in spoil banks varies within short horizontal distances. The stripped soil material generally is very low in organic matter content and available water capacity. It is poorly suited to plants. Most areas are subject to erosion and are a potential source of siltation.

Many gravel pits that are no longer being mined should be smoothed and planted to reduce erosion. Grasses and trees that tolerate the very low available water capacity and unfavorable properties of the soil material should be selected for planting. If an area of this map unit is used as a site for sanitary facilities, the effluent can pollute underground water supplies.

This miscellaneous area is not assigned to a capability subclass or woodland suitability subclass.

PrB—Princeton sandy loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is on narrow convex ridges, circular knolls, and side slopes of outwash terraces and till plains. Most areas are long and narrow or irregular in shape and are 3 to 15 acres.

Typically, the surface layer is brown, very friable sandy loam about 7 inches thick. The subsoil is strong brown and brown, firm sandy clay loam and friable sandy loam about 44 inches thick. The substratum to a depth of about 65 inches is brown, loose loamy sand and sandy loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Sleeth soils at the base of slopes. The included soils make up about 5 percent of most areas.

Permeability is moderate, and runoff is medium or slow. The root zone is deep, and available water capacity is moderate. Tilth is good, and organic matter content is moderate. Reaction in the subsoil is mainly medium acid or strongly acid. The shrink-swell potential in the subsoil is low.

Most of the acreage is used for farmland. This soil has high potential for cultivated crops, nursery stock, hay, pasture, trees, development of building sites, and recreational uses.

This soil is well suited to corn, soybeans, wheat, oats, hay, and pasture. Soil blowing, erosion, and moderate droughtiness are main management concerns. This soil is better suited to early maturing crops than to crops that mature late in summer. It is suited to minimum tillage and irrigation. Planting cover crops and returning crop residue or regular additions of other organic material increase the rate of water intake and reduce soil loss.

This soil is well suited to deep-rooted grasses and legumes for hay and pasture and to grazing early in spring. Proper stocking rates and rotation of pasture help keep the pasture and soil in good condition.

This soil is well suited to woodland, but only a small acreage is used for woodland. Spraying, mowing, or disking helps reduce plant competition.

This soil is well suited to building sites and recreational uses. If it is used for sanitary facilities, there is a possible hazard of pollution to underground water supplies.

This soil is in capability subclass IIe and woodland suitability subclass 1o.

PrC—Princeton sandy loam, 6 to 12 percent slopes. This deep, sloping, well drained soil is on narrow convex ridges, circular knolls, and side slopes on outwash terraces and till plains. Most areas are long and narrow or circular and are 3 to 25 acres.

Typically, the surface layer is brown, very friable sandy loam about 7 inches thick. The subsoil is about 48 inches thick. It is dark yellowish brown, very friable sandy loam in the upper part; brown and strong brown, firm sandy clay loam in the middle part; and brown, friable sandy loam in the lower part. The substratum to a depth of about 65 inches is brown, loose loamy sand.

Included with this soil in mapping are narrow strips of soils that have 12 to 18 percent slopes and severely eroded spots on the upper part of slopes that have a clay loam surface layer. The included soils make up 5 to 10 percent of most areas.

Permeability is moderate, and runoff is medium or rapid. The root zone is deep, and available water capacity is moderate. Tilth is good, and organic matter content is moderately low. Reaction in the subsoil is mainly medium acid or strongly acid. The shrink-swell potential in the subsoil is low.

Most of the acreage is used for farmland. This soil has medium potential for cultivated crops and recreational uses and medium to high potential for development of building sites. It has high potential for hay, pasture, and woodland.

This soil is suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. Erosion and soil blowing are hazards in cultivated areas. Including grasses and legumes in the cropping system helps control erosion in cultivated areas. This soil is better suited to early maturing crops than to crops that mature late in summer. It is well suited to minimum tillage. Planting cover crops and returning crop residue or the regular additions of other organic material increase the rate of water intake and reduce soil loss.

This soil is well suited to deep-rooted grasses and legumes for hay and pasture and to grazing early in spring. Proper stocking rates and rotation of pasture help keep the pasture and soil in good condition.

This soil is well suited to trees and shrubs. Spraying, mowing, or disking helps reduce plant competition.

Slope is a limitation for building sites and recreational uses. Development should be on the contour. Plant cover should be maintained on the site during construction to reduce the hazard of erosion. If this soil is used for sanitary facilities, there is a possible hazard of pollution to underground water supplies.

This soil is in capability subclass IIIe and woodland suitability subclass 1o.

Rh—Riverwash. Riverwash consists mainly of gravel and sand areas in the channels of major streams. Within short distances the materials vary widely in texture and composition. In all parts of the county, except the southeast, the coarse material is mainly from limestone, igneous, and metamorphic rocks. Fragments of sandstone and shale are dominant in many of the Riverwash areas in the southeastern part of the county.

Most areas are periodically flooded, depending on characteristics of the stream. They are typically bare of vegetation, but willow, cattails, marsh grass, and other water-tolerant plants grow in places. Areas of Riverwash are used by wildlife.

This miscellaneous area is not assigned to a capability subclass or woodland suitability subclass.

RoC—Rodman gravelly sandy loam, 4 to 12 percent slopes. This deep, sloping, excessively drained soil is in long and narrow areas on terrace slope breaks. This soil is irregular in shape and is on kames and eskers. Most areas are 3 to 30 acres.

Typically, the surface layer is very dark grayish brown and very dark brown, friable gravelly sandy loam about 7 inches thick. The subsoil is brown, friable gravelly coarse sandy loam about 7 inches thick. The substratum to a depth of about 60 inches is brown, loose gravelly coarse sand.

Included with this soil in mapping are small areas of the very poorly drained Westland soils on toe slopes. The included soils make up 5 to 10 percent of most areas.

Permeability is moderately rapid in the subsoil and very rapid in the substratum. Runoff is slow or medium. The root zone is mainly shallow to outwash sand and gravel. Available water capacity is very low, tilth is good, and organic matter content is moderate. Reaction in the subsoil is neutral to moderately alkaline.

Most of the acreage is used for crops and pasture. Some areas are used for woodland. This soil has low potential for cultivated crops and medium potential for pasture and woodland. It has high potential for development of building sites, most recreational uses, and woodland wildlife.

Droughtiness is a severe limitation for cultivated crops. Areas used for cultivated crops are not well suited to irrigation because of erosion, but irrigation can be used on sod crops. This soil is well suited to deep-rooted grasses and legumes for hay and pasture and to grazing early in spring. Some plants have nutrient deficiencies because of the shallow depth to material that has a high content of lime. Gravel hinders tillage in some areas. Fertilizer is leached from this soil at a very rapid rate.

Response is generally better to smaller but more frequent or timely applications of nutrients than to one large application. Minimum tillage, planting cover crops, and incorporating crop residue or other organic matter into the surface layer reduce runoff and soil loss.

Woodland growth is limited by the very low available water capacity. Species adapted to dry sites should be selected for new plantings.

This soil is well suited to building sites and most recreational uses but slope is a moderate limitation. This soil is droughty for lawns. Lawn seedings are difficult to establish. They should be seeded early in spring. Mulching and watering of new seedings are good management methods. Gravel interferes with most recreational uses. Sanitary facilities are limited by the possible pollution to underground water supplies.

This soil is in capability subclass VIs and woodland suitability subclass 3s.

Rs—Ross loam, occasionally flooded. This deep, nearly level, well drained soil is commonly on the highest part of flood plains and is occasionally flooded. Slope is 0 to 2 percent. Most areas are 5 to 80 acres.

Typically, the surface layer is black, very friable loam about 9 inches thick. The subsurface layer is black and very dark brown, friable loam about 22 inches thick. The subsoil is dark brown, friable loam about 7 inches thick. The substratum to a depth of about 60 inches is brown and dark yellowish brown, friable loam and very gravelly sandy clay loam.

Included with this soil in mapping are areas of the moderately well drained Eel soils in slightly lower positions and the somewhat poorly drained Shoals soils in narrow, high water channels near breaks to uplands. Also included are the well drained Wea and Warsaw soils on low stream terraces. The included soils make up about 10 to 20 percent of most areas.

Permeability is moderate, and runoff is slow. The root zone is deep, and available water capacity and organic matter content are high. The surface layer is easily tilled through a fairly wide range in moisture content. Reaction in the subsoil is mainly slightly acid to mildly alkaline.

Most areas are used for farmland. This soil has high potential for cultivated crops and pasture and low potential for most building sites and sanitary facilities. It has medium potential for most recreational uses and high potential as a source of topsoil.

This soil is suited to continuous row crops and to hay and pasture. Row crops can be planted and harvested during the nonflooding period in most years. The hazard of flooding limits winter grain crops. Dikes help prevent flooding. Minimum tillage, incorporating crop residue, and planting cover crops maintain tilth, reduce crusting, and protect the surface in areas subject to scouring during floods.

This soil is suited to trees and other vegetation grown for wildlife habitat. Spraying, mowing, and disking reduce plant competition.

Flooding is a severe limitation for building sites and sanitary facilities. This soil is suited to such recreational uses as picnic areas and paths and trails.

This soil is in capability subclass IIw and woodland suitability subclass 1o.

Rt—Ross silt loam, overwash, frequently flooded. This deep, nearly level, well drained soil is on flood plains and is frequently flooded. It has dark grayish brown and brown alluvium over a darker colored buried soil. Slope is 0 to 2 percent. Most areas are 5 to 80 acres or more.

Typically, the surface layer is dark grayish brown, friable silt loam about 10 inches thick. The subsurface layer is brown, friable silt loam about 8 inches thick. The subsoil is about 43 inches thick. It is very dark brown and dark brown, friable silt loam in the upper part and brown, friable loam in the lower part. The substratum to a depth of about 70 inches is brown, very friable sandy loam. Some areas have a loam surface layer and other areas are slightly wetter.

Included with this soil in mapping are small areas of the very poorly drained Sloan soils near breaks to uplands and areas that have a sandy loam or loamy sand surface layer and are more droughty. The included soils make up 10 to 20 percent of most areas.

Permeability is moderate, and runoff is slow. The root zone is deep, available water capacity is high, and organic matter content is moderate. The surface layer is easily tilled through a fairly wide range in moisture content. Reaction in the subsoil is mainly neutral or mildly alkaline.

Most areas are used for farmland. This soil has high potential for cultivated crops and pasture and low potential for most building sites and sanitary facilities. It has medium to low potential for most recreational uses and high potential as a source of topsoil.

Frequent flooding is a limitation for farmland. Areas protected from flooding are well suited to continuous row crops and hay and pasture. Flooding in unprotected areas severely damages winter grain crops in most years. Hay, pasture, and new plantings and seedings are commonly damaged by sediment. Minimum tillage, incorporating crop residue, and planting cover crops help maintain tilth, reduce crusting, and protect the surface in areas subject to scouring during floods.

This soil is suited to trees and other vegetation grown for wildlife habitat. Young seedlings are subject to damage during floods. Spraying, mowing, and disking reduce plant competition.

Frequent flooding is a severe limitation for building sites and sanitary facilities. During nonflooding periods some areas are suited to such recreational uses as picnic areas and paths and trails.

This soil is in capability subclass IIIw and woodland suitability subclass 1o.

Sh—Shoals silt loam, occasionally flooded. This deep, nearly level, somewhat poorly drained soil is in narrow strips near slope breaks on uplands and terraces and in high water channels on flood plains of major streams and tributaries. It is occasionally flooded for brief periods in fall, winter, and spring. Slope is 0 to 2 percent. Most areas are 4 to 50 acres, but some range to about 100 acres.

Typically, the surface layer is dark grayish brown and very dark grayish brown, friable silt loam about 10 inches thick. The subsoil is mottled, yellowish brown and grayish brown, friable silt loam about 24 inches thick. The substratum to a depth of about 60 inches is mottled brown and dark gray, friable loam.

Included with this soil in mapping are areas of the moderately well drained Eel soils on slightly higher positions and the very poorly drained Sloan soils in depressions near breaks to uplands and terraces. The included soils make up 10 to 20 percent of most areas.

A seasonal high water table is between a depth of 12 and 36 inches in winter, spring, and other extended wet periods. Permeability is moderate, and runoff is very slow. The surface layer is easily tilled through a fairly wide range in moisture content. The root zone is deep, available water capacity is high, and organic matter content is moderate. Reaction in the subsoil is slightly acid to mildly alkaline.

This soil is mainly used for cultivated crops and pasture. It has high potential for cropland, pasture, and woodland and low potential for sanitary facilities and development of building sites.

Flooding and wetness are limitations for cropland. They delay planting in most years and limit the choice of crops. This soil is suited to corn and soybeans planted after the main threat of flooding. Flooding severely damages winter grain crops, if they are not protected. In some places, dikes help prevent flooding. In some areas subsurface drainage is needed, but suitable outlets are not available. Use of crop residue and cover crops reduce crusting, increase water intake, and protect the surface in areas subject to scouring.

This soil is suited to pasture. Maintaining tilth and desirable forage stands is difficult, unless the soil is drained and grazing is controlled. Overgrazing or grazing when this soil is wet causes compaction and poor tilth. Rotation of pasture and deferment of grazing during wet periods help keep the pasture and soil in good condition.

This soil is suited to trees. Native hardwoods are in a few areas. Tree seedlings survive and grow well if competing vegetation is controlled or removed by spraying, mowing, and disking. Species that are tolerant of some wetness should be selected for reforestation.

The hazard of flooding and seasonal wetness are severe limitations for building sites and sanitary facilities. The soil has potential for such recreational uses as hiking during the drier part of the year. Use of fill and a suitable base material from outside the area help improve local roads.

This soil is in capability subclass IIw and woodland suitability subclass 2o.

SlA—Sleeth silt loam, 0 to 2 percent slopes. This deep, nearly level, somewhat poorly drained soil is mainly in transitional areas between the Thackery soils on flats and slight rises and the Westland soils in depressions on stream terraces and outwash plains. Most areas are long and narrow or irregular in shape and are 4 to 50 acres.

Typically, the surface layer is dark brown, friable silt loam about 10 inches thick. The subsoil is about 38 inches thick. It is mottled, yellowish brown and brown, firm loam in the upper part; mottled, brown and yellowish brown, firm clay loam in the middle part; and mottled, brown, firm sandy clay loam in the lower part. The substratum to a depth of about 60 inches is mottled, brown, loose loamy sand and sand.

Included with this soil in mapping are small areas of the very poorly drained Westland soils in depressions. The included soils make up 5 to 10 percent of most areas.

A seasonal high water table is between a depth of 12 and 36 inches in winter, early in spring, and in other extended wet periods. Permeability is moderate in the subsoil and very rapid in the substratum. Runoff is slow. The root zone is deep, available water capacity is moderate or high, and organic matter content is moderate. The surface layer is easily tilled through a fairly wide range in moisture content. Reaction in the subsoil is medium acid to neutral and commonly becomes less acid as depth increases. The shrink-swell potential in the subsoil is moderate.

Most of the acreage is used for farmland. This soil has high potential for cultivated crops, hay, pasture, and trees. It has low potential for sanitary facilities and development of building sites and medium potential for most recreational uses.

This soil is suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. Seasonal wetness is the main limitation for farmland. Where undrained, this soil warms slowly and dries late in spring. Most areas used for cropland are drained. Subsurface drainage systems are commonly used. Use of crop residue or addition of other organic material helps maintain good tilth and reduce surface crusting. Tilling and harvesting should be performed at optimum moisture levels and with equipment that minimizes soil compaction.

Overgrazing or grazing when this soil is wet causes poor tilth. Rotation of pasture and restricted grazing during wet periods help keep the pasture and soil in good condition.

This soil is suited to trees that tolerate some wetness. Seedlings of adapted species survive and grow well if competing vegetation is reduced by spraying, mowing, and disking.

The seasonal high water table and hazard of pollution to underground water supplies are limitations for building sites and most sanitary facilities. Sanitary facilities should be connected to commercial sewers. Drainage ditches and subsurface drains lower the seasonal high water table in areas that have good outlets. Landscaping building sites keeps surface water away from the foundations. Artificial drainage and use of a suitable base material helps improve local roads. Excavations are limited during winter and spring because of the high water table and sloughing of banks. Extensive drainage is needed for such intensive recreational uses as ball diamonds and tennis courts.

This soil is in capability subclass IIw and woodland suitability subclass 3o.

Sn—Sloan silt loam, occasionally flooded. This deep, nearly level, very poorly drained soil is in low lying areas on flood plains. Some of these areas are narrow swales, referred to as high water channels. This soil is occasionally flooded for brief periods in winter and spring. Most areas are 3 to 35 acres. Slope is 0 to 2 percent.

Typically, the surface layer is very dark gray, friable silt loam about 11 inches thick. The subsurface layer is very dark gray, friable silt loam about 5 inches thick. The subsoil is mottled, gray and dark gray, friable loam about 26 inches thick. The substratum to a depth of about 60 inches is mottled, grayish brown, loose gravelly sandy loam.

Included with this soil in mapping are narrow strips of the somewhat poorly drained Shoals and Algiers soils on very slight rises and the very poorly drained Westland soils near slope breaks to uplands. The included soils make up 10 to 20 percent of most areas.

A seasonal high water table is near the surface in winter, spring, and other extended wet periods. Permeability is moderate or moderately slow. Runoff is very slow, and the soil is subject to ponding. The root zone is deep and available water capacity and organic matter content are high. Reaction in the subsoil is neutral to moderately alkaline.

Most of the acreage is used for farmland. This soil has high potential for cropland, hay, pasture, and woodland and low potential for sanitary facilities, development of building sites, and recreational uses.

Flooding and seasonal wetness are limitations for farmland. They delay planting and limit the choice of crops. Crops, such as winter wheat, are generally not grown because of the hazard of flooding. Drained areas are suited to row crops. Surface drains commonly remove ponded water. Subsurface drains are used where suitable outlets are available. Use of crop residue and planting cover crops maintain tilth, reduce crusting, and protect the surface in areas subject to scouring.

This soil is poorly suited to grazing early in spring. Overgrazing or grazing when this soil is wet causes compaction and poor tilth. Rotation of pasture and deferment of grazing during wet periods help keep the pasture and soil in good condition.

This soil is suited to trees adapted to wet sites. Seedlings of adapted species survive and grow well if competing vegetation is controlled or removed by spraying, mowing, and disking. Wetness and flooding limit the planting and harvesting of trees.

The hazard of flooding, prolonged wetness, and the moderate or moderately slow permeability are severe limitations for building sites, sanitary facilities, and recreational uses. Diking to control flooding is difficult. Use of fill and a suitable base material from outside the area improve local roads.

This soil is in capability subclass IIIw and woodland suitability subclass 2w.

St—Stonelick sandy loam. This deep, nearly level, well drained soil is on very slightly undulating areas of flood plains. It is occasionally flooded for very brief periods in winter and spring. Most areas are long and narrow and are 2 to 50 acres.

Typically, the surface layer is brown, very friable sandy loam about 6 inches thick. The substratum to a depth of about 60 inches is brown, very friable, and loose, stratified sandy loam, loamy sand, and gravelly loamy sand.

Included with this soil in mapping are small areas of the less sandy Genesee and Ross soils and spots of Riverwash that has sand and gravel on the soil surface. Also included are more droughty areas of soils that have a surface layer of loamy sand. The included soils make up about 20 percent of most areas.

Permeability is moderately rapid, and runoff is slow. The root zone is deep, available water capacity is low, and organic matter content is moderately low. The surface layer is easily tilled through a wide range in moisture content. Reaction in the root zone is mildly alkaline or moderately alkaline.

Most areas are used for cropland. Some areas are used for woodland. This soil has medium potential for cultivated crops and pasture and high potential for woodland. It has low potential for development of building sites and sanitary facilities.

The low available water capacity and occasional flooding are limitations for cultivated crops, pasture, and hay. This soil is well suited to irrigation and, if irrigated, it is suited to row crops such as corn and soybeans. Flooding is rare during the growing season. Without irrigation, this soil is better suited to crops that mature early rather than those that mature late. The hazard of flooding limits winter grain crops. Grasses and legumes for hay and pasture dry up during droughty periods. Applied fertilizer is leached from this soil at a rapid rate. Response is generally better to smaller but more frequent applications of fertilizer than to one large application. Use of cover crops and crop residue help maintain organic matter content and protect the surface during floods.

This soil is suited to trees tolerant of some droughtiness. Seedlings are difficult to establish during dry periods in summer and early in fall. Spraying, mowing, or disking helps reduce plant competition.

The hazard of flooding is a severe limitation for building sites and sanitary facilities. This soil has potential for such recreational uses as picnic areas, hiking trails, and golf fairways. Lawns are droughty during dry periods.

This soil is in capability subclass IIs and woodland suitability subclass 2o.

ThA—Thackery silt loam, 0 to 2 percent slopes. This deep, nearly level, moderately well drained soil is near breaks to uplands on stream terraces and outwash plains. Most areas are long and narrow or irregular in shape and are 5 to 20 acres.

Typically, the surface layer is brown, friable silt loam about 12 inches thick. The subsoil is about 38 inches thick. It is yellowish brown, friable silt loam and mottled, yellowish brown, firm clay loam in the upper part; mottled, yellowish brown, firm gravelly clay loam in the middle part; and mottled, brown, friable gravelly sandy clay loam in the lower part. The substratum to a depth of about 60 inches is mottled, yellowish brown, loose gravelly sand.

Included with this soil in mapping are small areas of the very poorly drained Westland and the somewhat poorly drained Sleeth soils in depressions and along waterways. The included soils make up 5 to 10 percent of most areas.

A seasonal high water table is between a depth of 18 and 36 inches in winter, spring, and other extended wet periods. Permeability is moderate in the subsoil and rapid or very rapid in the substratum. Runoff is slow. The root zone is deep, and available water capacity is moderate or high. Organic matter content is moderate, and tilth is good. Reaction in the subsoil increases with depth and ranges from strongly acid in the upper part to mildly alkaline in the lower part. The shrink-swell potential in the subsoil is moderate.

Most of the acreage is used for farmland. This soil has high potential for cultivated crops, hay, and pasture. It has medium potential for most building sites and medium to high potential for recreational uses.

This soil is suited to row crops, small grain, pasture, and hay. The surface layer can be worked through a fairly wide range of moisture content. Minimum tillage and planting deep-rooted cover crops are good management methods if this soil is used for continuous row crops. Incorporating crop residue or other organic matter into the surface layer increases the rate of water infiltration, improves tilth, and reduces crusting. Grazing or overgrazing when this soil is wet causes surface compaction, poor tilth, reduced growth, and decreased infiltration rates.

This soil is well suited to trees and shrubs. Cutting, spraying, girdling, or mowing helps reduce plant competition.

The seasonal wetness, shrink-swell potential, and low strength are limitations for building sites, sanitary facilities, and recreational uses. This soil is better suited to houses without basements than to houses with basements. Building sites should be landscaped for good surface drainage away from the foundations. Use of artificial drainage and a suitable base material helps improve local roads. The possible pollution to underground water supplies limits most sanitary facilities. This soil is poorly suited to water impoundment because of the rapidly or very rapidly permeable substratum.

This soil is in capability class I and woodland suitability subclass 1o.

ThB—Thackery silt loam, 2 to 6 percent slopes. This deep, gently sloping, moderately well drained soil is irregular in shape on low rises and in long narrow strips on stream terraces and outwash plains. Most areas are 5 to 15 acres.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsoil is about 35 inches thick. It is brown, friable silt loam and mottled, yellowish brown, firm clay loam in the upper part and mottled, yellowish brown, firm gravelly sandy clay loam in the lower part. The substratum to a depth of about 60 inches is mottled, brown, loose gravelly loamy sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Sleeth soils on foot slopes and slight depressions and narrow strips of the very poorly drained Westland soils in depressions and along waterways. The included soils make up 5 to 10 percent of most areas.

A seasonal high water table is between a depth of 18 to 36 inches in wet periods. Permeability is moderate in the subsoil and rapid or very rapid in the substratum. Runoff is medium. The root zone is deep, and available water capacity is moderate or high. Organic matter content is moderate, and tilth is good. Reaction in the subsoil increases with depth and ranges from strongly acid in the upper part to mildly alkaline in the lower part. The shrink-swell potential in the subsoil is moderate.

Most of the acreage is used for farmland. This soil has high potential for cultivated crops, hay, and pasture. It has medium potential for most building sites, and medium to high potential for recreational uses.

This soil is suited to row crops, small grain, hay, or pasture. A good soil management program helps control erosion in most areas. The surface layer can be worked through a fairly wide range of moisture content. Minimum tillage, planting cover crops, and using grassed waterways help reduce soil loss. Incorporating crop residue or other organic matter into the surface layer increases the rate of water infiltration, improves tilth, and reduces crusting. Overgrazing or grazing when the soil is wet causes surface compaction, poor tilth, reduced growth, and decreased infiltration rates.

This soil is well suited to trees and shrubs. Seedlings grow well if competing vegetation is controlled or removed by cutting, spraying, girdling, or mowing. Good site preparation helps improve survival and growth.

The seasonal wetness, shrink-swell potential, and low strength are limitations for building sites, sanitary facilities, and recreational uses. This soil is better suited to houses without basements than to houses with basements. Building sites should be landscaped for good surface drainage away from the foundations. Because of the rapidly or very rapidly permeable substratum, the pollution of ground water by sanitary facilities is possible. This soil is poorly suited to water impoundment.

This soil is in capability subclass IIe and woodland suitability subclass 1o.

TpA—Tippecanoe silt loam, 0 to 2 percent slopes. This deep, nearly level, moderately well drained soil is in slightly concave positions on stream terraces and outwash plains. Most areas are irregular in shape and are 2 to 48 acres.

Typically, the surface layer is black, friable silt loam about 11 inches thick. The subsoil is about 39 inches thick. It is very dark grayish brown, friable clay loam and mottled, brown firm clay loam in the upper part; mottled, yellowish brown and dark yellowish brown, firm clay loam and gravelly clay in the middle part; and brown, friable gravelly sandy loam in the lower part. The substratum to a depth of about 64 inches is brown, loose gravelly loamy sand.

Included with this soil in mapping are small areas of the very poorly drained Westland soils in depressions and along drainageways. The included soils make up 5 to 10 percent of most areas.

A seasonal high water table is between a depth of 36 to 72 inches in spring and other extended wet periods. Permeability is moderate in the subsoil and very rapid in the substratum. Runoff is slow. The root zone is deep, and available water capacity is high. Organic matter content is high, and tilth is good. Reaction in the subsoil ranges from slightly acid or medium acid in the upper part to mildly alkaline in the lower part. The shrink-swell potential is moderate in the upper and middle parts of the subsoil.

Most areas are used for farmland. This soil has high potential for cultivated crops, hay, woodland, pasture, and recreational uses. It has medium potential for development of building sites.

This soil is well suited to corn, soybeans, small grain, hay, and pasture. Cultivated crops can be grown continuously if good management is used. Maintaining soil tilth and a high fertility level are main management concerns. Soil compaction results if this soil is tilled when wet. Minimum tillage, planting cover crops, incorporating crop residue, and tilling at proper moisture levels increase the rate of water infiltration and reduce crusting and the hazard of erosion. Randomly spaced subsurface drains are needed in the wetter soils.

Overgrazing or grazing when this soil is wet causes compaction and poor tilth. Rotation of pasture and restricted grazing help keep the pasture and soil in good condition.

This soil is well suited to trees and shrubs. Seedlings grow well if competing vegetation is controlled or removed by spraying, cutting, girdling, or mowing.

This soil is well suited to buildings without basements and to most recreational uses. The seasonal wetness is a limitation for buildings with basements. Artificial drains and storm sewers reduce wetness. Buildings should be landscaped for good surface drainage away from the foundation. If this soil is used for sanitary facilities, the pollution of underground water supplies is possible. This soil is a good source of sand and gravel.

This soil is in capability class I and is not assigned to a woodland suitability subclass.

Ud—Udorthents. These nearly level to steep soils are in areas of cut and fill for roads, housing developments, recreational areas, and other similar uses. In areas where the soil material has been removed, the remaining material is similar to the subsoil or substratum of adjacent soils. In fill or disposal areas, the soil material is variable but generally is made up of the subsoil and substratum of nearby soils. Slope is very complex and ranges from 0 to 25 percent. Most areas are 3 to 15 acres, but a few areas range to 300 acres.

Typically, the upper 60 inches is clay loam, loam, or gravelly sandy loam. Available water capacity and organic matter content are variable but are mainly low or very low. Internal water movement and runoff are variable. Tilth is poor. In poorly vegetated areas, hard rains tend to seal the surface, reduce the infiltration rate, and restrict the emergence and growth of plants. A seasonal high water table is evident in some areas, particularly in graded areas that are depressed or bowl-shaped. Reaction in the root zone is medium acid to moderately alkaline.

These soils are poorly suited to grasses and legumes for hay and pasture. In areas where the surface is bare, the hazard of erosion is severe. Suitable plant cover helps control erosion. The suitability varies for building sites and sanitary facilities. Onsite investigation is needed to determine the potential and limitation for any proposed use.

These soils are not assigned to a capability subclass or woodland suitability subclass.

Ur—Urban land. Urban land consists of areas 30 to 80 acres in size that are covered by pavement, buildings, or other man-made surfaces. Commercial and industrial areas are also included. Construction covers a high percentage of the total area, leaving only limited acreage of natural soil. As a result, the volume and rate of runoff from these areas has increased. Urban land is a potential source of pollution to nearby streams. Onsite investigation is needed to determine the potential and limitation for any proposed use.

This miscellaneous area is not assigned to a capability subclass or woodland suitability subclass.

WbA—Warsaw loam, 0 to 2 percent slopes. This deep, nearly level, well drained soil is in moderately broad, long areas on stream terraces and outwash plains. Slope is mainly 1 to 2 percent. Most areas are 25 to 200 acres, but some areas along small streams are 2 to 25 acres.

Typically, the surface layer is very dark grayish brown, friable loam about 7 inches thick. The subsurface layer is very dark grayish brown and dark brown, friable loam about 9 inches thick. The subsoil is about 18 inches thick. It is brown, firm gravelly sandy clay loam in the upper part and dark yellowish brown, friable sandy loam in the lower part. The substratum to a depth of about 70 inches is brown, dark yellowish brown, yellowish brown, and pale brown, loose sand and gravelly coarse sand.

Included with this soil in mapping are Eldean soils, which have a lighter colored surface layer and slightly lower available water capacity. The included soils make up 5 to 10 percent of most areas.

Permeability is moderate in the subsoil and very rapid in the substratum. Runoff is slow. The root zone is moderately deep to outwash sand and gravel. Available water capacity is moderate or low, and organic matter content is high. The surface layer can be worked through a fairly wide range of moisture content. Reaction in the subsoil is mainly strongly acid to slightly acid. The shrink-swell potential is low.

Most areas are used for farmland. This soil has high potential for cultivated crops, hay, and pasture. It has high potential for most building sites and recreational uses, and as a source of sand and gravel. It has low potential for water impoundment because of the very rapidly permeable substratum.

This soil is suited to corn, soybeans, wheat, oats, and specialty crops (fig. 11). The moderate droughtiness is the main limitation for cropland. Crops can be planted early, because this soil warms and dries early in spring. Row crops can be grown continuously if a high level of management is used. This soil is well suited to irrigation. Minimum tillage, use of cover crops, and incorporating crop residue or other organic matter into the surface layer increase the rate of water infiltration, improve tilth, and reduce crusting.

This soil is well suited to grazing early in spring and to deep-rooted legumes, such as alfalfa. Proper stocking rates, selection of plants, rotation of pasture, and timely deferment of grazing help keep the pasture and soil in good condition.

This soil is well suited to trees and shrubs. Native hardwoods are in a few small areas. Spraying, mowing, or disking helps reduce plant competition. Good site preparation helps improve survival and growth.

This soil is well suited to building sites. Soil strength is a moderate limitation. Extending the building foundation to the substratum helps overcome the low strength. Replacing the subsoil with a suitable base material helps improve local roads and streets. The possible pollution to underground water supplies limits sanitary facilities. This soil is somewhat droughty for lawns during dry periods. It is a good source of sand and gravel.

This soil is in capability subclass IIs and is not assigned to a woodland suitability subclass.

Figure 11.—Warsaw loam, 0 to 2 percent slopes, is well suited to specialty crops, such as melons.

WbB—Warsaw loam, 2 to 6 percent slopes. This gently sloping, deep, well drained soil is in broad areas on terraces. Slope is mainly 2 to 4 percent. Most areas are 10 to 80 acres, but some areas range to more than 150 acres.

Typically, the surface layer is very dark grayish brown and dark brown friable loam about 14 inches thick. The subsoil is about 19 inches thick. It is dark yellowish brown, firm gravelly clay loam in the upper part and dark brown, firm gravelly sandy clay loam in the lower part. The substratum to a depth of about 70 inches is brown, loose gravelly sand and sand.

Included with this soil in mapping are Eldean soils, which have a lighter colored surface layer and a slightly lower available water capacity, and small areas of more droughty soils that have a gravelly loam surface layer and are near tops of knolls and on slope breaks. The included soils make up 5 to 10 percent of most areas.

Permeability is moderate in the subsoil and very rapid in the substratum. Runoff is medium. The root zone is mainly moderately deep to outwash sand and gravel, and available water capacity is moderate or low. Organic matter content is high, and the surface layer can be worked through a fairly wide range of moisture content. Reaction in the subsoil is mainly strongly acid to slightly acid. The shrink-swell potential is low.

Most areas are used for farmland. This soil has high potential for cultivated crops, hay, and pasture. It has high potential for most building sites and recreational uses and as a source of sand and gravel. It has low potential for water impoundment because of the very rapidly permeable substratum.

This soil is suited to corn, soybeans, wheat, and oats. Moderate droughtiness and control of erosion are main management concerns. This soil is better suited to early maturing crops than to crops that mature late in summer. This soil is well suited to irrigation. Minimum tillage, use of cover crops and grassed waterways, and incorporating crop residue or other organic matter into the surface layer increase the rate of water infiltration and improve tilth.

This soil is well suited to grazing early in spring. Proper stocking rates, selection of plants, rotation of pasture, timely deferment of grazing, and control of weeds help keep the pasture and soil in good condition.

This soil is well suited to trees and shrubs. Native hardwoods are in a few small areas. Spraying, mowing, or disking helps reduce plant competition. Good site preparation helps improve survival and growth.

This soil is well suited to building sites. Low soil strength is a moderate limitation. Extending building foundations to the substratum helps overcome the low strength. Replacing the subsoil with a suitable base material helps improve local roads and streets. If this soil is used for sanitary facilities, the hazard of pollution to underground water supplies is possible. This soil is somewhat droughty for lawns during dry periods. It is a good source of sand and gravel.

This soil is in capability subclass IIe and is not assigned to a woodland suitability subclass.

WeA—Wea silt loam, 0 to 2 percent slopes. This deep, nearly level, well drained soil is in moderately broad and long areas on stream terraces and outwash plains. Slope is mainly 1 or 2 percent. Most areas are 10 to 50 acres.

Typically, the surface layer is very dark brown, friable silt loam about 8 inches thick. The subsurface layer is black and very dark grayish brown, friable silt loam about 9 inches thick. The subsoil is about 38 inches thick. It is brown and dark brown, firm loam and sandy clay loam in the upper part and brown and dark yellowish brown, firm gravelly clay loam, sandy clay loam, and gravelly sandy clay loam in the lower part. The substratum to a depth of about 62 inches is brown, loose gravelly sand. In some areas, the surface layer is lighter colored than typical.

Included with this soil in mapping are small areas of the more droughty Eldean soils on low knolls. The included soils make up 5 to 10 percent of most areas.

Permeability is moderate in the subsoil and very rapid in the substratum. Runoff is slow. The root zone is deep and available water capacity and organic matter content are high. Tilth is good. Reaction in the subsoil is strongly acid to neutral. The shrink-swell potential in the subsoil is moderate in the upper part and low in the lower part.

Most areas are used for farmland. This soil has high potential for cultivated crops, hay, and pasture. It has high potential for most building sites and recreational uses and as a source of sand and gravel. It has low potential for water impoundment because of the very rapidly permeable substratum.

This soil is well suited to row crops, such as corn and soybeans, grown year after year and to specialty crops. It can be tilled and grazed early in spring and is well suited to irrigation. Maintaining high fertility and good soil structure are main management concerns. Minimum tillage, use of cover crops and incorporating crop residue or other organic matter into the surface layer help maintain tilth, increase the rate of water infiltration, and reduce crusting.

This soil is well suited to pasture and hay. Overgrazing or grazing when the soil is wet causes surface compaction, reduced growth, and poor tilth. Proper stocking rates, selection of plants, rotation of pasture, timely deferment of grazing, and control of weeds help keep the pasture and soil in good condition.

This soil is well suited to trees and shrubs. Good site preparation helps improve survival and growth. Cutting, spraying, girdling, or mowing helps reduce plant competition.

This soil is well suited to building sites. The shrink-swell potential and low strength are limitations that can be overcome by extending foundations to the underlying sand and gravel and by backfilling with a suitable material. Use of a suitable base material helps improve local roads. The possible contamination of ground water limits some sanitary facilities. This soil is well suited to recreational uses and is a good source of sand and gravel.

This soil is in capability class I and is not assigned to a woodland suitability subclass.

WeB—Wea silt loam, 2 to 6 percent slopes. This deep, gently sloping, well drained soil is in broad, long areas on stream terraces and outwash plains. Slope is mainly 2 to 4 percent. Most areas are 4 to 16 acres.

Typically, the surface layer is black and very dark gray silt loam about 14 inches thick. The subsoil is brown and dark yellowish brown, firm clay loam, sandy clay loam, and gravelly clay loam about 36 inches thick. The substratum to a depth of about 62 inches is brown, loose gravelly sand. In some areas the surface layer is lighter colored than typical and in other areas it is loam.

Included with this soil in mapping are small areas of the Eldean soils that have low available water capacity. The included soils make up 5 to 10 percent of most areas.

Permeability is moderate in the subsoil and very rapid in the substratum. Runoff is medium. The root zone is deep and available water capacity and organic matter content are high. Tilth is good. Reaction in the subsoil is strongly acid to neutral. The shrink-swell potential in the subsoil is moderate in the upper part and low in the lower part.

Most areas are used for farmland. This soil has high potential for cultivated crops, hay, and pasture. It has high potential for most building sites and recreational uses and as a source of sand and gravel. It has low potential for water impoundment because of the very rapidly permeable substratum.

This soil is suited to corn, soybeans, wheat, oats, hay, and pasture. Row crops can be grown year after year, if erosion is controlled. The soil dries early in spring and is well suited to grazing early in spring. The surface layer can be worked through a fairly wide range of moisture content. This soil is well suited to most types of irrigation. Irrigation is seldom needed, because the high available water capacity. Minimum tillage, use of cover crops, and grassed waterways reduce soil loss. Incorporating crop residue or other organic matter into the surface layer helps maintain tilth, increase the rate of water infiltration, and reduce crusting.

This soil is well suited to trees and shrubs. Seedlings are easy to establish, if competing vegetation is controlled or removed by cutting, spraying, girdling, or mowing.

This soil is well suited to building sites. The shrink-swell potential and low strength are limitations. These limitations can be overcome by extending the foundations to the underlying sand and gravel and by backfilling with a suitable material. Use of a suitable base material helps improve local roads. The possible contamination of ground water limits some sanitary facilities. Plant cover should be maintained on the site during construction to reduce runoff and erosion. This soil is well suited to recreational uses and is a good source of sand and gravel.

This soil is in capability subclass IIe and is not assigned to a woodland suitability subclass.

Ws—Westland silty clay loam. This deep, nearly level, very poorly drained soil is on outwash plains and stream terraces. It extends into the uplands along some drainageways. This soil is subject to ponding in the lower part of depressions because of runoff from adjacent, higher lying soils. Slope is 0 to 2 percent. Most areas are 3 to 100 acres.

Typically, the surface layer is very dark gray, friable, silty clay loam about 8 inches thick. The subsurface layer is mottled, black, firm silty clay loam about 8 inches thick. The subsoil is about 38 inches thick. It is mottled, dark gray and gray, firm clay loam in the upper part and mottled, dark grayish brown and grayish brown, firm sandy clay loam and friable gravelly sandy clay loam in the lower part. The substratum to a depth of about 78 inches is mottled, dark grayish brown and dark gray, friable gravelly sandy loam and loose gravelly sand.

Included with this soil in mapping are narrow strips of the very poorly drained Sloan soils on flood plains and small areas of the somewhat poorly drained Sleeth soils on slight rises. The included soils make up 2 to 10 percent of most areas.

A seasonal high water table is near the surface in fall, winter, spring, and other extended wet periods. Permeability is moderately slow in the subsoil and very rapid in the substratum. Runoff is very slow or ponded. The root zone is deep, and available water capacity is high. Tilth is fair to good. Organic matter content is high. Reaction in the subsoil is medium acid to neutral in the upper part and neutral to moderately alkaline in the lower part. The shrink-swell potential in the subsoil is moderate.

Most acreage is used for farmland. This soil has high potential for cultivated crops, hay, pasture, and trees. The potential for sanitary facilities, recreational uses, and development of building sites is low.

If artificially drained, this soil is well suited to corn, soybeans, small grain, and grasses and legumes for hay and pasture. Unless adequate drainage is provided, stands of wheat and oats are poor in most years. Most areas used for cropland are drained. Row crops can be grown continuously, if optimum management is used. Subsurface drains and open ditches help provide drainage. Timely tillage is important. This soil puddles and clods if worked when it is wet. Crop residue and use of cover crops improve tilth, reduce crusting, and increase the rate of water infiltration.

This soil is poorly suited to grazing early in spring. If this soil is drained, controlled grazing is needed. The surface layer compacts easily and results in poor tilth, if grazed when wet.

This soil is suited to trees that are tolerant of wetness. Native hardwoods are in a few areas. Competing vegetation needs to be controlled or removed for survival and growth of tree seedlings. Wetness limits the use of planting and harvesting equipment during winter and spring.

Seasonal wetness, seepage, moderately slow permeability, and ponding are severe limitations for building sites, most sanitary facilities, and recreational uses. Ditches to control the water level are somewhat effective, if outlets are available. Excavations are limited during the winter and spring because of the high water table and sloughing of banks. Underground water supplies can be polluted by seepage from sanitary facilities. Sanitary facilities should be connected to commercial sewers. Suitable base material and artifical drainage are needed for roads. Extensive drainage is also needed for intensive recreational uses such as ball diamonds and tennis courts.

This soil is in capability subclass IIw and woodland suitability subclass 2w.

Use and management of the soils

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

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

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

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

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

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

Crops and pasture

Donald V. Archer, district conservationist, Soil Conservation Service, helped prepare this section.

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

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Soil maps for detailed planning." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

More than 285,000 acres in the survey area was used for crops and pasture in 1967 (*6*). Of this, about 25,000 acres was used for permanent pasture; 148,000 acres was used for row crops, mainly corn and soybeans; about 39,000 acres was used for close-grown crops, mainly wheat and oats; and 52,000 acres was used for rotation hay and pasture. A very small acreage was used for tree fruits and vegetables.

The potential of the soils in Pickaway County for increased production of crops is good. About 12,000 acres of potentially good cropland is currently used as woodland, and about 20,000 acres is used as pasture. In addition to the reserve capacity represented by this land, food production could also be increased considerably by extending the latest crop production technology to all cropland in the county. This soil survey can greatly facilitate the application of such technology.

The acreage in crops and pasture in this county has been affected by the use of land for urban development. In 1967, an estimated 13,000 acres of urban and built-up land was in the county. The acreage of such land has been increasing at a rapid pace because of close proximity of the expanding metropolitan area of Columbus. The use of this soil survey to help make land use decisions that will influence the future role of farming in the county is described in the section "General soil map for broad land use planning."

Soil erosion is the major problem on more than one-third of the cropland and pasture in Pickaway County. If the slope is more than 2 percent, erosion is a hazard. Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging on soils that have a clayey subsoil, such as Bennington and Crosby soils. Erosion also reduces productivity on soils that tend to be droughty, such as Casco, Rodman, and Eldean soils. Second, soil erosion results in sediment entering streams. Control of erosion minimizes the pollution of streams by sediment and improves the quality of water for municipal use, for recreation, and for fish and wildlife.

Soil erosion and wetness are limitations, especially on the Bennington and Crosby soils that have slope of 2 to 6 percent.

In eroded spots in many gently sloping and sloping fields, preparing a good seedbed and tilling are difficult because the original friable surface soil has been eroded. Such spots are common in areas of the eroded Miamian, Miamian-Kendallville, Eldean, Eldean-Kendallville, Alexandria, and Cardington soils and in the severely eroded areas of Miamian soils. Seedings are difficult to establish in the clay loam surface layer of the severely eroded Miamian soils.

Erosion control provides protective surface cover, reduces runoff, and increases the infiltration rate. A cropping system that keeps plant cover on the soil for extended periods can hold soil erosion losses to an amount that will not reduce the productive capacity of the soils. On livestock farms, on which pasture plants and hay are grown, legume and grass forage crops in the cropping system reduce the risk of erosion, provide nitrogen, and improve tilth.

Slopes are so short and irregular that contour tillage and terracing are not practical in most areas of Casco, Rodman, and the gently sloping to moderately steep Kendallville and Eldean soils. On these soils a cropping system that provides substantial plant cover is needed to control erosion, unless tillage is kept to a minimum. Minimum tillage and leaving crop residue on the surface increase the rate of water infiltration and reduce the hazards of runoff and erosion. These methods are suited to many of the soils in the survey area but are less successful on eroded soils, especially on severely eroded soils. No-tillage for corn, which is common on an increasing acreage, is effective in reducing the risk of erosion on sloping soils and can be adapted to many of the soils in the survey area (fig. 12). It is less successful, however, on severely eroded soils.

Although terraces and diversions shorten the length of slopes, slow runoff, and reduce the risk of erosion, the soils in Pickaway County are less suited to terraces and diversions because the slopes are irregular, the terrace channel is excessively wet, and the clayey subsoil would be exposed in terrace channels.

Grassed waterways are natural or are constructed. If constructed they should be protected by plant cover. Natural drainageways are the best locations for waterways and commonly require only a minimum of shaping to produce a good channel. They should be wide and flat so that farm machinery can cross them easily. Subsurface drains are used near the channel of some waterways to remove excess water from the subsoil.

Contouring and contour stripcropping are helpful in controlling erosion. These methods are well suited to soils that have smooth, uniform slopes. Their use is limited, however, in Pickaway County because slopes are generally irregular in shape. In some areas contouring and even contour stripcropping are practical on such sloping soils as Alexandria, Miamian, Cardington, and Celina Variant soils.

Figure 12.—Excellent stand of corn planted directly in sod on Celina soils on slight rises and on Kokomo soils on lower positions.

Information about the design of erosion-control practices for each kind of soil is contained in the Technical Guide, available in the local office of the Soil Conservation Service.

Soil drainage is the major management need on slightly more than half the acreage used for crops and pasture in the survey area. Artificial drainage is commonly provided by open ditches, shallow surface drains, tile, and plastic tubing. Some soils are naturally so wet that the production of common crops is generally not possible without artificial drainage, for example such very poorly drained soils as Kokomo, Westland, Montgomery, Sloan, Carlisle, and Linwood, and the poorly drained Patton soils. These soils make up about 69,000 acres in the survey area.

Unless artificially drained, the somewhat poorly drained Crosby, Bennington, Sleeth, Henshaw, Shoals, and Algiers soils are so wet that crops are damaged during most years. These soils make up about 59,000 acres.

The design of surface and subsurface drainage systems varies with the kind of soil. A combination of surface drainage and subsurface drainage is needed in most areas of very poorly drained soils used intensively for row crops. Drains should be more closely spaced in slowly or very slowly permeable soils than in the more permeable soils. Subsurface drainage is slow in Montgomery soils. Finding adequate outlets for tile drainage systems is difficult in many areas of Montgomery, Sloan, Carlisle, Linwood, Patton, and Shoals soils.

Organic soils oxidize and subside when the pore space is filled with air; therefore, special drainage systems are needed to control the depth and the period of drainage. Keeping the water table at the level required by crops during the growing season and raising it to the surface during other parts of the year minimize the oxidation and subsidence of organic soils. Information about the design of drainage systems for each kind of soil is available in the local office of the Soil Conservation Service.

Soil fertility is naturally low in many soils on the uplands in the survey area. All soils that have a light colored surface layer are naturally acid. The soils on flood plains, such as the Eel, Medway, Genesee, Ross, Shoals, and Sloan soils, range from slightly acid to mildly alkaline and are naturally higher in plant nutrients than most soils on uplands. Montgomery, Kokomo, and Westland soils, in depressions and drainageways, are medium acid to neutral. Special fertilizers may be needed on Carlisle and Linwood soils because of deficiencies of boron and other trace elements.

Many upland soils are naturally strongly acid or very strongly acid, and if they have never been limed, they require applications of ground limestone to raise the pH level sufficiently for good growth of alfalfa and other crops. Available phosphorus and potassium are naturally low in many of these soils. On all soils, additions of lime and fertilizer should be based on the results of soil tests, the need of the crop, and the expected level of yield. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer and lime to apply.

Soil tilth is an important factor in the germination of seeds and in the infiltration of water into the soil. Soils with good tilth are friable and porous.

Many of the soils used for crops in the survey area have a silt loam surface layer that is light in color and moderate or moderately low in organic matter content. Generally, intense rainfall and drying crusts the surface of these soils. The crust is hard when dry and nearly impervious to water. Once the crust forms, it reduces the infiltration rate and increases runoff. Regular additions of crop residue, manure, and other organic material maintains and improves soil structure and reduces crusting.

Fall plowing is not a good practice on the soils that have a surface layer of light colored silt loam because of crusting during winter and spring. Many of these soils are nearly as dense and hard at planting time after fall plowing as they were before plowing. In addition, soils that have slope of 2 percent or more are subject to damaging erosion if they are plowed in the fall.

The Kokomo, Westland, Montgomery, and Patton soils that have a dark colored surface layer contain more clay than most of the soils that have a light colored surface layer. Poor tilth is a common problem because many of these soils stay wet until late in spring. If they are plowed when wet, the soils tend to be very cloddy when dry and preparing a good seedbed is difficult. Fall plowing of these soils generally results in improved tilth in spring.

Field crops suited to the soils and climate of the survey area include many that are not now commonly grown. Corn and soybeans are the main row crops. Grain sorghum, sunflowers, and navy beans and other similar crops can be grown if economic conditions are favorable.

Wheat and oats are the most common close-growing crops. Rye, barley, and flax could be grown, and grass seed could be produced from bromegrass, fescue, timothy, and bluegrass. Also, legume seed from red clover and alsike clover could be produced.

Specialty crops grown commercially in the survey area are limited mainly to sweet corn, tomatoes, and melons. The acreage used for such crops and other vegetables and small fruits can be greatly increased if economic conditions are favorable.

The soils in the county that have good natural drainage and moderate or high available water capacity and that warm early in spring are especially well suited to many vegetables and small fruits, for example, such soils as Eldean, Ockley, Princeton, Warsaw, and Wea have slopes of less than 6 percent. These soils make up about 27,000 acres in the survey area. Crops can generally be planted and harvested earlier on these soils than on other soils.

When adequately drained, the organic soils in the county are well suited to a wide range of vegetable crops. Organic soils are Carlisle and Linwood soils, which make up about 700 acres.

The latest information about growing specialty crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

Permanent pasture makes up about 9 percent of the acreage on farms. This low percentage is partly the result of the high percentage of forage provided by meadow crops. Some permanent pasture is on eroded soils that formerly were cultivated and in narrow strips and irregular-shaped areas of frequently flooded soils. Open woodlots are also used for pasture, but generally provide poor quality grazing because forage plants are sparse. Permanent pasture near farmsteads is generally used for feedlots or access lanes.

Yields of permanent pasture vary widely, but most soils in the county could be used to produce high quality permanent pasture. Sloping and moderately steep soils, such as Miamian and Alexandria soils, are commonly eroded and low in fertility, and less water is available to plants because runoff is rapid. Forage production on these soils is less than on some other soils. Growth is good on most of the gently sloping, somewhat poorly drained and moderately well drained soils, such as Crosby, Bennington, Celina, and Cardington soils. These soils are subject to erosion if the plant cover is damaged by overgrazing. Severe soil compaction occurs if grazing is allowed when the soils are wet.

The Genesee, Eel, Ross, Medway, Shoals, and Sloan soils on flood plains are potentially well suited to permanent pasture. Flooding during the growing season would damage cash crops but is much less damaging to permanent pasture. These alluvial soils are fertile, have moderate or high available water capacity, and are capable of producing good grass or grass-legume pasture. Surface and subsurface drains are needed to remove excess water in areas of the somewhat poorly drained and very poorly drained soils, particularly where legumes are grown. Such drainage is generally not needed on the better drained Eel, Medway, Ross, and Genesee soils.

Permanent pasture and cropland require similar management. Lime and fertilizer should be applied at rates indicated by soil tests. Control of weeds by periodic clipping and use of recommended herbicides encourage the growth of desirable pasture plants. Proper stocking rates and controlled grazing help to maintain well established permanent pasture. The latest information about seeding mixtures, herbicide treatments, and other management concerns for specific soils can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

Yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

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

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

Land capability classification

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

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit (*10*). Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

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

Class I soils have slight limitations that restrict their use.

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

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

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

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

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

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

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

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

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

The acreage of soils in each capability class and subclass is shown in table 6. The capability classification of each map unit is given in the section "Soil maps for detailed planning."

Woodland management and productivity

Table 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination (woodland suitability) 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 important trees. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *x* indicates stoniness or rockiness; *w*, excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted root depth; *c*, clay in the upper part of the soil; *s*, sandy texture; *f*, high content of coarse fragments in the soil profile; and *r*, steep slopes. The letter *o* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: x, w, t, d, c, s, f, and r.

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

Ratings of the *erosion hazard* indicate the risk of loss of soil in well managed woodland. The risk is *slight* if the expected soil loss is small, *moderate* if measures are needed to control erosion during logging and road construction, and *severe* if intensive management or special equipment and methods are needed to prevent excessive loss of soil.

Ratings of *equipment limitation* reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or a need for some modification in management or in equipment; and *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Seedling mortality ratings indicate the degree to which the soil affects the mortality of tree seedlings. Plant competition is not considered in the ratings. The ratings apply to seedlings from good stock that are properly planted during a period of sufficient rainfall. A rating of *slight* indicates that the expected mortality is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

Ratings of *windthrow hazard* are based on soil characteristics that affect the development of tree roots and the ability of the soil to hold trees firmly. A rating of *slight* indicates that a few trees may be blown down by normal winds; *moderate*, that some trees will be blown down during periods of excessive soil wetness and strong winds; and *severe*, that many trees are blow down during periods of excessive soil wetness and moderate or strong winds.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index*. This 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.

Trees to plant are those that are suited to the soils and to commercial wood production.

Engineering

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

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

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

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

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

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

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

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

Building site development

Table 8 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

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

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

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock 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 9 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 9 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

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

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

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

Table 9 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

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

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

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

The ratings in table 9 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

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

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

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegation. 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

The suitability of each soil as a source of roadfill, sand, gravel, and topsoil is indicated in table 10 by ratings of good, fair, or poor. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

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

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

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

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

Sand and *gravel* are used in great quantities in many kinds of construction. The ratings in table 10 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in table 14 or table 15.

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

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

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

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

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

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

Water management

Table 11 gives information on the soil properties and site features that affect water management. It gives for each soil the restrictive features that affect pond reservoir areas; embankments, dikes, and levees; aquifer-fed excavated ponds; drainage; terraces and diversions, and grassed waterways.

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

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

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

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

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

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, 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 potential 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.

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

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

Recreation

The soils of the survey area are rated in table 12 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 12, 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 12 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 9 and interpretations for dwellings without basements and for local roads and streets in table 8.

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

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

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

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

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife habitat

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 13, 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 (*1*). A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

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

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

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, timothy, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are foxtail, goldenrod, smartweed, ragweed, and fescue.

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

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

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 duckweed, wild millet, willow, reed canarygrass, 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 shallow ponds.

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

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail, 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 ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, and deer.

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

Soil properties

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

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

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

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

Engineering properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

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

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains particles coarser than sand, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*4*) and the system adopted by the American Association of State Highway and Transportation Officials (*3*).

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, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

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

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

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

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

Physical and chemical properties

Table 15 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.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

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

8. Stony or gravelly soils and other soils not subject to wind erosion.

Soil and water features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

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

The four hydrologic soil groups are:

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

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

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

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

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes is not considered flooding.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

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

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

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

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is shown for all soils that are underlain by bedrock at a depth of 5 to 6 feet or less. For many soils, the limited depth to bedrock is a part of the definition of the soil series. The depths shown are based on measurements made in many soil borings and on other observations during the mapping of the soils. The kind of bedrock and its hardness as related to ease of excavation is also shown. Rippable bedrock can be excavated with a single-tooth ripping attachment on a 200-horsepower tractor, but hard bedrock generally requires blasting.

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 most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

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

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

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Physical and chemical analyses of selected soils

Many of the soils in Pickaway County were sampled and laboratory data determined by the Soil Characterization Laboratory, Department of Agronomy, Ohio State

University, Columbus, Ohio. The physical and chemical data obtained on most samples include particle size distribution, reaction, organic matter content, calcium carbonate equivalent, and extractable cations. These data were used in classification and correlation of these soils and in evaluating their behavior under various land uses. Among these data, seven soils were selected as representative for their respective series and are described in this survey. These series and their laboratory identification numbers are: Alexandria (PY-17), Bennington (PY-18), Cardington (PY-19), Kokomo (PY-9), Lewisburg (PY-7), Rodman (PY-34), and Ross (PY-21).

In addition to the Pickaway County data, laboratory data are also available from nearby counties in central Ohio that have many of the same soils. These data and the Pickaway County data are on file at the Department of Agronomy, Ohio State University, Columbus, Ohio; the Ohio Department of Natural Resources, Division of Lands and Soil, Columbus, Ohio; and the Soil Conservation Service, State Office, Columbus, Ohio. Some of these data have been published through special studies of soils in Ohio (*8*).

Engineering test data

Several of the soils in Pickaway County were analyzed for engineering properties by the Soil Physical Studies Laboratory, Department of Agronomy, Ohio State University and the Ohio Department of Highways Testing Laboratory. Data from eight of the soils are considered as representative for series in the county. The soils analyzed by the Soil Physical Studies Laboratory and their laboratory identification numbers are: Alexandria (PY-17), Bennington (PY-18), Cardington (PY-19), Crosby (PY-27), Kokomo (PY-9, 15, and 28) and Lewisburg (PY-7). The soils analyzed by the Ohio Department of Highways Testing Laboratory and their laboratory identification numbers are: Cardington (PY-19), Crosby (PY-27), Rodman (PY-34), and Ross (PY-21). The soil profiles sampled are typical of the series discussed in the section "Soil series and morphology."

In addition to the Pickaway County data, engineering test data are also available from nearby counties in central Ohio that have many of the same soils. These data and the Pickaway County data are on file at the Department of Agronomy, Ohio State University, Columbus, Ohio; the Ohio Department of Natural Resources, Division of Lands and Soil, Columbus, Ohio; and the Soil Conservation Service, State Office, Columbus, Ohio.

Soil series and morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (*9*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*11*). 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 "Soil maps for detailed planning."

Alexandria series

The Alexandria series consists of deep, well drained soils on uplands. Permeability is moderately slow. These soils formed in glacial till. The glacial till has a medium content of lime. Slope ranges from 2 to 35 percent.

Alexandria soils are commonly adjacent to the Bennington, Cardington, and Loudonville soils and are similar to the Kendallville and Miamian soils. Bennington and Cardington soils are wetter and have mottling closer to the surface. Loudonville soils have sandstone bedrock at a depth of 20 to 40 inches. Kendallville soils formed in glacial outwash over glacial till that has a higher calcium carbonate equivalent. Miamian soils formed in glacial till that has a higher calcium carbonate equivalent. They contain less sandstone and shale fragments and have mixed mineralogy.

Typical pedon of Alexandria silt loam, 6 to 12 percent slopes, eroded, about 1.2 miles southwest of Tarlton, Salt Creek Township, T. 11 N., R. 20 W., 1,100 feet north and 2,000 feet west of the southeast corner of sec. 4:

Ap—0 to 7 inches; brown (10YR 4/3) silt loam; moderate fine and medium granular structure; friable; many roots; 2 percent coarse fragments; very strongly acid; abrupt smooth boundary.

B1—7 to 11 inches; yellowish brown (10YR 5/4) silt loam; weak medium subangular blocky structure; friable; common roots; grayish brown (10YR 5/2) coatings on faces of peds and in root channels; 10 percent coarse fragments; very strongly acid; clear wavy boundary.

B21t—11 to 15 inches; yellowish brown (10YR 5/6) silty clay loam; moderate fine and medium subangular blocky structure; firm; common roots; thin very patchy yellowish brown (10YR 5/4) and brown (7.5YR 5/4) clay films on vertical and horizontal faces of peds; 10 percent coarse fragments; very strongly acid; gradual wavy boundary.

B22t—15 to 21 inches; brown (7.5YR 5/4) silty clay loam; strong fine and medium subangular and angular blocky structure; firm; few roots; thin patchy yellowish brown (10YR 5/4) clay films on vertical and horizontal faces of peds; 10 percent coarse fragments; very strongly acid; clear wavy boundary.

B23t—21 to 27 inches; brown (10YR 4/3) clay; moderate medium subangular blocky structure; firm; few roots; yellowish brown (10YR 5/4) and brown (7.5YR 5/4) clay films that are thin patchy on horizontal faces of peds and medium continuous on vertical faces; thin patchy pale brown (10YR 6/3) silt coatings on vertical and horizontal faces of peds; 10 percent coarse fragments; very strongly acid; gradual wavy boundary.

B24t—27 to 36 inches; yellowish brown (10YR 5/4) clay loam; common fine and medium faint brown (7.5YR 4/4), common fine and medium distinct strong brown (7.5YR 5/8), and few fine distinct light brownish gray (10YR 6/2) mottles; moderate medium and coarse subangular blocky structure; firm; few roots; grayish brown (10YR 5/2) clay films that are medium patchy on horizontal faces of peds and medium continuous on vertical faces; common fine black (10YR 2/1) iron and manganese stains and concretions; 10 percent coarse fragments; slightly acid; clear wavy boundary.

B3—36 to 42 inches; yellowish brown (10YR 5/4) clay loam; few fine distinct strong brown (7.5YR 5/8) and light brownish gray (10YR 6/2) mottles; weak coarse subangular blocky structure; firm; few roots; thin patchy dark brown (7.5YR 4/4) clay films on vertical faces of peds; 10 percent coarse fragments; slight effervescence; mildly alkaline; gradual wavy boundary.

C1—42 to 55 inches; yellowish brown (10YR 5/4) loam; few fine faint yellowish brown (10YR 5/8) mottles; massive; firm; gray (10YR 6/1) weathered limestone fragments; 10 percent coarse fragments; slight effervescence; mildly alkaline; diffuse smooth boundary.

C2—55 to 60 inches; yellowish brown (10YR 5/4) clay loam; few fine faint yellowish brown (10YR 5/8) and common medium distinct light brownish gray (10YR 6/2) mottles; massive; firm; few fine very dark brown (10YR 2/2) iron and manganese stains and concretions and gray (10YR 6/1) weathered limestone fragments; 10 percent coarse fragments; strong effervescence; moderately alkaline.

Thickness of the solum and depth to carbonates range from 28 to 45 inches. Coarse fragments of mainly partially weathered sandstone and shale range from 0 to 10 percent by volume in the solum and from 10 to 20 percent in the C horizon.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. Some pedons do not have B1 horizons. The B2 and B3 horizons have hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. They are clay loam, silty clay loam, silty clay, or clay. These horizons are very strongly acid to medium acid in the upper part and medium acid to mildly alkaline in the lower part. The C horizon has hue of 7.5YR to 2.5YR, value of 4 or 5, and chroma of 2 to 4.

Algiers series

The Algiers series consists of deep, nearly level, somewhat poorly drained, moderately permeable soils. These soils are on flood plains and terraces and in upland depressions. They formed in recent alluvium over a buried soil. Slope is 0 to 2 percent.

Algiers soils are commonly adjacent to Genesee, Shoals, and Sloan soils. Genesee, Shoals, and Sloan soils formed entirely of alluvium. Genesee soils are better drained and are on slightly higher positions closer to the streams on flood plains. Sloan soils are wetter and have a mollic epipedon.

Typical pedon of Algiers silt loam, about 2.5 miles south-southeast of South Bloomfield, Walnut Township, T. 2 N., R. 22 W., 150 feet north and 1,900 feet west of the southeast corner of sec. 23:

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) silt loam; moderate fine and medium granular structure; friable; many roots; 2 percent coarse fragments; neutral; abrupt smooth boundary.

C1—10 to 18 inches; dark grayish brown (10YR 4/2) silt loam; weak fine and medium subangular blocky structure; friable; common roots; 2 percent coarse fragments; neutral; clear smooth boundary.

C2—18 to 22 inches; dark grayish brown (10YR 4/2) heavy silt loam; weak medium subangular blocky structure; friable; common roots; 2 percent coarse fragments; neutral; clear smooth boundary.

IIA1b—22 to 35 inches; black (10YR 2/1) silty clay loam; strong fine and medium subangular and angular blocky structure; firm; common roots; 2 percent coarse fragments; mildly alkaline; clear smooth boundary.

IIB2bg—35 to 46 inches; dark gray (10YR 4/1) silty clay loam; moderate medium subangular blocky structure; firm; few roots; 3 percent coarse fragments; mildly alkaline; clear smooth boundary.

IIB3b—46 to 62 inches; yellowish brown (10YR 5/4) clay loam; common medium prominent gray (N 6/0) mottles; weak coarse subangular blocky structure; firm; common dark gray (10YR 4/1) krotovinas; 5 percent coarse fragments; mildly alkaline; gradual smooth boundary.

IIC—62 to 72 inches; yellowish brown (10YR 5/4) clay loam; common medium prominent gray (N 6/0) mottles; massive; firm; 5 percent coarse fragments; strong effervescence; moderately alkaline.

Thickness of the recent alluvium ranges from 20 to 36 inches.

The Ap and C horizons have hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 or 3. The C horizon is silt loam, loam, or light silty clay loam. The IIA1b horizon has hue of 10YR, value of 2 or 3, and chroma of 0 or 1. It is heavy silt loam, silty clay loam, or clay loam. The IIB2bg horizon has hue of 10YR to 5Y, value of 4 or 5, and chroma of 1 or 2. The IIB and IIC horizons are heavy loam, silty clay loam, clay loam, or light silty clay. They range from 2 to 10 percent coarse fragments by volume. The IIC horizon is mildly alkaline or moderately alkaline.

Bennington series

The Bennington series consists of deep, somewhat poorly drained, slowly permeable soils on uplands. These soils formed in glacial till. The glacial till has a medium content of lime. Slope ranges from 0 to 6 percent.

Bennington soils are commonly adjacent to the Alexandria, Cardington, and Kokomo soils and are similar to the Crosby soils. Alexandria and Cardington soils are better drained and are on ridgetops, hillsides, and side slopes along drainageways. They do not have mottles immediately under the A horizon. Kokomo soils are wetter and are in depressions and along waterways. They have a mollic epipedon. Crosby soils have mixed mineralogy, less sandstone and shale fragments throughout, and formed in glacial till that has a higher calcium carbonate equivalent.

Typical pedon of Bennington silt loam, 0 to 2 percent slopes, about 2 miles south of Tarlton, Salt Creek Township, T. 11 N., R. 20 W., 630 feet south and 450 feet east of the northwest corner of sec. 15:

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam; moderate medium granular structure; friable; common roots; few fine very dark grayish brown (10YR 3/2) iron and manganese concretions; 2 percent coarse fragments; strongly acid; abrupt smooth boundary.

A2—9 to 15 inches; grayish brown (10YR 5/2) silt loam; common medium faint pale brown (10YR 6/3) mottles; weak medium platy structure parting to moderate fine and medium granular; friable; common roots; few fine distinct very dark grayish brown (10YR 3/2) iron and manganese concretions; 2 percent coarse fragments; strongly acid; abrupt smooth boundary.

B1t—15 to 18 inches; yellowish brown (10YR 5/4) silty clay loam; common medium distinct light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; friable; few roots; few fine distinct very dark grayish brown (10YR 3/2) iron and manganese concretions; 3 percent coarse fragments; very strongly acid; clear wavy boundary.

B21t—18 to 27 inches; yellowish brown (10YR 5/4) silty clay; many medium distinct grayish brown (10YR 5/2) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few roots; thin patchy grayish brown (10YR 5/2) clay films on vertical and horizontal faces of peds; common medium black (10YR 2/1) iron and manganese stains and concretions; thin patchy pale brown (10YR 6/3) silt coatings on vertical and horizontal faces of peds; 8 percent coarse fragments; very strongly acid; gradual wavy boundary.

B22t—27 to 34 inches; yellowish brown (10YR 5/6) silty clay; common medium distinct gray (10YR 5/1) mottles; weak medium prismatic structure parting to weak coarse subangular blocky; firm; grayish brown (10YR 5/2) clay films that are thin very patchy on horizontal faces of peds and thin continuous on vertical faces; 10 percent coarse fragments; neutral; clear wavy boundary.

B3t—34 to 44 inches; yellowish brown (10YR 5/6) clay loam; common medium distinct grayish brown (10YR 5/2) mottles; weak coarse subangular blocky structure; firm; thin very patchy gray (10YR 5/1) clay films on horizontal faces of peds; medium continuous dark gray (10YR 4/1) clay films on vertical faces of peds; 10 percent coarse fragments; mildly alkaline; clear wavy boundary.

C1—44 to 56 inches; brown (10YR 4/3) clay loam; few fine faint brown (10YR 5/3) and common medium distinct grayish brown (10YR 5/2) mottles; massive; firm; 10 percent coarse fragments; slight effervescence; mildly alkaline; clear smooth boundary.

C2—56 to 60 inches; brown (10YR 4/3) loam; few fine distinct yellowish brown (10YR 5/8) and common medium distinct grayish brown (10YR 5/2) mottles; massive; firm; 10 percent coarse fragments; strong effervescence; moderately alkaline.

Thickness of the solum and depth to carbonates range from 28 to 45 inches.

The Ap horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 to 6. It is silty clay, silty clay loam, or clay loam and has clay content of 35 to 44 percent. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4.

Cana Variant

The Cana Variant consists of moderately deep, moderately well drained, slowly permeable soils on bedrock-controlled uplands. These soils formed in glacial till and residuum from acid shale bedrock. The glacial till has a medium content of lime. Slope ranges from 2 to 50 percent.

Cana Variant soils are commonly adjacent to the Lewisburg and Miamian soils and are similar to the Celina Variant and Loudonville soils. Celina Variant soils are underlain by calcareous shale bedrock. Lewisburg and Miamian soils are on hillsides, ridgetops, and knolls and have bedrock at a depth of more than 40 inches. Loudonville and Miamian soils are better drained and do not have mottles of low chroma in the upper 10 inches of the argillic horizon. Loudonville soils also have a lower base saturation than Cana Variant soils.

Typical pedon of Cana Variant silt loam, 2 to 6 percent slopes, about 0.75 mile west-northwest of Williamsport, Deer Creek Township, 1,700 feet north of the intersection of Williamsport-Crownover Road and U.S. Route 22, along Williamsport-Crownover Road, then 50 feet west:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam; moderate fine and medium granular structure; friable; many roots; 1 percent coarse fragments; neutral; abrupt smooth boundary.

A2—8 to 11 inches; light yellowish brown (10YR 6/4) silt loam; moderate medium and coarse granular structure; friable; common roots; many patchy dark grayish brown (10YR 4/2) organic matter coatings on vertical faces of peds; 3 percent coarse fragments; neutral; abrupt wavy boundary.

B1t—11 to 16 inches; brown (10YR 5/3) silty clay loam; weak fine and medium subangular blocky structure; firm; few roots; thin very patchy yellowish brown (10YR 5/4) clay films on vertical and horizontal faces of peds; thin patchy pale brown (10YR 6/3) silt coatings on vertical and horizontal faces of peds; 3 percent coarse fragments; slightly acid; clear wavy boundary.

B21t—16 to 21 inches; yellowish brown (10YR 5/4) heavy silty clay loam; moderate fine and medium subangular blocky structure; firm; few roots; thin patchy dark yellowish brown (10YR 4/4) clay films on vertical and horizontal faces of peds; thin patchy pale brown (10YR 6/3) silt coatings on vertical and horizontal faces of peds; few fine very dark brown (10YR 2/2) iron and manganese concretions and stains; 4 percent coarse fragments; slightly acid; clear wavy boundary.

B22t—21 to 26 inches; yellowish brown (10YR 5/4) clay; common medium distinct light brownish gray (2.5Y 6/2) and common medium faint strong brown (7.5YR 5/6) mottles; moderate fine and medium subangular blocky structure; firm; few roots; thin patchy brown (10YR 4/3) clay films on vertical and horizontal faces of peds; thin continuous pale brown (10YR 6/3) silt coatings on horizontal and vertical faces of peds; few fine black (10YR 2/1) iron and manganese concretions and stains; 4 percent coarse fragments; strongly acid; clear wavy boundary.

IIB23t—26 to 33 inches; yellowish brown (10YR 5/4) silty clay; many medium distinct grayish brown (10YR 5/2) and common medium faint yellowish brown (10YR 5/6) mottles; moderate medium and coarse subangular blocky structure; firm; few roots; brown (7.5YR 5/4) clay films that are thin very patchy on horizontal faces of peds and thin patchy on vertical faces; medium continuous pale brown (10YR 6/3) silt coatings on vertical and horizontal faces of peds; 5 percent coarse fragments; very strongly acid; abrupt wavy boundary.

IIB3—33 to 37 inches; strong brown (7.5YR 5/6) shaly silty clay loam; many coarse distinct light brownish gray (10YR 6/2) mottles; weak coarse subangular blocky structure parting to weak platy; firm; few roots; thin patchy light brownish gray (2.5Y 6/2) silt coatings on horizontal and vertical faces of peds; 45 percent coarse fragments of dominantly shale; very strongly acid; abrupt smooth boundary.

IICr—37 to 42 inches; dark brown (7.5YR 3/2) fractured rippable shale bedrock; light brownish gray (2.5Y 6/2) and pale brown (10YR 6/3) silty clay loam fillings and coatings on faces of fractures; very strongly acid; clear smooth boundary.

IIR—42 inches; unweathered rippable thin bedded shale bedrock.

Thickness of the solum and depth to paralithic contact ranges from 20 to 40 inches. Depth to horizons weathered mainly from shale bedrock ranges from 18 to 36 inches. Coarse fragments range from 2 to 10 percent, by volume, in horizons weathered from glacial till and from 5 to 50 percent in horizons weathered from shale bedrock.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is strongly acid to neutral. The B horizon has hue of 7.5YR to 2.5Y, value of 4 or 5, and chroma of 3 to 6. In some pedons, chroma of 2 or less is dominant in the IIB horizon below a depth of 30 inches. The IIB horizon is silty clay loam, clay loam, silty clay, or clay with shaly analogs. The B horizon is strongly acid to slightly acid in the upper part and extremely acid or very strongly acid in the lower part.

Cardington series

The Cardington series consists of deep, moderately well drained soils on uplands. Permeability is moderately slow. These soils formed in glacial till. The glacial till has a medium content of lime. Slope ranges from 2 to 12 percent.

Cardington soils are commonly adjacent to the Alexandria and Bennington soils and are similar to the Celina and Lewisburg soils. Alexandria soils are better drained and are mainly on hillsides, side slopes along waterways, and ridges. They do not have mottles of low chroma in the upper part of the argillic horizon. Bennington soils are wetter and are on broad flats and low rises. They have mottles immediately below the A horizon. Celina and Lewisburg soils formed in glacial till that has a higher calcium carbonate equivalent and have mixed mineralogy. Lewisburg soils have a thinner solum and do not have mottles of low chroma in the upper 10 inches of the argillic horizon.

Typical pedon of Cardington silt loam, 2 to 6 percent slopes, about 1.5 miles north of Stringtown, T. 11 N., R. 20 W., 1,000 feet south and 2,475 feet east of northwest corner of sec. 14:

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam; moderate fine and medium granular structure; friable; many roots; 2 percent coarse fragments; slightly acid; abrupt smooth boundary.

A2—9 to 12 inches; pale brown (10YR 6/3) silt loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak thick platy structure parting to weak medium subangular blocky; friable; common roots; 3 percent coarse fragments; medium acid; clear wavy boundary.

B21t—12 to 18 inches; yellowish brown (10YR 5/6) silty clay loam; moderate fine and medium subangular blocky structure; firm; common roots; thin very patchy gray (10YR 5/1) and brown (10YR 4/3) clay films on vertical and horizontal faces of peds; thin patchy pale brown (10YR 6/3) silt coatings on horizontal and vertical faces of peds; 8 percent coarse fragments; very strongly acid; gradual wavy boundary.

B22t—18 to 27 inches; dark yellowish brown (10YR 4/4) clay loam; common medium distinct yellowish brown (10YR 5/8) and light gray (10YR 6/1) mottles; weak medium prismatic structure parting to strong medium subangular blocky; firm; few roots; gray (10YR 5/1) clay films that are thin patchy on horizontal faces of peds and medium continuous on vertical faces; thin very patchy pale brown (10YR 6/3) silt coatings on vertical faces of peds; very dark brown (10YR 2/2) iron and manganese stains; 10 percent coarse fragments; very strongly acid; clear wavy boundary.

B3t—27 to 33 inches; yellowish brown (10YR 5/6) clay loam; common fine distinct dark yellowish brown (10YR 4/4) and grayish brown (10YR 5/2) mottles; weak medium and coarse subangular blocky structure; firm; few roots; thin patchy dark gray (10YR 4/1) clay films on horizontal and vertical faces of peds; few fine distinct very dark brown (10YR 2/2) iron and manganese stains; 10 percent coarse fragments; neutral; clear wavy boundary.

C1—33 to 45 inches; yellowish brown (10YR 5/4) clay loam; common medium distinct light brownish gray (10YR 6/2) and common medium faint yellowish brown (10YR 5/8) mottles; massive; firm; few fine very dark brown (10YR 2/2) iron and manganese stains; 10 percent coarse fragments; slight effervescence; mildly alkaline; diffuse smooth boundary.

C2—45 to 57 inches; brown (10YR 5/3) loam; common medium distinct light gray (10YR 6/1) and light brownish gray (10YR 6/2) and few fine faint yellowish brown (10YR 5/4 and 5/6) mottles; massive; firm; few fine faint very dark brown (10YR 2/2) iron and manganese stains; 10 percent coarse fragments; strong effervescence; moderately alkaline; diffuse smooth boundary.

C3—57 to 60 inches; yellowish brown (10YR 5/4) loam; common medium distinct light gray (10YR 6/1) and gray (10YR 5/1) and few fine faint yellowish brown (10YR 5/8 and 5/6) mottles; massive; firm; few fine very dark brown (10YR 2/2) iron and manganese stains; 10 percent coarse fragments; strong effervescence; moderately alkaline.

Thickness of the solum and depth to carbonates range from 28 to 45 inches.

The Ap horizon has hue of 10YR, value of 4, and chroma of 2 or 3. The B horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is silty clay loam, clay loam, light clay, or silty clay. The C horizon has hue of 7.5YR to 2.5Y, value of 4 or 5, and chroma of 2 to 4. It is loam, light clay loam, or light silty clay loam.

Carlisle series

The Carlisle series consists of deep, very poorly drained soils. These soils are in kettle holes on terraces and in depressions on uplands. They formed in organic deposits more than 60 inches thick over mineral material. Permeability ranges from moderately slow to moderately rapid. Slope ranges from 0 to 2 percent.

Carlisle soils are commonly adjacent to the Linwood and Montgomery soils and are similar to the Linwood soils. Linwood soils formed in a thinner organic deposit. Montgomery soils formed in lacustrine sediment in slackwater basins.

Typical pedon of Carlisle muck, about 4 miles north of South Bloomfield, Harrison Township, T. 3 N., R. 22 W., 600 feet north and 1,440 feet east of the southwest corner of sec. 22:

Oa1—0 to 8 inches; black (5YR 2/1) broken face and rubbed sapric material; about 5 percent fiber, 1 percent rubbed; weak fine granular structure; friable; 20 percent mineral material; clear wavy boundary.

Oa2—8 to 16 inches; black (10YR 2/1) broken face and rubbed sapric material; about 5 percent fiber, 1 percent rubbed; weak fine granular structure; friable; 20 percent mineral material; neutral; clear wavy boundary.

Oa3—16 to 24 inches; black (10YR 2/1) broken face and rubbed sapric material; about 10 percent fiber, 2 percent rubbed; moderate fine subangular blocky structure; friable; 25 percent mineral material; slightly acid; clear wavy boundary.

Oa4—24 to 36 inches; dark brown (7.5YR 3/2) broken face and rubbed sapric material; about 20 percent fiber, 3 percent rubbed; massive; friable; 20 percent mineral material; neutral; clear wavy boundary.

Oa5—36 to 43 inches; dark brown (7.5YR 3/2) broken face and rubbed sapric material; about 25 percent fiber, 4 percent rubbed; massive; friable; 15 percent mineral material; neutral; clear wavy boundary.

Oa6—43 to 50 inches; dark reddish brown (5YR 3/2) broken face and rubbed sapric material; about 30 percent fiber, 6 percent rubbed; massive; friable; 15 percent mineral material; neutral; clear wavy boundary.

Oa7—50 to 62 inches; dark brown (7.5YR 3/2) broken face and rubbed sapric material; about 10 percent fiber, 3 percent rubbed; massive; friable; 10 percent mineral material; neutral.

Thickness of organic material is more than 60 inches.

The surface tier has hue of 5YR to 10YR or neutral, value of 2 or 3, and chroma of 0 or 1. It is slightly acid or neutral. The subsurface tier has hue of 5YR to 10YR or neutral, value of 2 or 3, and chroma of 0 to 2. It is slightly acid to mildly alkaline. The bottom tier has hue of 5YR to 10YR or neutral, value of 2 or 3, and chroma of 0 to 2. It is neutral or mildly alkaline. Some pedons have 3 to 20 percent, by volume, freshwater shell fragments.

Casco series

The Casco series consists of deep, well drained to somewhat excessively drained soils on outwash terraces, stream terraces, kames, and eskers. These soils formed in glacial outwash. Permeability is moderate in the subsoil and very rapid in the substratum. Slope ranges from 6 to 35 percent.

Casco soils are commonly adjacent to the Eldean, Kendallville, Rodman, and Warsaw soils and are similar to the Rodman soils. Eldean, Kendallville, and Warsaw soils have a thicker solum. Kendallville soils formed in glacial outwash over glacial till. Rodman soils do not have an argillic horizon, and Rodman and Warsaw soils have a mollic epipedon.

Typical pedon of Casco gravelly loam, from an area of Casco-Rodman gravelly loams, 12 to 18 percent slopes, about 2 miles south of Circleville, Circleville Township, T. 11 N., R. 21 W., 3,100 feet west and 1,750 feet north of the southeast corner of sec. 31:

Ap—0 to 7 inches; brown (10YR 4/3) gravelly loam; moderate medium granular structure; friable; many roots; 15 percent coarse fragments; neutral; abrupt smooth boundary.

B2t—7 to 11 inches; dark yellowish brown (10YR 4/4) gravelly clay loam; weak medium subangular blocky structure; friable; common roots; thin continuous brown (10YR 4/3) clay films on faces of peds; 30 percent coarse fragments; neutral; clear wavy boundary.

B3t—11 to 14 inches; dark brown (10YR 3/3) gravelly clay loam; moderate medium subangular blocky structure; firm; few roots; thin patchy brown (10YR 4/3) clay films on faces of peds; 35 percent coarse fragments; neutral; abrupt irregular boundary.

C1—14 to 20 inches; yellowish brown (10YR 5/4) and dark yellowish brown (10YR 4/4) very gravelly sand; single grain; loose; 50 percent coarse fragments; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—20 to 60 inches; brown (10YR 5/3) very gravelly sand; single grain; loose; 55 percent coarse fragments; strong effervescence; moderately alkaline.

Thickness of the solum ranges from 12 to 20 inches, and depth to carbonates ranges from 10 to 18 inches.

The Ap horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3. It is dominantly gravelly loam but is loam or silt loam in some pedons. The B horizon has hue of 10YR to 5YR, value of 3 to 5, and chroma of 3 or 4. It is clay loam, sandy clay loam, heavy loam, or gravelly analogs of these textures. Content of coarse fragments in the B horizon ranges from 10 to 35 percent by volume. The B horizon is medium acid to mildly alkaline. The C horizon has hue of 10YR, value of 5 or 6, and chroma of 2 to 4. It is dominantly stratified gravelly sand or very gravelly sand and is mildly alkaline or moderately alkaline.

Celina series

The Celina series consists of deep, moderately well drained soils on bedrock-controlled uplands. Permeability is moderately slow. These soils formed in glacial till. The glacial till has a high content of lime. Slope ranges from 0 to 6 percent.

Celina soils are commonly adjacent to the Crosby, Kokomo, and Miamian soils and are similar to the Cardington and Lewisburg soils. Cardington soils formed in glacial till that has a lower calcium carbonate equivalent, they have more sandstone and shale fragments throughout, and they have illitic mineralogy. Crosby and Kokomo soils are wetter and have mottles of low chroma immediately below the A horizon. Kokomo soils also have a mollic epipedon. Lewisburg and Miamian soils do not have mottles of low chroma in the upper 10 inches of the argillic horizon. Lewisburg soils also have a thinner solum than the Celina soils.

Typical pedon of Celina silt loam, 2 to 6 percent slopes, about 4.6 miles east-southeast of Circleville, Washington Township, T. 11 N., R. 21 W., 2,000 feet south and 2,220 feet west of the northeast corner of sec. 35:

Ap—0 to 8 inches; brown (10YR 4/3) silt loam; moderate fine granular structure; friable; many roots; common fine dark brown (7.5YR 4/4) iron and manganese stains; neutral; abrupt smooth boundary.

A2—8 to 12 inches; light yellowish brown (10YR 6/4) and yellowish brown (10YR 5/4) silt loam; weak thick platy structure parting to weak medium subangular blocky; friable; many roots; common fine dark brown (7.5YR 4/4) iron and manganese stains; neutral; clear wavy boundary.

IIB21t—12 to 20 inches; yellowish brown (10YR 5/6) silty clay loam; common medium faint yellowish brown (10YR 5/4) and common medium distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; common roots; thin patchy dark yellowish brown (10YR 4/4) clay films on vertical and horizontal faces of peds; thin patchy pale brown (10YR 6/3) silt coatings on vertical and horizontal faces of peds; common medium very dark brown (10YR 2/2) iron and manganese stains; 3 percent coarse fragments; slightly acid; clear wavy boundary.

IIB22t—20 to 28 inches; yellowish brown (10YR 5/6) heavy clay loam; common fine faint yellowish brown (10YR 5/4) and few fine distinct grayish brown (2.5Y 5/2) mottles; strong medium and coarse subangular blocky structure; firm; few roots; thick continuous and medium patchy dark gray (10YR 4/1) and gray (10YR 5/1) clay films on vertical and horizontal faces of peds; thin very patchy pale brown (10YR 6/3) silt coatings on vertical and horizontal faces of peds; common medium very dark brown (10YR 2/2) iron and manganese stains; 5 percent coarse fragments; slightly acid; clear wavy boundary.

IIB3t—28 to 36 inches; yellowish brown (10YR 5/6) heavy clay loam; common fine faint yellowish brown (10YR 5/4) and common fine distinct grayish brown (2.5Y 5/2) mottles; weak coarse subangular blocky structure; firm; few roots; medium and thin very patchy dark brown (10YR 3/3) clay films on vertical and horizontal faces of peds; 8 percent coarse fragments; slight effervescence in spots; neutral; clear wavy boundary.

IIC—36 to 60 inches; yellowish brown (10YR 5/4) loam; common fine faint yellowish brown (10YR 5/6) and common fine distinct gray (10YR 6/1) mottles; massive; firm; 10 percent coarse fragments; strong effervescence; moderately alkaline.

Thickness of the solum ranges from 20 to 38 inches, and depth to carbonates ranges from 18 to 36 inches. Coarse fragments range from 0 to 5 percent by volume in the A horizon, from 3 to 10 percent in the B horizon, and from 5 to 15 percent in the C horizon.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is slightly acid or neutral. Many pedons do not have an A2 horizon. The B horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is heavy clay loam, silty clay loam, or clay and is strongly acid to neutral. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 or 4. It is loam or silt loam and is mildly alkaline or moderately alkaline.

Celina Variant

The Celina Variant consists of moderately deep, moderately well drained, slowly permeable soils on bedrock-controlled uplands. These soils formed in glacial till and residuum from calcareous shale bedrock over calcareous shale bedrock. Slope ranges from 6 to 15 percent.

Celina Variant soils are commonly adjacent to the Celina, Corwin, and Crosby soils and are similar to the Cana Variant and Loudonville soils. Cana Variant soils are underlain with acid shale bedrock. Celina, Corwin, and Crosby soils are deep to bedrock. Corwin soils have a mollic epipedon. Crosby soils are wetter and have mottles of low chroma immediately below the A horizon. Loudonville soils are better drained and are moderately deep to hard sandstone bedrock.

Typical pedon of Celina Variant silt loam, 6 to 15 percent slopes, about 1.5 miles northwest of Meade, Pickaway Township, T. 10 N., R. 21 W., 2,050 feet north and 1,000 feet east of the southwest corner of sec. 15:

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam; moderate fine and medium granular structure; friable; common roots; 1 percent coarse fragments; slightly acid; abrupt smooth boundary.

B1t—6 to 11 inches; yellowish brown (10YR 5/4) silty clay loam; weak fine and medium subangular blocky structure; firm; few roots; medium patchy dark yellowish brown (10YR 4/4) clay films on vertical and horizontal faces of peds; few fine very dark brown (10YR 2/2) iron and manganese stains; 2 percent coarse fragments; medium acid; clear wavy boundary.

B21t—11 to 16 inches; yellowish brown (10YR 5/6) clay loam; common medium distinct grayish brown (10YR 5/2) mottles; moderate medium and coarse subangular blocky structure; firm; few roots; dark yellowish brown (10YR 4/4) clay films that are medium patchy on vertical faces of peds and thin patchy on horizontal faces; common fine and medium black (10YR 2/1) iron and manganese stains; 5 percent coarse fragments; strongly acid; clear wavy boundary.

B22t—16 to 21 inches; yellowish brown (10YR 5/4) heavy clay loam; few fine distinct grayish brown (10YR 5/2) mottles; moderate medium and coarse subangular blocky structure; firm; few roots; dark grayish brown (10YR 4/2) clay films that are medium continuous on vertical faces of peds and thin patchy on horizontal faces; common fine and medium black (10YR 2/1) iron and manganese stains and concretions; 7 percent coarse fragments; slightly acid; clear wavy boundary.

IIB31—21 to 27 inches; dark gray (5Y 4/1) clay; common medium distinct dark yellowish brown (10YR 4/4) and few fine distinct yellowish brown (10YR 5/6) mottles; weak coarse angular blocky structure; firm; few roots; 5 percent coarse fragments; mildly alkaline; gradual wavy boundary.

IIB32—27 to 34 inches; gray (5Y 5/1) clay; common medium distinct yellowish brown (10YR 5/4) mottles; weak coarse angular blocky structure; firm; few roots; 10 percent coarse fragments; strong effervescence; moderately alkaline; clear wavy boundary.

IICr—34 inches; very dark grayish brown (10YR 3/2) rippable shale bedrock; strong effervescence; moderately alkaline.

Thickness of the solum and depth to bedrock range from 20 to 40 inches.

The Ap horizon has hue of 10YR, value of 4, and chroma of 2 or 3. It is medium acid to neutral. The B2 horizon has hue of 2.5Y to 7.5YR, value of 4 of 5, and chroma of 4 to 6. It is clay loam, silty clay loam, or clay and is strongly acid to slightly acid. The IIB3 horizon has hue of 5Y, value of 4 to 6, and chroma of 1 to 3. It is silty clay loam, silty clay, or clay and is neutral to moderately alkaline.

Corwin series

The Corwin series consists of deep, moderately well drained soils on uplands. Permeability is moderately slow. These soils formed in glacial till. Slope ranges from 0 to 6 percent.

Corwin soils are commonly adjacent to the Kokomo and Miamian soils. Kokomo soils are in depressions and along waterways. They are wetter and have more gray colors in the subsoil. Miamian soils are drier and are on knolls, ridges, and hillsides and on side slopes along drainageways. They have an ochric epipedon.

Typical pedon of Corwin silt loam, 0 to 2 percent slopes, about 2.8 miles southeast of Circleville, Washington Township, T. 11 N., R. 21 W., 2,175 feet north and 450 feet west of the southeast corner of sec. 33:

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam; moderate medium granular structure; friable; many roots; less than 2 percent coarse fragments; neutral; clear smooth boundary.

A12—8 to 14 inches; very dark grayish brown (10YR 3/2) silty clay loam; weak coarse granular structure; friable; many roots; less than 2 percent coarse fragments; slightly acid; clear wavy boundary.

B21t—14 to 20 inches; yellowish brown (10YR 5/6) silty clay loam; weak medium subangular blocky structure; firm; many roots; very dark grayish brown (10YR 3/2) coatings on vertical faces of peds; thin patchy dark brown (10YR 4/3) and very dark grayish brown (10YR 3/2) clay films on faces of peds; 2 percent coarse fragments; slightly acid; clear smooth boundary.

B22t—20 to 30 inches; yellowish brown (10YR 5/4) clay loam; common medium distinct grayish brown (10YR 5/2) and common medium faint yellowish brown (10YR 5/6) mottles; weak medium and coarse subangular blocky structure; firm; common roots; thin patchy dark brown (10YR 4/3) and very dark grayish brown (10YR 3/2) clay films on faces of peds; 2 percent coarse fragments; slightly acid; clear wavy boundary.

B3—30 to 36 inches; yellowish brown (10YR 5/6) clay loam; common medium distinct grayish brown (10YR 5/2) mottles; weak coarse prismatic structure; firm; few roots; 5 percent coarse fragments; neutral; clear wavy boundary.

C1—36 to 47 inches; yellowish brown (10YR 5/4) loam; many medium distinct grayish brown (10YR 5/2) and common medium faint yellowish brown (10YR 5/6) mottles; massive; firm; 7 percent coarse fragments; strong effervescence; moderately alkaline; diffuse wavy boundary.

C2—47 to 60 inches; dark yellowish brown (10YR 4/4) loam; common medium distinct light brownish gray (10YR 6/2) mottles; massive; firm; 7 percent coarse fragments; strong effervescence; moderately alkaline.

Thickness of the solum ranges from 24 to 38 inches, and depth to carbonates ranges from 20 to 38 inches. Thickness of the mollic epipedon ranges from 12 to 18 inches. Coarse fragments typically range from 2 to 5 percent by volume in the upper part of the solum and from 2 to 15 percent in the lower part.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The B horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is clay loam or silty clay loam and, in some pedons, has a loam subhorizon in the lower part. The B horizon is slightly acid or medium acid in the upper part and neutral in the lower part. Typically, the C horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 5.

Crosby series

The Crosby series consists of deep, somewhat poorly drained, slowly permeable soils on uplands. These soils formed in glacial till. The glacial till has a high content of lime. Slope ranges from 0 to 6 percent.

Crosby soils are commonly adjacent to the Celina, Kokomo, and Miamian soils and are similar to the Bennington soils. Bennington soils formed in glacial till that has a higher calcium carbonate equivalent. They have more sandstone and shale coarse fragments throughout and have illitic mineralogy. Celina and Miamian soils are better drained and are on low knolls, ridgetops, and hillsides, and on side slopes along drainageways. They have less gray colors in the subsoil. Kokomo soils are wetter and are in depressions and along waterways. They have more gray colors in the subsoil and have a mollic epipedon.

Typical pedon of Crosby silt loam, 0 to 2 percent slopes, about 2 miles north-northeast of New Holland, Perry Township, 670 feet east of the intersection of Waterloo-New Holland-Egypt and Dick Roads, along Dick Road, then 1,465 feet north:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam; moderate fine granular structure; friable; common roots; less than 2 percent coarse fragments; slightly acid; abrupt smooth boundary.

A2—8 to 12 inches; brown (10YR 5/3) silt loam; common medium distinct light brownish gray (10YR 6/2) mottles; weak medium platy structure parting to weak fine subangular blocky; friable; common roots; less than 2 percent coarse fragments; slightly acid; clear wavy boundary.

Blt—12 to 15 inches; yellowish brown (10YR 5/4) silty clay loam; common fine faint yellowish brown (10YR 5/6) and common medium distinct light gray (10YR 7/2) and light brownish gray (10YR 6/2) mottles; moderate fine and medium subangular blocky structure; firm; few roots; thin patchy dark grayish brown (10YR 4/2) coatings on horizontal faces of peds; thin very patchy dark grayish brown (10YR 4/2) clay films on vertical faces of peds; common fine black

(10YR 2/1) iron and manganese stains; 3 percent coarse fragments; medium acid; clear wavy boundary.

B21t—15 to 20 inches; yellowish brown (10YR 5/4) clay; common medium distinct grayish brown (10YR 5/2) and light brownish gray (10YR 6/2) mottles; moderate fine and medium subangular and angular blocky structure; firm; few roots; medium patchy dark grayish brown (10YR 4/2) clay films on vertical and horizontal faces of peds; common fine black (10YR 2/1) iron and manganese stains; 5 percent coarse fragments; medium acid; clear wavy boundary.

B22t—20 to 24 inches; dark yellowish brown (10YR 4/4) clay; common fine faint yellowish brown (10YR 5/6) and few fine distinct grayish brown (10YR 5/2) mottles, strong fine and medium angular and subangular blocky structure; firm; few roots; medium continuous dark grayish brown (10YR 4/2) coatings on vertical faces of peds; medium patchy dark grayish brown (10YR 4/2) clay films on horizontal faces of peds; common fine black (10YR 2/1) iron and manganese stains; 3 percent coarse fragments; slightly acid; clear wavy boundary.

B23t—24 to 29 inches; dark yellowish brown (10YR 4/4) clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; thin continuous dark grayish brown (10YR 4/2) coatings on vertical faces of peds; thin patchy dark grayish brown (10YR 4/2) clay films on horizontal faces of peds; common fine black (10YR 2/1) iron and manganese concretions and stains; 3 percent coarse fragments; neutral; gradual wavy boundary.

B3t—29 to 36 inches; dark yellowish brown (10YR 4/4) clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; firm; thin patchy dark grayish brown (10YR 4/2) coatings on vertical faces of peds; thin very patchy dark grayish brown (10YR 4/2) clay films on horizontal faces of peds; common fine very dark brown (10YR 2/2) iron and manganese stains; 5 percent coarse fragments; mildly alkaline; clear irregular boundary.

C—36 to 60 inches; yellowish brown (10YR 5/4) loam; common medium distinct light brownish gray (10YR 6/2) and common medium faint yellowish brown (10YR 5/6) mottles; massive; firm; 14 percent coarse fragments; strong effervescence; moderately alkaline.

Thickness of the solum ranges from 22 to 40 inches, and depth to carbonates ranges from 18 to 36 inches. Coarse fragments range from 0 to 5 percent in the A horizon, from 3 to 10 percent in the B horizon, and from 5 to 15 percent in the C horizon.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2. The A2 horizon is not present in some pedons. If present, it has hue of 10YR, value of 5 or 6, and chroma of 2 or 3. The B horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 6. It is silty clay loam, clay loam, silty clay, or clay. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 6. It is loam or clay loam.

Eel series

The Eel series consists of deep, moderately well drained, moderately permeable soils on flood plains. These soils formed in alluvium that eroded mainly from uplands and terraces. They are occasionally flooded. Slope is 0 to 2 percent.

Eel soils in Pickaway county have a brighter colored subsoil that has a more strongly developed structure than is defined in the range of the Eel series. This difference, however, does not alter the use or behavior of the soils.

Eel soils are commonly adjacent to the Genesee, Ross, Shoals, Sloan, and Stonelick soils and are similar to the Medway soils. Genesee, Ross, and Stonelick soils are on slightly higher positions and are better drained. Ross, Sloan, and Medway soils have a mollic epipedon. Stonelick soils formed in coarse textured alluvium. Shoals and Sloan soils are in lower positions on the flood plain and are wetter.

Typical pedon of Eel silt loam, occasionally flooded, about 2 miles south-southwest of Harrisburg, Darby Township, 2,275 feet southeast of the intersection of U.S. Route 62 and Ballan Road, along Ballan Road, then 450 feet east:

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam; weak fine and medium granular structure; friable; many fine and medium roots; 3 percent coarse fragments; neutral; abrupt smooth boundary.

B21—9 to 18 inches; brown (10YR 4/3) silt loam; moderate fine and medium subangular blocky structure; friable; few fine and medium roots; thin patchy dark grayish brown (10YR 4/2) organic coatings on faces of peds; 3 percent coarse fragments; neutral; clear wavy boundary.

B22—18 to 24 inches; dark yellowish brown (10YR 4/4) loam; common fine distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; firm; few fine roots; thin patchy dark brown (10YR 4/3) organic coatings on faces of peds; 5 percent coarse fragments; neutral; clear wavy boundary.

B23—24 to 30 inches; yellowish brown (10YR 5/4) silt loam; many fine distinct grayish brown (10YR 5/2) and many fine faint yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; firm; thin patchy brown (10YR 4/3) coatings on faces of peds; 4 percent coarse fragments; neutral; clear wavy boundary.

B3—30 to 38 inches; yellowish brown (10YR 5/4) loam; many medium distinct grayish brown (10YR 5/2) and many medium faint yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; firm; thin patchy dark grayish brown (10YR 4/2) coatings on faces of peds; common very dark brown (10YR 2/2) iron and manganese stains; 5 percent coarse fragments; mildly alkaline; clear wavy boundary.

C1—38 to 48 inches; brown (10YR 5/3) heavy sandy loam; many fine faint grayish brown (10YR 5/2) and few fine faint yellowish brown (10YR 5/4) mottles; massive; friable; 10 percent coarse fragments; slight effervescence; mildly alkaline; abrupt smooth boundary.

C2—48 to 60 inches; brown (10YR 5/3) sandy loam; few fine distinct light brownish gray (10YR 6/2) mottles; massive; friable; 14 percent coarse fragments; strong effervescence; moderately alkaline; abrupt smooth boundary.

Thickness of the solum ranges from 24 to 40 inches. Depth to free carbonates is commonly about 30 inches and ranges from about 24 to 40 inches.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is neutral or slightly acid. The B horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. It is mainly silt loam or loam but is light silty clay loam, clay loam, or sandy loam in individual subhorizons. The B horizon is commonly neutral or moderately alkaline. In some pedons, it is slightly acid to a depth of 24 to 30 inches. The C horizon has hue of 10YR, value of 4 to 6, and chroma of 2 or 3. It is stratified silt loam, loam, sandy loam, loamy sand, or sand. Strata of loamy sand or sand are less than 6 inches thick. In some pedons, the C horizon is gravelly below a depth of 40 inches. It is mildly alkaline or moderately alkaline.

Eldean series

The Eldean series consist of deep, well drained soils on stream terraces, outwash terraces, kames, eskers, and moraines. These soils formed in glacial outwash. Permeability is moderate or moderately slow in the subsoil and rapid or very rapid in the substratum. Slope ranges from 0 to 12 percent.

Eldean soils are commonly adjacent to the Casco, Kendallville, Ockley, Rodman, and Warsaw soils and are similar to the Ockley soils. All of these soils have less clay in the argillic horizon. Casco and Rodman soils have a thinner solum. Kendallville soils formed in glacial outwash over glacial till. Ockley soils have a thicker solum and are on positions in the landscape similar to those of Eldean soils. Rodman and Warsaw soils have a mollic epipedon.

Typical pedon of Eldean loam, 0 to 2 percent slopes, about 6 miles northwest of Circleville, Jackson Township, 5,200 feet southeast of the intersection of Circleville Florence Chapel and Anderson Roads, along Circleville Florence Chapel Road, then 350 feet east:

Ap—0 to 8 inches; dark brown (10YR 4/3) loam; moderate fine and medium granular structure; friable; many fine roots; 5 percent coarse fragments; neutral; abrupt smooth boundary.

B21t—8 to 11 inches; brown (7.5YR 4/4) clay loam; weak medium subangular blocky structure; firm; few fine roots; thin very patchy dark brown (7.5YR 4/4) clay films and coatings on vertical faces of peds; 10 percent coarse fragments; slightly acid; abrupt smooth boundary.

B22t—11 to 14 inches; reddish brown (5YR 4/4) gravelly heavy clay loam; moderate fine and medium subangular blocky structure; firm; few fine roots; thin patchy dark brown (7.5YR 4/4) clay films on vertical and horizontal faces of peds; 15 percent coarse fragments; slightly acid; abrupt smooth boundary.

B23t—14 to 19 inches; reddish brown (5YR 4/4) gravelly heavy clay loam; moderate coarse and medium subangular blocky structure; firm; few fine roots; thin patchy dark brown (7.5YR 4/4) clay films on vertical and horizontal faces of peds; 20 percent coarse fragments; medium acid; clear wavy boundary.

B24t—19 to 24 inches; reddish brown (5YR 4/4) gravelly heavy clay loam; moderate coarse subangular blocky structure; firm; few fine roots; thin patchy dark brown (7.5YR 4/4) clay films on vertical and horizontal faces of peds; 30 percent coarse fragments; slighty acid; abrupt smooth boundary.

B3t—24 to 30 inches; dark brown (7.5YR 4/4) gravelly sandy loam; weak coarse subangular blocky structure; friable; thin patchy dark brown (7.5YR 3/2) clay films on vertical and horizontal faces of peds; many medium white (10YR 8/2) weathered limestone fragments; 35 percent coarse fragments; slight effervescence; mildly alkaline; abrupt smooth boundary.

C1—30 to 35 inches; light yellowish brown (10YR 6/4) gravelly loamy sand; single grain; loose; 40 percent coarse fragments; strong effervescence; moderately alkaline; abrupt smooth boundary.

C2—35 to 42 inches; pale brown (10YR 6/3) very gravelly loamy sand; single grain; loose; 50 percent coarse fragments; strong effervescence; moderately alkaline; diffuse boundary.

C3—42 to 60 inches; pale brown (10YR 6/3) gravelly sand; single grain; loose; 40 percent coarse fragments; strong effervescence; moderately alkaline.

Thickness of the solum and depth to loose sand and gravel range from 24 to 40 inches. In some places, as much as 20 inches of silty alluvium overlies the loamy outwash. Depth to carbonates ranges from 21 to 35 inches.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is loam or gravelly loam. The B horizon has hue of 7.5YR to 5 YR, value of 3 to 5, and chroma of 3 or 4. It is clay loam, clay, or sandy loam and gravelly analogs of these textures. A B1 horizon of silt loam, loam, or silty clay loam is in some pedons. The C horizon has hue of 10YR, value of 4 to 6, and chroma of 3 or 4. It is stratified sand or loamy sand and gravelly or very gravelly analogs of these textures. The C horizon is mildly alkaline or moderately alkaline.

Genesee series

The Genesee series consists of deep, well drained, moderately permeable soils on flood plains. These soils formed in alluvium. They are occasionally flooded. Slope is 0 to 2 percent.

Genesee soils are commonly adjacent to the Algiers, Eel, Ross, Shoals, and Stonelick soils and are similar to the Ross soils. Algiers, Eel, and Shoals soils are wetter than Genesee soils, and Algiers soils formed in recent alluvium over a buried soil. Ross soils have a mollic epipedon. Stonelick soils formed in coarser textured alluvium.

Typical pedon of Genesee silt loam, occasionally flooded, about 2.3 miles south of South Bloomfield, Harrison Township, T. 2 N., R. 22 W., 400 feet north and 850 feet east of the southwest corner of sec. 23:

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam; moderate fine and medium granular structure; friable; many roots; 2 percent coarse fragments; mildly alkaline; abrupt smooth boundary.

B21—9 to 17 inches; dark brown (10YR 4/3) silt loam; weak fine and medium subangular blocky structure; friable; common roots; many dark grayish brown (10YR 4/2) organic coatings on vertical faces of peds; 2 percent coarse fragments; slight effervescence; moderately alkaline; gradual smooth boundary.

B22—17 to 29 inches; dark brown (10YR 4/3) silt loam; weak medium subangular blocky structure; friable; common roots; common dark brown (10YR 4/3) organic coatings on vertical fases of peds; 2 percent coarse fragments; strong effervescence; moderately alkaline; clear smooth boundary.

B23—29 to 38 inches; dark brown (10YR 4/3) loam; weak coarse and medium subangular blocky structure; friable; few roots; few dark grayish brown (10YR 4/2) organic coatings on vertical faces of peds; 2 percent coarse fragments; strong effervescence; moderately alkaline; gradual smooth boundary.

C1—38 to 55 inches; dark brown (10YR 4/3) silt loam; massive; friable; few roots; 2 percent coarse fragments; strong effervescence; moderately alkaline; gradual smooth boundary.

C2—55 to 60 inches; brown (10YR 4/3) silt loam; massive; friable; 2 percent coarse fragments; strong effervescence; moderately alkaline.

Thickness of the solum ranges from 24 to 40 inches.

The A horizon has hue of 10YR, value of 3 to 5, and chroma of 2 to 4. It is slightly acid to mildly alkaline. The B horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. It is commonly silt loam or loam but ranges to light silty clay loam or clay loam. The B horizon is neutral to moderately alkaline. The C horizon is loam, silt loam, or sandy loam that has sand and gravel at a depth below 60 inches. It is mildly alkaline or moderately alkaline.

Hennepin series

The Hennepin series consists of deep, well drained soils on uplands. Permeability is slow or moderately slow. These soils formed in glacial till. The glacial till has a high content of lime. Slope ranges from 18 to 50 percent.

Hennepin soils are commonly adjacent to the Celina, Lewisburg, and Miamian soils and are similar to the Lewisburg soils. Celina, Lewisburg, and Miamian soils have an argillic horizon. Celina and Miamian soils have a thicker solum and a higher clay content in the subsoil. Lewisburg soils are also on low knolls and ridges.

Typical pedon of Hennepin silt loam from an area of Hennepin-Miamian silt loams, 25 to 50 percent slopes, about 4 miles north-northeast of New Holland, Perry Township, 830 feet northwest of the intersection of State Route 207, Crownover Mill, and Waterloo-New Holland-Egypt Roads, along State Route 207, then 600 feet north:

Ap—0 to 6 inches; brown (10YR 4/3) silt loam; moderate fine and medium granular structure; friable; common roots; less than 2 percent coarse fragments; mildly alkaline; abrupt smooth boundary.

B2—6 to 13 inches; dark yellowish brown (10YR 4/4) loam; moderate fine and medium subangular blocky structure; friable; common roots; dark brown (10YR 3/3) organic stains on faces of peds; 5 percent coarse fragments; mildly alkaline; clear smooth boundary.

B3—13 to 17 inches; yellowish brown (10YR 5/4) loam; moderate medium subangular blocky structure; friable; few roots; dark yellowish brown (10YR 3/4) organic stains on faces of peds; 10 percent coarse fragments; strong effervescence; moderately alkaline; clear wavy boundary.

C—17 to 60 inches; brown (10YR 5/3) loam; massive; friable and firm; few roots; 10 percent coarse fragments; strong effervescence; moderately alkaline.

Thickness of the solum ranges from 8 to 20 inches. The content of coarse fragments ranges from 2 to 10 percent by volume in the A horizon, from 5 to 10 percent in the B horizon, and from 10 to 20 percent in the C horizon.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4. The B horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is silt loam or loam and is slightly acid to moderately alkaline. The C horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. It is loam or silt loam or the gravelly analogs of these textures.

Henshaw series

The Henshaw series consists of deep, somewhat poorly drained soils on low terraces and in shallow basinlike areas on uplands. Permeability is moderately slow. These soils formed in silty alluvium and lacustrine deposits. Slope ranges from 0 to 4 percent.

The Henshaw soils in Pickaway County have more gray colors in the solum than is defined in the range of the Henshaw series. This difference, however, does not alter the use or behavior of the soils.

Henshaw soils are commonly adjacent to the Patton soils and are similar to the Sleeth soils. Patton soils are wetter and are in depressions. They have a mollic epipedon. Sleeth soils are on stream terraces and outwash plains and are underlain with stratified sand and gravel.

Typical pedon of Henshaw silt loam, 0 to 4 percent slopes, about 2.5 miles south of South Bloomfield, Harrison Township, T. 2 N., R. 22 W., 1,000 feet north and 430 feet east of the southwest corner of sec. 23:

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam; weak fine and medium granular structure; friable; many roots; slightly acid; abrupt smooth boundary.

B1—8 to 13 inches; brown (10YR 5/3) silt loam; common medium distinct light brownish gray (10YR 6/2) and few medium distinct yellowish brown (10YR 5/6) mottles; weak fine and medium subangular blocky structure; friable; common roots; medium acid; clear smooth boundary.

B21t—13 to 21 inches; grayish brown (2.5Y 5/2) silt loam; common medium distinct yellowish brown (10YR 5/6) and common fine faint light brownish gray (2.5Y 6/2) mottles; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; firm; few roots; thin patchy olive brown (2.5Y 4/4) clay films on vertical and horizontal faces of peds; medium acid; clear wavy boundary.

B22t—21 to 28 inches; yellowish brown (10YR 5/4) silty clay loam; many medium distinct grayish brown (2.5Y 5/2) and few medium distinct strong brown (7.5YR 5/6) mottles; moderate coarse prismatic structure parting to moderate medium subangular blocky; firm; few roots; thin continuous dark gray (10YR 4/1) clay films on vertical faces of peds and thin patchy olive brown (2.5Y 4/4) clay films on horizontal faces of peds; slightly acid; gradual wavy boundary.

B23t—28 to 37 inches; yellowish brown (10YR 5/6) silty clay loam; common medium distinct grayish brown (2.5Y 5/2) and few fine distinct brown (7.5YR 4/4) mottles; weak coarse prismatic structure parting to weak medium subangular blocky; firm; thin continuous dark grayish brown (10YR 4/2) clay films on vertical faces of peds and thin patchy brown (10YR 4/3) clay films on horizontal faces of peds; neutral; clear smooth boundary.

B3t—37 to 42 inches; olive brown (2.5Y 4/4) silt loam; common fine distinct yellowish brown (10YR 5/6) and common medium distinct grayish brown (2.5Y 5/2) mottles; weak medium and coarse subangular blocky structure; individual peds have thin lamination; friable; thin very patchy dark grayish brown (10YR 4/2) clay films on vertical faces of peds; neutral; clear smooth boundary.

C1—42 to 54 inches; grayish brown (2.5Y 5/2) silt loam; common medium distinct yellowish brown (10YR 5/6 and 5/8) mottles; horizontal bedding; friable; slight effervescence; mildly alkaline; clear smooth boundary.

C2—54 to 62 inches; yellowish brown (10YR 5/6) silt loam; common medium distinct grayish brown (2.5Y 5/2) mottles; horizontal bedding; friable; strong effervescence; moderately alkaline.

Thickness of the solum and depth to carbonates range from 30 to 50 inches.

The A horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 or 3. The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 6. It is heavy silt loam or silty clay loam and is strongly acid to mildly alkaline. The C horizon has colors similar to those of the B horizon. The C horizon is dominantly silt loam or silty clay loam but has strata of loam, clay loam, or silty clay. It is neutral to moderately alkaline.

Kendallville series

The Kendallville series consists of deep, well drained soils on till plains, kames, and eskers. Permeability is moderately slow. These soils formed in glacial outwash and glacial till. The glacial till has a high content of lime. Slope ranges from 0 to 18 percent.

Kendallville soils are commonly adjacent to the Casco, Eldean, and Miamian soils and are similar to the Miamian and Ockley soils. Casco, Eldean, and Ockley soils formed in silty and loamy glacial outwash over sand and gravel. Miamian soils formed in glacial till and have more clay in the subsoil.

Typical pedon of Kendallville loam from an area of Eldean-Kendallville loams, 2 to 6 percent slopes, about 1.7 miles west of South Bloomfield, Sciota Township, 1,320 feet south of the intersection of State Routes 104 and 316, along State Route 104, then 600 feet east:

Ap—0 to 10 inches; brown (10YR 4/3) loam; moderate fine and medium granular structure; very friable; many roots; 1 percent coarse fragments; slightly acid; abrupt smooth boundary.

B1t—10 to 15 inches; brown (7.5YR 4/4) loam; moderate fine and medium subangular blocky structure;

friable; common roots; thin brown (10YR 4/3) clay films that are very patchy on horizontal faces of peds and patchy on vertical faces; common very dark gray (10YR 3/1) and very dark grayish brown (10YR 3/2) organic coatings on faces of peds and in old root channels; few fine very dark brown (10YR 2/2) iron and manganese stains; 1 percent coarse fragments; medium acid; gradual wavy boundary.

IIB21t—15 to 22 inches; brown (7.5YR 4/4) clay loam; moderate fine and medium subangular blocky structure; firm; few roots; thin patchy brown (10YR 4/3) clay films on vertical and horizontal faces of peds; common fine very dark brown (10YR 2/2) iron and manganese stains; 5 percent coarse fragments; medium acid; clear wavy boundary.

IIB22t—22 to 30 inches; dark yellowish brown (10YR 4/4) gravelly clay loam; moderate medium and coarse subangular blocky structure; firm; few roots; thin dark brown (10YR 4/3) clay films that are patchy on vertical faces of peds and very patchy on horizontal faces; common fine very dark brown (10YR 2/2) iron and manganese stains; 20 percent coarse fragments; strongly acid; gradual wavy boundary.

IIB23t—30 to 36 inches; dark yellowish brown (10YR 4/4) gravelly sandy clay loam; weak medium and coarse subangular blocky structure; firm; thin very patchy dark brown (10YR 4/3) clay films on vertical faces of peds; common fine very dark brown (10YR 2/2) iron and manganese stains; 25 percent coarse fragments; slightly acid; clear irregular boundary.

IIIB3—36 to 39 inches; yellowish brown (10YR 5/4) loam; weak coarse subangular blocky structure; firm; thin very patchy dark brown (10YR 4/3) clay films in voids and old channels; 10 percent coarse fragments; mildly alkaline; gradual wavy boundary.

IIIC—39 to 60 inches; yellowish brown (10YR 5/4) loam; massive; firm; 10 percent coarse fragments; strong effervescence; moderately alkaline.

Thickness of the solum and depth to carbonates range from 24 to 40 inches. Content of coarse fragments ranges from 0 to 20 percent by volume in the upper part of the B horizon, from 10 to 30 percent in the lower part of the B horizon formed in glacial outwash, and from 2 to 15 percent in the C horizon.

The Ap horizon has hue of 10YR, value of 4, and chroma of 2 or 3. It is dominantly silt loam or loam, but is gravelly loam in some pedons. The B2 horizon has dominant hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. This horizon has thin subhorizons that have hue of 5YR. In some pedons, the B horizon is clay loam, sandy clay loam, loam, or gravelly analogs of these textures. Reaction is medium acid or strongly acid in the upper part of the B horizon and increases with depth to neutral or mildly alkaline in the lower part. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is loam or silt loam and is mildly alkaline or moderately alkaline.

Kokomo series

The Kokomo series consists of deep, very poorly drained, moderately slowly permeable soils in depressions and along waterways on uplands. These soils formed in glacial till. Slope is 0 to 2 percent.

Kokomo soils are commonly adjacent to the Bennington, Cardington, Celina, Corwin, and Crosby soils. These soils are on higher landscape positions, are better drained, and have less gray colors in the subsoil than Kokomo soils. Also, Bennington, Cardington, Celina, and Crosby soils have an ochric epipedon.

Typical pedon of Kokomo silty clay loam, about 1.8 miles north of Atlanta, Perry Township, 150 feet south of the intersection of Badger Road and Locust Grove Dublin Hill Road along Locust Grove Dublin Hill Road, then 900 feet west:

Ap—0 to 8 inches; very dark brown (10YR 2/2) silty clay loam; weak medium and coarse subangular blocky structure parting to moderate fine granular; friable; many roots; few medium very dark brown (10YR 2/2) iron and manganese concretions; less than 2 percent coarse fragments; neutral; abrupt smooth boundary.

A12—8 to 18 inches; very dark brown (10YR 2/2) silty clay loam; moderate fine and medium subangular blocky structure; friable; common roots; few medium very dark brown (10YR 2/2) iron and manganese concretions; black (10YR 2/1) organic coatings on faces of peds; 3 percent coarse fragments; slightly acid; clear wavy boundary.

B21tg—18 to 24 inches; dark gray (10YR 4/1) silty clay; common medium distinct yellowish brown (10YR 5/6 and 5/4) mottles; weak coarse prismatic structure parting to moderate fine and medium subangular blocky; firm; few roots; thin patchy dark gray (10YR 4/1) and very dark gray (10YR 3/1) organo-clay films on vertical and horizontal faces of peds; common fine very dark brown (10YR 2/2) iron and manganese concretions and stains; 3 percent coarse fragments; neutral; gradual wavy boundary.

B22tg—24 to 33 inches; dark grayish brown (10YR 4/2) silty clay; common medium distinct yellowish brown (10YR 5/6) and common medium faint grayish brown (10YR 5/2) mottles; moderate fine and medium subangular blocky structure; firm; dark gray (10YR 4/1) clay films that are continuous on vertical faces of peds and thin patchy on horizontal faces; 3 percent coarse fragments; neutral; clear wavy boundary.

B3tg—33 to 40 inches; dark grayish brown (10YR 4/2) clay loam; common medium distinct yellowish brown (10YR 5/6) and common medium faint grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; few roots; thin continuous gray (10YR 5/1) clay films on vertical and horizontal faces of peds; 5 percent coarse fragments; neutral; clear irregular boundary.

C1—40 to 45 inches; yellowish brown (10YR 5/4) light clay loam; common medium faint strong brown (7.5YR 5/6) and common medium distinct grayish brown (10YR 5/2) mottles; massive; firm; 14 percent coarse fragments; slight effervescence; mildly alkaline; gradual diffuse boundary.

C2—45 to 60 inches; yellowish brown (10YR 5/4) loam; common medium faint strong brown (7.5YR 5/6) and common medium distinct grayish brown (10YR 5/2) mottles; massive; firm; 14 percent coarse fragments; strong effervescence; moderately alkaline.

Thickness of the solum ranges from 36 to 50 inches. Thickness of the mollic epipedon ranges from 10 to 20 inches. Content of coarse fragments commonly increases with depth and ranges by volume from 0 in the Ap horizon to 15 percent in the C horizon.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The B horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. It is dominantly silty clay, silty clay loam, or clay loam, but subhorizons in some pedons are clay. The C horizon has hue of 10YR or 2.5Y, value of 5, and chroma of 2 to 4. It is loam or light clay loam and is mildly alkaline or moderately alkaline.

Lewisburg series

The Lewisburg series consists of deep, moderately well drained soils on uplands. These soils formed in glacial till. The glacial till has a high content of lime. Permeability is moderate or moderately slow in the subsoil and slow in the substratum. Slope ranges from 0 to 6 percent.

Lewisburg soils are commonly adjacent to the Crosby and Miamian soils and are similar to the Cardington, Celina, and Hennepin soils. Cardington, Celina, Crosby, and Miamian soils have a thicker solum. Cardington soils have illitic mineralogy and formed in glacial till that has a lower calcium carbonate equivalent than Lewisburg soils. Crosby soils are on broad flats, slight rises, and along waterways. They are wetter and have mottles of low chroma immediately below the A horizon. Hennepin and Miamian soils are better drained and are on hillsides, side slopes along waterways, and on knolls. Hennepin soils do not have an argillic horizon.

Typical pedon of Lewisburg silt loam from an area of Miamian-Lewisburg silt loams, 2 to 6 percent slopes, about 3.8 miles north-northeast of New Holland, Perry Township, 150 feet northwest of the intersection of State Route 207, Crownover Mill, and Waterloo-New Holland-Egypt Roads along State Route 207, then 150 feet north:

Ap—0 to 7 inches; brown (10YR 4/3) silt loam; weak fine and medium granular structure; friable; many roots; 1 percent coarse fragments; slightly acid; abrupt smooth boundary.

B21t—7 to 11 inches; yellowish brown (10YR 5/4) clay loam; strong fine and medium subangular and angular blocky structure; firm; many roots; thin patchy dark brown (7.5YR 4/4) clay films on vertical and horizontal faces of peds; common medium very dark brown (10YR 2/2) iron and manganese stains; 3 percent coarse fragments; slightly acid; clear wavy boundary.

B22t—11 to 16 inches; yellowish brown (10YR 5/4) clay; moderate medium prismatic structure parting to strong fine and medium subangular and angular blocky; firm; few roots; continuous dark brown (7.5YR 4/2) clay films on vertical and horizontal faces of peds; common medium very dark brown (10YR 2/2) iron and manganese stains; 5 percent coarse fragments; neutral; clear wavy boundary.

B3t—16 to 18 inches; yellowish brown (10YR 5/4) clay loam; moderate medium subangular blocky structure; firm; few roots; thin patchy dark brown (7.5YR 4/2) clay films on vertical and horizontal faces of peds; few fine distinct very dark brown (10YR 2/2) iron and manganese stains; light gray (10YR 7/1) weathered limestone fragments; 8 percent coarse fragments; slight effervescence; mildly alkaline; clear irregular boundary.

C1—18 to 24 inches; yellowish brown (10YR 5/4) loam; common medium distinct light brownish gray (10YR 6/2) mottles; massive; firm; few roots; few fine very dark brown (10YR 2/2) iron and manganese stains; 10 percent coarse fragments; strong effervescence; moderately alkaline; diffuse smooth boundary.

C2—24 to 36 inches; yellowish brown (10YR 5/4) loam; common medium distinct light brownish gray (10YR 6/2) and few medium faint yellowish brown (10YR 5/6) mottles; massive; firm; 10 percent coarse fragments; strong effervescence; moderately alkaline; diffuse smooth boundary.

C3—36 to 60 inches; yellowish brown (10YR 5/4) loam; massive; firm; 10 percent coarse fragments; strong effervescence; moderately alkaline.

Thickness of the solum ranges from 12 to 20 inches, and depth to carbonates ranges from 12 to 18 inches. The upper part of the solum is medium acid to neutral.

The A horizon has hue of 10YR, value of 4, and chroma of 2 or 3. The B horizon has hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 3 to 6. It is clay loam or clay. Coarse fragments of mostly igneous and limestone pebbles range from 2 to 10 percent by volume. The C horizon has hue of 10YR or 2.5Y, value of 5, and chroma of 3 or 4. It is loam or silt loam and is mildly alkaline or moderately alkaline.

Linwood series

The Linwood series consists of deep, very poorly drained, moderately permeable, organic soils in low lying positions on terraces and uplands. These soils formed in organic material 16 to 51 inches thick over loamy mineral material. Slope is 0 to 2 percent.

Linwood soils are commonly adjacent to the Carlisle, Montgomery, and Patton soils and are similar to the Carlisle soils. Carlisle soils formed in a thicker organic deposit. Montgomery and Patton soils formed in lacustrine sediment in slackwater basins.

Typical pedon of Linwood muck, about 4 miles north of South Bloomfield, Harrison Township, T. 3 N., R. 22 W., 200 feet north and 1,250 feet east of the southwest corner of sec. 22:

Oal—0 to 12 inches; black (N 2/0) broken face and rubbed sapric material; about 5 percent fiber, 1 percent rubbed; strong medium granular structure; friable; 30 percent mineral material; neutral; clear smooth boundary.

Oa2—12 to 19 inches; black (N 2/0) broken face and rubbed sapric material; about 5 percent fiber, 1 percent rubbed; moderate coarse angular and subangular blocky structure; friable; 30 percent mineral material; neutral; abrupt smooth boundary.

Oa3—19 to 31 inches; dark reddish brown (5YR 2/2) broken face and rubbed sapric material; about 50 percent fiber, 4 percent rubbed; weak thick platy laminations; friable; 2 percent woody fragments; neutral; clear smooth boundary.

Oa4—31 to 45 inches; dark brown (7.5YR 3/2) broken face and rubbed sapric material; 30 percent fiber, 2 percent rubbed; weak thick platy laminations; friable; 1 percent woody fragments; neutral; abrupt smooth boundary.

IICg—45 to 60 inches; dark gray (5Y 4/1) light silty clay loam; massive; firm; strong effervescence; moderately alkaline.

Depth to the IIC horizon ranges from 16 to 51 inches. The solum ranges from strongly acid to neutral.

The surface tier has hue of 10YR, 2.5Y, or neutral; value of 1 or 2; and chroma of 0 to 2. The subsurface and bottom tiers have hue of 10YR to 5YR or neutral, value of 2 or 3, and chroma of 0 to 3. The C horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. It is fine sandy loam to light silty clay loam and is slightly acid to moderately alkaline.

Loudonville series

The Loudonville series consists of moderately deep, well drained, moderately permeable soils on bedrock-controlled uplands. These soils formed in glacial till and residuum from sandstone bedrock over sandstone bedrock. Slope ranges from 2 to 50 percent.

Loudonville soils are commonly adjacent to the Alexandria and Miamian soils and are similar to the Cana Variant and Celina Variant soils. Alexandria, Cana Variant, Celina Variant, and Miamian soils have a higher base saturation. Alexandria and Miamian soils are deep to bedrock. Cana Variant soils are underlain by rippable acid shale bedrock, and Celina Variant soils are underlain by alkaline shale bedrock.

Typical pedon of Loudonville silt loam, 6 to 18 percent slopes, about 3.8 miles northeast of Circleville, Washington Township, T. 11 N., R. 21 W., 2,400 feet west of the southwest corner of sec. 10:

A1—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam; moderate fine and medium granular structure; very friable; many roots; 3 percent coarse fragments; medium acid; abrupt wavy boundary.

B1—6 to 8 inches; yellowish brown (10YR 5/4) silt loam; moderate fine and medium subangular blocky structure; firm; common roots; thin very patchy brown (7.5YR 4/4) clay films on vertical and horizontal faces of peds; common fine very dark brown (10YR 2/2) iron and manganese stains; 5 percent coarse fragments; medium acid; clear wavy boundary.

B21t—8 to 13 inches; brown (7.5YR 4/4) clay loam; strong fine and medium subangular blocky structure; firm; common roots; thin patchy yellowish brown (10YR 5/4) clay films on vertical and horizontal faces of peds; common fine very dark brown (10YR 2/2) iron and manganese stains; 8 percent coarse fragments; very strongly acid; gradual wavy boundary.

B22t—13 to 21 inches; brown (7.5YR 4/4) clay loam; strong fine and medium subangular blocky structure; firm; few roots; thin brown (10YR 5/3) clay films that are continuous on vertical faces of peds and patchy on horizontal faces; common fine very dark brown (10YR 2/2) iron and manganese stains; 8 percent coarse fragments; strongly acid; gradual wavy boundary.

B23t—21 to 27 inches; brown (7.5YR 5/4) clay loam; moderate medium subangular blocky structure; firm; few roots; thin brown (7.5YR 5/4) clay films that are continuous on vertical faces of peds and patchy on horizontal faces; common fine very dark brown (10YR 2/2) iron and manganese stains; 10 percent coarse fragments; strongly acid; clear wavy boundary.

B3t—27 to 34 inches; yellowish brown (10YR 5/4) channery clay loam; weak coarse subangular blocky structure; firm; few roots; thin very patchy brown (7.5YR 5/4) clay films on vertical and horizontal faces of peds; common fine very dark brown (10YR 2/2) iron and manganese stains; 20 percent coarse fragments; strongly acid; abrupt wavy boundary.

IICr—34 to 38 inches; strong brown (7.5YR 5/6) and yellowish brown (10YR 5/6) fractured sandstone bedrock that has weathered loamy sand material in fractures; massive; firm; few roots; 75 to 90 percent coarse fragments; strongly acid; abrupt smooth boundary.

IIR—38 inches; unweathered hard sandstone bedrock; very few horizontal or vertical cracks.

Thickness of the solum ranges from 20 to 35 inches, and depth to bedrock ranges from 20 to 40 inches. If the solum is not limed, reaction ranges from medium acid to very strongly acid throughout.

The A horizon has hue of 10YR, value of 4 or 5, and chroma of 1 to 4. The Bt horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. It is clay loam, silty clay loam, or loam or, in the lower part, channery analogs of these textures. The C horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6.

Medway series

The Medway series consists of deep, nearly level, moderately permeable, moderately well drained soils on flood plains. These soils formed in alluvium eroded mainly from uplands and terraces. Slope is 0 to 2 percent.

Medway soils are commonly adjacent to the Eel, Genesee, Ross, and Shoals soils and are similar to the Ross soils. Eel, Genesee, and Shoals soils have an ochric epipedon. Genesee and Ross soils are better drained and do not have mottles of low chroma above a depth of 20 inches. Shoals soils are wetter and have mottling immediately below the A horizon.

Typical pedon of Medway silt loam, occasionally flooded, about 7 miles southeast of Circleville, Pickaway Township, T. 10 N., R. 21 W., 2,885 feet south and 50 feet west of the northeast corner of sec. 12:

Ap—0 to 7 inches; very dark brown (10YR 2/2) silt loam; weak fine and medium granular structure; friable; many roots; thin patchy black (10YR 2/1) organic coatings on vertical and horizontal faces of peds; 1 percent coarse fragments; neutral; abrupt smooth boundary.

A12—7 to 13 inches; black (10YR 2/1) silt loam; moderate fine and medium subangular blocky structure; friable; common roots; 1 percent coarse fragments; neutral; clear wavy boundary.

A3—13 to 18 inches; very dark grayish brown (10YR 3/2) silt loam; weak medium subangular blocky structure; friable; few roots; thin patchy black (10YR 2/1) organic coatings on vertical faces of peds; 1 percent coarse fragments; neutral; clear wavy boundary.

B21—18 to 24 inches; brown (10YR 4/3) loam; few medium distinct yellowish brown (10YR 5/6) and common medium distinct grayish brown (10YR 5/2) mottles; weak medium and coarse subangular blocky structure; friable; few roots; thin patchy very dark grayish brown (10YR 3/2) organic coatings on vertical faces of peds; few fine and medium very dark brown (10YR 2/2) iron and manganese stains; 2 percent coarse fragments; neutral; clear wavy boundary.

B22—24 to 31 inches; brown (10YR 5/3) loam; common medium distinct yellowish brown (10YR 5/6) and many fine and medium faint grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; friable; few roots; thin patchy dark grayish brown (10YR 4/2) organic coatings in old root channels; few fine very dark brown (10YR 2/2) iron and manganese stains; 2 percent coarse fragments; slightly acid; clear wavy boundary.

B23—31 to 38 inches; yellowish brown (10YR 5/4) loam; few medium faint yellowish brown (10YR 5/6) and common fine and medium distinct gray (10YR 6/1) and grayish brown (10YR 5/2) mottles; weak coarse subangular blocky structure; friable; few roots; dark grayish brown (10YR 4/2) coatings in old root channels; 4 percent coarse fragments; neutral; clear wavy boundary.

C1—38 to 42 inches; brown (10YR 4/3) sandy loam; few fine faint dark yellowish brown (10YR 4/4) mottles; massive; friable; 14 percent coarse fragments; slight effervescence; mildly alkaline; clear smooth boundary.

C2—42 to 50 inches; yellowish brown (10YR 5/6) clay loam; few fine faint dark yellowish brown (10YR 4/4) mottles; massive; friable; 14 percent coarse fragments; slight effervescence; mildly alkaline; clear smooth boundary.

C3—50 to 60 inches; grayish brown (10YR 5/2) gravelly loam; common medium distinct yellowish brown (10YR 5/6) mottles; massive; friable; 25 percent coarse fragments; strong effervescence; moderately alkaline.

Thickness of the solum ranges from 28 to 45 inches. Thickness of the mollic epipedon ranges from 16 to 24 inches. Reaction of the solum ranges from slightly acid to mildly alkaline.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 to 3. The B horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4. It is silt loam, loam, or silty clay loam. The C horizon is silt loam, loam, sandy loam, clay loam, silty clay loam, or sandy clay loam. It has gravelly phases of these textures at a depth of 48 inches or more in many pedons.

Miamian series

The Miamian series consists of deep, well drained, soils on uplands. Permeability is moderately slow. These soils formed in glacial till. The glacial till has a high content of lime. Slope ranges from 0 to 50 percent.

Miamian soils are commonly adjacent to the Cana Variant, Celina, Hennepin, Kendallville, Lewisburg, and Loudonville soils and are similar to the Alexandria, Kendallville, and Lewisburg soils. Alexandria soils have more sandstone and shale coarse fragments throughout. They formed in glacial till that has lower calcium carbonate equivalent, and they have illitic mineralogy. Cana Variant and Loudonville soils have bedrock at a depth of 20 to 40 inches. Celina soils are on foot slopes and low knolls and have gray mottles in the argillic horizon. Hennepin soils are on hillsides and valley sides and have a thinner solum. Kendallville soils are in areas influenced by glacial outwash and formed in glacial outwash over glacial till. Lewisburg soils are in a complex pattern with the Miamian soils and have a thinner solum.

Typical pedon of Miamian silt loam from an area of Miamian-Lewisburg silt loams, 2 to 6 percent slopes, about 3.8 miles north-northeast of New Holland, Perry Township, 100 feet northwest of intersection of State Route 207, Crownover Mill Road, and Waterloo-New Holland-Egypt Road, along State Route 207, then 350 feet north:

Ap—0 to 9 inches; brown (10YR 4/3) silt loam; weak fine and medium subangular blocky structure; friable; many roots; 2 percent coarse fragments; neutral; abrupt smooth boundary.

B1t—9 to 13 inches; brown (10YR 5/3) silty clay loam; weak fine and medium subangular blocky structure; firm; few roots; thin patchy dark brown (10YR 4/3) clay films on vertical and horizontal faces of peds; thin patchy pale brown (10YR 6/3) silt coatings on vertical and horizontal faces of peds; 5 percent coarse fragments; neutral; clear wavy boundary.

B21t—13 to 20 inches; yellowish brown (10YR 5/4) clay loam; moderate fine and medium subangular blocky structure; firm; few roots; medium continuous dark yellowish brown (10YR 4/4) clay films on horizontal and vertical faces of peds; 8 percent coarse fragments; slightly acid; clear wavy boundary.

B22t—20 to 28 inches; dark yellowish brown (10YR 4/4) clay; moderate medium and coarse subangular blocky structure; firm; few roots; medium patchy dark brown (10YR 4/3) clay films on vertical and horizontal faces of peds; 8 percent coarse fragments; neutral; clear wavy boundary.

B3t—28 to 32 inches; yellowish brown (10YR 5/4) clay loam; weak medium and coarse subangular blocky structure; firm; few roots; dark brown (10YR 4/3) clay films that are thin patchy on horizontal faces of peds and medium patchy on vertical faces; 10 percent coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

C1—32 to 40 inches; yellowish brown (10YR 5/4) loam; common medium distinct light gray (10YR 7/2) and common fine faint yellowish brown (10YR 5/6) mottles; massive; firm; 10 percent coarse fragments; strong effervescence; moderately alkaline; clear wavy boundary.

C2—40 to 60 inches; yellowish brown (10YR 5/4) loam; common medium distinct light brownish gray (10YR 6/2) and common fine faint yellowish brown (10YR 5/6) mottles; massive; firm; 10 percent coarse fragments; strong effervescence; moderately alkaline.

Thickness of the solum ranges from 20 to 40 inches. Depth to carbonates ranges from 18 to 36 inches. Content of coarse fragments ranges from 0 to 3 percent by volume in the A horizon, 3 to 10 percent in the B horizon, and 5 to 10 percent in the C horizon. The solum ranges from strongly acid to neutral in the upper part and from slightly acid to mildly alkaline in the lower part.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is silt loam or clay loam. The B horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is heavy clay loam, silty clay loam, silty clay, or clay. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. It is loam or silt loam and is mildly alkaline or moderately alkaline.

Montgomery series

The Montgomery series consists of deep, very poorly drained soils in flat or depressional areas in slackwater basins. These soils formed in lacustrine deposits. Permeability is slow or very slow. Slope is 0 to 2 percent.

Montgomery soils are commonly adjacent to the Carlisle, Patton, and Westland soils and are similar to the Patton soils. Carlisle soils formed in deep organic deposits. Patton soils have less clay in the subsoil. Westland soils are underlain by outwash sand and gravel.

Typical pedon of Montgomery silty clay loam, about 4 miles south-southwest of Circleville, Pickaway Township, T. 3 N., R. 22 W., 3,150 feet north and 500 feet west of the southeast corner of sec. 5:

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam; weak fine and medium subangular blocky structure; firm; common fine roots; slightly acid; abrupt smooth boundary.

A12—8 to 16 inches; black (10YR 2/1) silty clay loam; moderate medium subangular blocky structure; firm; few fine roots; common medium very dark brown (10YR 2/2) iron and manganese nodules; slightly acid; clear wavy boundary.

B21g—16 to 26 inches; dark gray (10YR 4/1) silty clay; many medium distinct yellowish brown (10YR 5/4 and 5/6) mottles; moderate medium prismatic structure parting to moderate medium and coarse angular blocky; firm; few fine roots; medium patchy very dark gray (10YR 3/1) organic coatings on vertical faces of peds; few fine very dark brown (10YR 2/2) iron and manganese nodules; neutral; clear wavy boundary.

B22g—26 to 33 inches; dark gray (5Y 4/1) silty clay; many medium prominent yellowish brown (10YR 5/6) mottles; moderate medium prismatic structure parting to weak coarse angular blocky; firm; medium very patchy very dark gray (10YR 3/1) organic coatings on vertical faces of peds; few fine very dark brown (10YR 2/2) iron and manganese nodules; neutral; clear wavy boundary.

B3g—33 to 40 inches; dark gray (5Y 4/1) silty clay; few medium prominent yellowish brown (10YR 5/6) mottles; weak coarse angular blocky structure; firm; thin very patchy very dark gray (10YR 3/1) organic coatings on vertical faces of peds; common fine very dark brown (10YR 2/2) iron and manganese nodules; very dark gray (N 3/0) krotovinas; slight effervescence; mildly alkaline; abrupt smooth boundary.

C1g—40 to 47 inches; grayish brown (2.5Y 5/2) silty clay; common fine distinct light yellowish brown (2.5Y 6/4) mottles; massive; firm; very dark gray (N 3/0) krotovinas; few medium white (10YR 8/2) weathered limestone fragments; slight effervescence; moderately alkaline; abrupt smooth boundary.

C2g—47 to 55 inches; grayish brown (2.5Y 5/2) silty clay; few fine faint gray (2.5Y 5/1) mottles; massive; firm; few fine white (10YR 8/2) weathered limestone fragments; strong effervescence; moderately alkaline; clear smooth boundary.

C3g—55 to 66 inches; grayish brown (2.5Y 5/2) silty clay; few fine faint gray (10YR 5/1) mottles; massive; firm; strong effervescence; moderately alkaline.

Thickness of the solum and depth to free carbonates is typically 30 to 42 inches and ranges from 26 to 48 inches. Thickness of the mollic epipedon ranges from 10 to 20 inches.

The Ap or A1 horizon commonly has hue of 10YR, value of 2 or 3, and chroma of 0 to 2. The B2 horizon commonly has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. It is silty clay loam or silty clay and is neutral or mildly alkaline. The C horizon has hue of 10YR to 5Y, value of 5 or 6, and chroma of 2 or less. It is dominantly clay, silty clay, silty clay loam, or silt loam and is mildly alkaline or moderately alkaline.

Ockley series

The Ockley series consists of deep, well drained soils on stream terraces and outwash plains. These soils formed in silty and loamy glacial outwash or loess over stratified sand and gravel. Permeability is moderate in the subsoil and very rapid in the substratum. Slope ranges from 0 to 6 percent.

Ockley soils are commonly adjacent to the Eldean, Princeton, and Warsaw soils and are similar to the Eldean and Princeton soils. Eldean and Warsaw soils have less depth to stratified sand and gravel, and Eldean soils have a higher clay content in the argillic horizon. Warsaw soils also have a mollic epipedon. Princeton soils have more sand and less silt and clay in the subsoil and do not have coarse fragments in the solum.

Typical pedon of Ockley silt loam, 0 to 2 percent slopes, about 5 miles south of Circleville, Pickaway Township, T. 3 N., R. 22 W., 2,620 feet west and 400 feet south of the northeast corner of sec. 8:

Ap—0 to 9 inches; dark brown (10YR 4/3) silt loam; weak fine granular structure; friable; common medium roots; slightly acid; abrupt smooth boundary.

B1—9 to 13 inches; brown (7.5YR 4/4) and dark brown (10YR 4/3) silt loam; weak medium subangular blocky structure; friable; few fine roots; slightly acid; clear wavy boundary.

IIB21t—13 to 18 inches; dark brown (7.5YR 4/4) loam; moderate fine and medium subangular blocky structure; firm; few fine roots; thin patchy dark yellowish brown (10YR 4/4) clay films on vertical and horizontal faces of peds; 2 percent pebbles; medium acid; clear wavy boundary.

IIB22t—18 to 23 inches; brown (7.5YR 4/4) light clay loam; moderate medium subangular blocky structure; firm; few fine roots; medium patchy dark yellowish brown (10YR 4/4) clay films on vertical and horizontal faces of peds; 3 percent pebbles; strongly acid; clear wavy boundary.

IIB23t—23 to 30 inches; strong brown (7.5YR 5/6) clay loam; moderate fine and medium subangular blocky structure; firm; few fine roots; medium patchy dark yellowish brown (10YR 4/4) clay films on vertical and horizontal faces of peds; 5 percent pebbles; medium acid; clear wavy boundary.

IIB24t—30 to 36 inches; strong brown (7.5YR 5/6) clay loam; moderate fine and medium subangular blocky structure; firm; few fine roots; medium patchy dark yellowish brown (10YR 4/4) clay films on vertical and horizontal faces of peds; 8 percent coarse fragments; strongly acid; clear wavy boundary.

IIB25t—36 to 40 inches; strong brown (7.5YR 5/6) sandy clay loam; moderate fine and medium subangular blocky structure; firm; few fine roots; medium patchy dark yellowish brown (10YR 4/4) clay films on vertical and horizontal faces of peds; 10 percent coarse fragments; strongly acid; clear wavy boundary.

IIB31—40 to 45 inches; brown (7.5YR 4/4) gravelly sandy clay loam; weak fine subangular blocky structure; firm; medium patchy dark yellowish brown (10YR 4/4) clay films on vertical and horizontal faces of peds; 20 percent coarse fragments; medium acid; clear wavy boundary.

IIB32t—45 to 52 inches; dark brown (7.5YR 4/4) gravelly sandy clay loam; weak medium and coarse subangular blocky structure; firm; medium patchy very dark grayish brown (10YR 3/2) clay films on vertical and horizontal faces of peds; common white (10YR 8/2) weathered limestone fragments; 25 percent coarse fragments; neutral; clear wavy boundary.

IIC1—52 to 60 inches; pale brown (10YR 6/3) gravelly loamy sand; single grain; loose; 35 percent gravel; slight effervescence; mildly alkaline; clear wavy boundary.

IIC2—60 to 66 inches; brown (10YR 5/3) gravelly sand; single grain; loose; 45 percent gravel; strong effervescence; moderately alkaline.

Thickness of the solum and depth to carbonates range from 40 to 60 inches. Thickness of the silty mantle ranges from 0 to 20 inches.

The Ap horizon has hue of 10YR, value of 4, and chroma of 3 to 6. It is dominantly silt loam, but is loam in some pedons. The B2 horizon has hue of 10YR to 5YR, value of 4 or 5, and chroma of 4 to 6. It is loam, clay loam, or silty clay loam in the upper part and gravelly sandy clay loam, gravelly clay loam, sandy loam, sandy clay loam, or clay loam in the lower part. The B2 horizon is slightly acid to strongly acid. The C horizon has hue of 10YR, value of 4 to 6, and chroma of 3 or 4. It is loamy sand or sand and gravelly analogs of these textures.

Patton series

The Patton series consists of deep, poorly drained, moderately permeable soils in depressional areas on stream terraces and in upland basins. These soils formed in lacustrine deposits. Slope is 0 to 2 percent.

Patton soils are commonly adjacent to the Carlisle, Henshaw, Montgomery, and Westland soils and are similar to the Montgomery soils. Carlisle soils formed in deeper organic deposits. Henshaw soils are better drained and on slightly higher positions. They have an ochric epipedon. Montgomery soils have more clay in the subsoil. Westland soils are underlain by outwash sand and gravel.

Typical pedon of Patton silty clay loam, about 2.6 miles west of Adelphi, Salt Creek Township, T. 11 N., R. 20 W., 650 feet north and 50 feet east of the southwest corner of sec. 34:

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam; moderate medium and coarse granular structure; friable; common roots; neutral; abrupt smooth boundary.

A3—9 to 14 inches; very dark gray (10YR 3/1) silty clay loam; moderate fine and medium subangular blocky structure; firm; few roots; few fine yellowish brown (10YR 5/6) iron and manganese stains; neutral; clear wavy boundary.

B2lg—14 to 22 inches; dark gray (10YR 4/1) silty clay loam; common medium prominent light brownish gray (2.5Y 6/2) and olive yellow (2.5Y 6/6) mottles; moderate medium and coarse subangular blocky structure; firm; few roots; medium patchy very dark gray (10YR 3/1) organic coatings on vertical and horizontal faces of peds; common fine black (10YR 2/1) iron and manganese stains; neutral; clear wavy boundary.

B22g—22 to 32 inches; gray (10YR 5/1) silty clay loam; many coarse distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few roots; medium patchy very dark gray (10YR 3/1) organic coatings on vertical faces of peds; common fine black (10YR 2/1) iron and manganese stains; mildly alkaline; clear wavy boundary.

B3g—32 to 37 inches; gray (10YR 5/1) silty clay loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate fine and medium subangular blocky; firm; common fine (10YR 2/1) iron and manganese stains; slight effervescence; mildly alkaline; clear wavy boundary.

Clg—37 to 43 inches; gray (N 5/0) silt loam; many medium prominent yellowish brown (10YR 5/6) mottles; massive; firm; slight effervescence; mildly alkaline; gradual wavy boundary.

C2g—43 to 52 inches; dark gray (5Y 4/1) silty clay loam; common medium distinct yellowish brown (10YR 5/4) mottles; massive; firm; strong effervescence; moderately alkaline; gradual smooth boundary.

C3g—52 to 62 inches; gray (5Y 5/1) silt loam; few medium distinct light yellowish brown (2.5Y 6/4) mottles; massive; firm; strong effervescence; moderately alkaline.

Thickness of the solum is typically 30 to 42 inches and ranges from 24 to 42 inches.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is neutral or slightly acid. The Bg horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. It is silty clay loam or silt loam and has thin subhorizons of silty clay or clay. The Bg horizon is slightly acid to mildly alkaline. The C horizon has hue of 10YR to 5Y or neutral, value of 4 to 6, and chroma of 0 to 3. It is silty clay loam or silt loam and is mildly alkaline or moderately alkaline.

Princeton series

The Princeton series consists of deep, well drained, moderately permeable, hummocky soils on outwash terraces and till plains. These soils formed in sandy and loamy eolian deposits. Slope ranges from 2 to 12 percent.

Princeton soils are commonly adjacent to the Eldean, Ockley, and Warsaw soils and are similar to the Ockley soils. Eldean, Ockley, and Warsaw soils contain coarse fragments in the lower part of the subsoil and have less sand in the subsoil. They are underlain by outwash sand and gravel. Also, Eldean soils have a mollic epipedon.

Typical pedon of Princeton sandy loam, 6 to 12 percent slopes, 1.2 miles west-southwest of South Bloomfield, Harrison Township, T. 2 N., R. 22 W., 600 feet south and 1,000 feet west of the northeast corner of sec. 16:

Ap—0 to 7 inches; brown (10YR 4/3) sandy loam; weak fine granular structure; very friable; many roots; neutral; abrupt smooth boundary.

B1—7 to 11 inches; dark yellowish brown (10YR 4/4) sandy loam; weak thin platy structure parting to moderate fine granular; very friable; common roots; brown (10YR 5/3) coatings; medium acid; clear smooth boundary.

B21t—11 to 19 inches; brown (7.5YR 4/4) sandy clay loam; weak fine and medium subangular blocky structure; firm; common roots; thin very patchy dark brown (7.5YR 3/2) clay films on vertical and horizontal faces of peds and bridging of sand grains; few fine very dark brown (10YR 2/2) iron and manganese stains; strongly acid; clear wavy boundary.

B22t—19 to 32 inches; strong brown (7.5YR 5/6) sandy clay loam; moderate medium subangular blocky structure; firm; few roots; dark brown (7.5YR 4/4) thin patchy clay films on vertical faces of peds and thin very patchy on horizontal faces and bridging between sand grains; few fine very dark brown (10YR 2/2) iron and manganese stains; medium acid; gradual wavy boundary.

B23t—32 to 44 inches; strong brown (7.5YR 5/6) sandy clay loam; moderate medium and coarse subangular blocky structure; firm; few roots; thin patchy dark brown (7.5YR 4/4) clay films on faces of peds; few fine very dark brown (10YR 2/2) iron and manganese stains; medium acid; clear wavy boundary.

B3—44 to 55 inches; brown (7.5YR 4/4) sandy loam; weak coarse subangular blocky structure; friable; medium acid; clear wavy boundary.

C—55 to 65 inches; brown (10YR 4/3) loamy sand; single grain; loose; slightly acid.

Thickness of the solum ranges from 40 to 60 inches.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. It is dominantly sandy loam but is fine sandy loam or loam in some pedons. The B horizon has hue of 5YR to 10YR, value of 4 or 5, and chroma of 4 to 6. It is mainly sandy clay loam but ranges to loam, light clay loam, or sandy loam. The B horizon is dominantly medium acid or strongly acid but ranges to very strongly acid in some pedons. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 6. It is mainly loamy sand or sandy loam and gravelly analogs of these textures. The C horizon is slightly acid to moderately alkaline.

Rodman series

The Rodman series consists of deep, excessively drained soils. These soils are on side slopes of outwash plains and on kames, eskers, and high stream terraces formed in glacial outwash. Permeability is moderately rapid in the subsoil and very rapid in the substratum. Slope ranges from 4 to 35 percent.

Free carbonates in the B horizon of the Rodman soils in Pickaway County are not within the defined range of the Rodman series. This difference, however, does not alter the use or behavior of the soils.

Rodman soils are commonly adjacent to the Casco and Eldean soils and are similar to the Casco soils. Casco and Eldean soils have a thicker solum, have more clay in the subsoil, and do not have a mollic epipedon.

Typical pedon of Rodman gravelly sandy loam, 4 to 12 percent slopes, about 3 miles southwest of Circleville, Wayne Township, 1.5 miles northeast of the intersection of State Road 104 and Circleville Westfall Road, along Circleville Westfall Road, then 190 feet west:

A11—0 to 4 inches; very dark grayish brown (10YR 3/2) gravelly sandy loam; weak fine granular structure; friable; many roots; 15 percent coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

A12—4 to 7 inches; very dark brown (10YR 2/2) gravelly sandy loam; moderate fine granular structure; friable; many roots; 30 percent coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

B2—7 to 14 inches; brown (10YR 4/3) gravelly coarse sandy loam; moderate fine granular structure; friable; common roots; 45 percent coarse fragments; strong effervescence; moderately alkaline; clear wavy boundary.

C1—14 to 24 inches; brown (10YR 5/3) gravelly coarse sand; single grain; loose; few roots; 35 percent coarse fragments; strong effervescence; moderately alkaline; clear wavy boundary.

C2—24 to 60 inches; brown (10YR 5/3) gravelly coarse sand; single grain; loose; few roots; 20 percent coarse fragments; strong effervescence; moderately alkaline.

Thickness of the solum ranges from 8 to 15 inches.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is dominantly gravelly loam or gravelly sandy loam but is loam or sandy loam in some pedons. The B horizon has hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 3 or 4. It is gravelly or very gravelly loam or coarse sandy loam and is neutral to moderately alkaline. The C horizon is gravelly coarse sand or gravelly loamy sand.

Ross series

The Ross series consists of deep, well drained, moderately permeable soils on flood plains. These soils formed in alluvium eroded mainly from uplands and terraces and are occasionally flooded. Slope is 0 to 2 percent.

Ross soils are commonly adjacent to the Genesee, Medway, and Stonelick soils and are similar to the Warsaw and Wea soils. Genesee and Stonelick soils have an ochric epipedon and Stonelick soils formed in coarser textured alluvium. Medway soils are in slightly lower positions and are wetter. Warsaw and Wea soils are on stream terraces and outwash plains and have an argillic horizon.

Typical pedon of Ross loam, occasionally flooded, about 1 mile south of Fox, Jackson Township, 3,650 feet south of the intersection of Circleville-Florence Chapel Road and State Route 104, along State Route 104, then 200 feet west:

Ap—0 to 9 inches; black (10YR 2/1) loam; weak fine and medium granular structure; very friable; many roots; 2 percent coarse fragments; mildly alkaline; abrupt smooth boundary.

A12—9 to 20 inches; black (10YR 2/1) loam; moderate fine and medium subangular blocky structure; friable; common roots; 2 percent coarse fragments; mildly alkaline; gradual smooth boundary.

A13—20 to 31 inches; very dark brown (10YR 2/2) loam; moderate fine and medium subangular blocky structure; friable; few roots; 2 percent coarse fragments; mildly alkaline; clear wavy boundary.

B2—31 to 38 inches; dark brown (10YR 4/3) loam; moderate fine and medium subangular blocky structure; friable; few roots; common very dark brown (10YR 2/2) organic coatings on vertical and horizontal faces of peds and in old root and worm channels; 2 percent coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

C1—38 to 50 inches; brown (10YR 4/3) and dark yellowish brown (10YR 4/4) loam; massive; friable; 5 percent coarse fragments; strong effervescence; moderately alkaline; clear wavy boundary.

C2—50 to 60 inches; brown (10YR 4/3) very gravelly sandy clay loam; massive; friable; 60 percent coarse fragments; strong effervescence; moderately alkaline.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 to 3. It is loam or silt loam. Some pedons have an overwash of sediment that has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The B horizon has hue of 10YR and value and chroma of 3 or 4. It is silt loam or loam. The B horizon is dominantly slightly acid to mildly alkaline but is moderately alkaline in some pedons. The C horizon has hue of 10YR and value and chroma of 3 or 4. It is loam, sandy loam, sandy clay loam, or sand and has gravelly or very gravelly analogs of these textures below a depth of 50 inches.

Shoals series

The Shoals series consists of deep, moderately permeable, somewhat poorly drained soils on flood plains. These soils formed in alluvium eroded mainly from uplands and terraces. They are occasionally flooded. Slope is 0 to 2 percent.

Shoals soils are commonly adjacent to the Algiers, Eel, Genesee, Medway, and Sloan soils. Algiers soils formed in recent alluvium over a buried soil. Eel and Genesee soils are better drained, on slightly higher positions, and do not have mottles immediately under the A horizon. Medway and Sloan soils have a mollic epipedon. Sloan soils are wetter and in depressions.

Typical pedon of Shoals silt loam, occasionally floded, about 1.5 miles southwest of South Bloomfield, Harrison Township, T. 2 N., R. 22 W., about 550 feet north and 1,150 feet west of the southeast corner of sec. 16:

A11—0 to 3 inches; very dark grayish brown (10YR 3/2) silt loam; moderate fine and medium granular structure; friable; many roots; slightly acid; abrupt smooth boundary.

A12—3 to 10 inches; dark grayish brown (10YR 4/2) silt loam; few fine faint yellowish brown (10YR 5/4) mottles; moderate fine and medium granular structure; friable; many roots; slightly acid; abrupt smooth boundary.

B1—10 to 16 inches; yellowish brown (10YR 5/4) silt loam; common medium distinct light brownish gray (10YR 6/2) mottles; moderate medium granular structure; friable; common roots; 2 percent coarse fragments; neutral; clear smooth boundary.

B21—16 to 23 inches; grayish brown (10YR 5/2) silt loam; many medium distinct brown (7.5YR 4/4) and few medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure parting to moderate fine and medium granular; friable; common roots; common very dark brown (10YR 2/2) iron and manganese stains; 5 percent coarse fragments; neutral; gradual smooth boundary.

B22—23 to 34 inches; grayish brown (10YR 5/2) silt loam; many medium distinct yellowish brown (10YR 5/6) and few medium prominent strong brown (7.5YR 5/8) mottles; weak thick platy structure parting to weak medium and coarse subangular blocky; friable; few roots; common very dark brown (10YR 2/2) iron and manganese stains; 8 percent coarse fragments; mildly alkaline; clear wavy boundary.

C1—34 to 46 inches; brown (10YR 5/3) loam; many medium distinct gray (10YR 6/1) and common medium distinct strong brown (7.5YR 5/8) mottles; massive; friable; few roots; 12 percent coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

C2—46 to 60 inches; dark gray (10YR 4/1) loam; many medium distinct light brownish gray (10YR 6/2) and common medium prominent strong brown (7.5YR 5/6) mottles; massive; friable; 14 percent coarse fragments; strong effervescence; moderately alkaline.

Thickness of the solum ranges from 24 to 40 inches. The solum is slightly acid to mildly alkaline throughout.

The A1 horizon has hue of 10YR, value of 3 to 5, and chroma of 2. The B horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4. It is dominantly silt loam or loam but has thin subhorizons of sandy loam, light silty clay loam, and clay loam. The C horizon typically has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 3. It is loam, silt loam, or sandy loam and has gravelly analogs in some pedons. Sand and gravel are commonly below a depth of 60 to 96 inches.

Sleeth series

The Sleeth series consists of deep, somewhat poorly drained soils. These soils are on stream terraces and outwash plains. They formed in silty or loamy glacial outwash or loess over stratified sand and gravel. Permeability is moderate in the subsoil and very rapid in the substratum. Slope is 0 to 2 percent.

Sleeth soils are commonly adjacent to the Henshaw, Thackery, and Westland soils. Henshaw soils formed in medium textured and moderately fine textured alluvium and lacustrine sediment. Thackery soils are better drained and are in slightly higher positions. They do not have mottles of low chroma immediately under the A horizon. Westland soils are wetter and are in depressions and along waterways. They have a mollic epipedon.

Typical pedon of Sleeth silt loam, 0 to 2 percent slopes, about 1 mile north of South Bloomfield, Harrison Township, T. 3 N., R. 22 W., 3,825 feet south and 2,375 feet west of the northeast corner of sec. 3:

Ap—0 to 10 inches; dark brown (10YR 4/3) silt loam; weak fine and medium granular structure; friable; common fine roots; slightly acid; abrupt smooth boundary.

B1t—10 to 14 inches; yellowish brown (10YR 5/4) loam; few medium distinct strong brown (7.5YR 5/8) and common fine distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/8) mottles; weak medium subangular blocky structure; firm; few fine roots; grayish brown (10YR 5/2) continuous coatings on faces of peds and thin patchy clay films on vertical faces of peds; common fine and medium black (10YR 2/1) iron and manganese nodules and stains; 2 percent pebbles; medium acid; clear wavy boundary.

B21t—14 to 20 inches; brown (10YR 5/3) loam; common medium faint grayish brown (10YR 5/2), common fine faint yellowish brown (10YR 5/4), and few medium prominent strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; grayish brown (10YR 5/2) continuous coatings and thin patchy clay films on faces of peds; few fine black (10YR 2/1) iron and manganese nodules and stains; 4 percent pebbles; medium acid; clear wavy boundary.

B22t—20 to 27 inches; brown (10YR 4/3) clay loam; common fine faint yellowish brown (10YR 5/4), and common medium faint brown (7.5YR 4/4) and grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; few fine roots; grayish brown (10YR 5/2) continuous coatings and thin patchy clay films on vertical and horizontal faces of peds; few fine black (10YR 2/1) iron and manganese nodules and stains; 5 percent pebbles; medium acid; clear wavy boundary.

B23t—27 to 36 inches; yellowish brown (10YR 5/4) clay loam; common medium distinct grayish brown (10YR 5/2) and common medium faint yellowish brown (10YR 5/6) mottles; moderate medium and coarse subangular blocky structure; firm; few fine roots; thick patchy grayish brown (10YR 5/2) clay films on vertical and horizontal faces of peds; 6 percent pebbles; slightly acid; clear wavy boundary.

B24t—36 to 41 inches; yellowish brown (10YR 5/4) clay loam; few fine distinct grayish brown (10YR 5/2) and few fine faint yellowish brown (10YR 5/6) mottles; moderate medium and coarse subangular blocky structure; firm; thin patchy grayish brown (10YR 5/2) clay films on vertical and horizontal faces of peds; few fine very dark grayish brown (10YR 3/2) iron and manganese stains; 4 percent pebbles; neutral; clear wavy boundary.

B3t—41 to 48 inches; brown (10YR 5/3) sandy clay loam; common coarse distinct yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; firm; very patchy grayish brown (10YR 5/2) clay films on vertical and horizontal faces of peds; 6 percent pebbles; slight effervescence; mildly alkaline; abrupt wavy boundary.

C1—48 to 53 inches; brown (10YR 5/3) loamy sand; many medium faint light brownish gray (10YR 6/2) and common fine distinct dark yellowish brown (10YR 3/4) mottles; single grain; loose; 4 percent pebbles; strong effervescence; moderately alkaline; clear wavy boundary.

C2—53 to 60 inches; brown (10YR 5/3) sand; few fine distinct yellowish brown (10YR 5/6) mottles; single grain; loose; 7 percent pebbles; strong effervescence; moderately alkaline; clear wavy boundary.

Thickness of the solum and depth to free carbonates range from 40 to 60 inches.

The Ap horizon has hue of 10YR, value of 4, and chroma of 2 or 3. It is dominantly silt loam but is loam in some pedons. The B2 horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4. It is mainly clay loam but has subhorizons of loam or sandy loam and the gravelly analogs of these textures in the lower part. The B2 horizon has 0 to 20 percent coarse fragments by volume. It is medium acid to neutral and generally becomes less acid as depth increases. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 6. It is loamy sand, sand, gravelly loamy sand, or gravelly sand and is mildly alkaline or moderately alkaline.

Sloan series

The Sloan series consists of deep, very poorly drained soils on flood plains. These soils formed in alluvium eroded mainly from uplands and terraces. They are occasionally flooded. Permeability is moderate or moderately slow. Slope is 0 to 2 percent.

Sloan soils are commonly adjacent to the Algiers, Eel, Genesee, and Shoals soils and are similar to the Westland soils. Algiers, Eel, Genesee, and Shoals soils have an ochric epipedon, are better drained, and have less gray color in the subsoil. Westland soils are on stream terraces and outwash plains. They have an argillic horizon and a regular decrease in organic matter content as depth increases.

Typical pedon of Sloan silt loam, occasionally flooded, about 3.5 miles southeast of Williamsport, Deer Creek Township, 2,200 feet south of the intersection of Rector Road and State Route 138, along Rector Road, then 50 feet west:

A11—0 to 11 inches; very dark gray (10YR 3/1) silt loam; moderate fine and medium granular structure; friable; many roots; 2 percent coarse fragments; mildly alkaline; clear smooth boundary.

A12—11 to 16 inches; very dark gray (10YR 3/1) silt loam; weak coarse prismatic structure parting to weak medium and coarse angular blocky; friable; common roots; 2 percent coarse fragments; mildly alkaline; clear wavy boundary.

Blg—16 to 25 inches; dark gray (10YR 4/1) loam; common fine distinct dark yellowish brown (10YR 4/4) mottles; weak coarse prismatic structure parting to weak medium angular blocky; friable; few roots; 2 percent coarse fragments; slight effervescence; mildly alkaline; gradual wavy boundary.

B2g—25 to 30 inches; gray (10YR 5/1) loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; weak medium and coarse angular blocky structure; friable; few roots; brown (7.5YR 4/4) iron and manganese rinds; 5 percent coarse fragments; slight effervescence; mildly alkaline; gradual wavy boundary.

B3g—30 to 42 inches; dark gray (10YR 4/1) loam; common medium distinct dark yellowish brown (10YR 4/4) mottles; weak medium and coarse angular blocky structure; friable; few roots; brown (7.5YR 4/4) iron and manganese rinds; 5 percent coarse fragments; strong effervescence; moderately alkaline; gradual wavy boundary.

Cg—42 to 60 inches; grayish brown (10YR 5/2) gravelly sandy loam; common fine faint gray (10YR 6/1) and common fine distinct yellowish brown (10YR 5/4) mottles; massive; friable; 20 percent coarse fragments; strong effervescence; moderately alkaline.

Thickness of the solum ranges from 30 to 60 inches. The A horizon has hue of 10YR, 2.5Y, or neutral; value of 2 or 3; and chroma of 0 to 2. It is 10 to 18 inches thick. The B horizon has hue of 10YR to 5Y, value of 4 or 5, and chroma of 1 or 2. It is dominantly silty clay loam, clay loam, or loam but has subhorizons of sandy loam in some pedons. The B horizon is neutral to moderately alkaline. The C horizon is commonly stratified sandy loam, loam, or silty clay loam and the gravelly analogs of these textures.

Stonelick series

The Stonelick series consists of deep, well drained soils on flood plains. These soils formed in stratified calcareous alluvium. Permeability is moderately rapid. Slope is 0 to 2 percent.

Stonelick soils are commonly adjacent to the Eel, Genesee, and Ross soils and are similar to the Genesee soils. Eel soils are wetter and have mottles closer to the soil surface. Genesee soils have more clay and silt and less sand between a depth of 10 and 40 inches. Ross soils have a mollic epidedon.

Typical pedon of Stonelick sandy loam, about 1.5 miles west-northwest of Leistville, Pickaway Township, T. 10 N., R. 21 W., 1,500 feet north and 1,450 feet east of the southeast corner of sec. 11.

Ap—0 to 6 inches; brown (10YR 4/3) sandy loam; weak fine granular structure; very friable; many roots; 2 percent coarse fragments; slight effervescence; mildly alkaline; abrupt smooth boundary.

C1—6 to 12 inches; brown (10YR 4/3) sandy loam; weak medium subangular blocky structure; very friable; common roots; 2 percent coarse fragments; slight effervescence; mildly alkaline; gradual wavy boundary.

C2—12 to 20 inches; brown (10YR 5/3) sandy loam; weak coarse subangular blocky structure; very friable; few roots; 2 percent coarse fragments; slight effervescence; mildly alkaline; abrupt smooth boundary.

C3—20 to 25 inches; brown (10YR 5/3) gravelly loamy sand; single grain; loose; few roots; 20 percent coarse fragments; slight effervescence; mildly alkaline; abrupt smooth boundary.

C4—25 to 32 inches; brown (10YR 4/3) sandy loam; massive; very friable; few roots; 8 percent coarse fragments; strong effervescence; moderately alkaline; clear wavy boundary.

C5—32 to 40 inches; brown (10YR 5/3) loamy sand; single grain; loose; few roots; 8 percent coarse fragments; strong effervescence; moderately alkaline; clear wavy boundary.

C6—40 to 45 inches; brown (10YR 4/3) loamy sand; single grain; loose; few roots; 5 percent coarse fragments; strong effervescence; moderately alkaline; clear wavy boundary.

C7—45 to 60 inches; brown (10YR 4/3) and pale brown (10YR 6/3) gravelly loamy sand; single grain; loose; 45 percent coarse fragments; strong effervescence; moderately alkaline.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. The C horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 to 4. It is stratified loam, sandy loam, or loamy sand and has gravelly analogs of these textures mainly below a depth of 40 inches.

Thackery series

The Thackery series consists of deep, moderately well drained soils on stream terraces and outwash plains. These soils formed in silty or loamy glacial outwash or loess over stratified sand and gravel. Permeability is moderate in the subsoil and rapid or very rapid in the substratum. Slope ranges from 0 to 6 percent.

Thackery soils are commonly adjacent to the Ockley, Sleeth, and Westland soils. Ockley soils are better drained and are on broad flats and in areas that have gentle slopes. They do not have mottles in the upper part of the subsoil. Sleeth and Westland soils are wetter and are in depressions and along waterways. They have mottles immediately below the surface layer. Westland soils also have a mollic epipedon.

Typical pedon of Thackery silt loam, 0 to 2 percent slopes, about 1.5 miles northwest of Laurelville, Salt Creek Township, T. 11 N., R. 20 W., 1,270 feet north and 900 feet east of the southwest corner of sec. 25:

Ap—0 to 12 inches; brown (10YR 4/3) silt loam; weak fine and medium granular structure; friable; many fine roots; 3 percent coarse fragments; medium acid; abrupt smooth boundary.

B1t—12 to 16 inches; yellowish brown (10YR 5/4) heavy silt loam; weak fine and medium subangular blocky structure; friable; few fine roots; thin very patchy dark yellowish brown (10YR 4/4) clay films on vertical and horizontal faces of peds; thin patchy pale brown (10YR 6/3) silt coatings on vertical and horizontal faces of peds; 3 percent coarse fragments; medium acid; clear smooth boundary.

B21t—16 to 22 inches; yellowish brown (10YR 5/4) clay loam; common fine distinct light brownish gray (10YR 6/2) and common medium faint yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine roots; thin patchy dark yellowish brown (10YR 4/4) clay films on vertical and horizontal faces of peds; thin patchy pale brown (10YR 6/3) silt coatings on vertical and horizontal faces of peds; 8 percent coarse fragments; slightly acid; clear wavy boundary.

B22t—22 to 32 inches; yellowish brown (10YR 5/4) gravelly clay loam; common fine distinct grayish brown (10YR 5/2) and common medium faint yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; thin patchy dark yellowish brown (10YR 4/4) clay films on vertical and horizontal faces of peds; common medium distinct black (10YR 2/1) iron and manganese concretions; 15 percent coarse fragments; slightly acid; clear wavy boundary.

B23t—32 to 40 inches; yellowish brown (10YR 5/4) gravelly clay loam; common fine distinct light brownish gray (2.5Y 6/2) and few fine distinct yellowish brown (10YR 5/8) mottles; weak fine and medium subangular blocky structure; firm; thin patchy brown (10YR 4/3) clay films on vertical and horizontal faces of peds; 15 percent coarse fragments; neutral; clear wavy boundary.

B3—40 to 50 inches; brown (10YR 5/3) gravelly sandy clay loam; common medium faint grayish brown (10YR 5/2) mottles; weak coarse subangular blocky structure; friable; many coarse distinct white (10YR 8/2) weathered limestone fragments; 25 percent coarse fragments; mildly alkaline; abrupt smooth boundary.

C—50 to 60 inches; yellowish brown (10YR 5/4) gravelly sand; common fine distinct grayish brown (10YR 5/2) mottles; single grain; loose; 40 percent coarse fragments; strong effervescence; moderately alkaline.

Thickness of the solum ranges from 40 to 60 inches, and depth to carbonates ranges from 32 to 55 inches.

The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The B horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is dominantly clay loam or sandy clay loam and gravelly analogs of these textures but has subhorizons of silt loam or silty clay loam. This horizon generally decreases in acidity as depth increases and ranges from strongly acid in the upper part to mildly alkaline in the lower part. The C horizon has hue of 10YR, value of 5, and chroma of 3 or 4. It is dominantly stratified gravelly loamy sand or gravelly sand.

Tippecanoe series

The Tippecanoe series consists of deep, moderately well drained soils on stream terraces and outwash plains. These soils formed in silty and loamy glacial outwash or loess over calcareous stratified sand and gravel. Permeability is moderate in the subsoil and very rapid in the substratum. Slope is 0 to 2 percent.

Tippecanoe soils are commonly adjacent to the Eldean, Medway, Warsaw, and Wea soils and are similar to the Medway soils. Eldean, Warsaw, and Wea soils are on slightly higher positions and are better drained. Eldean and Warsaw soils have a thinner solum, and Eldean soils have an ochric epipedon. Medway soils are on flood plains and do not have an argillic horizon.

Typical pedon of Tippecanoe silt loam, 0 to 2 percent slopes, about 3 miles southeast of Circleville, Pickaway Township, T. 10 N., R. 21 W., 450 feet east and 150 feet south of the northwest corner of sec. 4:

Ap—0 to 8 inches; black (10YR 2/1) silt loam; moderate medium granular structure; friable; 5 percent coarse fragments; slightly acid; clear smooth boundary.

A12—8 to 11 inches; black (10YR 2/1) silt loam; moderate medium angular blocky structure; friable; 10 percent coarse fragments; slightly acid; clear wavy boundary.

B1t—11 to 16 inches; very dark grayish brown (10YR 3/2) clay loam; moderate medium subangular blocky structure; friable; thin patchy black (10YR 2/1) clay films on horizontal and vertical faces of peds; 10 percent coarse fragments; slightly acid; clear wavy boundary.

B21t—16 to 21 inches; brown (10YR 4/3) clay loam; few fine distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; firm; thin very patchy dark yellowish brown (10YR 3/4) clay films on vertical and horizontal faces of peds; dark gray (10YR 4/1) organic coatings on faces of peds; 10 percent coarse fragments; slightly acid; clear wavy boundary.

B22t—21 to 30 inches; yellowish brown (10YR 5/4) clay loam; common medium faint yellowish brown (10YR 5/6) and dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky structure; firm; thin very patchy dark yellowish brown (10YR 3/4) clay films on vertical and horizontal faces of peds; clay bridging between pebbles and sand grains; dark gray (10YR 4/1) organic coatings on faces of peds; 10 percent coarse fragments; slightly acid; clear wavy boundary.

B23t—30 to 35 inches; dark yellowish brown (10YR 4/4) heavy clay loam; common medium distinct yellowish brown (10YR 5/6) and few fine distinct grayish brown (10YR 5/2) mottles; weak coarse subangular blocky structure; firm; thin very patchy dark yellowish brown (10YR 3/4) clay films on vertical and horizontal faces of peds; clay bridging between pebbles and sand grains; 14 percent coarse fragments; neutral; clear wavy boundary.

B24t—35 to 39 inches; dark yellowish brown (10YR 4/4) gravelly clay; common medium distinct yellowish brown (10YR 5/6) and few fine distinct grayish brown (10YR 5/2) mottles; weak coarse subangular blocky structure; firm; clay bridging between pebbles and sand grains; 20 percent coarse fragments; slight effervescence in spots; mildly alkaline; clear smooth boundary.

B3—39 to 50 inches; brown (10YR 5/3) gravelly sandy loam; massive; friable; 30 percent coarse fragments; slight effervescence; mildly alkaline; clear irregular boundary.

C—50 to 64 inches; brown (10YR 4/3) gravelly loamy sand; single grain; loose; 40 percent coarse fragments; strong effervescence; moderately alkaline.

Thickness of the solum ranges from 40 to 60 inches. The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The B horizon below the mollic epipedon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. In some pedons, the upper part of the B horizon has value of 3 and chroma of 2 or 3. The B horizon is silt loam, clay loam, silty clay loam, clay, or sandy loam and gravelly analogs of these textures. It is medium acid or slightly acid in the upper part and mildly alkaline in the lower part. The B horizon is 5 to 35 percent coarse fragments by volume. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is commonly stratified gravelly loamy sand to gravelly sand.

Warsaw series

The Warsaw series consists of deep, well drained soils on stream terraces and outwash plains. These soils formed in loamy glacial outwash over stratified sand and gravel. Permeability is moderate in the subsoil and very rapid in the substratum. Slope ranges from 0 to 6 percent.

Warsaw soils are commonly adjacent to the Casco, Eldean, Princeton, Tippecanoe, and Wea soils and are similar to the Wea soils. Casco, Eldean, and Princeton soils have an ochric epipedon. Tippecanoe soils are in slightly lower positions and have mottles in the lower part of the subsoil. Wea soils have a thicker solum.

Typical pedon of Warsaw loam, 0 to 2 percent slopes, about 3.7 miles south of Circleville, Pickaway Township, T. 3 N., R. 22 W., 680 feet south and 2,770 feet west of the northeast corner of sec. 6:

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) loam; moderate fine and medium granular structure; friable; many roots; 2 percent coarse fragments; slightly acid; clear smooth boundary.

A12—7 to 11 inches; very dark grayish brown (10YR 3/2) loam; moderate medium and coarse granular structure; friable; common roots; 1 percent coarse fragments; slightly acid; clear wavy boundary.

A3—11 to 16 inches; dark brown (7.5YR 3/2) loam; weak fine and medium subangular blocky structure; friable; common roots; 10 percent coarse fragments; slightly acid; clear wavy boundary.

B21t—16 to 22 inches; brown (7.5YR 4/4) gravelly sandy clay loam; moderate medium subangular blocky structure; firm; few roots; thin patchy dark yellowish brown (10YR 3/4) clay films on vertical and horizontal faces of peds; thin patchy dark brown (10YR 3/3) organic coatings on vertical and horizontal faces of peds; 15 percent coarse fragments; strongly acid; clear wavy boundary.

B22t—22 to 26 inches; brown (7.5YR 4/4) gravelly sandy clay loam; moderate fine and medium subangular blocky structure; firm; few roots; thin patchy dark yellowish brown (10YR 3/4) clay films on vertical and horizontal faces of peds; thin patchy dark brown (10YR 3/3) organic coatings on vertical faces of peds; 20 percent coarse fragments; slightly acid; clear wavy boundary.

B3t—26 to 34 inches; dark yellowish brown (10YR 4/4) heavy sandy loam; weak medium and coarse subangular blocky structure; friable; few roots; thin patchy dark yellowish brown (10YR 3/4) clay films on vertical and horizontal faces of peds; 10 percent coarse fragments; slightly acid; abrupt wavy boundary.

C1—34 to 46 inches; brown (10YR 4/3) and pale brown (10YR 6/3) sand; single grain; loose; few roots; 10 percent coarse fragments; slight effervescence; moderately alkaline; clear wavy boundary.

C2—46 to 58 inches; dark yellowish brown (10YR 4/4) and dark grayish brown (10YR 4/2) gravelly coarse sand; single grain; loose; 20 percent coarse fragments; strong effervescence; moderately alkaline; clear wavy boundary.

C3—58 to 70 inches; brown (10YR 5/3) and yellowish brown (10YR 5/4) gravelly coarse sand; single grain; loose; 20 percent coarse fragments; strong effervescence; moderately alkaline.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 to 3. The B horizon has hue of 10YR to 5YR and value of 3 to 5. It generally has chroma of 3 or 4, but has chroma of 2 in the upper part of some pedons. The B horizon is typically gravelly sandy clay loam, sandy clay loam, clay loam, loam, or gravelly clay loam. The C horizon has hue of 10YR, value of 4 to 6, and chroma of 3 or 4. It is gravelly coarse sand to sand and varies considerably in percentages of sand and gravel.

Wea series

The Wea series consists of deep, well drained soils on stream terraces and outwash plains. These soils formed in loamy glacial outwash or silty alluvium and loamy outwash over stratified calcareous sand and gravel. Permeability is moderate in the subsoil and very rapid in the substratum. Slope ranges from 0 to 6 percent.

Wea soils are commonly adjacent to the Eldean, Ockley, Ross, Tippecanoe, and Warsaw soils and are similar to the Warsaw soils. Eldean and Ockley soils have an ochric epipedon. Eldean and Warsaw soils have a thinner solum. Ross soils are on flood plains and do not have an argillic horizon. Tippecanoe soils are in slightly lower positions and have mottles in the lower part of the subsoil.

Typical pedon of Wea silt loam, 0 to 2 percent slopes, about 5 miles south-southwest of Circleville, Pickaway Township, T. 3 N., R. 22 W., 1,750 feet south and 485 feet east of the northwest corner of sec. 7:

Ap—0 to 8 inches; very dark brown (10YR 2/2) silt loam; moderate fine and medium granular structure; friable; many medium roots; slightly acid; abrupt smooth boundary.

A12—8 to 12 inches; black (10YR 2/1) silt loam; moderate medium subangular blocky structure; friable; common fine roots; 2 percent coarse fragments; medium acid; clear wavy boundary.

A13—12 to 17 inches; very dark grayish brown (10YR 3/2) silt loam; moderate medium and coarse subangular blocky structure; friable; few fine roots; thin very patchy very dark brown (10YR 2/2) organic coatings on vertical and horizontal faces of peds; 4 percent coarse fragments; medium acid; clear wavy boundary.

B1t—17 to 21 inches; dark brown (7.5YR 4/4) loam; moderate medium and coarse subangular blocky structure; firm; few fine roots; thin very patchy very dark grayish brown (10YR 3/2) organic coatings and dark yellowish brown (10YR 4/4) clay films on vertical and horizontal faces of peds; 4 percent coarse fragments; medium acid; clear wavy boundary.

B21t—21 to 26 inches; brown (7.5YR 4/4) heavy loam; moderate medium subangular blocky structure; firm; few fine roots; thin very patchy dark brown (10YR 3/3) coatings and brown (10YR 4/3) clay films on vertical and horizontal faces of peds; 5 percent coarse fragments; strongly acid; clear wavy boundary.

B22t—26 to 31 inches; brown (7.5YR 4/4) sandy clay loam; moderate medium subangular blocky structure; firm; few fine roots; thin very patchy brown (10YR 4/3) clay films on vertical and horizontal faces of peds; 7 percent coarse fragments; medium acid; clear wavy boundary.

B23t—31 to 38 inches; brown (7.5YR 4/4) sandy clay loam; moderate fine and medium subangular blocky structure; firm; few fine roots; thin very patchy brown (10YR 4/3) clay films on vertical and horizontal faces of peds; 12 percent coarse fragments; slightly acid; clear wavy boundary.

B24t—38 to 44 inches; brown (7.5YR 4/4) gravelly clay loam; weak coarse subangular blocky structure; firm; thin very patchy brown (10YR 4/3) clay films on vertical and horizontal faces of peds; 15 percent coarse fragments; neutral; clear wavy boundary.

B31t—44 to 49 inches; dark yellowish brown (10YR 4/4) sandy clay loam; weak coarse subangular blocky structure; firm; thin very patchy brown (10YR 4/3) clay films on vertical and horizontal faces of peds; 10 percent coarse fragments; clear wavy boundary.

B32t—49 to 55 inches; dark yellowish brown (10YR 4/4) gravelly sandy clay loam; weak coarse subangular blocky structure; firm; thin very patchy dark brown (7.5YR 4/2) clay films on vertical faces of peds; common white (10YR 8/2) calcium carbonate accumulations; 15 percent coarse fragments; neutral; abrupt wavy boundary.

C—55 to 62 inches; brown (10YR 5/3) gravelly sand; single grain; loose; 40 percent coarse fragments; strong effervescence; moderately alkaline.

Thickness of the solum, depth to free carbonates, and depth to sand and gravel range from 40 to 70 inches. Thickness of the mollic epipedon ranges from 10 to 20 inches. Thickness of the silty alluvium or loess ranges from 0 to 20 inches.

The Ap horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is mainly silt loam but is loam in some pedons. The B2 horizon has hue of 10YR or 7.5YR. It generally has value of 4 or 5 and chroma of 4 to 6, but it has value of 3 and chroma of 2 or 3 in the upper part of some pedons. The B2 horizon is heavy loam, clay loam, sandy clay loam, gravelly clay loam, or gravelly sandy clay but has subhorizons of silty clay loam in the upper part of some pedons. The B2 horizon is 2 to

30 percent gravel by volume, and the amount of gravel generally increases as depth increases. The B2t horizon is strongly acid to neutral but generally becomes less acid as depth increases. The C horizon has hue of 10YR, value of 4 to 6, and chroma of 3 or 4. It is loamy sand, loamy coarse sand, sand, or coarse sand and gravelly analogs of these textures. This horizon is mildly alkaline or moderately alkaline.

Westland series

The Westland series consists of deep, very poorly drained soils on stream terraces and outwash plains. These soils formed in silty alluvium and loamy glacial outwash or entirely in loamy glacial outwash over stratified sand and gravel. Permeability is moderately slow in the subsoil and very rapid in the substratum. Slope is 0 to 2 percent.

Westland soils are commonly adjacent to the Algiers, Patton, Sleeth, and Sloan soils. Algiers and Sleeth soils are better drained, do not have a mollic epipedon, and do not have dominant low chroma throughout the subsoil. Patton soils formed in lakebed sediment on stream terraces and in upland basins. Sloan soils formed in alluvium on flood plains. They have an irregular distribution of organic matter with depth.

Typical pedon of Westland silty clay loam, about 5 miles north of Circleville, Walnut Township, T. 9., N., R. 21 W., 550 feet south and 1,300 feet west of the northeast corner of sec. 25:

Ap—0 to 8 inches; very dark gray (10YR 3/1) silty clay loam; moderate fine and medium granular structure; friable; common roots; 3 percent coarse fragments; neutral; clear smooth boundary.

A12—8 to 16 inches; black (10YR 2/1) silty clay loam; few fine distinct dark yellowish brown (10YR 4/4) mottles; moderate medium subangular blocky structure parting to moderate fine and medium granular; firm; common roots; 5 percent coarse fragments; slightly acid; clear wavy boundary.

B21t—16 to 23 inches; dark gray (10YR 4/1) clay loam; common fine distinct dark yellowish brown (10YR 4/4) and few medium prominent strong brown (7.5YR 5/6) mottles; weak coarse prismatic structure parting to moderate medium and coarse subangular blocky; firm; few roots; thin very patchy very dark gray (N 3/0) clay films on faces of peds; few medium very dark brown (10YR 2/2) iron and manganese stains; 10 percent coarse fragments; neutral; clear wavy boundary.

B22tg—23 to 35 inches; gray (10YR 5/1) clay loam; many medium distinct yellowish brown (10YR 5/6) and common fine distinct light olive brown (2.5Y 5/4), and olive brown (2.5Y 4/4) mottles; moderate coarse prismatic structure parting to moderate medium subangular blocky; firm; few roots; thin patchy dark gray (10YR 4/1) clay films on faces of peds; common medium black (10YR 2/1) iron and manganese stains; 8 percent coarse fragments; neutral; clear wavy boundary.

B23tg—35 to 47 inches; dark grayish brown (2.5Y 4/2) sandy clay loam; common medium prominent strong brown (7.5YR 5/6) and common medium distinct olive brown (2.5Y 4/4) mottles; weak very coarse prismatic structure parting to weak coarse subangular blocky; firm; few roots; thin very patchy dark gray (10YR 4/1) clay films on faces of peds; common medium black (10YR 2/1) iron and manganese stains; 12 percent coarse fragments; neutral; clear wavy boundary.

B3g—47 to 54 inches; grayish brown (10YR 5/2) gravelly sandy clay loam; common medium distinct dark gray (10YR 4/1) and few fine distinct strong brown (7.5YR 5/6) mottles; weak coarse subangular blocky structure; friable; 20 percent coarse fragments; mildly alkaline, moderately alkaline in pockets; abrupt irregular boundary.

C1—54 to 62 inches; dark grayish brown (10YR 4/2) gravelly sandy loam; common medium distinct grayish brown (10YR 5/2) and few medium distinct dark gray (10YR 4/1) mottles; massive; friable; 30 percent coarse fragments; strong effervescence; moderately alkaline; clear wavy boundary.

C2—62 to 78 inches; dark gray (N 4/0) gravelly sand; common medium distinct brown (10YR 4/3) mottles; single grain; loose; 15 percent coarse fragments; strong effervescence; moderately alkaline.

Thickness of the solum ranges from 40 to 60 inches.

The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The B horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 2 or less. It is typically clay loam in the upper part and sandy clay loam or gravelly sandy clay loam in the lower part, but has subhorizons of loam or silty clay loam in some pedons. The B horizon is neutral to medium acid in the upper part and neutral to moderately alkaline in the lower part. The C horizon has hue of 10YR or neutral, value of 4 or 5, and chroma of 0 to 2. It is gravelly sandy loam, gravelly sand, or sand.

Classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*11*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 17, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is 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 Aqualf (*Aqu*, meaning water, 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 Ochraqualfs (*Ochr*, meaning light colored surface layer, plus *aqualf*, the suborder of the Alfisols that have an aquic moisture regime).

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

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

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.

Formation of the soils

This section discusses the factors and processes of soil formation and explains the effects they have had on the formation of soils in Pickaway County.

Factors of soil formation

Soils are formed as a result of complex interactions among principal soil-forming factors. The major factors in soil formation are parent material, relief, climate, living organisms, and time.

Climate and living organisms, particularly vegetation, are the active forces of soil formation. Their effect on parent material is modified by relief and by the length of time the parent material has been acted upon. The relative importance of each factor differs from place to place. In some places, one factor dominates and determines most of the soil properties, but normally the interaction of all five factors determines what kind of soil forms in any given place.

Parent Material

Parent material of mineral soils is the unconsolidated mass of fine earth material resulting from the weathering of rock. Some kinds of parent material have been derived from bedrock in place, some have been transported into the county by glaciers, and some have been transported by water. The parent material largely determines the chemical and mineralogical composition of the soil.

The soils of Pickaway County originated from parent material of glacial till, glacial outwash and loess or combinations of these materials, lacustrine deposits, recent alluvium, and accumulated organic materials. Soils formed from glacial till are the most extensive. Miamian, Celina, and Crosby soils are examples. Soils formed from glacial outwash are generally loamy textured and commonly underlain by stratified sand and gravel. Examples of these are Eldean, Ockley, and Warsaw soils. A few soils in the county formed in lacustrine or slack water deposits of silty and clayey material. Examples of soils formed in lacustrine material are Montgomery, Patton, and Henshaw soils. Soils on flood plains formed in alluvium. They are commonly medium textured and have little or no soil development. Examples of these are Genesee and Eel soils. Carlisle soils are an example of soils formed in accumulated organic material.

Relief

Relief can account for the development of different kinds of soils from the same kind of parent material because of the resulting natural drainage conditions. This is illustrated by comparing the well drained Miamian soils with the somewhat poorly drained Crosby soils. Both soils formed in a similar kind of Wisconsin age glacial till. Commonly, a given set of soil characteristics is indirectly related to the slope and internal drainage.

Rainfall that does not infiltrate the soil runs off and collects on soils in depressions, or is removed through natural surface drainage. Therefore, sloping soils have less water intake and depressional soils have more water intake. Soils that have gentle slopes and significant movement of water downward through the soil commonly show the greatest degree of development. This is because these soils are neither saturated nor lack sufficient moisture for development.

Climate

The climate of Pickaway County is uniform enough that it has not greatly contributed to differences among the soils. It has been favorable to both chemical change and chemical weathering of parent materials and to biological activity.

Rainfall has been such that percolating water has been adequate to leach carbonates to moderate depths in Miamian, Crosby, and other soils. Translocation of clay and sesquioxides is accomplished by water percolating from the surface to the lower horizons.

The range in temperature has favored both physical change and chemical weathering of parent material. Freezing and thawing have aided in the development of soil structure. Warm temperatures in summer have favored chemical reactions in the weathering of primary minerals.

Both rainfall and temperature have promoted plant growth and subsequent accumulation of a high organic matter content in Corwin, Kokomo, Warsaw, and similar soils.

More information about climate in Pickaway County is given in the section "General nature of the county."

Living organisms

All living organisms play a role in the process of soil formation. These include vegetation, animals, bacteria, and fungi.

The original vegetation in Pickaway County was chiefly deciduous forest and grasses. Soils formed in the forests are light colored, acid, and moderate or low in natural fertility. These include Alexandria, Cardington, and Bennington soils. The well drained grassy clearings have dark colored, less acid and more fertile soils, such as Warsaw and Corwin soils. Some soils, such as Carlisle soils, formed in swampy areas under elm, white ash, or red maple.

Small animals such as insects, earthworms, and burrowing animals help keep the soil open and porous. Worm channels or casts are abundant in the surface layer of Corwin and Warsaw soils, which are high in organic matter content. Crawfish channels are most prevalent in the very poorly drained soils, such as Kokomo, Patton, and Westland soils.

The activities of man also affect the course of soil formation. Man plows and plants and introduces vegetation. He drains some areas, irrigates some, and removes soil material from others for construction purposes. The use of lime and fertilizer changes the chemistry of the soils. Each of these activities, in its own way, affects the future formation of soils.

Time

Time is needed for the other soil forming factors to produce their effects. The age of a soil is indicated, to some extent, by the degree of profile formation. In many places, factors other than time have been responsible for most of the differences in kind and distinctness of horizons in the different soils. If the parent material weathers slowly, the profile forms slowly. If the slopes are steep and the soil is removed almost as fast as it forms, no distinct horizons form.

Processes of soil formation

All of the factors of soil formation act in unison to control the processes by which horizons form. These processes are the additions, removals, transfers, and transformations of soil material. They are caused by basic chemical and physical interactions, such as oxidation, reduction, hydration, hydrolosis, solution, eluviation (leaching) and illuviation (accumulation), and other highly complex phenomena (*7*).

In this region the most evident addition to the soil is organic matter. Other additions are the deposition of sediment or accumulation of nutrients and colloidal matter from sources such as organic matter, ground water, lime, and fertilizers. Some nutrients move in a cycle from soil to plant and then back to the soil as byproducts of organic matter decomposition. This is true for all soils in the county, except where this cycle is modified by cropping. Alluvial soils, such as Genesee and Shoals soils, periodically receive sediment deposits from floodwater.

Soil is commonly lost by erosion, soluble salts are lost by leaching, colloids are lost by eluviation of percolating waters, and nutrients are lost by harvesting of crops.

Leaching of carbonates is one of the most significant losses that precedes other chemical changes in the solum. After the removal of carbonates, the alteration of minerals, such as biotite and feldspars, results in changes of color within the profile. Free iron oxides are produced. In places the oxides are segregated by a fluctuating high water table, and this results in formation of gray colors and mottling. The periodic or seasonal high water table causes reduction of iron oxides in Kokomo and Patton soils and is mainly responsible for the gray subsoil in these soils.

Seasonal wetting and drying of the soil profile is largely responsible for the transfer of clay from the A horizon to the ped surfaces in the B horizon. The fine clays become suspended in percolating water moving through the A horizon. They are carried by the water to the B horizon. There, the fine clays are deposited on the surfaces of peds by drying or by precipitation caused by free carbonates. This transfer of fine clay accounts for the patchy or nearly continous clay films on faces of peds in the B horizon of the Miamian and Celina soils.

Transformations of mineral compounds occur in most soils. The results are most apparent if the formation of horizons is not affected by rapid erosion or by accumulation of material at the surface. The primary silicate minerals are weathered chemically to produce secondary minerals, mainly those of the layer-lattice silicate clays. Most of the layer-lattice clays remain in the soil profile, but clay from the A horizon is transferred to deeper horizons.

References

(1) Allan, P. F., L. E. Garland, and R. Dugan. 1963. Rating northeastern soils for their suitability for wildlife habitat. 28th North Am. Wildl. Nat. Resour. Conf. Wildl. Manage. Inst., pp. 247-261, illus.

(2) Allen, Bernice and James W. Kerr. 1978. History and development of Pickaway County. Pickaway Cty. Hist. Soc., Pickaway Quart. vol. 20, No. 1, pp. 11 and 12.

(3) American Association of State Highway [and Transportation] Officials. 1970. Standard specifications for highway materials and methods of sampling and testing. Ed. 10, 2 vol., illus.

(4) American Society for Testing and Materials. 1974. Method for classification of soils for engineering purposes. ASTM Stand. D 2487-69. *In* 1974 Annual Book of ASTM Standards, Part 19, 464 pp., illus.

(5) Boyne, David H., Francis P. McCormick, Homer L. Carter, and Mark A. Evans. 1977. 1976 Ohio farm income. Ohio Agric. Res. and Dev. Cent. Ser. E.S.S. 553, 26 pp., illus.

(6) Ohio Soil and Water Conservation Needs Inventory. 1971. Sponsored by the U.S. Dep. Agric. Publ. by the Ohio Soil and Water Conserv. Needs Comm., Columbus, Ohio. 131 pp., illus.

(7) Simonson, Roy W. 1959. Outline of a generalized theory of soil genesis. Soil Sci. Soc. Am. Proc. 23: 152-156, illus.

(8) Smeck, N. E., L. P. Wilding, and N. Holowaychuck. 1968. Genesis of argillic horizons in Celina and Morley soils of western Ohio. Soil Sci. Soc. of Amer. Proc. 32: 550-556, illus.

(9) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus. [Supplements replacing pp. 173-188 issued May 1962]

(10) United States Department of Agriculture. 1961. Land capability classification. U.S. Dep. Agric. Handb. 210, 21 pp.

(11) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436, 754 pp., illus.

(12) United States Department of Agriculture. 1977. Ohio agricultural statistics. Ohio Crop Rep. Serv., Columbus, Ohio. 44 pp., illus.

(13) Williams Brothers. 1880. History of Franklin and Pickaway Counties, Ohio. Publ. by William Brothers. 593 pp., illus.

Glossary

Ablation till. Loose, permeable till deposited during the final downwasting of glacial ice. Lenses of crudely sorted sand and gravel are common.

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.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	More than 12

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.

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

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

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a fragment.

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

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

Coarse fragments. Mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter.

Coarse textured soil..Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

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

Compressible (in tables). Excessive decrease in volume of soft soil under load.

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.

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 (or contour farming). Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Depth to rock. 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 for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Esker (geology). A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Fast intake (in tables). The rapid movement of water into the soil.

Favorable. Favorable soil features for the specified use.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 37.5 centimeters) long.

Flooding. The temporary covering of soil with water from overflowing streams, runoff from adjacent slopes, and tides. Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; *November-May*, for example, means that flooding can occur during the period November through May. Water standing for short periods after rainfall or commonly covering swamps and marshes is not considered flooding.

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.

Forage. Plant material used as feed by domestic animals. Forage can be grazed or cut for hay.

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 melt water.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial melt water. Many deposits are interbedded or laminated.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Green manure (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 underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

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 upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hummocky. Refers to a landscape of hillocks, separated by low sags, having sharply rounded tops and steep sides. Hummocky relief resembles rolling or undulating relief, but the tops of ridges are narrower and the sides are shorter and less even.

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.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

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.

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Light textured soil. Sand and loamy sand.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous areas. Areas that have little or no natural soil and support little or no vegetation.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, end, and ground.

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).

Muck. Dark colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by glacial melt water.

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.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, differences in 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. The water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Productivity (soil). The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

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 groundwater runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 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 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	Less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single 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.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

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.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

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 it can soak into the soil or flow slowly to a prepared outlet without harm. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area 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.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the low lands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Varve. A sedimentary layer or a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by melt water streams, in a glacial lake or other body of still water in front of a glacier.

Water table. The upper limit of the soil or underlying rock material that is wholly saturated with water.

Water table, apparent. A thick zone of free water in the soil. An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Water table, artesian. A water table under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

Water table, perched. A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.