United States
Department of
Agriculture

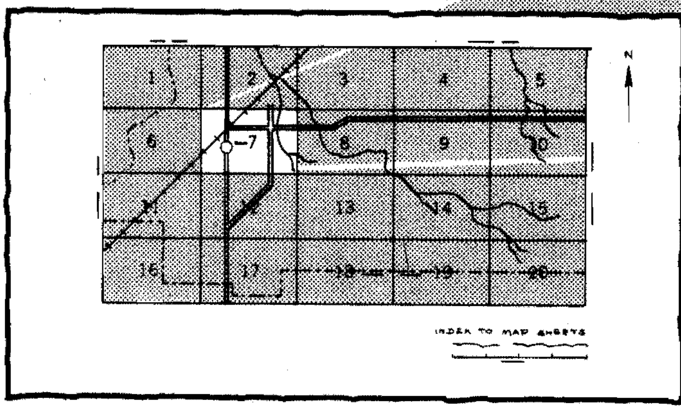
Soil
Conservation
Service

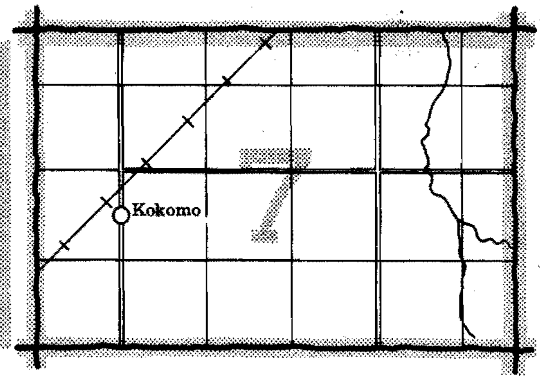
In Cooperation with the
Ohio Department of
Natural Resources,
Division of Lands and
Soil, and the Ohio
Agricultural Research
and Development
Center

Soil Survey of Carroll County Ohio

HOW TO USI

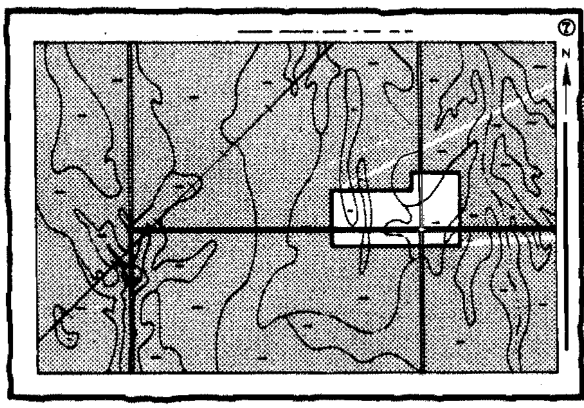
1. Locate your area of interest on the "Index to Map Sheets" (the last page of this publication).

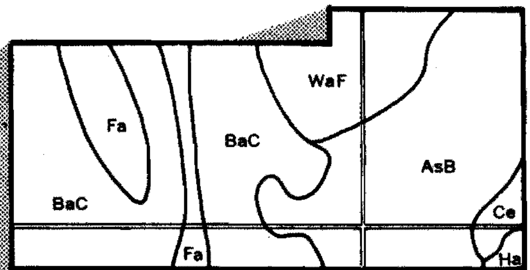




2. Note the number of the map sheet and turn to that sheet.

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





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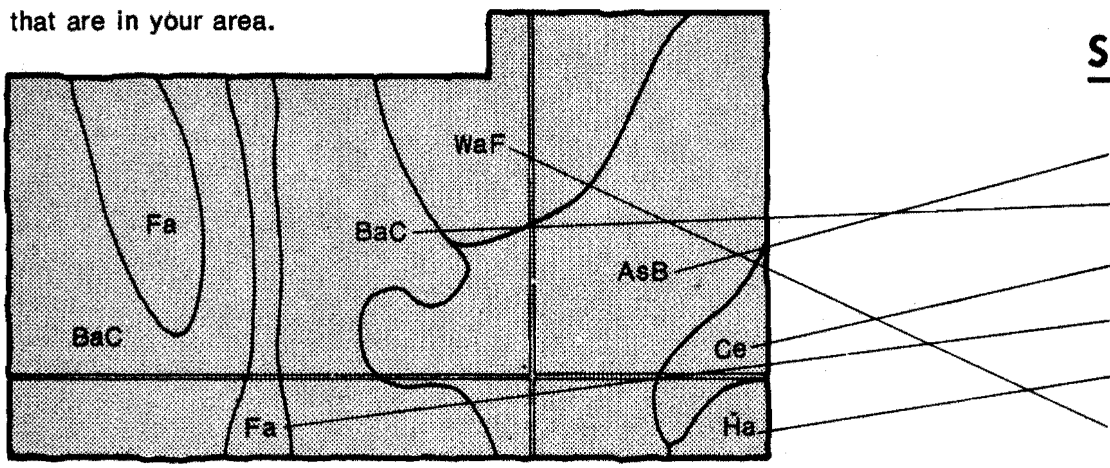

Symbols

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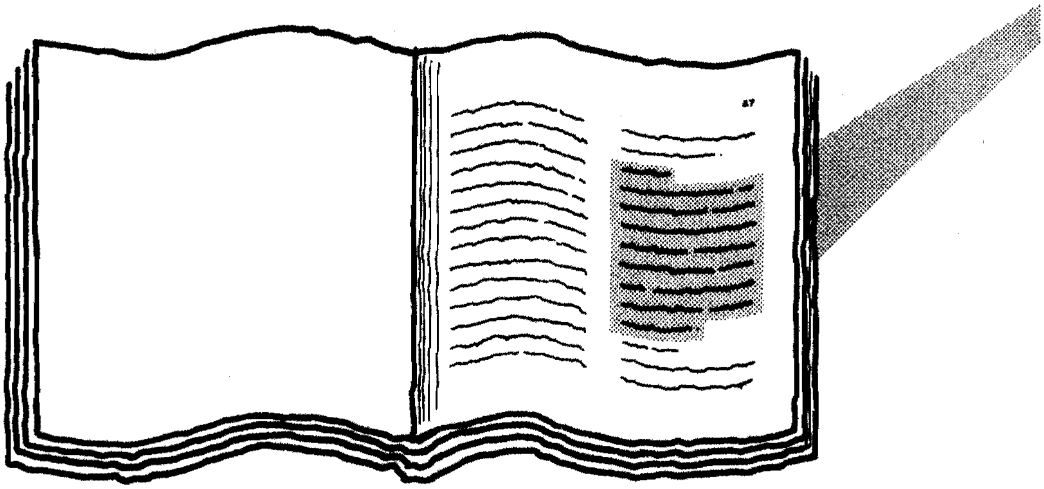
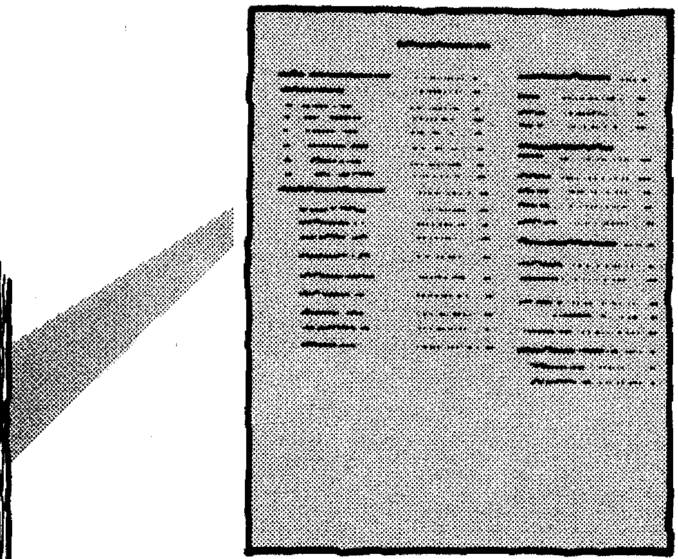
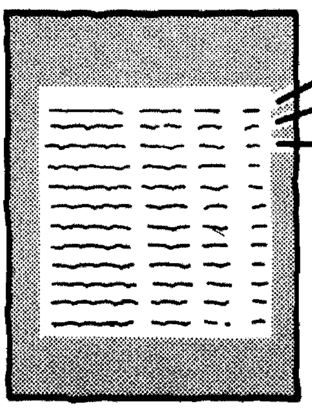
THIS SOIL SURVEY

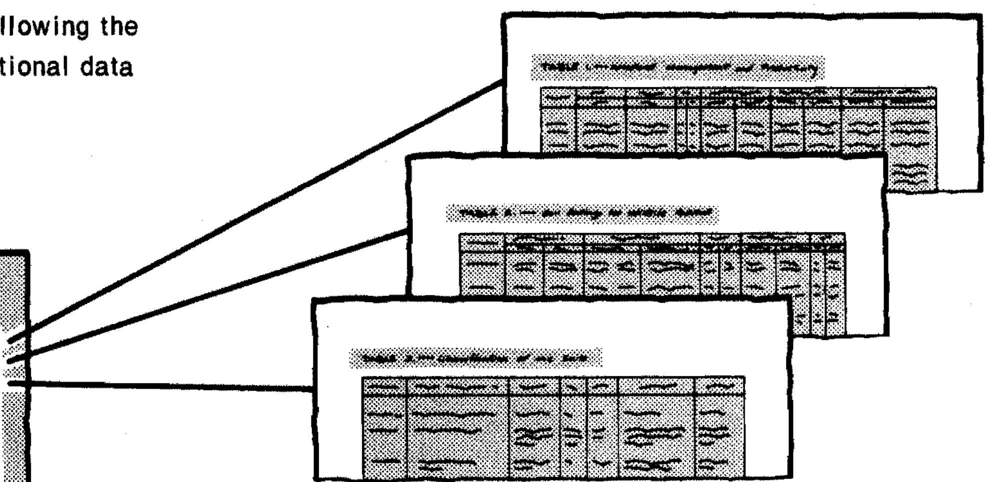
5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.





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.

This survey was made cooperatively by the Soil Conservation Service; 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 Carroll Soil and Water Conservation District. Financial assistance was provided by the Carroll County Commissioners. Major fieldwork was performed in the period 1974-80. Soil names and descriptions were approved in 1981. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1981.

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: Typical landscape in Carroll County. The farm buildings are on Westmoreland-Coshocton silt loams, 8 to 15 percent slopes.

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soil series

Issued May 1983

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foreword

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

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

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

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

Robert R. Shaw
State Conservationist
Soil Conservation Service

soil survey of
Carroll County, Ohio

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

general nature of the county

CARROLL COUNTY is in the eastern part of Ohio (fig. 1). It has a total area of 249,856 acres, or 390 square miles. In 1980, the population was 25,473 (*23*). About 78 percent of the population is rural. Carrollton, the county seat, is the largest town completely within the county. It has a population of 3,054 (*23*). Minerva, which lies within both Carroll and Stark Counties, is somewhat larger than Carrollton. The smaller villages include Dellroy, Leesville, Magnolia, Malvern, and Sherrodsville.

No interstate or federal highways pass through the county. State Route 43 passes through Carrollton and Malvern. It links the industrial cities of Canton, which is in Stark County, and Steubenville, which is in Jefferson County.

About 52 percent of the acreage in the county is used for farming (*21*). The rest is used for residential, industrial, recreational, and other purposes. Most of the farms are general farms, which are characterized by several kinds of farming enterprises. Dairy products are the largest source of local farm revenue.

Figure 1.—Location of Carroll County in Ohio.

climate

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

Carroll County is cold in winter but generally hot in summer. Winter precipitation, frequently snow, results in a good accumulation of soil moisture by spring and minimizes drought during summer on most soils. The normal annual precipitation is adequate for all crops suited to the temperature and growing season in the county.

Table 1 gives data on temperature and precipitation for the survey area as recorded at New Philadelphia in the period 1960 to 1978. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 27 degrees F, and the average daily minimum temperature is 18 degrees. The lowest temperature on record, which occurred at New Philadelphia on January 18, 1977, is minus 18 degrees. In summer the average temperature is 70 degrees, and the average daily maximum temperature is 83 degrees. The highest recorded temperature, which occurred on July 4, 1966, is 99 degrees.

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

Of the total annual precipitation, 22 inches, or 55 percent, usually 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 19 inches. The heaviest 1-day rainfall during the period of record was 4.50 inches at New Philadelphia on July 5, 1969. Thunderstorms occur on about 36 days each year, and most occur in summer.

Average seasonal snowfall is about 37 inches. The greatest snow depth at any one time during the period of record was 18 inches. On an average of 10 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 85 percent. The sun shines 70 percent of the time possible in summer and 45 percent in winter. The prevailing wind is from the southwest. Average windspeed is highest, 12 miles per hour, in winter.

physiography, relief, geology, and drainage

Carroll County is on the unglaciated, dissected Allegheny Plateau. The underlying bedrock is mainly sandstone, siltstone, clay shale, and limestone, all of which were derived from sediments laid down during the Pennsylvanian period. Later, these rocks were elevated above sea level and then were eroded and at least partly leveled. Many of the ridges in the county are at elevations of 1,240 to 1,280 feet above sea level. They are considered part of the Harrisburg Peneplain. In many areas in the eastern part of the county, isolated hills or ridges called "monadnocks" rise above the Harrisburg level (*16*).

The underlying sedimentary rocks belong to the Allegheny, Conemaugh, and Monongahela Formations of the Pennsylvanian System. The rock strata are not horizontal or regularly sloping. In general, the eastern component of the dip is slight and the slope to the south the most marked, but the regularity of the dip is broken by many structural noses and ridges, which slope in a southerly direction (*13*). Rock layers of the Allegheny Formation crop out on the side slopes in Brown and Rose Townships and the western part of Harrison Township (*5, 6, 7, 24*). They are at the lower elevations along the major streams in all townships, except for Lee and Loudon. Rock strata of the Conemaugh Formation cap those of the Allegheny Formation throughout much of the county (*4, 8, 9*). Bedrock strata of the Monongahela Formation cap a few ridgetops near the southeast corner.

The water in most of the county drains into the Tuscarawas and Muskingum Rivers through Conotton Creek, which crosses the southwestern part, and through Sandy Creek, which crosses the northwestern part. A small area in the southwest corner is drained through Little Stillwater Creek into the Tuscarawas River. Most of the eastern part of the county is drained by tributaries of Yellow Creek, but a small area in the northeastern part is drained by tributaries of the West Fork of Little Beaver Creek. The divide between watersheds of the Muskingum River and the Ohio River is called the Flushing escarpment. It passes through the eastern part of the county. Since pre-Pleistocene time, this escarpment has been the divide separating major streams, and the drainage pattern in the county has changed very little.

During the Pleistocene epoch, however, glaciation north of this survey area altered the drainage pattern of the major streams to the east and to the west (*16*). The valleys of Sandy and Conotton Creeks were cut to levels about 100 feet below the present level of their streams during pre-Illinoian time. Glacial outwash was deposited along the valley of Sandy Creek during Wisconsin time and perhaps during Illinoian time (*5, 6, 24*). The fill material in the other stream valleys in the county consists of nonglacial deposits of Pleistocene age formed while water was ponded in the valleys by ice and by glacial outwash dams downstream (*4, 7, 8, 9*).

The average local relief is about 200 feet. The highest point in the county, which is near the northern border, in

East Township, is 1,375 feet above sea level. The lowest point, in an area in the southwestern part of Rose Township where Beggar Run leaves the county, is 900 feet above sea level.

farming and other land uses

Although the acreage of farmland has decreased steadily since the turn of the century, it is about half of the acreage in the county (*22*). About half of the farmland is used for crops, including corn, wheat, oats, and hay, which commonly are grown in contour strips. The other half of the farmland is pasture or farm woodlots. About half of the local farm income is from the sale of dairy products, about one-fifth is from the sale of cattle, calves, poultry, and poultry products, and one-fifth is from the sale of crops.

Most of the farms are managed by the owner, who typically resides on the farm. More than half of the farmers work at least part-time off the farm. In recent years, the number of farmers has steadily declined and the average size of active farms has increased.

Almost half of the acreage in the county is not actively farmed. About three-fourths of the nonfarm acreage is woodland. Less than 5 percent has been developed for residential, commercial, or industrial uses (*12*). Most of the commercial and industrial land is in or near Carrollton, Minerva, and Malvern, the three largest villages. Less than one-third of the nonfarm population, however, resides in these villages. The rest generally resides in the smaller villages or in small subdivisions, including those near Atwood Lake, Leesville Lake, and Lake Mohawk. Much of the most recent residential development is near Lake Mohawk or in the mobile home parks in the northwestern part of the county.

More than one-tenth of the nonfarm acreage is used for recreational purposes. Since the creation of the lakes in the Muskingum Watershed Conservancy District, many areas have been developed for recreational uses. A number of privately owned recreational areas and summer youth campgrounds have facilities for camping, fishing, hiking, swimming, picnicking, and similar activities. Also, several sportsmen's clubs and service organizations own recreational areas. Nonresidents own many of the lots near Atwood Lake, Leesville Lake, and Lake Mohawk. They use the lots for access to recreational facilities. The acreage of the county used for recreational purposes is likely to increase in the future.

natural resources and industries

The most important natural resources in Carroll County are soil, various bedrock layers that crop out on hillsides, sand and gravel, water, and oil and natural gas.

Scattered areas throughout all parts of the county, except for the central part, have been surface mined. Clay, shale, and coal deposits of the Allegheny Formation have been mined in the western part. Sandstone from the Conemaugh Formation has been quarried near Lindentree for foundry sand and near Sherrodsville for dimension and rough construction stone. Mahoning coal has been surface mined in the northern and western parts, and Ames limestone and Harlem coal have been mined in many areas in the southeastern part. Sand and gravel have been removed from several areas along Sandy Creek.

The gravelly fill in the valley of Sandy Creek can supply water for heavy industrial use. Wells in the fill of other valleys generally are adequate for residential use. In some areas, however, they are unsuitable even for residential use because of contamination by mine waste. Most of the wells in the underlying sandstone layers of the Pottsville, Allegheny, and Conemaugh Formations are adequate for residential use. Brine generally is at a depth of 300 feet or more. Most of the farms have one or more good springs suitable for watering livestock or for domestic use. Also, runoff water can be used if suitable ponds are available.

Most of the natural gas produced in the county is from wells in Berea sandstone of the Mississippian System and in "Clinton" sands of the Silurian System. The approximate depths of these wells are 1,000 feet and 5,500 feet, respectively. Most of the oil wells have been drilled into the Berea sandstone.

history

Although there is no evidence of any Indian village, the area now known as Carroll County was traversed by several Indian trails. The Great Trail, which followed Sandy Creek in the county, is an example. It was used by settlers headed for the Tuscarawas Valley in the late 1700's.

The first known settlers within the current boundaries of the county arrived around 1802 (*10, 11*). Settlements grew along Sandy and Conotton Creeks and along other travel routes west from the Ohio River. The county was established in 1832 from parts of the five surrounding counties. By 1840, the population was 18,108, a figure which was not exceeded for the next 100 years.

Construction of the Sandy and Beaver Canal, designed to link the upper part of the Ohio River with the Ohio and Erie Canal, began in the 1820's. It was not completed until 20 years later, when railroad lines were being expanded. The railroad doomed the canal to failure. Construction of the railroad line that linked Carrollton to Canton and Sherrodsville in the 1880's was considered the turning point in the county's history. It made possible the shipment of coal from Dellroy and Sherrodsville mines to northern Ohio. It resulted in a rapid increase in the extent of coal mining near those villages and in the production of tile and brick in Carrollton and Malvern.

Mining activity declined around the turn of the century. When the Atwood Dam was constructed in the 1930's, the railroad line from Carrollton to Sherrodsville was abandoned, leaving Carrollton at the end of a branch line to Canton. As a result, further industrial development in the county seat was discouraged. The creation of the scenic Atwood and Leesville Lakes, however, helped to make this inherently rural county a center for outdoor recreation.

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; 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 in this survey area are described under "General soil map units" and "Detailed soil map units."

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.

general soil map units

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

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

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

soil descriptions

1. Westmoreland-Coshocton association

Deep, dominantly gently sloping to steep, well drained and moderately well drained soils formed in residuum and colluvium derived from sandstone, siltstone, and shale; on uplands

This association consists of gently undulating to very hilly soils on ridgetops and on side slopes dissected by intermittent drainageways. The ridgetops range from several hundred to several thousand feet wide. The soils on the narrow ridgetops dominantly are strongly sloping, and those on the broader ones are gently sloping and strongly sloping. The soils on the side slopes are moderately steep and steep. Springs and seepy areas are common in the drainageways. Narrow flood plains and terraces are along the larger streams.

This association makes up about 59 percent of the county. It is about 40 percent Westmoreland soils, 20 percent Coshocton soils, and 40 percent soils of minor extent.

The strongly sloping to steep, well drained Westmoreland soils are on the side slopes and ridgetops. On the side slopes, they commonly occur as wide bands alternating with narrow bands of the Coshocton soils. On some of the ridgetops, they occur as areas intricately mixed with areas of the Coshocton soils. Typically, the surface layer is brown silt loam. The subsoil is yellowish brown and light olive brown silt loam, silty clay loam, and channery silty clay loam. Bedrock is dominantly at a depth of 40 to 72 inches but is deeper in some areas. Permeability and available water capacity are moderate.

The Coshocton soils are moderately well drained and gently sloping to moderately steep. Typically, the surface layer is brown silt loam. The subsoil is yellowish brown and brown silt loam, silty clay loam, shaly clay loam, and shaly silt loam. It is mottled below a depth of about 11 inches. Bedrock is dominantly at a depth of 40 to 72 inches but in some areas is deeper. Permeability is slow or moderately slow, and available water capacity is moderate. A perched seasonal high water table is at a depth of 18 to 42 inches in winter and in spring and other extended wet periods.

The most extensive minor soils in this association are the moderately deep Berks soils and the Hazleton and Rigley soils, all three of which are on ridgetops and side slopes; the moderately well drained Glenford soils on slack water terraces; and the somewhat poorly drained Orrville soils on flood plains. The subsoil of Hazleton and Rigley soils is coarser textured than that of the major soils.

Most of the areas on ridgetops and the gentler side slopes are used as cropland or pasture. The soils in these areas are well suited to cropland, pasture, and woodland. The steeper soils are less well suited to these uses, mainly because erosion is a hazard. Minimizing tillage, contour stripcropping, including grasses and legumes in the cropping system, planting cover crops, and incorporating crop residue into the plow layer help to control erosion on cropland. Grassed waterways and diversions help to control surface water. The steeper soils are used as woodland. The slope limits the use of logging equipment in some areas. Because of the hazard of erosion, logging roads and skid trails should be built on the contour if possible. Also, the wooded areas should not be clearcut.

The gently sloping and strongly sloping soils are moderately well suited to building site development, septic tank absorption fields, and recreational uses, but the moderately steep and steep soils are poorly suited or generally unsuited. The main limitations are the wetness and slow or moderately slow permeability in the Coshocton soils and the slope of both the major soils.

Because bedrock is as shallow as 40 inches in some areas, the soils are better suited to dwellings without basements than to dwellings with basements. Waterproofing basement walls and installing drains at the base of footings in the Coshocton soils help to keep water away from basements. Removing as little vegetation as possible, mulching, and establishing a temporary plant cover help to control erosion on construction sites.

2. Berks-Westmoreland association

Moderately deep and deep, dominantly gently sloping to very steep, well drained soils formed in residuum and colluvium derived from sandstone, siltstone, and shale; on uplands

This association consists of undulating to very steep soils on ridgetops and side slopes dissected by drainageways. The soils on the side slopes are moderately steep to very steep. The ridgetops generally are 150 to 1,000 feet wide. Narrow flood plains are along the larger streams.

This association makes up about 15 percent of the county. It is about 50 percent Berks soils, 20 percent Westmoreland soils, and 30 percent soils of minor extent.

The gently sloping to very steep, moderately deep Berks soils are on ridgetops and side slopes. Typically, the surface layer is brown shaly silt loam. The subsoil is brown and yellowish brown shaly and very shaly silt loam. Bedrock is at a depth of 20 to 40 inches. Permeability is moderate or moderately rapid, and available water capacity is very low.

The strongly sloping and moderately steep, deep Westmoreland soils also are on ridgetops and side slopes. Typically, the surface layer is dark brown silt loam. The subsoil is yellowish brown and light olive brown silt loam, silty clay loam, and channery silty clay loam. Bedrock is dominantly at a depth of 40 to 72 inches but in some areas is deeper. Permeability and available water capacity are moderate.

The most extensive minor soils in this association are the moderately well drained Coshocton soils on the ridgetops and side slopes, the well drained Elba soils on ridgetops and isolated hills, and the somewhat poorly drained Orrville soils on flood plains.

Most of the gently sloping and strongly sloping areas are used as cropland, pasture, or woodland. The steeper areas are used as woodland. These soils are suited to cropland, pasture, and woodland. Erosion and droughtiness are the major concerns of management. Minimizing tillage, contour stripcropping, planting cover crops, including grasses and legumes in the cropping system, and incorporating crop residue into the plow layer help to control erosion and conserve moisture. Grassed waterways and diversions help to control surface water. Measures that prevent overgrazing help to control erosion in pastured areas. The steep and very steep slopes limit the use of logging equipment. Because of the hazard of erosion, logging roads and skid trails should be built on the contour if possible. Also, the wooded areas should not be clearcut.

The gently sloping and strongly sloping soils are moderately well suited or well suited to building site development and moderately well suited to septic tank absorption fields. The steeper soils, however, are poorly suited or generally unsuited. The main limitations are the moderate depth to bedrock in the Berks soils and the slope of both the major soils. The bedrock commonly is rippable. Removing as little vegetation as possible, mulching, and establishing a temporary plant cover help to control erosion on construction sites.

3. Rigley-Westmoreland association

Deep, dominantly gently sloping to steep, well drained soils formed in residuum and colluvium derived from sandstone, siltstone, and shale; on uplands

This association consists of undulating to very hilly soils on ridgetops and side slopes dissected by drainageways. The ridgetops generally are at higher elevations than those in areas of the other associations on uplands. Most are 150 to 1,000 feet wide. The soils on the side slopes are moderately steep and steep. Most of the major drainageways are bordered by very narrow flood plains.

This association makes up about 8 percent of the county. It is about 50 percent Rigley soils, 35 percent Westmoreland soils, and 15 percent soils of minor extent.

The gently sloping to steep Rigley soils are on ridgetops and side slopes. Typically, the surface layer is brown sandy loam. The subsoil is dark brown and yellowish brown fine sandy loam and channery loamy sand. Permeability is moderately rapid, and available water capacity is moderate.

The strongly sloping and moderately steep Westmoreland soils commonly are on ridgetops and on the lower parts of side slopes, below the steeper areas of Rigley soils. Typically, the surface layer is dark brown silt loam. The subsoil is yellowish brown and light olive brown silt loam, silty clay loam, and channery silty clay loam. Bedrock is dominantly at a depth of 40 to 72 inches but in some areas is deeper. Permeability and available water capacity are moderate.

The most extensive minor soils in this association are the moderately deep Culleoka soils on ridgetops, the moderately well drained Coshocton soils on ridgetops and the lower parts of side slopes, and the somewhat poorly drained Orrville soils on flood plains.

Most of the gently sloping and strongly sloping areas are used as cropland or pasture. The steeper areas are used as woodland. These soils are suited to cropland, pasture, and woodland. Erosion is the main concern of management. It can be controlled by minimizing tillage, planting cover crops, contour stripcropping, including grasses and legumes in the cropping system, and incorporating crop residue into the plow layer. Grassed waterways and diversions help to control surface water. Measures that prevent overgrazing help to control erosion in the pastured areas. The steep slopes limit the use of logging equipment. Because of the hazard of erosion, logging roads and skid trails should be built on the contour if possible. Also, the wooded areas should not be clearcut.

The gently sloping and strongly sloping soils are suited or moderately well suited to building site development and septic tank absorption fields, but the steeper soils are poorly suited. The main limitations are the slope of both the major soils and the depth to bedrock in the Westmoreland soils. Removing as little vegetation as possible, mulching, and establishing a temporary plant cover help to control erosion on construction sites.

4. Coshocton-Westmoreland association

Deep, dominantly gently sloping and strongly sloping, moderately well drained and well drained soils formed in residuum and colluvium derived from sandstone, siltstone, and shale; on uplands

This association mainly consists of gently sloping soils on broad ridgetops and strongly sloping soils on side slopes (fig. 2). The ridgetops commonly are 1/2 mile to more than 1 mile wide. Differences in elevation generally are less than 50 feet. Isolated hills, commonly 50 to 75 feet high and less than 1,000 feet across at the base, are on some of the broad ridges.

This association makes up about 6 percent of the county. It is about 40 percent Coshocton soils, 25 percent Westmoreland soils, and 35 percent soils of minor extent.

The gently sloping and strongly sloping, moderately well drained Coshocton soils are on broad ridgetops and are adjacent to the Westmoreland soils on side slopes. Typically, the surface layer is brown silt loam. The subsoil is yellowish brown and brown silt loam, silty clay loam, shaly clay loam, and shaly silt loam. It is mottled below a depth of about 11 inches. Bedrock is dominantly at a depth of 40 to 72 inches but in some areas is

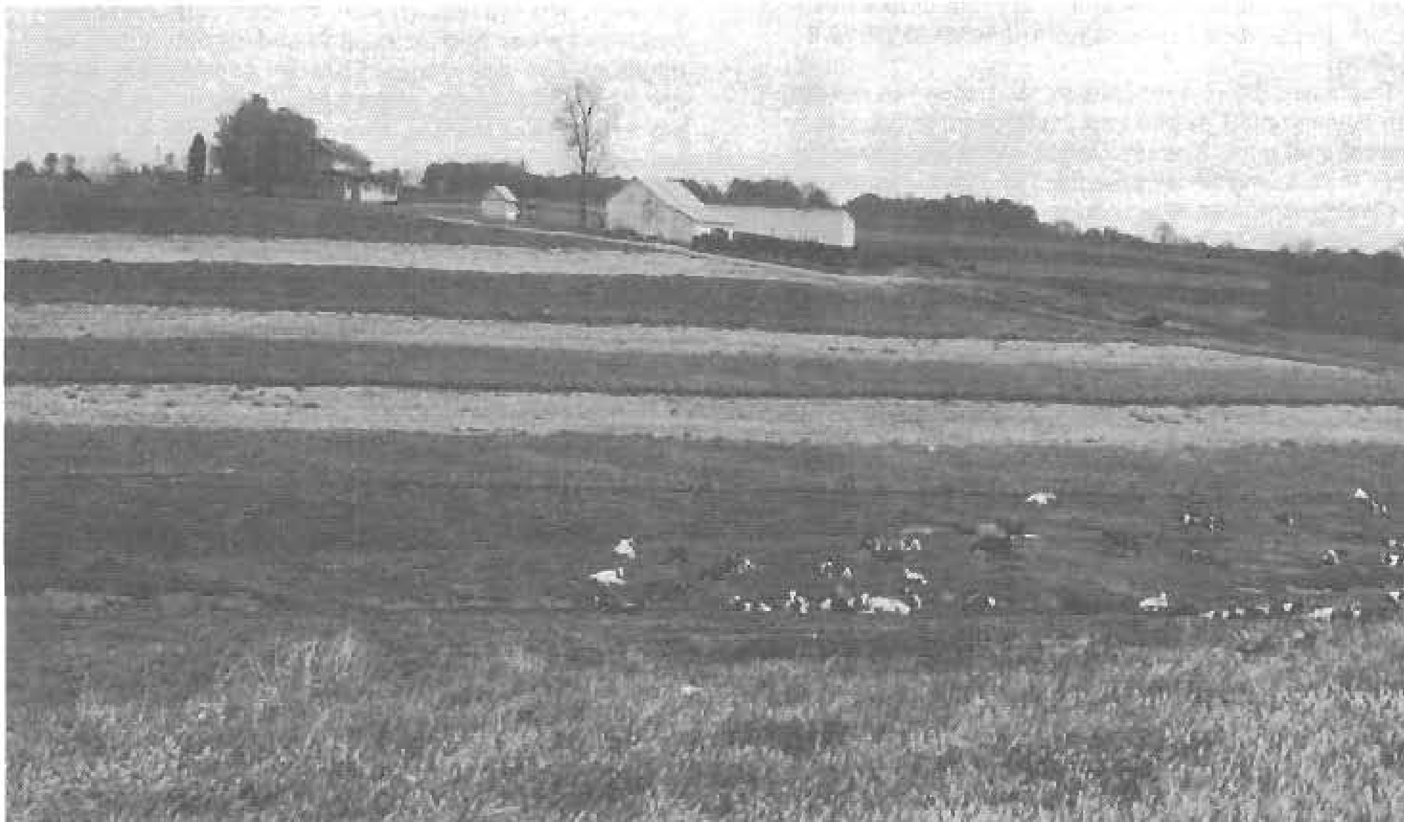

Figure 2.—Typical area of the Coshocton-Westmoreland association. These gently sloping and strongly sloping soils commonly are used as cropland or pasture.

deeper. Permeability is slow or moderately slow, and available water capacity is moderate. A perched seasonal high water table is at a depth of 18 to 42 inches in winter and in spring and other extended wet periods.

The strongly sloping, well drained Westmoreland soils are on side slopes along waterways and on somewhat narrow ridgetops. Typically, the surface layer is brown silt loam. The subsoil is yellowish brown and light olive brown silt loam, silty clay loam, and channery silty clay loam. Bedrock is dominantly at a depth of 40 to 72 inches but in some areas is deeper. Permeability and available water capacity are moderate.

The most extensive minor soils in this association are the moderately deep Culleoka and moderately well drained Keene soils on ridgetops and the moderately deep Berks soils on ridgetops and side slopes.

Much of this association is cropland or pasture. Groves of trees are on the steeper slopes adjacent to drainageways. The association is suited to cropland, pasture, and woodland. Controlling erosion is the major concern of management. Also, the surface layer crusts after heavy rainfall. Minimizing tillage, farming on the contour, including grasses and legumes in the cropping system, and incorporating crop residue into the plow layer help to control erosion and prevent deterioration of tilth. A grass cover in drainageways helps to prevent gullying.

This association is moderately well suited to building site development, septic tank absorption fields, and recreational uses. The undulating areas are appealing sites for housing developments. The main limitations are the wetness and slow or moderately slow permeability in the Coshocton soils and the slope of both the major soils. Land shaping is needed in some areas. Because bedrock is as shallow as 40 inches in some areas, the soils are better suited to dwellings without basements than to dwellings with basements. Waterproofing basement walls and installing drains at the base of footings in the Coshocton soils help to keep water away from basements.

5. Bethesda-Westmoreland association

Deep, dominantly strongly sloping to very steep, well drained soils formed in material mixed by surface mining and in residuum and colluvium derived from sandstone, siltstone, and shale; on uplands

This association consists of strongly sloping to very steep soils on side slopes, ridgetops, and toe slopes. Spoil ridges and clifflike walls of exposed bedrock are distinctive features of the landscape. These spoil ridges commonly are 25 to 100 feet high. In many areas the top of the ridge has been graded and thus is a continuous ridgetop 50 to 100 feet wide. The walls of exposed bedrock commonly are 50 to 100 feet high and range from several hundred feet to several miles long. They are the result of the latest excavation into the hillside. Small water impoundments are at the base of some of the walls.

This association makes up about 2 percent of the county. It is about 40 percent Bethesda soils, 15 percent Westmoreland soils, and 45 percent soils of minor extent.

The strongly sloping to very steep Bethesda soils are on spoil ridges. Typically, the surface layer is dark grayish brown channery clay loam. The substratum is multicolored very channery clay loam and shaly silty clay loam. Permeability is moderately slow, and available water capacity is low.

The strongly sloping to steep Westmoreland soils are on side slopes, on toe slopes, at the base of spoil ridges, and on ridgetops surrounded by the walls of exposed bedrock. Typically, the surface layer is dark brown silt loam. The subsoil is yellowish brown and light olive brown silt loam, silty clay loam, and channery silty clay loam. Bedrock is dominantly at a depth of 40 to 72 inches but in some areas is deeper. Permeability and available water capacity are moderate.

The most extensive minor soils in this association are Fairpoint and Morristown soils on spoil ridges and in reclaimed areas and Coshocton and Hazleton soils on ridgetops and side slopes. Fairpoint and Morristown soils are less acid than the major soils. Coshocton soils are moderately well drained. Hazleton soils have a subsoil of loam, sandy loam, or the channery or very channery analogs of these textures. A few areas have been reclaimed by grading and by blanketing the surface with a layer of material removed from other soils.

This association dominantly is woodland or is reverting to woodland. Most of the areas that were surface mined support some scrubby trees. In some areas, however, black locust and pine have been planted. The Bethesda soils generally are unsuited to cropland and unsuited or poorly suited to pasture. Though the slope and irregular shape of some areas are limitations, the Westmoreland soils are better suited to cropland. They are suited to woodland and moderately well suited or well suited to pasture.

The Westmoreland soils are better sites for buildings and septic tank absorption fields than the Bethesda soils. Onsite investigation is needed to determine the suitability of specific areas of the Bethesda soils. Cutting and filling in these areas increase the hazard of hillside slippage. Because bedrock is as shallow as 40 inches in some areas, the Westmoreland soils are better suited to dwellings without basements than to dwellings with basements. Removing as little vegetation as possible, mulching, and establishing a temporary plant cover help to control erosion on construction sites.

6. Sebring-Fitchville-Glenford association

Deep, dominantly nearly level and gently sloping, poorly drained to moderately well drained soils formed in lacustrine sediments; on slack water terraces

This association is on slack water terraces that occur as benches above the narrow flood plains along low-gradient streams. The terraces are only a few hundred feet wide near the upper end of valleys but are as much as 1 mile wide in the broader valleys. The longest area is more than 10 miles long. Differences in elevation generally are less than 20 feet.

This association makes up about 4 percent of the county. It is about 40 percent Sebring soils, 20 percent Fitchville soils, 15 percent Glenford soils, and 25 percent soils of minor extent.

The nearly level, poorly drained Sebring soils are in the lowest areas on the slack water terraces. Typically, the surface layer is gray silt loam. The subsoil is gray and light gray, mottled silt loam and silty clay loam. Permeability is moderately slow, and available water capacity is high. The seasonal high water table is near or above the surface during extended wet periods. These soils are frequently ponded.

The nearly level and gently sloping, somewhat poorly drained Fitchville soils are in an intermediate position between the Sebring and Glenford soils on the terraces. Typically, the surface layer is dark grayish brown silt loam. The subsoil is yellowish brown and brown, mottled silty clay loam. Permeability is moderately slow, and available water capacity is high. A perched seasonal high water table is at a depth of 12 to 30 inches during extended wet periods.

The gently sloping, moderately well drained Glenford soils are in the lowest areas on the terraces. Typically, the surface layer is dark grayish brown silt loam. The subsoil is yellowish brown and strong brown silt loam and silty clay loam. It is mottled below a depth of about 18 inches. Permeability is moderately slow, and available water capacity is moderate or high. A perched seasonal high water table is at a depth of 24 to 42 inches during extended wet periods.

The most extensive minor soils in this association are the very poorly drained, moderately fine textured Lorain soils on slack water terraces; the very poorly drained Holly soils on flood plains; and the well drained Westmoreland soils on uplands.

Most of this association is pasture, wetland, or woodland. Some of the wider gently sloping areas are used as cropland. Unless drained, the Sebring soils are poorly suited to cropland and pasture. They are suited to habitat for wetland wildlife. The Fitchville and Glenford soils are suited to cropland and pasture. Drainage ditches help to conduct runoff from uplands to natural drainageways. Subsurface drains are needed to remove excess water from the subsoil, but drainage outlets are available only in a few areas. The surface layer crusts after heavy rainfall. Restricted grazing when the soil is wet helps to prevent surface compaction in the pastured areas.

This association is suited to woodland. The ponding on the Sebring soils, however, limits the use of planting and harvesting equipment. The trees that can tolerate wetness should be selected for planting on the Sebring and Fitchville soils.

The Glenford soils are moderately well suited to building site development and septic tank absorption fields, but the Fitchville soils are poorly suited and the Sebring soils generally are unsuited. The Fitchville and Glenford soils are better suited to dwellings without basements than to dwellings with basements. The ponding, the seasonal wetness, and the moderately slow permeability are the main limitations. Surface and subsurface drains reduce the wetness. Waterproofing basement walls and installing drains at the base of footings help to keep water away from basements. Septic tank absorption fields can be improved by installing curtain drains in areas where drainage outlets are available and by enlarging the absorption field. Installing a drainage system and providing suitable base material help to prevent the damage to local roads and streets caused by low strength and frost action.

7. Glenford-Tioga association

Deep, dominantly nearly level to strongly sloping, moderately well drained and well drained soils formed in lacustrine sediments and alluvium; on slack water terraces and flood plains

This association consists of gently sloping and strongly sloping soils on slack water terraces and nearly level soils on flood plains. The slack water terraces commonly are only a few hundred feet wide and a few thousand feet long. In a few areas, however, they extend for several miles. The flood plains are a few hundred feet wide along the smaller streams and a few thousand feet wide along the larger streams. A short, steep slope commonly is between the terraces and flood plains.

This association makes up about 3 percent of the county. It is about 35 percent Glenford soils, 20 percent Tioga soils, and 45 percent soils of minor extent.

The gently sloping and strongly sloping, moderately well drained Glenford soils are on the slack water terraces. Typically, the surface layer is dark grayish brown silt loam. The subsoil is yellowish brown and strong brown silt loam and silty clay loam. It is mottled below a depth of about 18 inches. Permeability is moderately slow, and available water capacity is moderate or high. A perched seasonal high water table is at a depth of 24 to 42 inches during extended wet periods.

The nearly level, well drained Tioga soils are on the flood plains. They are occasionally flooded. Typically, the surface layer is dark grayish brown and brown silt loam.

The subsoil is dark brown silt loam and sandy loam. Permeability is moderate or moderately rapid, and available water capacity is moderate. A seasonal high water table is at a depth of 36 to 72 inches in winter and in spring and other extended wet periods.

The most extensive minor soils in this association are the somewhat poorly drained Orrville and very poorly drained Holly soils on the flood plains; the poorly drained Peoga and well drained Elkinsville soils on low terraces; the well drained, moderately coarse textured Oshtemo soils on the higher terraces; and the well drained Westmoreland soils on uplands adjacent to the terraces. The Oshtemo soils have a loamy substratum.

This association is used mainly for cultivated crops or for hay and pasture. It is well suited to cropland, pasture, and woodland. The occasional flooding on the Tioga soils may result in crop damage. As a result, these soils are better suited to the crops planted after the normal period of flooding than to the crops planted early in spring. The soils crust after heavy rainfall. Shallow cultivation of intertilled crops, however, breaks up the crust. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, and cover crops help to prevent deterioration of tilth, reduce the runoff rate, and help to control erosion.

The Glenford soils are only moderately well suited to building site development and septic tank absorption fields because of the wetness and the moderately slow permeability, and the Tioga soils generally are unsuited because of the hazard of flooding. Waterproofing basement walls and installing drains at the base of footings in the Glenford soils help to keep water away from basements. The wetness in septic tank absorption fields can be reduced by installing perimeter drains. The moderately slow permeability can be overcome by installing a double absorption field system or by enlarging the field. Removing as little vegetation as possible, mulching, or establishing a temporary plant cover helps to control erosion on construction sites.

8. Chili-Boyer-Tioga association

Deep, dominantly nearly level to strongly sloping, well drained soils formed in glacial outwash and alluvium; on stream terraces and flood plains

This association is on broad terraces and flood plains. Three terrace levels are evident. The highest level is the best defined. It is less than 1,500 feet wide in most areas. The flood plains are 200 to 1,000 feet wide. The difference in elevation from the highest terrace level to the stream generally is less than 40 feet.

This association makes up about 3 percent of the county. It is about 45 percent Chili soils, 15 percent Boyer soils, 15 percent Tioga soils, and 25 percent soils of minor extent.

The nearly level to strongly sloping Chili soils are on the highest terrace levels. Typically, the surface layer is brown silt loam. The subsoil is brown, dark yellowish brown, strong brown, and yellowish brown loam, clay loam, gravelly sandy loam, and gravelly sandy clay loam. Permeability is moderately rapid, and available water capacity is moderate or low.

The nearly level and gently sloping Boyer soils are on the lowest terrace levels. Typically, the surface layer is dark brown loam. The subsoil is dark brown loam and brown gravelly loamy sand. Permeability is moderately rapid in the subsoil and very rapid in the substratum. Available water capacity is low.

The nearly level Tioga soils are on flood plains. They are occasionally flooded. Typically, the surface layer is dark grayish brown and brown silt loam. The subsoil is dark brown silt loam and sandy loam. Permeability is moderate or moderately rapid, and available water capacity is moderate.

The most extensive minor soils in this association are the moderately coarse textured Oshtemo soils on terraces and the well drained Westmoreland soils on uplands adjacent to the terraces.

This is the most intensively cropped association in the county. Intertilled crops are grown year after year. The soils are suited to cropland, pasture, and woodland. The Chili and Boyer soils dry early in spring and are droughty during periods of below normal rainfall. Because of their limited available water capacity, they are better suited to the crops that mature early in the growing season than to crops that mature late in summer. Plant nutrients are leached from the Chili and Boyer soils at a moderately rapid rate. As a result, timely applications of lime and fertilizer are needed. Because they are subject to flooding, the Tioga soils are better suited to the crops planted after the normal period of flooding than to the crops planted early in spring. Planting cover crops and returning crop residue to the soil conserve moisture, help to prevent deterioration of tilth, and help to control erosion.

Some areas of this association are developed for urban uses. The Chili and Boyer soils are suited or moderately well suited to building site development and septic tank absorption fields, but the Tioga soils generally are unsuited. If the Chili or Boyer soils are used as septic tank absorption fields, the effluent can pollute streams, lakes, and shallow wells. Safety precautions are needed to prevent the caving of cutbanks in excavated areas.

detailed soil map units

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

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

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

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

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Westmoreland silt loam, 25 to 40 percent slopes, is one of several phases in the Westmoreland 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 that occur as areas so intricately mixed or so small that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Westmoreland-Coshocton silt loams, 8 to 15 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. These dissimiliar soils are described in each map unit. Also, some of the more unusual or strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes some *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, gravel, is an example. This miscellaneous area is large enough to be delineated on the soil maps.

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

soil descriptions

BkB—Berks shaly silt loam, 3 to 8 percent slopes. This gently sloping, moderately deep, well drained soil is on the tops of ridges in the uplands. Areas are long and narrow. Most are about 200 feet wide and 3 to 20 acres in size, but some are as wide as 500 feet and as large as 100 acres.

Typically, the surface layer is dark brown, friable shaly silt loam about 7 inches thick. The subsoil is yellowish brown, friable shaly and very shaly silt loam about 16 inches thick. The substratum is yellowish brown, firm very shaly silt loam. Shale or siltstone bedrock is at a depth of about 28 inches. In places the surface layer and subsoil contain fewer shale or siltstone fragments.

Included with this soil in mapping are small areas of shallow soils near the edge of the ridgetops. Also included, on broad ridgetops, are the deep, moderately well drained Coshocton soils in plane or depressional areas about 1 acre in size. Included soils make up about 10 to 15 percent of most mapped areas.

Permeability is moderate or moderately rapid in the Berks soil. Available water capacity is very low. Runoff is medium. In the surface layer, the content of organic matter is moderate and tilth is good. This layer can be easily tilled throughout a fairly wide range in moisture content. The subsoil is extremely acid to medium acid. The root zone generally is restricted by the moderate depth to bedrock.

Most of the acreage is pasture or cropland. This soil is suited to pasture and to a crop rotation of corn, small grain, and hay. It is droughty, however, and is subject to erosion. If the soil is cultivated, plowed during seedbed preparation, or overgrazed, the hazard of erosion is moderate. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour farming, and cover crops help to prevent deterioration of tilth, reduce the runoff rate, and help to control erosion. The shale fragments in the surface layer hinder tillage.

This soil is suited to woodland and to habitat for openland wildlife. Seedling mortality is the main concern in managing woodland. It can be controlled by selecting drought-tolerant trees for planting.

This soil is suited to building site development and is moderately well suited to septic tank absorption fields. It is only moderately well suited to recreational development because of the shale fragments in the surface layer. Erosion is a hazard on construction sites. It can be controlled, however, by removing as little vegetation as possible, mulching, and establishing a temporary plant cover. The bedrock at a depth of 20 to 40 inches is a limitation on sites for dwellings with basements, but it commonly is rippable. It is the major limitation in septic tank absorption fields, but the filtering capacity can be improved by installing the fields on suitable fill material. The soil has a highly corrosive effect on concrete, but other material, such as steel, can be substituted in water, sewer, or drain lines, particularly at boundaries with other soils.

The capability subclass is IIe; woodland suitability subclass 3f.

BkC—Berks shaly silt loam, 8 to 15 percent slopes. This strongly sloping, moderately deep, well drained soil is on rounded ridgetops and the upper parts of side slopes in the uplands. Areas generally are long and narrow. Those on ridgetops commonly are 150 to 350 feet wide, whereas those on side slopes are as much as 500 feet wide. Most areas are 3 to 20 acres in size, but some of those on side slopes are as large as 200 acres.

Typically, the surface layer is brown, friable shaly silt loam about 6 inches thick. The subsoil is yellowish brown, friable shaly and very shaly silt loam about 19 inches thick. The substratum is yellowish brown, firm very shaly silt loam. Shale or siltstone bedrock is at a depth of about 30 inches. In places the surface layer and subsoil contain fewer shale or siltstone fragments.

Included with this soil in mapping are scattered areas, generally less than 2 acres in size, of the deep Westmoreland soils. These soils are less shaly than the Berks soil. Also included are small areas of shallow soils near the edge of the ridgetops and some narrow bands of the deep, moderately well drained Coshocton soils. Included soils make up about 10 to 15 percent of most mapped areas.

Permeability is moderate or moderately rapid in the Berks soil. Available water capacity is very low. Runoff is medium or rapid. In the surface layer, the content of organic matter is moderate and tilth is good. This layer can be easily tilled throughout a fairly wide range in moisture content. The subsoil is extremely acid to medium acid. The root zone generally is restricted by the moderate depth to bedrock.

Most of the acreage is pasture or cropland. This soil is suited to a crop rotation of corn, small grain, and hay. It is droughty, however, and is subject to erosion. The hazard of erosion is severe if cultivated crops are grown. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour stripcropping, and cover crops help to prevent deterioration of tilth, reduce the runoff rate, and help to control erosion. The shale fragments in the surface layer hinder tillage.

This soil is suited to pasture. If the pasture is overgrazed or is plowed during seedbed preparation, however, the hazard of erosion is severe. Proper stocking rates and pasture rotation help to prevent overgrazing and excessive soil loss. No-till seeding also helps to prevent excessive soil loss. Mowing helps to control weeds. Timely applications of lime and fertilizer are needed.

This soil is suited to woodland and to habitat for openland wildlife. Seedling mortality is the main concern in managing woodland. It can be controlled by selecting drought-tolerant trees for planting.

This soil is moderately well suited to building site development. Erosion is a hazard on construction sites. It can be controlled, however, by removing as little vegetation as possible, mulching, and establishing a temporary plant cover. On sites for local roads and streets, it can be controlled by building on the contour and by seeding road cuts. The bedrock at a depth of 20 to 40 inches is a limitation on sites for dwellings with basements, but it commonly is rippable. The soil has a highly corrosive effect on concrete, but other material, such as steel, can be substituted in water, sewer, or drain lines, particulary at boundaries with other soils.

This soil is poorly suited to septic tank absorption fields because of the slope and the moderate depth to bedrock. Installing the leach lines on the contour helps to prevent seepage of the effluent to the surface. The filtering capacity can be improved by installing the fields on suitable fill material.

Because of the slope and the shale fragments in the surface layer, this soil is only moderately well suited to recreational development. Erosion is a hazard on trails. It can be controlled, however, by laying out the trails on the contour, establishing water bars, and building steps.

The capability subclass is IIIe; woodland suitability subclass 3f.

BkD—Berks shaly silt loam, 15 to 25 percent slopes. This moderately steep, moderately deep, well drained soil generally is on hillsides. Areas commonly are 150 to 350 feet wide. Most are 5 to 25 acres in size, but some are as large as 150 acres.

Typically, the surface layer is brown, friable shaly silt loam about 5 inches thick. The subsoil is yellowish brown, friable shaly and very shaly silt loam about 20 inches thick. The substratum is yellowish brown, firm very shaly silt loam. Shale or siltstone bedrock is at a depth of about 34 inches. In places the surface layer and subsoil contain fewer shale or siltstone fragments.

Included with this soil in mapping are scattered areas, generally less than 2 acres in size, of the deep Westmoreland soils. These soils are less shaly than the Berks soil. Also included are small areas of shallow soils near the top of the slopes and, in seepy areas, narrow bands of the deep, moderately well drained Coshocton and Guernsey soils, which are subject to slippage. Included soils make up about 10 to 15 percent of most mapped areas.

Permeability is moderate or moderately rapid in the Berks soil. Available water capacity is very low. Runoff is rapid. In the surface layer, the content of organic matter is moderately low and tilth is good. This layer can be easily tilled throughout a fairly wide range in moisture content. The subsoil is extremely acid to medium acid. The root zone generally is restricted by the moderate depth to bedrock.

Much of the acreage is pasture, and some is cropland. This soil is suited to a crop rotation of corn, small grain, and hay. It is droughty, however, and is subject to erosion. The hazard of erosion is very severe if cultivated crops are grown. The rotation commonly includes a cultivated crop about once every 4 years. A permanent plant cover is the best means of controlling erosion. A system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and cover crops help to prevent deterioration of tilth, reduce the runoff rate, and help to control erosion (fig. 3). The moderately steep slope hinders the use of some farm machinery. The shale fragments in the surface layer hinder tillage.

Figure 3.—Contour strips of corn and hay on Berks shaly silt loam, 15 to 25 percent slopes. Contour stripcropping helps to control erosion.

This soil is suited to pasture. If the pasture is overgrazed or is plowed during seedbed preparation, however, the hazard of erosion is very severe. Proper stocking rates and pasture rotation help to prevent overgrazing and excessive soil loss. No-till seeding also helps to prevent excessive soil loss. Mowing helps to control weeds. Timely applications of lime and fertilizer are needed.

Many areas are wooded. This soil is suited to woodland and to habitat for openland wildlife. Seedling mortality is the main concern in managing woodland. The equipment limitation also is a concern, but mechanical tree planters and the mowers used to control plant competition can be operated on this soil. Selecting drought-tolerant trees for planting helps to control seedling mortality.

This soil is poorly suited to building site development. Erosion is a hazard on construction sites. It can be controlled, however, by removing as little vegetation as possible, mulching, and establishing a temporary plant cover. On sites for local roads and streets, it can be controlled by building on the contour and by seeding road cuts. The slope is a limitation on sites for dwellings. Also, the bedrock at a depth of 20 to 40 inches is a limitation on sites for dwellings with basements, but it commonly is rippable. Cutting and filling increase the susceptibility of the included Coshocton and Guernsey soils to hillside slippage. Installing a drainage system in the seepy areas helps to prevent this slippage. The Berks soil has a highly corrosive effect on concrete, but other material, such as steel, can be substituted in water, sewer, or drain lines, particularly at boundaries with other soils.

Because of the depth to bedrock and the slope, this soil is poorly suited to septic tank absorption fields. Installing the leach lines on the contour helps to prevent seepage of the effluent to the surface.

Because of the slope and shaly surface layer, this soil is poorly suited to recreational development. Erosion is a hazard on trails. It can be controlled, however, by laying out the trails on the contour, establishing water bars and switchbacks, and building steps.

The capability subclass is IVe; woodland suitability subclass 3f on north aspects, 4f on south aspects.

BkE—Berks shaly silt loam, 25 to 40 percent slopes. This steep, moderately deep, well drained soil is on hillsides. It is mainly on side slopes directly above less sloping soils but also is on valley walls on both sides of narrow drainageways. Most of the areas on side slopes are 250 to 450 feet long, but some are only 150 feet long and are 6 to 20 acres in size. The areas on valley walls are as large as 200 acres.

Typically, the surface layer is brown, friable shaly silt loam about 3 inches thick. The subsoil is yellowish brown and brown, friable shaly and very shaly silt loam about 16 inches thick. The substratum is yellowish brown, firm very shaly silt loam. Siltstone bedrock is at a depth of about 25 inches.

Included with this soil in mapping are scattered areas, generally less than 2 acres in size, of the deep Westmoreland soils. These soils are less shaly than the Berks soil. Also included are small areas of shallow soils near the upper parts of the slopes and, in seepy areas, narrow bands of the deep, moderately well drained Coshocton and Guernsey soils, which are subject to slippage. Included soils make up about 10 to 15 percent of most mapped areas.

Permeability is moderate or moderately rapid in the Berks soil. Available water capacity is very low. Runoff is very rapid. In the surface layer, the content of organic matter is moderately low and tilth is good. This layer can be easily tilled throughout a fairly wide range in moisture content. The subsoil is extremely acid to medium acid. The root zone generally is restricted by the moderate depth to bedrock.

Some areas are pastured. This soil is moderately well suited to pasture. Controlling erosion is the major concern of management. Also, the soil is droughty, and the slope hinders the use of equipment. If the pasture is plowed during seedbed preparation or overgrazed, the hazard of erosion is very severe. A permanent plant cover is the best means of controlling erosion. Proper stocking rates and pasture rotation help to prevent overgrazing and excessive soil loss. No-till seeding also helps to prevent excessive soil loss.

Most areas are used as woodland or support native vegetation. This soil is suited to woodland. Seedling mortality and the equipment limitation are the main concerns of management. Operating mechanical tree planters and the mowers used to control plant competition is difficult because of the steep slope. Selecting drought-tolerant trees for planting helps to control seedling mortality.

This soil generally is unsuited to building site development, septic tank absorption fields, and recreational development because of the steep slope and the bedrock at a depth of 20 to 40 inches. Cutting and filling increase the susceptibility of the included Guernsey and Coshocton soils to hillside slippage. Installing a drainage system in the seepy areas helps to prevent this slippage. Erosion is a hazard on trails. It can be controlled, however, by laying out the trails on the contour, by establishing water bars or switchbacks, and by building steps.

The capability subclass is VIe; woodland suitability subclass 3f on north aspects, 4f on south aspects.

BkF—Berks shaly silt loam, 40 to 70 percent slopes. This very steep, moderately deep, well drained soil generally is on upland side slopes directly above less sloping soils, but it also is on valley walls on both sides of narrow drainageways. Most areas are long and narrow and are 5 to 50 acres in size. Those on side slopes commonly are 250 to 400 feet long.

Typically, the surface layer is brown, friable shaly silt loam about 3 inches thick. The subsoil is yellowish brown, friable shaly and very shaly silt loam about 20 inches thick. The substratum is yellowish brown, firm very shaly silt loam. Shale or siltstone bedrock is at a depth of about 32 inches.

Included with this soil in mapping are scattered areas, generally less than 2 acres in size, of the deep Westmoreland soils. These soils are less shaly than the Berks soil. Also included are small areas of shallow soils near the upper parts of the slopes and narrow bands of the deep, moderately well drained Coshocton soils in seepy areas. Included soils make up about 10 to 15 percent of most mapped areas.

Permeability is moderate or moderately rapid in the Berks soil. Available water capacity is very low. Runoff is very rapid. In the surface layer, the content of organic matter is moderately low and tilth is good. The subsoil is extremely acid to medium aicd. The root zone generally is restricted by the moderate depth to bedrock.

Almost all areas are wooded. This soil is suited to woodland. Erosion, the equipment limitation, and seedling mortality are the main concerns of management. Erosion can be controlled by building logging roads and skid trails on the contour and by establishing water bars. The use of logging equipment is restricted because of the very steep slope. Selecting drought-tolerant trees for planting helps to control seedling mortality.

Because of the slope, this soil generally is unsuited to building site development, septic tank absorption fields, and recreational development.

The capability subclass is VIIe; woodland suitability subclass 3f on north aspects, 4f on south aspects.

BnD—Bethesda channery clay loam, 8 to 25 percent slopes. This strongly sloping and moderately steep, deep, well drained soil in on mine spoil ridges in areas that have been surface mined for coal. In some areas the ridges are continuous and have sides less than 40 feet high and strongly sloping tops 25 to 100 feet wide. In other areas they are discontinuous and about 40 feet high. The soil is a mixture of rock fragments and partly weathered fine earth material that was in or below the profile of the original soil. Most of the rock fragments are flat and less than 10 inches long. In most places a few large stones, 75 to 200 feet apart, are on the surface. Areas generally are long and narrow. They are 200 to 500 feet wide and are 5 to 20 acres in size.

Typically, the surface layer is dark grayish brown, friable channery clay loam about 4 inches thick. The substratum to a depth of about 60 inches is dominantly yellowish brown and brown, friable very channery clay loam. In some places it is medium acid or slightly acid. In other places the soil is a mixture of fire clay and coal that is so acid that it is toxic to most plants. In some areas the surface layer is shaly clay loam. A few areas have been reclaimed by grading and by blanketing the surface with a layer of material removed from other soils.

Included with this soil in mapping are small intermittent and perennial ponds, long and narrow walls of exposed bedrock as high as about 40 feet, and steep and very steep soils on the sides of the spoil ridges. Inclusions make up 5 to 15 percent of most mapped areas.

Permeability is moderately slow in the Bethesda soil. Available water capacity is low. Runoff is very rapid. In the surface layer, the content of organic matter is very low and tilth is poor. The depth of the root zone varies within short distances because of differences in the density of the soil material. This zone is extremely acid to strongly acid unless the soil has been limed. The potential for frost action is moderate.

This soil generally is unsuited to row crops and hay because it is a poor growing medium for roots. It is droughty and low in fertility. The surface layer is channery, has weak structure, and puddles and crusts easily. The hazard of erosion is very severe if cultivated crops are grown. A permanent plant cover is the best means of controlling erosion.

This soil is poorly suited to pasture. If the pasture is overgrazed or is plowed during seedbed preparation, the hazard of erosion is very severe. Proper stocking rates and pasture rotation help to prevent overgrazing and excessive soil loss. No-till seeding also helps to prevent excessive soil loss. Restricted grazing during wet periods helps to prevent surface compaction. Soil tests are needed to determine specific nutrient needs. Ground cover and surface mulch reduce the runoff rate and the susceptibility to erosion and increase the rate of water intake.

Most areas support trees or brush. Black locust, some aspen, and blackberry are established in many areas. Some areas are bare or only sparsely covered with broomsedge and other acid-tolerant plants. This soil is suited to the trees that can tolerate the strongly acid to extremely acid, droughty, restricted root zone. Such species as black locust grow well once they are established. Erosion can be controlled by building logging roads on the contour and by establishing water bars. Mechanical tree planters and the mowers used to control plant competition can be operated in all areas, except for the steep and very steep included areas. The use of equipment is sometimes restricted because the soil is soft and slippery when wet.

This soil is poorly suited to building site development, septic tank absorption fields, and recreational development,. mainly because of the slope and the likelihood of slippage. Also, the moderately slow permeability is a limitation in septic tank absorption fields. Once the soil settles, areas where slopes are 8 to 15 percent are somewhat better suited to these uses than the steeper areas. Onsite investigation is needed to determine suitability.

Measures that control erosion and reduce the likelihood of slippage are needed in the areas used for building site development or septic tank absorption fields. Erosion can be controlled by removing as little vegetation as possible, mulching, and establishing a temporary plant cover. On sites for local roads and streets, it can be controlled by building on the contour and by seeding road cuts. Cutting and filling increase the hazard of hillside slippage, but installing a drainage system in areas where water concentrates reduces the hazard. Installing the leach lines in septic tank absorption fields on the contour helps to prevent seepage of the effluent to the surface. Enlarging the field or installing a double absorption field system improves the filtering capacity. The soil has a highly corrosive effect on concrete, but other material, such as steel, can be substituted in water, sewer, or drain lines, particularly at boundaries with other soils.

Erosion and stickiness are concerns in managing recreational areas. Erosion on sites for paths and trails can be controlled by laying out the paths and trails on the contour, by establishing water bars and switchbacks, or by building steps. Because of the content of clay in the surface layer, the soil is soft and sticky during and immediately following periods of rainfall. Covering picnic and play areas with gravel, bark, or wood chips helps to reduce the stickiness.

The capability subclass is VIs; woodland suitability subclass not assigned.

BnF—Bethesda channery clay loam, 25 to 70 percent slopes. This steep and very steep, well drained

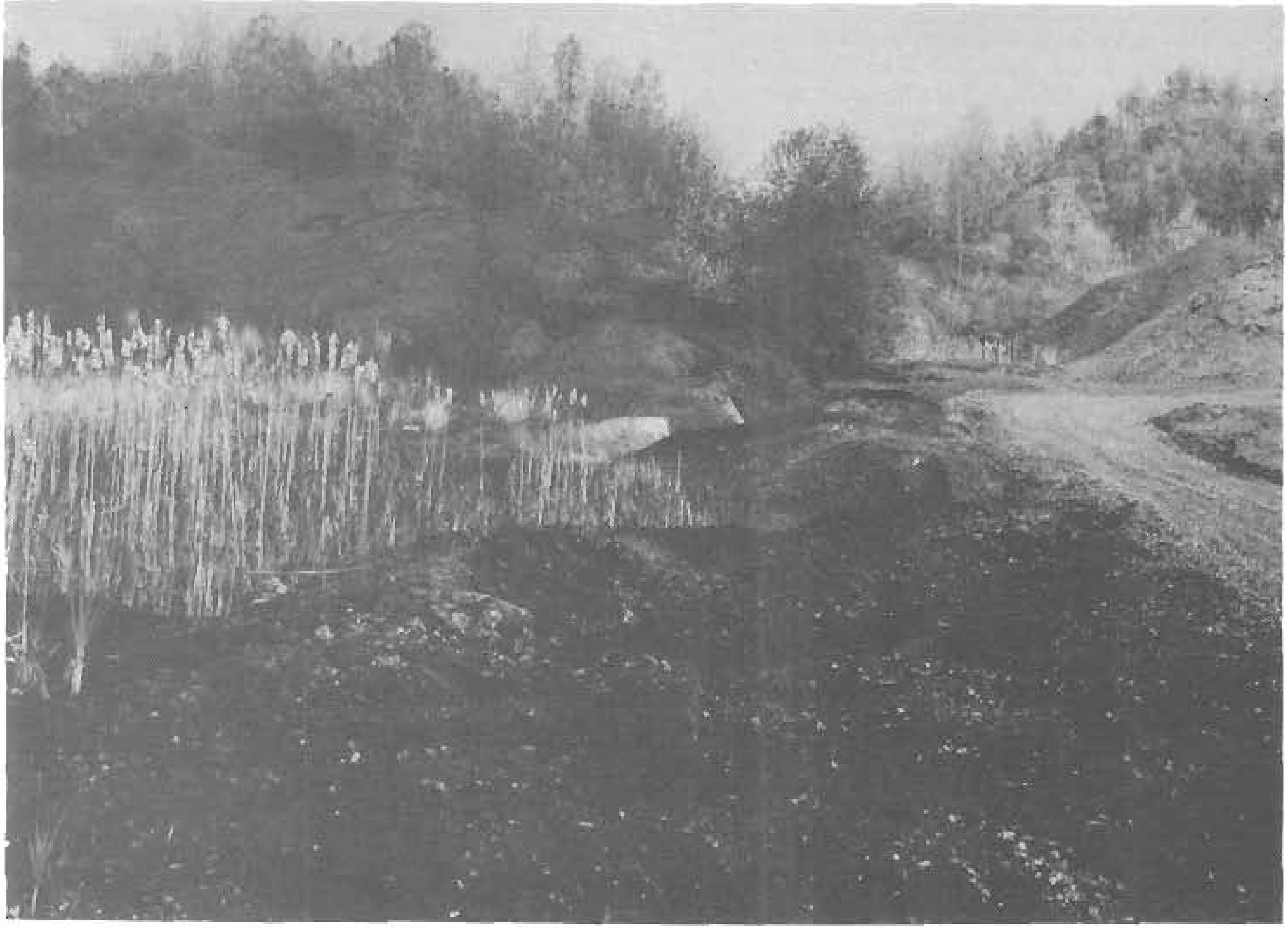

Figure 4.—Typical area of Bethesda channery clay loam, 25 to 70 percent slopes.

soil is on mine spoil ridges in areas that have been surface mined for coal (fig. 4). It is a mixture of rock fragments and partly weathered fine earth material that was in or below the profile of the original soil. Most of the rock fragments are flat and less than 10 inches long. In most places a few large stones, 75 to 200 feet apart, are on the surface. Hillside slips are common. Most areas are long and narrow and have not been graded and smoothed. They commonly are 200 to 400 feet wide and are 10 to 40 acres in size. A few areas are as wide as 1,500 feet and as large as several hundred acres.

Typically, the surface layer is dark grayish brown, friable channery clay loam about 4 inches thick. The substratum to a depth of about 60 inches in multicolored, friable very channery clay loam and firm shaly silty clay loam. In some places it is medium acid or slightly acid. In other places the soil is a mixture of fire clay and coal that is so acid that it is toxic to most plants. In some areas the surface layer is shaly clay loam.

Included with this soil in mapping are small intermittent and perennial ponds and long, narrow walls of exposed bedrock as high as about 100 feet. Inclusions make up 10 to 15 percent of most mapped areas.

Permeability is moderately slow in the Bethesda soil. Available water capacity is low. Runoff is very rapid. In the surface layer, the content of organic matter is very low and tilth is poor. The depth of the root zone varies within short distances because of differences in the density of the soil material. This zone is extremely acid to strongly acid. The potential for frost action is moderate.

This soil generally is unsuited to row crops, small grain, hay, and pasture because of the steep and very steep slope, droughtiness, and a very severe hazard of erosion.

Most areas support trees or brush. Black locust, some aspen, and blackberry are established in many areas. Some areas are bare or only sparsely covered with broomsedge and other acid-tolerant plants. This soil is suited to the trees that can tolerate the strongly acid to extremely acid, droughty, restricted root zone. Such species as black locust grow well once they are established. Erosion can be controlled by building logging roads on the contour and by establishing water bars. The use of equipment is restricted because the soil is steep and very steep and is soft and slippery when wet.

This soil generally is unsuited to building site development, septic tank absorption fields, and recreational development because of the slope and the susceptibility to hillside slippage. Cutting and filling increase the hazard of slippage, but installing a drainage system in areas where water concentrates reduces the hazard. The soil has a highly corrosive effect on concrete, but other material such as steel, can be substituted in water, sewer, or drain lines, particularly at boundaries with other soils.

The capability subclass is VIIe; woodland suitability subclass not assigned.

BrA—Boyer loam, 0 to 4 percent slopes. This nearly level and gently sloping, deep, well drained soil is on low stream terraces. Areas generally are 500 to 1,500 feet wide and are as much as several miles long. They are 50 to 300 acres in size.

Typically, the surface layer is dark brown, very friable loam about 10 inches thick. The subsoil is about 19 inches thick. It is dark brown and brown. The upper part is friable loam, and the lower part is very friable gravelly loamy sand. The substratum to a depth of about 60 inches is brown and yellowish brown, loose very gravelly loamy sand. In some areas the surface layer is sandy loam, gravelly loam, or gravelly sandy loam. In some places the subsoil is thicker and contains less gravel. In other places it is thicker and contains more clay.

Included with this soil in mapping are few areas in the flood pool of Bolivar Dam. These areas are subject to flooding.

Permeability is moderately rapid in the subsoil of the Boyer soil and very rapid in the substratum. Available water capacity is low. Runoff is slow. In the surface layer, the content of organic matter is moderate and tilth is good. The subsoil is medium acid to neutral. The root zone is deep.

Most areas are used for cultivated crops or for hay and pasture. This soil is suited to corn, small grain, and pasture. It dries early in spring. Because of the limited available water capacity, it is better suited to crops that mature early in the growing season than to crops that mature late in summer. The droughtiness is the main concern of management. Also, plant nutrients are leached from the soil at a moderately rapid rate. As a result, timely applications of lime and fertilizer are needed. Planting cover crops and returning crop residue to the soil conserve moisture and help to prevent deterioration of tilth.

A few areas are used as woodland. This soil is suited to woodland and to habitat for woodland wildlife. Drought-tolerant species should be selected for planting. Plant competition can be controlled by spraying, mowing, or disking.

This soil is suited to building site development, septic tank absorption fields, and recreational development. Because of the very rapid permeability in the substratum, however, the effluent from septic tank absorption fields can pollute streams, lakes, or shallow wells. This hazard can be reduced by providing suitable fill material. Safety precautions are needed to prevent the caving of cutbanks in excavated areas.

The capability subclass is IIIs; woodland suitability subclass 3o.

ChA—Chili silt loam 0 to 3 percent slopes. This nearly level, deep, well drained soil is on terraces along streams. Areas generally are 500 to 1,500 feet wide and as much as 1 mile long. They are 10 to 200 acres in size.

Typically, the surface layer is dark brown, very friable silt loam about 9 inches thick. The subsoil is about 35 inches thick. The upper part is dark brown, friable and firm loam and gravelly sandy clay loam, and the lower part is brown, very friable gravelly sandy loam. The substratum to a depth of about 60 inches is brown, loose gravelly loamy sand. In some areas the subsoil is thinner and contains less clay. In other areas it contains less clay and gravel or more silt and less gravel.

Permeability is moderately rapid. Available water capacity is moderate or low. Runoff is slow. In the surface layer, the content of organic matter is moderate and tilth is good. The subsoil is strongly acid to slightly acid. The root zone is deep. The potential for frost action is moderate.

Most areas are used as cropland. Corn, small grain, and hay are the principal crops. This soil is well suited to these crops and to pasture. It dries early in spring. Because of the limited available water capacity, it is better suited to crops that mature early in the growing season than to crops that mature late in summer. The droughtiness is the main limitation. Also, plant nutrients are leached from the soil at a moderately rapid rate. As a result, timely applications of lime and fertilizer are needed. A surface crust forms after heavy rainfall, especially in tilled areas. Shallow cultivation of intertilled crops, however, breaks up the crust. Returning crop residue to the soil and planting cover crops conserve moisture and help to prevent crusting.

This soil is suited to woodland and to habitat for woodland wildlife. Drought-tolerant species should be selected for planting.

This soil is suited to building site development, septic tank absorption fields, and recreational development. It has a highly corrosive effect on concrete, but other material, such as steel, can be substitued in water, sewer, or drain lines, particularly at boundaries with other soils. Safety precautions are needed to prevent the caving of cutbanks in excavated areas. The potential for frost action can result in damage to local roads and streets. Replacing the surface layer and subsoil with suitable base material, however, helps to prevent this damage.

The capability subclass is IIs; woodland suitability subclass 2o.

ChB—Chili silt loam, 3 to 8 percent slopes. This gently sloping, deep, well drained soil is on terraces along streams. Areas generally are 500 to 1,500 feet wide and as much as 1 mile long. They are 15 to 150 acres in size.

Typically, the surface layer is brown, friable silt loam about 6 inches thick. The subsoil is about 35 inches thick. It is friable. The upper part is brown and dark yellowish brown loam and clay loam, and the lower part is strong brown, brown, and yellowish brown gravelly sandy loam and gravelly sandy clay loam. The substratum to a depth of about 60 inches is yellowish brown, loose gravelly sand and gravelly loamy sand. In some places the subsoil is thinner and contains less clay. In other places it contains less clay and gravel or more silt and less gravel. In some areas the surface layer is loam.

Included with this soil in mapping are a few areas in the flood pool of Bolivar Dam. These areas are subject to flooding.

Permeability is moderately rapid in the Chili soil. Available water capacity is moderate or low. Runoff is medium. In the surface layer, the content of organic matter is moderate and tilth is good. The subsoil is strongly acid to slightly acid. The root zone is deep. The potential for frost action is moderate.

Most areas are used as cropland. Corn, small grain, and hay are the principal crops. This soil is suited to a rotation of these crops and to pasture. It dries early in spring. Because of the limited available water capacity, it is better suited to crops that mature early in the growing season than to crops that mature late in summer. Controlling erosion and conserving moisture are the major concerns of management. If the soil is cultivated, plowed during seedbed preparation, or overgrazed, the hazard of erosion is moderate. Plant nutrients are leached from the soil at a moderately rapid rate. As a result, timely applications of lime and fertilizer are needed. A surface crust forms after heavy rainfall, especially in tilled areas. Shallow cultivation of intertilled crops, however, breaks up the crust. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour farming, and cover crops help to prevent deterioration of tilth and surface crusting, reduce the runoff rate, and help to control erosion.

This soil is suited to woodland and to habitat for woodland wildlife. Drought-tolerant species should be selected for planting.

This soil is suited to building site development, septic tank absorption fields, and recreational development. Removing as little vegetation as possible, mulching, and establishing a temporary plant cover help to control erosion on construction sites. The soil has a highly corrosive effect on concrete, but other material, such as steel, can be substituted in water, sewer, or drain lines, particularly at boundaries with other soils. Safety precautions are needed to prevent the caving of cutbanks in excavated areas. The potential for frost action can result in damage to local roads and streets. Replacing the surface layer and subsoil with suitable base material, however, helps to prevent this damage.

The capability subclass is IIe; woodland suitability subclass 2o.

ChC—Chili silt loam, 8 to 15 percent slopes. This strongly sloping, deep, well drained soil is on short, irregular knolls and on slopes between terrace levels along streams. Most areas are 10 to 30 acres in size.

Typically, the surface layer is dark brown, friable silt loam about 4 inches thick. The subsoil is about 36 inches thick. It is friable. The upper part is dark yellowish brown clay loam and gravelly sandy clay loam, and the lower part is strong brown gravelly sandy loam. The substratum to a depth of about 60 inches is yellowish brown, loose gravelly sand. In some areas the surface layer is loam. In some places the subsoil is thinner and contains less clay. In other places it contains less clay and gravel.

Included with this soil in mapping are a few areas in the flood pool of Atwood Dam. These areas are subject to flooding.

Permeability is moderately rapid in the Chili soil. Available water capacity is moderate or low. Runoff is medium or rapid. In the surface layer, the content of organic matter is moderate and tilth is good. The subsoil is strongly acid to slightly acid. The root zone is deep. The potential for frost action is moderate.

Most areas are used as cropland. Corn, small grain, and hay are the principal crops. This soil is suited to a rotation of these crops and to pasture. It is droughty during periods of below normal rainfall and dries early in spring. Because of the limited available water capacity, it is better suited to crops that mature early in the growing season than to crops that mature late in summer. Controlling erosion and conserving moisture are the major concerns of management. If the soil is cultivated, the hazard of erosion is severe. Plant nutrients are leached from the soil at a moderately rapid rate. As a result, timely applications of lime and fertilizer are needed. A surface crust forms after heavy rainfall, especially in tilled areas. Shallow cultivation of intertilled crops, however, breaks up the crust. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour stripcropping, and cover crops help to prevent deterioration of tilth and surface crusting, conserve moisture, reduce the runoff rate, and help to control erosion.

This soil is suited to pasture. If the pasture is overgrazed or is plowed during seedbed preparation, however, the hazard of erosion is severe. Proper stocking rates and pasture rotation help to prevent overgrazing and thus control erosion. No-till seeding also helps to control erosion. Mowing helps to control weeds. Timely applications of lime and fertilizer are needed.

This soil is suited to woodland and to habitat for woodland wildlife. Drought-tolerant species should be selected for planting.

Because of the slope, this soil is only moderately well suited to building site development, septic tank absorption fields, and recreational development. Erosion can be controlled by removing as little vegetation as possible, mulching, and establishing a temporary plant cover on contruction sites and by building local roads and streets on the contour and seeding road cuts. On sites for trails, it can be controlled by laying out the trails on the contour, establishing water bars, and building steps. Installing the leach lines in septic tank absorption fields on the contour helps to prevent seepage of the effluent to the surface. The soil has a highly corrosive effect on concrete, but other material, such as steel, can be substituted in water, sewer, or drain lines, particularly at boundaries with other soils. Safety precautions are needed to prevent the caving of cutbanks in excavated areas. The potential for frost action can result in damage to local roads and streets. Replacing the surface layer and subsoil with suitable base material, however, helps to prevent this damage.

The capability subclass is IIIe; woodland suitability subclass 2o.

CnB—Coshocton silt loam, 3 to 8 percent slopes. This gently sloping, deep, moderately well drained soil is on upland ridgetops 200 to 500 feet wide. Most areas are long and narrow and are 5 to 30 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsoil is about 25 inches thick. It is yellowish brown and firm. The upper part is silty clay loam, and the lower part is mottled silty clay loam and channery silty clay loam. The substratum is brown, mottled, firm channery silty clay loam. Siltstone bedrock is at a depth of about 50 inches. In some areas the subsoil contains more clay. In other areas it contains less sand and fewer siltstone fragments.

Included with this soil in mapping are small areas of the moderately deep, well drained Berks and Culleoka soils near the edges and on the crest of some ridgetops. Also included are some areas of moderately deep soils that contain more shale fragments in the subsoil than the Coshocton soil. Included soils make up 10 to 15 percent of most mapped areas.

Permeability is slow or moderately slow in the Coshocton soil. Available water capacity is moderate. Runoff is medium. A perched seasonal high water table is at a depth of 18 to 42 inches in winter and in spring and other extended wet periods. In the surface layer, the content of organic matter is moderate and tilth is good. The subsoil is strongly acid or very strongly acid. The root zone is deep. The potential for frost action is high. The shrink-swell potential is moderate.

Most areas are used as cropland. Corn, small grain, and hay are the principal crops. This soil is suited to a rotation of these crops and to pasture. Controlling erosion is the major concern of management. If the soil is cultivated, plowed during seedbed preparation, or overgrazed, the hazard of erosion is moderate. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour farming, and cover crops reduce the runoff rate and help to prevent excessive soil loss and deterioration of tilth. Natural drainage generally is adequate, but subsurface drains are needed in scattered seepy areas and other wet areas. Crusting of the surface layer restricts moisture penetration and air movement, especially in tilled areas. Shallow cultivation of intertilled crops, however, breaks up the crust. Restricted grazing during wet periods helps to keep pastures in good condition.

This soil is suited to woodland and to habitat for woodland wildlife. Plant competition can be controlled by spraying, mowing, or disking.

This soil is moderately well suited to building site development and is well suited to recreational development. Removing as little vegetation as possible, mulching, and establishing a temporary plant cover help to control erosion on construction sites. The seasonal wetness is a limitation on sites for dwellings, especially dwellings with basements. Also, the moderate shrink-swell potential of the subsoil is a limitation. Waterproofing basement walls and installing drains at the base of footings help to keep water away from basements. The harmful effects of shrinking and swelling can be reduced by designing walls that have pilasters and are reinforced with concrete, by supporting the walls with a large spread footing, and by backfilling around foundations with material that has a low shrink-swell potential. The soil has a highly corrosive effect on concrete and uncoated steel, but coated steel can be used in water, sewer, or drain lines, particularly at boundaries with other soils.

The shrink-swell potential, low strength, and the potential for frost action can result in damage to local roads and streets. Providing suitable base material, however, helps to prevent this damage.

Because of the seasonal wetness and the slow or moderately slow permeability, this soil is only moderately well suited to septic tank absorption fields. Installing perimeter drains reduces the wetness. A double absorption field system and an increase in the size of the field help to overcome the slow or moderately slow permeability.

The capability subclass is IIe; woodland suitability subclass 2o.

CoB—Coshocton-Keene silt loams, 3 to 8 percent slopes. These gently sloping, deep, moderately well drained soils are on upland ridgetops as wide as 1 mile. The Coshocton soil is on the more convex slopes. Most areas are irregularly shaped and several hundred acres in size, but some are long and narrow and as small as 5 acres. The areas are 50 to 65 percent Coshocton silt loam and 25 to 35 percent Keene silt loam. The two soils occur as areas so intricately mixed or so small that mapping them seperately is not practical.

Typically, the Coshocton soil has a surface layer of dark grayish brown, friable silt loam about 8 inches thick. The subsoil is about 23 inches thick. It is yellowish brown and firm. The upper part is silty clay loam, and the lower part is mottled silty clay loam and shaly silty clay loam. The substratum is yellowish brown, mottled, firm shaly silty clay loam. Shale bedrock is at a depth of about 60 inches.

Typically, the Keene soil has a surface layer of dark grayish brown, friable silt loam about 8 inches thick. The subsoil is about 24 inches thick. The upper part is yellowish brown, friable silt loam; the next part is yellowish brown, mottled, firm and friable silty clay loam; and the lower part is dark yellowish brown, firm silty clay loam. The substratum is yellowish brown and light olive brown, mottled, firm silty clay loam and shaly silty clay loam. Shale bedrock is at a depth of about 60 inches. In a few areas the soil is better drained and does not have mottles in the subsoil.

Included with these soils in mapping are small areas of the moderately fine textured Guernsey soils on convex slopes and areas of the somewhat poorly drained Library Variant soils in small depressions, generally less than 2 acres in size. Also included are scattered small areas of the moderately deep, well drained Culleoka soils. Included soils make up 10 to 15 percent of most mapped areas.

Permeability is slow or moderately slow in the Coshocton and Keene soils. Available water capacity is moderate. Runoff is medium. Both soils have a perched seasonal high water table in the middle and lower parts of the subsoil in winter and in spring and other extended wet periods. In the surface layer, the content of organic matter is moderate and tilth is good. The subsoil mainly is strongly acid or very strongly acid. The root zone is deep. The shrink-swell potential is moderate. The potential for frost action is high.

Most areas are used as cropland. Corn, small grain, and hay the principal crops. These soils are suited to a rotation of these crops and to pasture (fig. 5). Erosion is the major concern of management. If the soil is cultivated, plowed during seedbed preparation, or overgrazed, the hazard of erosion is moderate. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour farming, and cover crops reduce the runoff rate and help to prevent excessive soil loss and deterioration of tilth. Natural drainage generally is adequate, but subsurface drains are needed in scattered seepy areas and in the wetter included areas. Crusting of the surface layer restricts moisture penetration and air movement, especially in tilled areas. Shallow cultivation of intertilled crops, however, breaks up the crust. Restricted grazing during wet periods helps to keep pastures in good condition.

Figure 5.—An area of Coshocton-Keene silt loams, 3 to 8 percent slopes. These soils are suited to crops and pasture.

These soils are suited to woodland and to habitat for woodland wildlife. Plant competition can be controlled by spraying, mowing, or disking.

These soils are well suited to recreational development and are moderately well suited to building site development. Removing as little vegetation as possible, mulching, and establishing a temporary plant cover help to control erosion on construction sites. The seasonal wetness is a limitation on sites for dwellings, especially dwellings with basements. Also, the moderate shrink-swell potential of the subsoil is a limitation. Waterproofing basement walls and installing drains at the base of footings help to keep water away from basements. The harmful effects of shrinking and swelling can be reduced by designing walls that have pilasters and are reinforced with concrete, by supporting the walls with a large spread footing, and by backfilling around foundations with material that has a low shrink-swell potential. The soils have a highly corrosive effect on concrete and uncoated steel, but coated steel can be used in water, sewer, or drain lines, especially at boundaries with other soils.

The shrink-swell potential, low strength, and the potential for frost action can result in damage to local roads and streets. Providing suitable base material and installing a drainage system, however, help to prevent this damage.

Because of the seasonal wetness and the slow or moderately slow permeability, these soils are only moderately well suited to septic tank absorption fields. Installing perimeter drains reduces the wetness. A double absorption field system and an increase in the size of the field help to overcome the slow or moderately slow permeability.

The capability subclass is IIe; woodland suitability subclass 2o.

CuB—Culleoka silt loam, 3 to 8 percent slopes. This gently sloping, moderately deep, well drained soil is on upland ridgetops. Most areas are long and about 250 feet wide and are 5 to 35 acres in size, but some are as wide as 650 feet and as large as 70 acres.

Typically, the surface layer is brown, very friable silt loam about 8 inches thick. The subsoil is about 23 inches of brown and yellowish brown, friable and firm silty clay loam and channery silty clay loam. The substratum is yellowish brown, firm very channery clay loam. Interbedded siltstone and sandstone bedrock is at a depth of about 35 inches. In some areas the subsoil contains more shale and siltstone fragments. In other areas the surface layer is loam.

Included with this soil in mapping are scattered areas, generally less than 2 acres in size, of the deep Westmoreland soils and the deep, moderately well drained Coshocton soils on broad ridgetops. Also included are areas of the deep Hazleton soils at the edges of the ridgetops or on the narrow parts of some ridgetops. The subsoil of the Hazleton soils contains more sandstone fragments than that of the Culleoka soil. Included soils make up 10 to 15 percent of most mapped areas.

Permeability is moderate or moderately rapid in the Culleoka soil. Available water capacity is low. Runoff is medium. In the surface layer, the content of organic matter is moderate and tilth is good. The subsoil is strongly acid or medium acid. The root zone is moderately deep. The potential for frost action is moderate.

Most areas are used as cropland. Corn, small grain, and hay are the principal crops. This soil is suited to a rotation of these crops and to pasture. Controlling erosion and conserving moisture are the major concerns of management. If the soil is cultivated, plowed during seedbed preparation, or overgrazed, the hazard of erosion is moderate. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour farming, and cover crops reduce the runoff rate and help to prevent excessive soil loss and deterioration of tilth. Crop yields are reduced in some years because of an insufficient amount of moisture during the growing season. Crusting of the surface layer restricts moisture penetration and air movement, especially in tilled areas. Shallow cultivation of intertilled crops, however, breaks up the crust.

This soil is suited to woodland and to habitat for woodland wildlife. Drought-tolerant trees should be selected for planting.

This soil is suited to building site development and recreational development and is moderately well suited to septic tank absorption fields. Removing as little vegetation as possible, mulching, and establishing a temporary plant cover help to control erosion on construction sites. The bedrock at a depth of 20 to 40 inches is a limitation on sites for dwellings with basements, but it commonly is rippable. It is the major limitation in septic tank absorption fields, but the filtering capacity can be improved by installing the fields on suitable fill material. Low strength and the potential for frost action can result in damage to local roads and streets. Replacing the surface layer and subsoil with suitable fill material, however, helps to prevent this damage.

The capability subclass is IIe; woodland suitability subclass 2o.

EbB—Elba silty clay loam, 3 to 8 percent slopes. This gently sloping, deep, well drained soil is on upland ridgetops 200 to 500 feet wide. Most areas are long and narrow and are 3 to 20 acres in size.

Typically, the surface layer is dark grayish brown, friable silty clay loam about 6 inches thick. The subsoil is yellowish brown, light olive brown, and olive brown, firm silty clay about 36 inches thick. It is mottled between depths of about 12 and 22 inches. The substratum is olive brown and light olive brown, firm silty clay between large limestone fragments. It is mottled in the lower part. Limestone bedrock is at a depth of about 71 inches. In some areas the subsoil and substratum are reddish brown. In some places the substratum is slightly acid or neutral. In other places the soil is deeper to carbonates.

Included with this soil in mapping are small areas of moderately deep soils, particularly in Brown Township. These soils make up 10 to 15 percent of most mapped areas.

Permeability is slow in the Elba soil. Available water capacity is moderate. Runoff is medium or rapid. The content of organic matter is moderate, and tilth is fair. The soil tends to dry out slowly and to crack at the surface. The subsoil is medium acid to mildly alkaline in the upper part and neutral to moderately alkaline in the lower part. The root zone is deep, but root growth is restricted somewhat by the clayey subsoil. The shrink-swell potential is high in the subsoil. The potential for frost action is moderate.

Most areas are used for cultivated crops or for hay and pasture. This soil is suited to pasture and to a crop rotation of corn, small grain, and hay. Controlling erosion and improving tilth are the major concerns of management. If the soil is cultivated, plowed during seedbed preparation, or overgrazed, the hazard of erosion is moderate. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour farming, and cover crops improve tilth, reduce the runoff rate, and help to prevent excessive soil loss. Tilling when the soil is wet causes surface compaction and cloddiness. Restricted grazing during wet periods helps to prevent compaction in pastured areas.

Some areas are used as woodland. This soil is suited to woodland and to habitat for woodland wildlife. The use of logging equipment is restricted at times because the soil is soft and slippery when wet. The trees can be logged during the drier parts of the year. Selecting species for planting that are tolerant of the high clay content in the subsoil reduces the seedling mortality rate and the windthrow hazard.

This soil is moderately well suited to building site development. The shrink-swell potential is a limitation on sites for dwellings. The harmful effects of shrinking and swelling can be reduced, however, by designing walls that have pilasters and are reinforced with concrete, by supporting the walls with a large spread footing, and by backfilling around foundations with material that has a low shrink-swell potential. The soil has a highly corrosive effect on uncoated steel, but other material, such as concrete, can be substituted in water, sewer, or drain lines, particularly at boundaries with other soils. The shrink-swell potential and low strength can result in damage to local roads and streets. Providing suitable base material, however, helps to prevent this damage.

Because of the slow permeability, this soil is poorly suited to septic tank absorption fields. Enlarging the field and installing a double absorption field system help to overcome the slow permeability.

This soil is moderately well suited to recreational development. It is soft and sticky during and immediately following periods of rainfall because of the content of clay in the surface layer. Covering picnic and play areas with gravel, bark, or wood chips reduces the stickiness.

The capability subclass is IIe; woodland suitability subclass 3c.

EbC2—Elba silty clay loam, 8 to 15 percent slopes, eroded. This strongly sloping, deep, well drained soil is on the upper part of side slopes and on narrow ridgetops in the uplands. Most areas are long and narrow. They are 150 to 500 feet wide and are 3 to 20 acres in size.

Typically, the surface layer is dark grayish brown, friable silty clay loam about 5 inches thick. Erosion has removed part of the original surface layer. The remaining surface layer is a mixture of the original surface layer and subsoil material. The subsoil is olive brown and light olive brown, firm silty clay about 36 inches thick. The substratum is olive brown and light olive brown, firm channery silty clay. Limestone bedrock is at a depth of about 72 inches. In places the subsoil and substratum are reddish brown. In a few areas the substratum is slightly acid or neutral. In some areas the soil is deeper to carbonates. In other areas the surface layer is silty clay. In a few areas the soil is moderately well drained and has gray mottles in the subsoil.

Permeability is slow in the Elba soil. Available water capacity is moderate. Runoff is rapid. The content of organic matter is moderately low, and tilth is fair. The soil tends to dry out slowly and to crack at the surface. The subsoil is medium acid to mildly alkaline in the upper part and neutral to moderately alkaline in the lower part. The root zone is deep, but root growth is restricted somewhat by the clayey subsoil. The shrink-swell potential is high in the subsoil. The potential for frost action is moderate.

Most areas are used for cultivated crops or for hay and pasture. This soil is suited to a crop rotation of corn, small grain, and hay. Controlling erosion and improving tilth are the major concerns of management. If the soil is cultivated, the hazard of further erosion is severe. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour stripcropping, and cover crops improve tilth, reduce the runoff rate, and help to prevent excessive soil loss. Tilling when the soil is wet causes surface compaction and cloddiness.

This soil is suited to pasture. Proper stocking rates and pasture rotation help to prevent overgrazing and control erosion. No-till seeding also helps to control erosion. Mowing helps to control weeds. Timely applications of lime and fertilizer are needed. Restricted grazing during wet periods helps to prevent surface compaction.

Some areas are used as woodland. This soil is suited to woodland and to habitat for woodland wildlife. Erosion can be controlled in wooded areas by building logging roads and skid trails on the contour and by establishing water bars. The use of logging equipment is restricted because the soil is soft and slippery when wet. The trees can be logged during the drier parts of the year. Selecting species for planting that are tolerant of the high clay content in the subsoil reduces the seedling mortality rate and the windthrow hazard.

This soil is moderately well suited to building site development. Removing as little vegetation as possible, mulching, or establishing a temporary plant cover helps to control erosion on construction sites. The shrink-swell potential is a limitation on sites for dwellings. The harmful effects of shrinking and swelling can be reduced, however, by designing walls that have pilasters and are reinforced with concrete, by supporting the walls with a large spread footing, and by backfilling around foundations with material that has a low shrink-swell potential. Cutting and filling increase the hazard of hillside slippage, but installing drains in areas where water concentrates reduces the hazard. The soil has a highly corrosive effect on uncoated steel, but other material, such as concrete, can be substituted in water, sewer, or drain lines, particularly at boundaries with other soils.

The slope, low strength, and the shrink-swell potential are limitations on sites for local roads and streets. Building on the contour and seeding road cuts help to control erosion. Providing suitable base material helps to prevent the road damage caused by low strength and by shrinking and swelling.

Because of the slow permeability and the slope, this soil is poorly suited to septic tank absorption fields. Installing the leach lines on the contour helps to prevent seepage of the effluent to the surface. Enlarging the field or installing a double absorption field system helps to overcome the slow permeability.

Because of the slope and the slow permeability, this soil is poorly suited to recreational development. It is soft and sticky during and immediately following periods of rainfall because of the content of clay in the surface layer. Covering picnic and play areas with gravel, bark, or wood chips, however, reduces the stickiness. On sites for trails, erosion can be controlled by laying out the trails on the contour and by building steps.

The capability subclass is IIIe; woodland suitability subclass 3c.

EcD2—Elba-Upshur silty clay loams, 15 to 25 percent slopes, eroded. These moderately steep, deep, well drained soils are on side slopes in the uplands. The Elba soil commonly is on the upper part of the side slopes, and the Upshur soil is on the lower part. Erosion has removed part of the original surface layer of both soils. The remaining surface layer is a mixture of the original surface layer and subsoil material. Most areas are long and 150 to 350 feet wide and are 3 to 40 acres in size. They are 50 to 65 percent Elba silty clay loam and 25 to 35 percent Upshur silty clay loam. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Elba soil has a surface layer of dark grayish brown, friable silty clay loam about 3 inches thick. The subsoil is olive brown and light olive brown, firm silty clay about 30 inches thick. The substratum is olive brown and light olive brown, firm channery silty clay. Limestone bedrock is at a depth of about 76 inches. In some areas the surface layer is silty clay. In a few areas the soil is moderately well drained and has gray mottles in the subsoil.

Typically, the Upshur soil has a surface layer of reddish brown, firm silty clay loam about 4 inches thick. The subsoil is dark reddish brown, firm silty clay about 30 inches thick. The substratum is dark reddish brown, firm silty clay loam. Shale bedrock is at a depth of about 60 inches. In some areas the surface layer is silty clay.

Included with these soils in mapping are small areas of the moderately deep Berks and deep Westmoreland soils. These included soils contain less clay in the subsoil than Elba and Upshur soils. They make up 10 to 15 percent of most mapped areas.

Permeability is slow in the Elba and Upshur soils. Available water capacity is moderate. Runoff is very rapid. The content of organic matter is moderately low, and tilth is fair. The soils tend to dry out slowly and to crack at the surface. The subsoil of the Elba soil is medium acid to moderately alkaline, and that of the Upshur soil is strongly acid to moderately alkaline. The root zone in both soils is deep, but root growth is restricted somewhat by the clayey subsoil. The shrink-swell potential is high in the subsoil. The potential for frost action is moderate.

Some areas are used for hay. These soils are moderately well suited to a crop rotation of corn, small grain, and hay. Commonly, a cultivated crop is grown in the rotation about once every 4 years. The slope, the hazard of erosion, and tilth are the major concerns of management. If the soil is cultivated, the hazard of further erosion is very severe. A permanent plant cover is the best means of controlling erosion. A system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and cover crops improve tilth, reduce the runoff rate, and help to prevent excessive soil loss. The moderately steep slope hinders the use of some farm machinery. Tilling when the soils are wet causes surface compaction and cloddiness.

Some areas are pastured. These soils are suited to pasture. If the pasture is overgrazed or is plowed during seedbed preparation, however, the hazard of further erosion is very severe. Proper stocking rates and pasture rotation help to prevent overgrazing and thus help to control erosion. No-till seeding also helps to control erosion. Mowing helps to control weeds. Timely applications of lime and fertilizer are needed. Restricted grazing during wet periods helps to prevent surface compaction.

Some areas are wooded. These soils are suited to woodland and to habitat for woodland wildlife. Erosion in the wooded areas can be controlled by building logging roads and skid trails on the contour and by establishing water bars. The use of logging equipment is restricted because the soils are soft and slippery when wet. The trees can be logged during the drier parts of the year. Selecting species for planting that are tolerant of the high clay content in the subsoil reduces the seedling mortality rate and the windthrow hazard.

These soils are poorly suited to building site development and generally are unsuited to septic tank absorption fields. Erosion on construction sites can be controlled by removing as little vegetation as possible, mulching, and establishing a temporary plant cover. The shrink-swell potential and the slope of both soils are limitations on sites for dwellings. Also, the Upshur soil is subject to slippage. The harmful effects of shrinking and swelling can be reduced by designing walls that have pilasters and are reinforced, by supporting the walls with a large spread footing, and by backfilling around foundations with material that has a low shrink-swell potential. Cutting and filling increase the hazard of hillside slippage, but installing drains in areas where water concentrates reduces the hazard. The soils have a highly corrosive effect on uncoated steel, but other material, such as concrete, can be substituted in water, sewer, or drain lines, particularly at boundaries with other soils.

The slope, the shrink-swell potential, and low strength are limitations on sites for local roads and streets. Building the roads and streets on the contour and seeding road cuts help to control erosion. Providing suitable base material helps to prevent the road damage resulting from low strength and from shrinking and swelling.

Mainly because of the slope and the hazard of further erosion, these soils are poorly suited to recreational development. On sites for trails, erosion can be controlled by laying out the trails on the contour and by building steps or establishing switchbacks. Because of the content of clay in the surface layer, the soils are soft and sticky during and immediately following periods of rainfall. Covering picnic and play areas with gravel, bark, or wood chips, however, reduces the stickiness.

The capability subclass is IVe; woodland suitability subclass 3c on north aspects, 4c on south aspects.

Ek—Elkinsville silt loam, rarely flooded. This nearly level, deep, well drained soil is on low terraces along streams. It is subject to rare flooding. Most areas are 2 to 50 acres in size. Most are long strips that are 150 to 800 feet wide, but some are irregularly shaped.

Typically, the surface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsoil is 40 inches of brown, friable silt loam and silty clay loam. The substratum to a depth of about 60 inches is yellowish brown, friable loam. It is mottled in the lower part. In places the lower part of the subsoil is sandy loam.

Included with this soil in mapping are small areas of moderately well drained soils and the poorly drained Peoga soils in small depressions near the base of escarpments and small areas of Tioga soils on flood plains. The subsoil of Tioga soils is coarser textured than that of the Elkinsville soil. Also included are some areas in the flood pools of Bolivar and Dover Dams. These areas are subject to controlled flooding. Included soils make up 10 to 15 percent of most mapped areas.

Permeability is moderate in the Elkinsville soil. Available water capacity is high or very high. Runoff is slow. In the surface layer, the content of organic matter is moderate and tilth is good. The subsoil is strongly acid or very strongly acid. The root zone is deep. The potential for frost action is high.

Most areas are used for corn, small grain, or hay and pasture. This soil is well suited to all of these uses. Row crops can be grown year after year if improved or intensive management is applied and flooding is controlled. The soil crusts after heavy rainfall, especially in tilled areas. Shallow cultivation of intertilled crops, however, breaks up the crust.

Some areas are wooded. This soil is well suited to woodland. Plant competition can be controlled by cutting, spraying, or disking.

Because it is subject to flooding, this soil generally is unsuited to building site development and septic tank absorption fields. It is well suited to most recreational uses. Low strength and the potential for frost action are limitations on sites for local roads and streets. Providing suitable base material, however, helps to prevent the road damage resulting from low strength and frost action. The soil has a highly corrosive effect on concrete, but other material, such as steel, can be substituted in water, sewer, or drain lines, particularly at boundaries with other soils.

The capability class is I; woodland suitability subclass 1o.

FaD—Fairpoint channery clay loam, 8 to 25 percent slopes. This strongly sloping and moderately steep, deep, well drained soil is on mine spoil ridges in areas that have been surface mined for coal. In some areas the ridges are continuous and have sides less than 40 feet high and strongly sloping tops 25 to 100 feet wide. In other areas they are discontinuous and about 40 feet high. The soil is a mixture of rock fragments and partly weathered fine earth material that was in or below the profile of the original soil. Most of the rock fragments are flat and less than 10 inches long. In most places a few large stones, 75 to 200 feet apart, are on the surface. Most areas are 200 to 1,000 feet wide and are 10 to 80 acres in size.

Typically, the surface layer is yellowish brown, friable channery clay loam about 5 inches thick. The substratum to a depth of about 60 inches is yellowish brown and brown, friable very channery clay loam. In some areas it is extremely acid to strongly acid or is mildly alkaline or moderately alkaline. In other areas the surface layer is shaly clay loam or shaly silty clay loam. A few areas have been graded so that the strongly sloping and moderately steep slopes are uniform. These areas have been blanketed with a layer of material removed from other soils.

Included with this soil in mapping are small intermittent and perennial ponds, long and narrow walls of exposed bedrock as high as about 40 feet, and steep and very steep soils on the sides of the spoil ridges. Inclusions make up 5 to 15 percent of most mapped areas.

Permeability is moderately slow in the Fairpoint soil. Available water capacity is low. Runoff is very rapid. Tilth is poor in the surface layer. The content of organic matter is very low. The depth of the root zone varies. This zone is medium acid to neutral unless the soil has been limed. The potential for frost action and the shrink-swell potential are moderate.

This soil generally is unsuited to row crops and hay because it is a poor growing medium for roots. It is droughty and low in fertility. The stone fragments on the surface or in the surface layer prevent or seriously interfere with tillage. If the soil is cultivated, the hazard of erosion is very severe. A permanent plant cover is the best means of controlling erosion. Slope hinders the use of farm machinery in the moderately steep areas.

This soil is poorly suited to pasture. If the pasture is overgrazed or is plowed during seedbed preparation, the hazard of erosion is very severe. Proper stocking rates and pasture rotation help to prevent overgrazing and thus control erosion. No-till seeding also helps to control erosion. Restricted grazing during wet periods helps to prevent surface compaction. Soil tests are needed to determine specific nutrient needs. Ground cover and surface mulch reduce the runoff rate and the susceptilibity to erosion and increase the rate of water intake.

Most areas support black locust and aspen and many undergrowth plants. This soil is suited to trees, but growth generally is slow because of the very low content of organic matter, the low available water capacity, and the depth of the root zone. Erosion can be controlled by building logging roads and skid trails on the contour and by establishing water bars. Mechanical tree planters and the mowers used to control plant competition can be operated in all areas, except for the steep and very steep included areas. The use of equipment is sometimes restricted because the soil is soft and slippery when wet.

This soil is poorly suited to building site development, septic tank absorption fields, and recreational development, mainly because of the slope and the likelihood of slippage. Also, the moderately slow permeability is a limitation in septic tank absorption fields. Once the soil settles, areas where slopes are 8 to 15 percent are somewhat better suited to these uses than the steeper areas. Onsite investigation is needed to determine suitability.

Measures that control erosion and reduce the likelihood of slippage are needed in the areas used for building site development or septic tank absorption fields. Erosion can be controlled by removing as little vegetation as possible, mulching, and establishing a temporary plant cover on construction sites and by building local roads and streets on the contour and seeding road cuts. Cutting and filling increase the hazard of hillside slippage, but installing drains in areas where water concentrates reduces the hazard. Installing the leach lines in septic tank absorption fields on the contour helps to prevent seepage of the effluent to the surface. Enlarging the field or installing a double absorption field system improves the filtering capacity. The soil has a highly corrosive effect on uncoated steel, but other material, such as concrete, can be substituted in water, sewer, or drain lines, particularly at boundaries with other soils.

Erosion and stickiness are concerns in managing recreational areas. On sites for trails, erosion can be controlled by laying out the trails on the contour, establishing water bars or switchbacks, and building steps. Because of the content of clay in the surface layer, the soil is soft and sticky during and immediately following periods of rainfall. Covering picnic and play areas with gravel, bark, or wood chips, however, reduces the stickiness.

The capability subclass is VIs; woodland suitability subclass not assigned.

FaF—Fairpoint channery clay loam, 25 to 70 percent slopes. This steep and very steep, deep, well drained soil is on mine spoil ridges in areas that have been surface mined for coal. In most areas the ridges are continuous, very steep, and about 60 to 100 feet high. The soil is a mixture of rock fragments and partly weathered fine earth material that was in or below the profile of the original soil. Most of the rock fragments are flat and less than 10 inches long. In most places a few large stones, 75 to 200 feet apart, are on the surface. Areas commonly are 200 to 500 feet wide and are 10 to 50 acres in size.

Typically, the surface layer is yellowish brown, friable channery clay loam about 3 inches thick. The substratum to a depth of about 60 inches is yellowish brown, brown, and grayish brown, mottled, friable channery clay loam and very channery clay loam. In some areas it is extremely acid to strongly acid or is mildly alkaline or moderately alkaline. In other areas the surface layer is shaly clay loam or shaly silty clay loam. In a few areas the slope is only 8 to 25 percent.

Permeability is moderately slow. Available water capacity is low. Runoff is very rapid. Tilth is poor in the surface layer. The content of organic matter is very low. The depth of the root zone varies. This zone is medium acid to neutral. The potential for frost action and the shrink-swell potential are moderate.

This soil generally is unsuited to row crops, small grain, and hay and pasture because of the steep and very steep slope, droughtiness, and a very severe hazard of erosion.

Most areas support black locust and aspen and many undergrowth plants. This soil is suited to trees, but growth generally is slow because of the very low content of organic matter, the low available water capacity, and the depth of the root zone. Erosion can be controlled by building logging roads on the contour and by establishing water bars. The use of equipment is restricted because the soil is steep and very steep and is soft and slippery when wet.

This soil generally is unsuited to building site development, septic tank absorption fields, and recreational development because of the slope and the susceptibility to hillside slippage. Cutting and filling increase the hazard of slippage, but installing drains in areas where water concentrates reduces the hazard. The soil has a highly corrosive effect on uncoated steel, but other material, such as concrete, can be substituted in water, sewer, or drain lines, particularly at boundaries with other soils.

The capability subclass is VIIe; woodland suitability subclass not assigned.

FcA—Fitchville silt loam, 0 to 3 percent slopes. This nearly level, deep, somewhat poorly drained soil is on slack water terraces along streams. Most areas are long strips 250 to 400 feet wide and 5 to 30 acres in size, but a few are as wide as 1,000 feet and 60 or more acres in size.

Typically, the surface layer is dark grayish brown, very friable silt loam about 9 inches thick. The subsoil is brown and yellowish brown, mottled, friable silty clay loam about 34 inches thick. The substratum to a depth of about 60 inches is dark yellowish brown, mottled, friable silt loam and silty clay loam. In some areas the subsoil is clay loam. In other areas it is silty clay in the lower part.

Included with this soil in mapping are areas, generally less than 2 acres in size, of the poorly drained Sebring soils in depressions. Also included are a few areas in the flood pool of Dover Dam. These areas are subject to flooding. Included soils make up 10 to 15 percent of most mapped areas.

Permeability is moderately slow in the Fitchville soil. Available water capacity is high. Runoff is slow. A perched seasonal high water table is at a depth of 12 to 30 inches during extended wet periods. In the surface layer, the content of organic matter is moderate and tilth is good. The subsoil is very strongly acid to neutral. The root zone is deep. The potential for frost action is high. The shrink-swell potential is moderate in the subsoil.

Most areas are pastured, but some are used as cropland. If adequately drained, this soil is suited to corn, small grain, and pasture. Subsurface drains are installed in areas where drainage outlets are available. Grassed waterways, diversions, and open ditches move the runoff from adjacent soils on uplands to natural drainageways or to other ditches. A surface crust forms after heavy rainfall. Shallow cultivation of intertilled crops, however, breaks up the crust. Restricted grazing during wet periods helps to prevent surface compaction in pastured areas. The forage species that can tolerate the wetness grow well.

Some areas are wooded. This soil is suited to woodland and to habitat for woodland wildlife. The trees that can tolerate some wetness should be selected for planting.

This soil is poorly suited to building site development and recreational development. The seasonal wetness is the main limitation. It can be reduced by surface and subsurface drains. Waterproofing basement walls, installing drains at the base of footings, and using sump pumps help to keep water away from basements. The shrink-swell potential is a limitation on sites for dwellings. It can be overcome, however, by designing walls that have pilasters and are reinforced, by supporting the walls with a large spread footing, and by backfilling around foundations with material that has a low shrink-swell potential. The soil has a highly corrosive effect on uncoated steel, but other material, such as concrete, can be substituted in water, sewer, or drain lines, particulalry at boundaries with other soils.

Low strength and the potential for frost action can result in damage to local roads and streets. Installing a drainage system and providing suitable base material, however, help to prevent this damage.

Because of the seasonal wetness and the moderately slow permeability, this soil is poorly suited to septic tank absorption fields. Perimeter drains can reduce the wetness if drainage outlets are available. Enlarging the field or installing a double absorption field system helps to overcome the moderately slow permeability.

The capability subclass is IIw; woodland suitability subclass 2o.

FcB—Fitchville silt loam, 3 to 8 percent slopes. This gently sloping, deep, somewhat poorly drained soil is on slack water terraces along streams. In some areas it has been gullied by runoff from the adjacent uplands. Most areas are long strips 200 to 400 feet wide and 5 to 50 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsoil is yellowish brown and dark yellowish brown, mottled, firm silty clay loam about 34 inches thick. The substratum to a depth of about 60 inches is dark yellowish brown, mottled, firm silt loam. In some areas the subsoil is clay loam.

Included with this soil in mapping are areas, generally less than 2 acres in size, of the poorly drained Sebring soils in depressions and small areas of the moderately well drained Glenford soils on the more sloping parts of the landscape. Also included are a few areas in the flood pool of Atwood Dam. These areas are subject to flooding. Included soils make up about 10 to 15 percent of most mapped areas.

Permeability is moderately slow in the Fitchville soil. Available water capacity is high. Runoff is medium. A perched seasonal high water table is at a depth of 12 to 30 inches during extended wet periods. In the surface layer, the content of organic matter is moderate and tilth is good. The subsoil is very strongly acid to neutral. The root zone is deep. The potential for frost action is high. The shrink-swell potential is moderate in the subsoil.

Most areas are pastured, but some are used as cropland. If adequately drained, this soil is suited to pasture and to a crop rotation of corn, small grain, and hay. Controlling erosion and reducing the wetness are the major concerns of management. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour farming, and cover crops reduce the runoff rate and help to prevent excessive soil loss and deterioration of tilth. Subsurface drains are installed in areas where drainage outlets are available. Grassed waterways, diversions, and open ditches move the runoff from the adjacent soils on uplands to natural drainageways or to other ditches. A crust forms after heavy rainfall. Shallow cultivation of intertilled crops, however, breaks up the crust. Restricted grazing during wet periods helps to prevent surface compaction in pastured areas. The forage species that can tolerate the wetness grow well.

Some areas are wooded. This soil is suited to woodland and to habitat for woodland wildlife. The trees that can tolerate some wetness grow well.

This soil is poorly suited to building site development and recreational development. The seasonal wetness is the main limitation. It can be reduced by surface and subsurface drains. Waterproofing basement walls, installing drains at the base of footings, and using sump pumps help to keep water away from basements. The shrink-swell potential is a limitation on sites for dwellings. It can be overcome, however, by designing walls that have pilasters and are reinforced with concrete, by supporting the walls with a large spread footing, and by backfilling around foundations with material that has a low shrink-swell potential. The soil has a highly corrosive effect on uncoated steel, but other material, such as concrete, can be substituted in water, sewer, or drain lines, particulalry at boundaries with other soils.

Low strength and the potential for frost action can result in damage to local roads and streets. Installing a drainage system and providing suitable base material, however, help to prevent this damage.

Because of the seasonal wetness and the moderately slow permeability, this soil is poorly suited to septic tank absorption fields. Perimeter drains can reduce the wetness if a drainage outlet is available. Enlarging the field or installing a double absorption field system helps to overcome the moderately slow permeability.

The capability sublcass is IIe; woodland suitability subclass 2o.

GfB—Glenford silt loam, 3 to 8 percent slopes. This gently sloping, deep, moderately well drained soil is on slack water terraces along streams. Most areas are at the base of moderately steep or steep upland side slopes. They are long strips 100 to 750 feet wide and commonly 5 to 75 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 8 inches thick. The subsoil is about 36 inches thick. The upper part is yellowish brown, friable silt loam and silty clay loam, and the lower part is yellowish brown and strong brown, mottled, firm silty clay loam. The substratum to a depth of about 60 inches is yellowish brown, mottled, firm silty clay loam. In some areas the subsoil is loam or clay loam. In a few areas the soil is well drained.

Included with this soil in mapping are areas, generally less than 2 acres in size, of the somewhat poorly drained Fitchville soils in depressions. Also included are some areas in the flood pools of the dams in the Muskingum Watershed Conservancy District. These areas are subject to flooding. Included soils make up 10 to 15 percent of most mapped areas.

Permeability is moderately slow in the Glenford soil. Available water capacity is moderate or high. Runoff is medium. A perched seasonal high water table is at a depth of 24 to 42 inches during extended wet periods. In the surface layer, the content of organic matter is moderate and tilth is good. The subsoil is very strongly acid to medium acid. The root zone is deep. The potential for frost action is high. The shrink-swell potential is moderate in the upper part of the subsoil.

Most areas are used for cultivated crops or for hay and pasture. This soil is suited to pasture and to a crop rotation of corn, small grain, and hay. Controlling erosion is the major concern of management. If the soil is cultivated, plowed during seedbed preparation, or overgrazed, the hazard of erosion is moderate. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour farming, and cover crops reduce the runoff rate and help to prevent excessive soil loss and deterioration of tilth. Natural drainage generally is adequate, but subsurface drains are needed in scattered areas of the wetter included soils. The surface layer crusts after heavy rainfall, especially in tilled areas. Shallow cultivation of intertilled crops, however, breaks up the crust. Restricted use during wet periods helps to keep pastures in good condition.

Some areas are wooded. This soil is suited to woodland and to habitat for woodland wildlife. Spraying, mowing, or disking helps to control plant competition.

This soil is suited to recreational development and is moderately well suited to building site development. Removing as little vegetation as possible, mulching, and establishing a temporary plant cover help to control erosion on construction sites. The seasonal wetness and the shrink-swell potential are limitations on sites for dwellings. Waterproofing basement walls and installing drains at the base of footings help to keep water away from basements. The harmful effects of shrinking and swelling can be reduced by designing walls that have pilasters and are reinforced with concrete, by supporting the walls with a large spread footing, and by backfilling around foundations with material that has a low shrink-swell potential. Low strength and the potential for frost action can result in damage to local roads and streets. Installing a drainage system and providing suitable base material, however, help to prevent this damage.

This soil is moderately well suited to septic tank absorption fields. The seasonal wetness and the moderately slow permeability are limitations. Perimeter drains reduce the wetness. Enlarging the field or installing a double absorption field system helps to overcome the moderately slow permeability.

The capability subclass is IIe; woodland suitability subclass 1o.

GfC—Glenford silt loam, 8 to 15 percent slopes. This strongly sloping, deep, moderately well drained soil is on slack water terraces along streams. Most areas are at the base of moderately steep or steep upland side slopes. They are long strips 100 to 400 feet wide and commonly 5 to 100 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 6 inches thick. The subsoil is about 36 inches thick. The upper part is yellowish brown, friable silt loam, and the lower part is yellowish brown, mottled, firm silty clay loam. The substratum to a depth of about 60 inches is yellowish brown, mottled, firm silty clay loam. In some small areas the surface layer contains coarse fragments of colluvial origin. In places the subsoil is loam or clay loam. In a few areas the soil is well drained.

Included with this soil in mapping are small areas of Coshocton soils at the base of upland side slopes. These soils have a higher content of coarse fragments in the subsoil and substratum than the Glenford soils. Also included are some areas in the flood pools of Atwood and Leesville Dams. These areas are subject to flooding. Included soils make up 10 to 15 percent of most mapped areas.

Permeability is moderately slow in the Glenford soil. Available water capacity is moderate or high. Runoff is medium or rapid. A perched seasonal high water table is at a depth of 24 to 42 inches during extended wet periods. In the surface layer, the content of organic matter is moderate and tilth is good. The subsoil is very strongly acid to medium acid. The root zone is deep. The potential for frost action is high. The shrink-swell potential is moderate in the upper part of the subsoil.

Most areas are used for cultivated crops or for hay and pasture. This soil is suited to a crop rotation of corn, small grain, and hay. Controlling erosion is the major concern of management. If the soil is cultivated, the hazard of erosion is severe. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour stripcropping, and cover crops reduce the runoff rate and help to prevent excessive soil loss and deterioration of tilth. Natural drainage generally is adequate, but subsurface drains are needed in scattered seepy areas. The surface layer crusts after heavy rainfall, especially in tilled areas. Shallow cultivation of intertilled crops, however, breaks up the crust.

This soil is suited to pasture. If the pasture is overgrazed or is plowed during seedbed preparation, however, the hazard of erosion is severe. Proper stocking rates and pasture rotation help to prevent overgrazing and thus control erosion. No-till seeding also helps to control erosion. Mowing helps to control weeds. Timely applications of lime and fertilizer are needed.

Some areas are wooded. This soil is suited to woodland and to habitat for woodland wildlife. Plant competition can be controlled by spraying, mowing, or disking.

This soil is moderately well suited to building site development and recreational development. Erosion can be controlled by removing as little vegetation as possible, mulching, and establishing a temporary plant cover on construction sites and by building local roads and streets on the contour and seeding road cuts. On sites for trails it can be controlled by laying out the trails on the contour, establishing water bars, and building steps.

The seasonal wetness and the shrink-swell potential are limitations on sites for dwellings. Waterproofing basement walls and installing drains at the base of footings help to keep water away from basements. The harmful effects of shrinking and swelling can be reduced by designing walls that have pilasters and are reinforced with concrete, by supporting the walls with a large spread footing, and by backfilling around foundations with material that has a low shrink-swell potential.

Low strength and the potential for frost action can result in damage to local roads and streets. Installing a drainage system and providing suitable base material, however, help to prevent this damage.

This soil is moderately well suited to septic tank absorption fields. The seasonal wetness, the moderately slow permeability, and the slope are limitations. Installing the leach lines on the contour helps to prevent seepage of the effluent to the surface. Perimeter drains reduce the wetness. Enlarging the field or installing a double absorption field system helps to overcome the moderately slow permeability.

The capability subclass is IIIe; woodland suitability subclass 1o.

GuB—Guernsey silty clay loam, 3 to 8 percent slopes. This gently sloping, deep, moderately well drained soil is on the convex tops of upland ridges. Most areas are long and narrow. They are 200 to 600 feet wide and are 3 to 40 acres in size.

Typically, the surface layer is dark grayish brown, friable silty clay loam about 7 inches thick. The subsoil is about 30 inches thick. It is yellowish brown and firm. The upper part is silty clay loam, and the lower part is mottled silty clay loam and silty clay. The substratum is grayish brown, mottled, firm shaly silty clay loam. Shale bedrock is at a depth of about 47 inches. In some areas the subsoil is thinner and is reddish brown or yellowish red. In other areas the surface layer is silt loam. In a few areas carbonates are closer to the surface.

Included with this soil in mapping are small areas of moderately deep soils and the medium textured Coshocton soils. Also included are small areas of the well drained Berks and Westmoreland soils, which contain less clay in the subsoil than the Guernsey soil and are on small knolls and at the edges of the ridgetops. Included soils make up about 15 percent of most mapped areas.

Permeability is slow or moderately slow in the Guernsey soil. Available water capacity is moderate. Runoff is medium or rapid. A perched seasonal high water table is at a depth of 24 to 42 inches in winter and in spring and other extended wet periods. The content of organic matter is moderately low, and tilth is fair. The soil tends to dry out slowly and to crack at the surface. The subsoil is very strongly acid to medium acid in the upper part and strongly acid to mildly alkaline in the lower part. The root zone is deep. The potential for frost action is high. The shrink-swell potential is high in the lower part of the subsoil.

Most areas are used as cropland. Corn, small grain, and hay are the principal crops. This soil is suited to a rotation of these crops and to pasture. Controlling erosion and improving tilth are the major concerns of management. If the soil is cultivated, plowed during seedbed preparation, or overgrazed, the hazard of erosion is moderate. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour farming, and cover crops reduce the runoff rate, help to prevent excessive soil loss, and improve tilth. Natural drainage generally is adequate, but subsurface drains are needed in scattered seepy areas. Tilling when the soil is wet causes surface compaction and cloddiness. Restricted grazing during wet periods helps to prevent compaction and helps to keep pastures in good condition.

This soil is suited to woodland and to habitat for woodland wildlife. Plant competition can be controlled by spraying, mowing, or disking.

This soil is moderately well suited to building site development. The seasonal wetness and the high shrink-swell potential in the lower part of the subsoil are limitations on sites for dwellings, especially dwellings with basements. Waterproofing basement walls and installing drains at the base of footings help to keep water away from basements. The harmful effects of shrinking and swelling can be reduced by designing walls that have pilasters and are reinforced with concrete, by supporting the walls with a large spread footing, and by backfilling around foundations with material that has a low shrink-swell potential. The soil has a highly corrosive effect on uncoated steel, but other material, such as concrete, can be substituted in water, sewer, or drain lines, particularly at boundaries with other soils.

The shrink-swell potential, the potential for frost action, and low strength can result in damage to local roads and streets. Providing suitable base material and installing a drainage system, however, help to prevent this damage.

Because of the seasonal wetness and the slow or moderately slow permeability, this soil is poorly suited to septic tank absorption fields. Perimeter drains reduce the wetness. Enlarging the field or installing a double absorption field system helps to overcome the slow or moderately slow permeability.

This soil is moderately well suited to recreational development. It is soft and sticky during and immediately following periods of rainfall because of the content of clay in the surface layer. Covering picnic and play areas with gravel, bark, or wood chips, however, reduces the stickiness.

The capability subclass is IIe; woodland suitability subclass 2o.

GuC2—Guernsey silty clay loam, 8 to 15 percent slopes, eroded. This strongly sloping, deep, moderately well drained soil dominantly is on the upper sides and convex tops of upland ridges and on saddles between the ridgetops. Most areas are long and narrow. They are 150 to 500 feet wide and are 3 to 50 acres in size.

Typically, the surface layer is brown, friable silty clay loam about 6 inches thick. Erosion has removed part of the original surface layer. The remaining surface layer is a mixture of the original surface layer and subsoil material. The subsoil is about 34 inches thick. It is firm. The upper part is yellowish brown silty clay loam; the next part is yellowish brown, mottled silty clay; and the lower part is grayish brown, mottled silty clay and silty clay loam. The substratum is grayish brown, light yellowish brown, and light olive brown, mottled, firm silty clay loam. Shale bedrock is at a depth of about 69 inches. In places the subsoil is thinner and has reddish brown or yellowish red colors. In some areas the surface layer is silt loam. In other areas carbonates are closer to the surface.

Included with this soil in mapping are small convex areas of the well drained Berks and Westmoreland soils. These soils contain less clay in the subsoil than the Guernsey soil. Also included are some small areas of moderately deep soils and the medium textured Coshocton soils. Included soils make up about 15 percent of most mapped areas.

Permeability is slow or moderately slow in the Guernsey soil. Available water capacity is moderate. Runoff is rapid. A perched seasonal high water table is at a depth of 24 to 42 inches in winter and in spring and other extended wet periods. The content of organic matter is moderately low, and tilth is fair. The subsoil is very strongly acid to medium acid in the upper part and strongly acid to mildly alkaline in the lower part. The root zone is deep. The potential for frost action is high. The shrink-swell potential is high in the middle and lower parts of the subsoil.

Most areas are used as pasture or cropland. Corn, small grain, and hay are the principal crops. This soil is suited to a rotation of these crops and to pasture. Controlling erosion is the major concern of management. If the soil is cultivated, the hazard of further erosion is severe. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour stripcropping, and cover crops improve tilth, reduce the runoff rate, and help to prevent excessive soil loss. Natural drainage generally is adequate, but subsurface drains are needed in scattered seepy areas. Tilling when the soil is wet causes surface compaction and cloddiness.

This soil is suited to pasture. If the pasture is overgrazed or is plowed during seedbed preparation, however, the hazard of further erosion is severe. Proper stocking rates and pasture rotation help to prevent overgrazing and thus control erosion. No-till seeding also helps to control erosion. Mowing helps to control weeds. Timely applications of lime and fertilizer are needed. Restricted grazing during wet periods helps to prevent surface compaction.

This soil is moderately well suited to building site development. Erosion can be controlled by removing as little vegetation as possible, mulching, and establishing a temporary plant cover on construction sites and by building local roads and streets on the contour and seeding road cuts. The seasonal wetness and the high shrink-swell potential in the middle and lower parts of the subsoil are limitations on sites for dwellings, especially dwellings with basements. Waterproofing basement walls and installing drains at the base of footings help to keep water away from basements. The harmful effects of shrinking and swelling can be reduced by designing walls that have pilasters and are reinforced with concrete, by supporting the walls with a large spread footing, and by backfilling around foundations with material that has a low shrink-swell potential. Cutting and filling increase the hazard of hillside slippage, but installing a drainage system in seepy areas reduces the hazard. The soil has a highly corrosive effect on uncoated steel, but other material, such as concrete, can be substituted in water, sewer, or drain lines, particularly at boundaries with other soils.

The shrink-swell potential, the potential for frost action, and low strength can result in damage to local roads and streets. Providing suitable base material and installing a drainage system, however, help to prevent this damage.

Because of the seasonal wetness, the slow or moderately slow permeability, and the slope, this soil is poorly suited to septic tank absorption fields. Installing the leach lines on the contour helps to prevent seepage of the effluent to the surface. Perimeter drains reduce the wetness. Enlarging the field or installing a double absorption field system helps to overcome the slow or moderately slow permeability.

This soil is poorly suited to recreational development. On sites for trails, erosion can be controlled by laying out the trails on the contour and by building steps. Because of the content of clay in the surface layer, the soil is soft and sticky during and immediately following periods of rainfall. Covering picnic and play areas with gravel, bark, or wood chips, however, reduces the stickiness.

The capability subclass is IIIe; woodland suitablility subclass 2o.

HeB—Hazleton loam, 3 to 8 percent slopes. This gently sloping, deep, well drained soil is on the tops of upland ridges. Areas generally are long and narrow. Most are 3 to 20 acres in size, but some are as large as 45 acres. Most of the ridgetops are about 200 feet wide, but those in the larger areas are as wide as 400 feet.

Typically, the surface layer is dark grayish brown, friable loam about 6 inches thick. The subsoil is about 24 inches of yellowish brown, friable channery loam and channery sandy loam. The substratum is yellowish brown, friable very channery loamy sand. Sandstone bedrock is at a depth of about 50 inches. In some areas the subsoil contains fewer sandstone fragments. In other areas the surface layer is channery loam.

Included with this soil in mapping are scattered areas, generally less than 2 acres in size, of the moderately deep Culleoka soils. The subsoil of these soils has a lower content of sandstone fragments and a higher content of clay than that of the Hazleton soil. Also included are plane or depressional areas, about one-half acre in size, of the moderately well drained Coshocton soils on the broader ridgetops. Included soils make up 5 to 10 percent of most mapped areas.

Permeability is rapid or moderately rapid in the Hazleton soil. Available water capacity is low. Runoff is medium. In the surface layer, the content of organic matter is moderate and tilth is good. The soil can be easily tilled throughout a wide range in moisture content. The subsoil is extremely acid to strongly acid. The root zone is deep. The potential for frost action is moderate.

Most areas are used as pasture or cropland. This soil is suited to pasture and to a crop rotation of corn, small grain, and hay. Controlling erosion and conserving moisture are the major concerns of management. If the soil is cultivated, plowed during seedbed preparation, or overgrazed, the hazard of erosion is moderate. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour farming, and cover crops reduce the runoff rate and help to prevent excessive soil loss and deterioration of tilth. Plant nutrients are leached from the soil at a moderately rapid rate. As a result, timely applications of lime and fertilizer are needed. Some crop yields are reduced because of droughtiness. In some areas sandstone fragments in the surface layer hinder tillage.

This soil is suited to woodland and to habitat for woodland wildlife. Drought-tolerant trees should be selected for planting.

This soil is suited to building site development and is well suited to recreational development. Erosion can be controlled by removing as little vegetation as possible, mulching, and establishing a temporary plant cover on construction sites. The flat stone fragments in the subsoil can be easily excavated by heavy construction equipment. Because the bedrock is as shallow as 40 inches in some areas, the soil is better suited to dwellings without basements than to dwellings with basements. It has a highly corrosive effect on concrete, but other material, such as steel, can be substituted in water, sewer, or drain lines, particularly at boundaries with other soils. The potential for frost action can result in damage to local roads and streets. Providing suitable base material, however, helps to prevent this damage. The droughtiness is a limitation if the soil is used for lawns.

This soil is suitable as a septic tank absorption field. It readily absorbs but does not adequately filter the effluent. Providing suitable fill material helps to prevent the pollution of streams, lakes, and shallow wells that can result from the poor filtering capacity.

The capability subclass is IIe; woodland suitability subclass 3f.

HeC—Hazleton loam, 8 to 15 percent slopes. This strongly sloping, deep, well drained soil is on the narrow, rounded tops of upland ridges. Areas generally are long and narrow. Most are 3 to 15 acres in size, but some are as large as several hundred acres. The ridgetops commonly are less than 200 feet wide, but those in the larger areas are as wide as 400 feet.

Typically, the surface layer is dark grayish brown, friable loam about 4 inches thick. The subsoil is about 41 inches thick. It is yellowish brown and friable. The upper part is loam and sandy loam, and the lower part is channery or very channery sandy loam. The substratum is yellowish brown, brown, and light yellowish brown, friable very channery loamy sand. Sandstone bedrock is at a depth of about 62 inches. In some areas the subsoil has a lower content of sandstone fragments. In other areas the surface layer is channery loam. In a few areas the depth to bedrock is 20 to 40 inches.

Included with this soil in mapping are areas, generally less than 2 acres in size, of Westmoreland soils on the less sloping parts of the landscape. The subsoil of these soils has a higher content of clay and a lower content of sandstone fragments than that of the Hazleton soil. Also included are some small areas of the moderately well drained Coshocton soils in saddles and on benches on the ridgetops. Included soils make up 5 to 10 percent of most mapped areas.

Permeability is rapid or moderately rapid in the Hazleton soil. Available water capacity is low. Runoff is medium or rapid. In the surface layer, the content of organic matter is moderately low and tilth is good. The soil can be easily tilled throughout a wide range in moisture content. The subsoil is extremely acid to strongly acid. The root zone is deep. The potential for frost action is moderate.

Most areas are used as pasture or cropland. This soil is suited to a crop rotation of corn, small grain, and hay. Controlling erosion and conserving moisture are the major concerns of management. If the soil is cultivated, the hazard of erosion is severe. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour stripcropping, and cover crops reduce the runoff rate and help to prevent excessive soil loss and deterioration of tilth. Plant nutrients are leached from the soil at a moderately rapid rate. As a result, timely applications of lime and fertilizer are needed. Some crop yields are reduced because of droughtiness. In some areas sandstone fragments in the surface layer hinder tillage.

This soil is suited to pasture. If the pasture is overgrazed or is plowed during seedbed preparation, however, the hazard of erosion is severe. Proper stocking rates and pasture rotation help to prevent overgrazing and thus control erosion. No-till seeding also helps to control erosion. Mowing helps to control weeds. Timely applications of lime and fertilizer are needed.

This soil is suited to woodland and to habitat for woodland wildlife. Drought-tolerant trees should be selected for planting.

This soil is moderately well suited to building site development and recreational development. Erosion can be controlled by removing as little vegetation as possible, mulching, or establishing a temporary plant cover on construction sites and by building local roads and streets on the contour and seeding road cuts. On sites for paths and trails, it can be controlled by laying out the paths and trails on the contour, establishing water bars, and building steps. The flat stone fragments in the subsoil can be easily excavated by heavy construction equipment. Because the bedrock is as shallow as 40 inches in some areas, the soil is better suited to dwellings without basements than to dwellings with basements. It has a highly corrosive effect on concrete, but other material, such as steel, can be substituted in water, sewer, or drain lines, particularly at boundaries with other soils. The potential for frost action can result in damage to local roads and streets. Providing suitable base material, however, helps to prevent this damage. The droughtiness is a limitation if the soil is used for lawns.

This soil is moderately well suited to septic tank absorption fields. It readily absorbs but does not adequately filter the effluent. Providing suitable fill material helps to prevent the pollution of streams, lakes, and shallow wells that can result from the poor filtering capacity. Installing the leach lines on the contour helps to prevent seepage of the effluent to the surface.

The capability subclass is IIIe; woodland suitability subclass 3f.

HeD—Hazleton loam, 15 to 25 percent slopes. This moderately steep, deep, well drained soil is on side slopes in the uplands. Most areas are 200 to 350 feet wide, as long as several miles, and as large as several hundred acres, but some are irregularly shaped and are only 5 to 20 acres in size.

Typically, the surface layer is dark grayish brown, friable loam about 3 inches thick. The subsoil is about 36 inches of yellowish brown, friable channery loam and channery sandy loam. The substratum is yellowish brown, friable very channery loamy sand. Sandstone bedrock is at a depth of about 72 inches. In some areas the subsoil has a lower content of sandstone fragments. In other areas the surface layer is channery loam. In a few areas the depth to bedrock is 20 to 40 inches.

Included with this soil in mapping are scattered areas, generally less than 2 acres in size, of Westmoreland soils. These soils have a higher content of clay and a lower content of sandstone fragments in the subsoil than the Hazleton soil. They make up 5 to 10 percent of most mapped areas.

Permeability is rapid or moderately rapid in the Hazleton soil. Available water capacity is low. Runoff is rapid. In the surface layer, the content of organic matter is moderately low and tilth is good. The subsoil is extremely acid to strongly acid. The root zone is deep. The potential for frost action is moderate.

This soil is suited to a crop rotation of corn, small grain, and hay. Commonly, a cultivated crop is grown in the rotation about once every 4 years. Controlling erosion and conserving moisture are the major concerns of management. If the soil is cultivated, the hazard of erosion is very severe. A permanent plant cover is the best means of controlling erosion. A system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and cover crops reduce the runoff rate and help to prevent excessive soil loss and deterioration of tilth. The moderately steep slope hinders the use of some farm machinery. Plant nutrients are leached from the soil at a moderately rapid rate. As a result, timely applications of lime and fertilizer are needed. Some crop yields are reduced because of droughtiness. In some areas sandstone fragments in the surface layer hinder tillage.

Many areas are pastured. This soil is suited to pasture. In areas that are overgrazed or are plowed during seedbed preparation, however, the hazard of erosion is very severe. Proper stocking rates and pasture rotation help to prevent overgrazing and thus control erosion. No-till seeding also helps to control erosion. Mowing helps to control weeds. Timely applications of lime and fertilizer are needed.

Many areas are wooded. This soil is suited to woodland and to habitat for woodland wildlife. Erosion can be controlled by building logging roads and skid trails on the contour and by establishing water bars. Mechanical tree planters and the mowers used to control plant competition can be operated on this soil. Because of the seedling mortality rate, drought-tolerant trees should be selected for planting, especially on south aspects.

Mainly because of the slope, this soil is poorly suited to building site development and recreational development. Erosion can be controlled by removing as little vegetation as possible, mulching, and establishing a temporary plant cover on construction sites and by building local roads and streets on the contour and seeding road cuts. On sites for paths and trails, it can be controlled by laying out the paths and trails on the contour, establishing water bars, and building steps. Because the bedrock is as shallow as 40 inches in some areas, the soil is better suited to dwellings without basements than to dwellings with basements. It has a highly corrosive effect on concrete, but other material, such as steel, can be substituted in water, sewer, or drain lines, particularly at boundaries with other soils. The potential for frost action can result in damage to local roads and streets. Providing suitable base material, however, helps to prevent this damage. The droughtiness is a limitation if the soil is used for lawns.

This soil is poorly suited to septic tank absorption fields. It readily absorbs but does not adequately filter the effluent. The poor filtering capacity may result in the pollution of streams, lakes, or shallow wells. Installing the leach lines on the contour helps to prevent seepage of the effluent to the surface.

The capability subclass is IVe; woodland suitability subclass 3f on north aspects, 4f on south aspects.

HeE—Hazleton loam, 25 to 40 percent slopes. This steep, deep, well drained soil is on upland side slopes that commonly are 200 to 400 feet long. It generally is in areas directly above less sloping soils, but in some areas it is on the valley walls on both sides of narrow drainageways. Most areas are long and narrow and are 20 to 200 acres in size.

Typically, the surface layer is dark grayish brown, friable loam about 3 inches thick. The subsoil is about 22 inches of yellowish brown, friable channery loam and channery sandy loam. The substratum is yellowish brown, friable very channery loamy sand. Sandstone bedrock is at a depth of about 60 inches. In some areas the subsoil has a lower content of sandstone fragments. In other areas the surface layer is channery loam. In a few areas the depth to bedrock is 20 to 40 inches.

Included with this soil in mapping are scattered areas, generally less than 2 acres in size, of Westmoreland soils. These soils have a higher content of clay and a lower content of sandstone fragments in the subsoil than the Hazleton soil. They make up 10 to 15 percent of most mapped areas.

Permeability is rapid or moderately rapid in the Hazleton soil. Available water capacity is low. Runoff is very rapid. In the surface layer, the content of organic matter is moderately low and tilth is good. The subsoil is extremely acid to strongly acid. The root zone is deep. The potential for frost action is moderate.

Some areas are pastured. This soil is moderately well suited to pasture. The hazard of erosion and the steep slope are the major concerns of management. If the pasture is plowed during seedbed preparation or overgrazed, the hazard of erosion is very severe. A permanent plant cover is the best means of controlling erosion. Proper stocking rates and pasture rotation help to prevent overgrazing and thus control erosion. No-till seeding also helps to control erosion.

Most areas are wooded. This soil is suited to woodland and to habitat for woodland wildlife. Erosion can be controlled by building logging roads and skid trails on the contour and by establishing water bars. Operating mechanical tree planters and the mowers used to control plant competition is difficult because of the steep slope. Because of the seedling mortality rate, drought-tolerant trees should be selected for planting, especially on south aspects.

This soil generally is unsuited to building site development, septic tank absorption fields, and most kinds of recreational development because of the slope. Erosion can be controlled by building local roads and streets on the contour and seeding road cuts. On sites for trails, it can be controlled by laying out the trails on the contour, establishing water bars and switchbacks, and building steps. The soil has a highly corrosive effect on concrete, but other material, such as steel, can be substituted in water, sewer, or drain lines, particularly at boundaries with other soils.

The capability subclass is VIe; woodland suitability subclass 3f on north aspects, 4f on south aspects.

Ho—Holly silt loam, ponded. This nearly level, deep, very poorly drained soil is on flood plains along small streams. It is subject to ponding and is frequently flooded for very long periods. Most areas are 100 to 500 feet wide and are as much as several miles long. They are 10 to 80 acres in size.

Typically, the surface layer is dark grayish brown, very friable silt loam about 7 inches thick. The subsoil is olive gray, mottled, friable silt loam about 14 inches thick. The substratum to a depth of about 60 inches is dark greenish gray, friable silt loam. In some areas the subsoil contains more clay.

Included with this soil in mapping are scattered areas, generally less than 2 acres in size, of the somewhat poorly drained Orrville soils. Also included are some areas in the flood pools of the dams in the Muskingum Watershed Conservancy District. These areas are subject to controlled flooding. Included soils make up 10 to 15 percent of most mapped areas.

Permeability is moderate or moderately slow in the Holly soil. Available water capacity is high. Runoff is very slow or ponded. The seasonal high water table is near or above the surface most of the year. In the surface layer, the content of organic matter is high and tilth is good. The subsoil is neutral or slightly acid. The root zone is deep. The potential for frost action is high.

A few areas are used as unimproved pasture. This soil generally is unsuited to row crops, small grain, and hay and is poorly suited to pasture because of the ponding and flooding. Subsurface drains are ineffective in nearly all areas because of a lack of drainage outlets. Pump drainage is needed in most areas. Restricted grazing during wet periods helps to prevent surface compaction. Water-tolerant forage species should be selected for planting.

Most areas support the weeds, brush, and trees adapted to wet sites. This soil is poorly suited to woodland and to habitat for woodland wildlife. The wetness limits the use of tree planting and logging equipment. Selecting water-tolerant trees for planting reduces the seedling mortality rate and the windthrow hazard.

This soil generally is unsuited to building site development, septic tank absorption fields, and recreational development because of the ponding and flooding.

The capability subclass is Vw; woodland suitability subclass 4w.

JwA—Jimtown silt loam, 0 to 3 percent slopes. This nearly level, deep, somewhat poorly drained soil is on stream terraces. Most areas are 150 to 600 feet wide and 1,000 to 2,000 feet long. They are 10 to 40 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 12 inches thick. The subsoil is about 20 inches thick. It is mottled and friable. The upper part is yellowish brown clay loam, and the lower part is dark yellowish brown sandy clay loam and sandy loam. The substratum to a depth of about 60 inches is grayish brown, loose very gravelly loamy sand.

Included with this soil in mapping are areas, generally less than 2 acres in size, of poorly drained soils in depressions and small areas of the well drained Chili soils on convex slopes. These soils make up 10 to 15 percent of most mapped areas.

Permeability and available water capacity are moderate in the Jimtown soil. Runoff is slow. The seasonal high water table is at a depth of 12 to 30 inches in winter and in spring and other extended wet periods. In the surface layer, the content of organic matter is moderate and tilth is good. The subsoil is slightly acid. The root zone is deep. The potential for frost action is high.

Most areas are used for cultivated crops or for hay and pasture. If adequately drained, this soil is suited to corn, small grain, and hay. Subsurface drains are installed in areas where drainage outlets are available. Grassed waterways, diversions, and open ditches help to move the runoff from the adjacent soils on uplands to natural drainageways or other ditches. A surface crust forms after heavy rainfall, especially in tilled areas. Shallow cultivation of intertilled crops, however, breaks up the crust. Restricted grazing during wet periods helps to prevent surface compaction. The forage species that are tolerant of the wetness grow well.

This soil is suited to woodland and to habitat for woodland wildlife. The species selected for planting should be tolerant of wetness. Plant competition can be controlled by spraying, mowing, or disking.

This soil is poorly suited to building site development, septic tank absorption fields, and recreational development because of the wetness. Surface and subsurface drains reduce the wetness. Waterproofing basement walls, installing drains at the base of footings, and using sump pumps help to keep water away from basements. Perimeter drains can reduce the wetness in septic tank absorption fields if a drainage outlet is available. The soil has a highly corrosive effect on concrete and on uncoated steel. As a result, coated steel should be used in water, sewer, or drain lines, particularly at boundaries with other soils. Safety precautions are needed to prevent the caving of cutbanks in excavated areas.

The potential for frost action can result in damage to local roads and streets. Providing suitable base material and installing a drainage system, however, help to prevent this damage.

The capability subclass is IIw; woodland suitability subclass 2o.

LbB—Library Variant silt loam, 3 to 8 percent slopes. This gently sloping, deep, somewhat poorly drained soil is on ridgetops 1,000 feet to 1 mile wide and on toe slopes below moderately steep and steep slopes. The areas on the broad ridgetops are in depressions 2 to 10 acres in size, and the areas on toe slopes are long and narrow and are 5 to 40 acres in size.

Typically, the surface layer is dark grayish brown, very friable silt loam about 8 inches thick. The subsoil is light olive brown and yellowish brown, mottled, firm and friable silty clay loam about 35 inches thick. The substratum is light olive brown, firm and friable silty clay loam and channery silt loam. Shale bedrock is at a depth of about 60 inches.

Included with this soil in mapping are small areas of the moderately well drained Keene and Coshocton soils on the more sloping parts of the landscape. Also included are some small areas of moderately deep soils, particularly in East Township. Included soils make up about 10 to 15 percent of most mapped areas.

Permeability is slow or moderately slow in the Library Variant soil. Available water capacity is moderate or high. Runoff is medium. A perched seasonal high water table is at a depth of 12 to 30 inches in winter and in spring and other extended wet periods. In the surface layer, the content of organic matter is moderate and tilth is good. The subsoil is strongly acid or very strongly acid. The root zone is deep. The shrink-swell potential is moderate in the subsoil. The potential for frost action is high.

Most areas are pastured, but some are used as cropland. This soil is suited to a rotation of corn, small grain, and hay. It also is suited to pasture but is poorly suited to grazing early in spring. Controlling erosion and reducing the wetness are the major concerns of management. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour farming, and cover crops reduce the runoff rate and help to prevent excessive soil loss and deterioration of tilth. Surface and subsurface drains reduce the wetness. Crusting of the surface layer retards moisture penetration and air movement, especially in tilled areas. Shallow cultivation of intertilled crops, however, breaks up the crust. Restricted grazing during wet periods helps to prevent surface compaction in the pastured areas. The forage species that are tolerant of the wetness grow well.

Some areas are wooded. This soil is suited to woodland and to habitat for woodland wildlife. The trees that are tolerant of some wetness should be selected for planting.

This soil is poorly suited to building site development and recreational development. Because of the seasonal wetness, it is better suited to buildings without basements than to buildings with basements. Waterproofing basement walls and installing drains at the base of footings helps to keep water away from basements. The soil has a highly corrosive effect on uncoated steel, but other material, such as concrete, can be substituted in water, sewer, or drain lines, particularly at boundaries with other soils. Low strength and the potential for frost action can result in damage to local roads and streets. Providing suitable base material and installing a drainage system, however, help to prevent this damage.

Because of the seasonal wetness and the slow or moderately slow permeability, this soil is poorly suited to septic tank absorption fields. Perimeter drains reduce the wetness. Enlarging the field or installing a double absorption field system helps to overcome the slow or moderately slow permeability.

The capability subclass is IIe; woodland suitability subclass 2o.

Lo—Lorain silty clay loam, silty substratum. This nearly level, deep, very poorly drained soil is in lake basins and on slack water terraces along low-gradient streams and ditches. It receives runoff from adjacent soils and is subject to ponding. The larger areas are on both sides of the streams or ditches. They are 1,200 to 2,000 feet wide and more than 6,000 acres in size. The smaller areas are in depressions about 20 acres in size.

Typically, the surface layer is very dark gray, friable silty clay loam about 9 inches thick. The subsoil is about 38 inches thick. It is firm and mottled. The upper part is dark gray and gray silty clay, the next part is gray silty clay loam, and the lower part is grayish brown and yellowish brown silty clay loam and silt loam. The substratum to a depth of about 60 inches is yellowish brown, mottled, friable silt loam. In some areas thin layers of organic material are at the surface or in the substratum. In other areas the surface layer is silty clay or gray silt loam.

Included with this soil in mapping are scattered areas, generally less than 2 acres in size, of Sebring soils. These soils contain less clay in the subsoil than the Lorain soil. Also, they have a lighter colored surface layer. They make up 10 to 15 percent of most mapped areas.

Permeability is slow in the Lorain soil. Available water capacity is high. Runoff is very slow or ponded. The seasonal high water table is near or above the surface in winter and in spring and other extended wet periods. In the surface layer, the content of organic matter is high and tilth is fair. The subsoil is neutral or slightly acid. The root zone is deep. The potential for frost action is high. The shrink-swell potential is high in the subsoil.

A few areas are used as unimproved pasture or as cropland. This soil generally is unsuited to row crops, small grain, and hay because of the ponding. It is poorly suited to pasture. Improving the subsurface drainage is very difficult because of the slow permeability and a lack of drainage outlets. Pump drainage is needed in most areas. Restricted grazing during wet periods helps to prevent surface compaction. Water-tolerant forage species should be selected for planting.

Most areas support the weeds, brush, and trees adapted to wet sites. This soil is well suited to habitat for wetland wildlife and is moderately well suited to woodland. The ponding limits the use of planting and logging equipment. Selecting water-tolerant trees for planting reduces the seedling mortality rate and the windthrow hazard. Mowing, spraying, or disking helps to control plant competition.

Because of the ponding, the high shrink-swell potential, and the slow permeability, this soil generally is unsuited to building site development, septic tank absorption fields, and recreational development. It has a highly corrosive effect on uncoated steel, but other material, such as concrete, can be substituted in water, sewer, or drain lines, particularly at boundaries with other soils. Shrinking and swelling, low strength, and frost action can result in damage to local roads and streets. Installing a drainage system and providing suitable base material, however, help to prevent this damage.

The capability subclass is Vw; woodland suitability subclass 2w.

MrD—Morristown shaly silty clay loam, 8 to 25 percent slopes. This strongly sloping and moderately steep, deep, well drained soil is on mine spoil ridges in areas that have been surface mined for coal and, in places, limestone. In some areas the ridges are continuous, are less than 40 feet high, and have strongly sloping tops that are 25 to 100 feet wide. In other areas they are discontinuous and about 40 feet high. The soil is a mixture of rock fragments and partly weathered fine earth material that was in or below the profile of the original soil. Most of the rock fragments are partly rounded limestone, shale, and siltstone and are less than 10 inches in diameter. In most places a few large stones, 75 to 200 feet apart, are on the surface. Most areas are long and narrow and are 5 to 200 acres in size. They are 200 to 1,000 feet wide and 100 feet to about 1 mile long.

Typically, the surface layer is dark gray, friable shaly silty clay loam about 3 inches thick. The substratum to a depth of about 60 inches is brown and gray, friable shaly and very channery silty clay loam. After they were mined, a few areas were graded. In these areas the strongly sloping and moderately steep slopes are uniform.

Included with this soil in mapping are small intermittent and perennial ponds, long and narrow walls of exposed bedrock as high as about 40 feet, and very steep soils on the sides of the spoil ridges. Inclusions make up 5 to 15 percent of most mapped areas.

Permeability is moderately slow in the Morristown soil. Available water capacity is low. Runoff is rapid or very rapid. Tilth is poor in the surface layer. The content of organic matter is very low. The depth of the root zone varies. This zone is mildly alkaline or moderately alkaline. The potential for frost action and the shrink-swell potential are moderate.

This soil generally is unsuited to row crops and hay because it is a poor growing medium for roots. It is droughty and low in fertility. If the soil is cultivated, the hazard of erosion is very severe. Slope hinders the use of some farm machinery in the moderately steep areas. The shale fragments in the surface layer hinder tillage.

This soil is poorly suited to pasture. If the pasture is overgrazed or is plowed during seedbed preparation, the hazard of erosion is very severe. Proper stocking rates and pasture rotation help to prevent overgrazing and thus control erosion. No-till seeding also helps to control erosion. Restricted grazing during wet periods helps to prevent surface compaction. Ground cover and surface mulch reduce the runoff rate and the susceptibility to erosion and increase the rate of water intake.

Some areas have an excellent cover of black locust and aspen and many undergrowth plants. This soil is suited to trees, but growth generally is slow because of the very low content of organic matter, the low available water capacity, and the depth of the root zone. Erosion can be controlled by building logging roads and skid trails on the contour and by establishing water bars. Mechanical tree planters and the mowers used to control plant competition can be operated in all areas, except for the very steep included areas. The use of this equipment is sometimes restricted because the soil is soft and slippery when wet.

This soil is poorly suited to building site development, septic tank absorption fields, and recreational development because of the slope and the likelihood of slippage. Also, the moderately slow permeability is a limitation in septic tank absorption fields. Once the soil settles, areas where slopes are 8 to 15 percent are somewhat better suited to these uses than the steeper areas. Onsite investigation is needed to determine suitability.

Measures that control erosion and reduce the likelihood of slippage are needed in the areas used for building site development or septic tank absorption fields. Erosion can be controlled by removing as little vegetation as possible, mulching, and establishing a temporary plant cover on construction sites and by building local roads and streets on the contour and seeding road cuts. Cutting and filling increase the hazard of hillside slippage, but installing a drainage system in areas where water concentrates reduces the hazard. Installing the leach lines in septic tank absorption fields on the contour helps to prevent seepage of the effluent to the surface. Enlarging the field or installing a double absorption field system improves the filtering capacity.

Erosion and stickiness are concerns in managing recreational areas. On sites for trails, erosion can be controlled by laying out the trails on the contour, establishing water bars or switchbacks, and building steps. Because of the content of clay in the surface layer, the soil is soft and sticky during and immediately following periods of rainfall. Covering picnic and play areas with gravel, bark, or wood chips, however, reduces the stickiness.

The capability subclass is VIs; woodland suitability subclass not assigned.

Or—Orrville silt loam, occasionally flooded. This nearly level, deep, somewhat poorly drained soil is on flood plains along small streams. It is occasionally flooded for brief periods. Most areas are 100 to 250 feet wide and are as much as several miles long. They are 10 to 60 acres in size.

Typically, the surface layer is dark grayish brown, friable silt loam about 7 inches thick. The subsoil is about 25 inches of brown and grayish brown, mottled, friable loam and silt loam. The substratum to a depth of about 60 inches is gray, mottled, friable loam and gravelly sandy loam. In some areas the subsoil contains more sand and less clay.

Included with this soil in mapping are areas, generally less than 2 acres in size, of the very poorly drained Holly soils in depressions and scattered small areas of moderately well drained soils on the slightly higher parts of the landscape. Also included are areas in the flood pools of the dams in the Muskingum Watershed Conservancy District. These areas are subject to controlled flooding. Included soils make up about 15 percent of most mapped areas.

Permeability and available water capacity are moderate in the Orrville soil. Runoff is slow. The seasonal high water table is at a depth of 12 to 30 inches during extended wet periods. In the surface layer, the content of organic matter is moderate and tilth is good. The subsoil is strongly acid to slightly acid. The root zone is deep. The potential for frost action is high.

Only a few areas have been drained and are cultivated. A few undrained areas are pastured. If adequately drained, this soil is suited to row crops, small grain, and hay. Row crops can be grown year after year if the soil is adequately drained and if the flooding is controlled or the crops are planted after the normal period of flooding. Subsurface drains are used in areas where drainage outlets are available. Grassed waterways, diversions, and open ditches move the runoff from the adjacent uplands to natural drainageways or other ditches. A surface crust forms after periods of heavy rainfall, especially in tilled areas. Shallow cultivation of intertilled crops, however, breaks up the crust. Restricted grazing during wet periods helps to prevent surface compaction in the pastured areas. The forage species that are tolerant of the wetness grow well.

Most areas support brush, trees, and the weeds adapted to wet sites. This soil is suited to woodland and to habitat for wetland wildlife. The trees that are tolerant of some wetness should be selected for planting.

This soil generally is unsuited to building site development, septic tank absorption fields, and recreational development because of the flooding and the wetness. Local roads and streets can be constructed on fill material above the expected high flood levels. Providing suitable base material helps to prevent the road damage caused by frost action.

The capability subclass is IIw; woodland suitability subclass 2o.

OsB—Oshtemo sandy loam, 3 to 8 percent slopes. This gently sloping, deep, well drained soil is on terraces along streams. Most areas are 300 to 1,500 feet wide and are irregularly shaped. They are 20 to 250 acres in size.

Typically, the surface layer is dark brown, very friable sandy loam about 9 inches thick. The subsoil is about 35 inches thick. It is yellowish brown. The upper part is friable and very friable sandy loam, and the lower part is very friable gravelly coarse sandy loam and gravelly loamy coarse sand. The substratum to a depth of about 60 inches is yellowish brown, loose loamy coarse sand.

Included with this soil in mapping are a few areas in the flood pool of Bolivar Dam. These areas are subject to flooding.

Permeability is moderately rapid in the upper part of the Oshtemo soil and rapid in the lower part. Available water capacity is low or moderate. Runoff is medium or slow. In the surface layer, the content of organic matter is moderate and tilth is good. The soil can be easily tilled throughout a wide range in moisture content. The subsoil is strongly acid or medium acid. The root zone is deep.

Most areas are used for cultivated crops or for hay and pasture. This soil is suited to pasture and to a crop rotation of corn, small grain, and hay, but it is droughty. It dries early in spring. Because of the limited available water capacity, it is better suited to crops that mature early in the growing season than to crops that mature late in summer. Controlling erosion and conserving moisture are the major concerns of management. If the soil is cultivated, plowed during seedbed preparation, or overgrazed, the hazard of erosion is moderate. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour farming, and cover crops reduce the runoff rate and help to prevent excessive soil loss and deterioration of tilth. Plant nutrients are leached from the soil at a moderately rapid rate. As a result, timely applications of lime and fertilizer are needed.

A few areas are wooded. This soil is suited to woodland and to habitat for woodland wildlife. Drought-tolerant trees should be selected for planting.

This soil is well suited to building site development and recreational development (fig. 6). Erosion on construction sites can be controlled by removing as little vegetation as possible, mulching, and establishing a temporary plant cover. The soil has a highly corrosive effect on concrete, but other material, such as uncoated steel, can be substituted in water, sewer, or drain lines, particularly at boundaries with other soils. Safety precautions are needed to prevent the caving of cutbanks in excavated areas.

This soil is suitable as a septic tank absorption field. It readily absorbs but does not adequately filter the effluent. Providing suitable fill material helps to prevent the pollution of streams, lakes, and shallow wells that can result from the poor filtering capacity.

The capability subclass is IIIs; woodland suitability subclass 3o.

OtB—Oshtemo sandy loam, loamy substratum, 3 to 8 percent slopes. This gently sloping, deep, well drained soil is on terraces along streams. Most areas are long strips 150 to 600 feet wide and 5 to 40 acres in size.

Typically, the surface layer is dark brown, very friable sandy loam about 8 inches thick. The subsoil is dark

Figure 6.—An area of Oshtemo sandy loam, 3 to 8 percent slopes, used as a site for buildings.

brown, very friable sandy loam about 36 inches thick. It is mottled in the lower part. The substratum to a depth of about 78 inches is brown and dark yellowish brown, mottled, friable and very friable stratified sandy loam, silt loam, and gravelly loam. In some areas the lower part of the subsoil is loam, clay loam, silt loam, or silty clay loam. In other areas the substratum has layers of silty clay.

Included with this soil in mapping are small areas of the moderately well drained Glenford soils on the more sloping parts of the landscape. Also included are a few areas in the flood pool of Dover Dam. These areas are subject to flooding. Included soils make up 10 to 15 percent of most mapped areas.

Permeability is moderately rapid in the subsoil of the Oshtemo soil and moderate or moderately slow in the substratum. Water moves laterally above the loamy substratum. Available water capacity is moderate. Runoff is medium. A perched seasonal high water table is at a depth of 36 to 72 inches during extended wet periods. In the surface layer, the content of organic matter is moderate and tilth is good. The soil can be easily tilled throughout a wide range in moisture content. The subsoil is strongly acid. The root zone is deep. The potential for frost action is moderate.

Most areas are used for cultivated crops or for hay and pasture. This soil is suited to pasture and to a crop rotation of corn, small grain, and hay. Controlling erosion and conserving moisture are the major concerns of management. If the soil is cultivated, plowed during seedbed preparation, or overgrazed, the hazard of erosion is moderate. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour farming, and cover crops conserve moisture, reduce the runoff rate, and help to prevent excessive soil loss and deterioration of tilth. Plant nutrients are leached from the soil at a moderately rapid rate. As a result, timely applications of lime and fertilizer are needed.

A few areas are wooded. This soil is suited to woodland and to habitat for woodland wildlife. Plant competition can be controlled by spraying, mowing, or disking.

This soil is suited to building site development and recreational development. Erosion on construction sites can be controlled by removing as little vegetation as possible, mulching, and establishing a temporary plant cover. The seasonal wetness is a limitation on sites for dwellings with basements. Waterproofing basement walls and installing drains at the base of footings help to keep water away from basements. The soil has a highly corrosive effect on concrete, but other material, such as steel, can be substituted in water, sewer, or drain lines, particularly at boundaries with other soils. The potential for frost action can result in damage to local roads and streets, but providing suitable base material helps to prevent this damage.

This soil is moderately well suited to septic tank absorption fields. The seasonal wetness and the moderately slow permeability are limitations. Perimeter drains reduce the wetness. Enlarging the field or installing a double absorption field system helps to overcome the moderately slow permeability.

The capability subclass is IIs; woodland suitability subclass 3o.

Pe—Peoga silt loam, rarely flooded. This nearly level, deep, poorly drained soil is on low terraces along streams. It is subject to flooding in winter and spring. Areas generally are 4 to 40 acres in size. Most are long strips that are 150 to 1,000 feet wide, but some are irregularly shaped.

Typically, the surface layer is dark grayish brown, friable silt loam about 10 inches thick. The subsoil is grayish brown and light brownish gray, mottled, friable and firm silty clay loam about 38 inches thick. The substratum to a depth of about 60 inches is dark yellowish brown, mottled, friable and firm silt loam and silty clay loam. In some areas, the subsoil contains more sand and flooding is frequent.

Included with this soil in mapping are small areas of somewhat poorly drained soils and the well drained Elkinsville soils on slight rises and flats. Also included are a few areas in the flood pool of Dover Dam. These areas are subject to controlled flooding. Included soils make up 10 to 15 percent of most mapped areas.

Permeability is slow in the Peoga soil. Available water capacity is high. Runoff is very slow. The seasonal high water table is at or near the surface in winter and in spring and other extended wet periods. In the surface layer, the content of organic matter is moderate and tilth is good. The subsoil is very strongly acid or strongly acid. The root zone is deep. The potential for frost action is high. The shrink-swell potential is moderate in the subsoil.

Many areas are used as cropland. If adequately drained, this soil is suited to row crops, small grain, and hay. If the soil is drained and otherwise well managed, row crops can be grown year after year. Surface drains are used to remove excess surface water. Subsurface drains are used in areas where drainage outlets are available. Pump drainage is needed in areas where outlets for subsurface drains are not available. Grassed waterways, diversions, and open ditches move the runoff from the adjacent soils on uplands to natural drainageways or other ditches. A surface crust forms after periods of heavy rainfall. Shallow cultivation of intertilled crops, however, breaks up the crust.

Many areas are pastured. If drained, this soil is suited to pasture, but it is poorly suited to grazing early in spring. Restricted grazing during wet periods helps to prevent surface compaction. Water-tolerant forage species grow well.

This soil is suited to woodland and to habitat for wetland wildlife. The wetness limits the use of planting and harvesting equipment. Selecting water-tolerant trees for planting reduces the seedling mortality rate and the windthrow hazard. Mowing, spraying, or disking helps to control plant competition.

This soil generally is unsuited to building site development and septic tank absorption fields. It is poorly suited to recreational development. A drainage system is needed in most recreational areas. Low strength, the wetness, and the potential for frost action can result in damage to local roads and streets. Providing suitable base material and installing a drainage system, however, help to prevent this damage. The soil has a highly corrosive effect on concrete and uncoated steel. As a result, coated steel should be used in water and sewer lines.

The capability subclass is IIIw; woodland suitability subclass 2w.

Pg—Pits, gravel. This map unit occurs as areas from which sand and gravel have been removed for use as construction material. It is on stream terraces. Most of the pits are 3 to 30 acres in size. Most have high walls on one or more sides. Small ponds are on some of the pit bottoms.

The material that is mined consists of stratified layers of gravel and sand of varying thickness and orientation. The kind and grain size of the aggregates generally are uniform within any one layer but commonly differ from layer to layer.

The material remaining after the sand and gravel are mined is poorly suited to plants. Organic matter content and available water capacity are very low.

Some areas that are no longer mined support weeds and trees. They could be developed as habitat for wildlife. If these areas are used as sites for sanitary facilities, pollution of the underground water supplies is a hazard.

No capability class or woodland suitability subclass is assigned.

RgB—Rigley sandy loam, 3 to 8 percent slopes. This gently sloping, deep, well drained soil is on the tops of upland ridges. Most areas are long and about 300 feet wide and are 5 to 10 acres in size. A few are more than 1 mile long and as large as 60 acres.

Typically, the surface layer is dark brown, friable sandy loam about 7 inches thick. The subsoil is brown and yellowish brown, friable sandy loam about 33 inches thick. The substratum to a depth of about 60 inches is yellowish brown, very friable channery sandy loam. In some areas the subsoil has a higher content of sandstone fragments. In other areas the surface layer is loam.

Included with this soil in mapping are scattered areas, generally less than 2 acres in size, of the moderately deep Culleoka soils. These soils contain more clay in the subsoil than the Rigley soil. They make up 5 to 10 percent of most mapped areas.

Permeability is moderately rapid in the Rigley soil. Available water capacity is moderate. Runoff is medium. In the surface layer, the content of organic matter is moderate and tilth is good. The soil can be easily tilled throughout a wide range in moisture content. The subsoil is extremely acid to strongly acid. The root zone is deep. The potential for frost action is moderate.

Most areas are used as cropland or pasture. This soil is suited to pasture and to a crop rotation of corn, small grain, and hay. Controlling erosion is the major concern of management. If the soil is cultivated, plowed during seedbed preparation, or overgrazed, the hazard of erosion is moderate. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour farming, and cover crops reduce the runoff rate and help to prevent excessive soil loss and deterioration of tilth. Timely applications of lime and fertilizer are needed because of the loss of plant nutrients through leaching.

This soil is suited to woodland and to habitat for woodland wildlife. Plant competition can be controlled by spraying, mowing, or disking.

This soil is well suited to building site development, septic tank absorption fields, and recreational development. Erosion on construction sites can be controlled by removing as little vegetation as possible, mulching, or establishing a temporary plant cover. The potential for frost action can result in damage to local roads and streets. Providing suitable base material, however, helps to prevent this damage. The soil has a highly corrosive effect on concrete, but other material, such as steel, can be substituted in water, sewer, or drain lines, particularly at boundaries with other soils.

The capability subclass is IIe; woodland suitability subclass 2o.

RgC—Rigley sandy loam, 8 to 15 percent slopes. This strongly sloping, deep, well drained soil is on the tops of upland ridges and on side slopes directly below gently sloping ridgetops. Areas generally are long and narrow. Those on ridgetops are 150 to 200 feet wide and are 3 to 15 acres in size. Those on side slopes are 200 to 400 feet wide and are 30 to 80 acres in size.

Typically, the surface layer is brown, very friable sandy loam about 6 inches thick. The subsoil is about 44 inches thick. The upper part is dark brown, friable fine sandy loam, and the lower part is yellowish brown and dark brown, very friable channery loamy sand. The substratum to a depth of about 60 inches is yellowish brown, very friable very channery sand. In some areas the subsoil has a higher content of sandstone fragments. In other areas it contains more clay. In places the surface layer is loam.

Permeability is moderately rapid. Available water capacity is moderate. Runoff is medium or rapid. In the surface layer, the content of organic matter is moderately low and tilth is good. The soil can be easily tilled throughout a wide range in moisture content. The subsoil is extremely acid to strongly acid. The root zone is deep. The potential for frost action is moderate.

Many areas are used as cropland. This soil is suited to a crop rotation of corn, small grain, and hay. Controlling erosion is the major concern of management. If the soil is cultivated, the hazard of erosion is severe. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour stripcropping, and cover crops reduce the runoff rate and help to prevent excessive soil loss and deterioration of tilth. Timely applications of lime and fertilizer are needed because of the loss of plant nutrients through leaching.

Many areas are pastured. This soil is suited to pasture. If the pasture is overgrazed or is plowed during seedbed preparation, however, the hazard of erosion is severe. Proper stocking rates and pasture rotation help to prevent overgrazing and thus help to control erosion. No-till seeding also helps to control erosion.

This soil is suited to woodland and to habitat for woodland wildlife. Plant competition can be controlled by spraying, mowing, or disking.

This soil is moderately well suited to building site development, septic tank absorption fields, and recreational development. The slope is the main limitation. Buildings should be designed to conform to the natural slope of the land. In some areas land shaping is needed. Erosion can be controlled by removing as little vegetation as possible, mulching, and establishing a temporary plant cover on construction sites and by building local roads and streets on the contour and seeding road cuts. On sites for trails, it can be controlled by laying out the trails on the contour, establishing water bars, and building steps. Installing the leach lines in septic tank absorption fields on the contour helps to prevent seepage of the effluent to the surface. The potential for frost action can result in damage to local roads and streets. Providing suitable base material, however, helps to prevent this damage. The soil has a highly corrosive effect on concrete, but other material, such as steel, can be substituted in water, sewer, or drain lines, particularly at boundaries with other soils.

The capability subclass is IIIe; woodland suitability subclass 2o.

RgD—Rigley sandy loam, 15 to 25 percent slopes. This moderately steep, deep, well drained soil dominantly is on upland side slopes 150 to 300 feet long. Most areas are long and narrow and are 5 to 50 acres in size.

Typically, the surface layer is dark brown, very friable sandy loam about 6 inches thick. The subsoil is brown and yellowish brown, friable sandy loam about 40 inches thick. The substratum to a depth of about 60 inches is yellowish brown, very friable channery sandy loam. In some areas the subsoil has a higher content of sandstone fragments. In other areas it contains more clay. In places the surface layer is loam.

Permeability is moderately rapid. Available water capacity is moderate. Runoff is rapid. In the surface layer, the content of organic matter is moderately low and tilth is good. The soil can be easily tilled throughout a wide range in moisture content. The subsoil is extremely acid to strongly acid. The root zone is deep. The potential for frost action is moderate.

A few areas are used as cropland. This soil is suited to a crop rotation of corn, small grain, and hay. Commonly, a cultivated crop is included in the rotation about once every 4 years. The slope and the hazard of erosion are the major concerns of management. If the soil is cultivated, the hazard of erosion is very severe. A permanent plant cover is the best means of controlling erosion. A system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and cover crops reduce the runoff rate and help to prevent excessive soil loss and deterioration of tilth. The moderately steep slope hinders the use of some farm machinery. Timely applications of lime and fertilizer are needed because of the loss of plant nutrients through leaching.

Many areas are pastured. This soil is suited to pasture. If the pasture is overgrazed or is plowed during seedbed preparation, however, the hazard of erosion is very severe. Proper stocking rates and pasture rotation help to prevent overgrazing and thus help to control erosion. No-till seeding also helps to control erosion.

Many areas are wooded. This soil is suited to woodland and to habitat for woodland wildlife. Erosion can be controlled by building logging roads and skid trails on the contour and by establishing water bars. Mechanical tree planters and the mowers used to control plant competition can be operated on this soil. Planting seedlings that have been transplanted once or mulching reduces the seedling mortality rate on south aspects.

This soil is poorly suited to building site development, septic tank absorption fields, and recreational development, mainly because of the slope. Erosion can be controlled by removing as little vegetation as possible, mulching, and establishing a temporary plant cover on construction sites and by building local roads and streets on the contour and seeding road cuts. On sites for trails, it can be controlled by laying out the trails on the contour, establishing water bars or switchbacks, and building steps. Installing the leach lines in septic tank absorption fields on the contour helps to prevent seepage of the effluent to the surface. The potential for frost action can result in damage to local roads and streets. Providing suitable base material, however, helps to prevent this damage. The soil has a highly corrosive effect on concrete, but other material, such as steel, can be substituted in water, sewer, or drain lines, particularly at boundaries with other soils.

The capability subclass is IVe; woodland suitablility subclass 2r on north aspects, 3r on south aspects.

RgE—Rigley sandy loam, 25 to 40 percent slopes. This steep, deep, well drained soil dominantly is on upland side slopes 150 to 300 feet long. Most areas are long and narrow and are 5 to 75 acres in size.

Typically, the surface layer is dark brown, very friable sandy loam about 5 inches thick. The subsoil is brown and yellowish brown, friable sandy loam about 36 inches thick. The substratum to a depth of about 60 inches is yellowish brown, very friable channery sandy loam. In some areas the subsoil has a higher content of sandstone fragments. In other areas it contains more clay.

Permeability is moderately rapid. Available water capacity is moderate. Runoff is very rapid. In the surface layer, the content of organic matter is moderately low and tilth is good. The soil can be easily tilled throughout a wide range in moisture content. The subsoil is extremely acid to strongly acid. The root zone is deep. The potential for frost action is moderate.

Some areas are pastured. This soil is poorly suited to pasture. The slope and the hazard of erosion are the major concerns of management. If the pasture is plowed during seedbed preparation or overgrazed, the hazard of erosion is very severe. A permanent plant cover is the best means of controlling erosion. Proper stocking rates and pasture rotation help to prevent overgrazing and thus help to control erosion. No-till seeding also helps to control erosion. Maintaining a good stand of grasses is very difficult because the steep slope hinders the use of farm machinery.

Most areas are wooded. This soil is suited to woodland and to habitat for woodland wildlife. Erosion can be controlled by building logging roads and skid trails on the contour and by establishing water bars. Operating mechanical tree planters and the mowers used to control plant competition is very difficult because of the steep slope. Planting seedlings that have been transplanted once or mulching reduces the seedling mortality rate on south aspects.

This soil generally is unsuited to building site development, septic tank absorption fields, and most kinds of recreational development because of the slope. On sites for local roads and streets, erosion can be controlled by building on the contour and seeding road cuts. On sites for trails, it can be controlled by laying out the trails on the contour, establishing water bars or switchbacks, and building steps. The soil has a highly corrosive effect on concrete, but other material, such as steel, can be substituted in water, sewer, or drain lines, particularly at boundaries with other soils.

The capability subclass is VIIe; woodland suitability subclass 2r on north aspects, 3r on south aspects.

Sb—Sebring silt loam. This nearly level, deep, poorly drained soil is on slack water terraces along streams. It receives runoff from adjacent soils and is subject to ponding. Most areas are 30 to several hundered acres in size. Some are in depressions 100 to 200 feet wide and 10 to 20 acres in size. The larger areas are on both sides of streams or ditches. They are 2,000 or more feet long and more than 400 feet wide.

Typically, the surface layer is gray, very friable silt loam about 8 inches thick. The subsoil is about 36 inches of gray and light gray, mottled, friable and firm silt loam and silty clay loam. The substratum to a depth of about 60 inches is gray, mottled, firm silty clay loam. In some areas, the subsoil contains more clay and the surface layer is silty clay loam. In other areas, the subsoil contains more sand and the soil is frequently flooded.

Included with this soil in mapping are areas, generally less than 2 acres in size, of the very poorly drained Lorain soils in depressions. The subsoil of these soils contains more clay than that of the Sebring soil. Also included are areas of the somewhat poorly drained Fitchville soils on slight rises and on toe slopes and areas of the somewhat poorly drained Orrville soils on flood plains less than 100 feet wide. Included soils make up 10 to 15 percent of most mapped areas.

Permeability is moderately slow in the Sebring soil. Available water capacity is high. Runoff is very slow or ponded. The seasonal high water table is near or above the surface during extended wet periods. In the surface layer, the content of organic matter is moderate or high and tilth is good. The subsoil is strongly acid to neutral. The root zone is deep. The potential for frost action is high. The shrink-swell potential is moderate.

If drained, this soil is suited to row crops, small grain, and hay. In undrained areas, however, it is poorly suited to these uses. Surface drains help to remove excess surface water. Subsurface drains are installed in areas where drainage outlets are available. Pumps are needed in areas where outlets are not available. Grassed waterways, diversions, and open ditches move runoff from the adjacent uplands to natural drainageways or other ditches. A surface crust forms after heavy rainfall. Shallow cultivation of intertilled crops, however, breaks up the crust.

Most areas are unimproved pasture that supports the weeds, brush, and trees adapted to wet sites. If drained, this soil is suited to pasture, but it is poorly suited to grazing early in spring. Restricted grazing during wet periods helps to prevent surface compaction. Water-tolerant forage species grow well.

This soil is suited to woodland and to habitat for woodland and wetland wildlife. The wetness limits the use of tree planting and harvesting equipment. The trees can be logged during the drier parts of the year. Selecting water-tolerant species for planting reduces the seedling mortality rate and the windthrow hazard.

Mowing, spraying, or disking helps to control plant competition.

This soil generally is unsuitable as a site for buildings, septic tank absorption fields, and recreational uses. The ponding is the main hazard. Also, the moderately slow permeability is a limitation in septic tank absorption fields. Ponding, low strength, and frost action can result in damage to local roads and streets. Providing suitable base material and installing a drainage system, however, help to prevent this damage.

The capability subclass is IIIw; woodland suitability subclass 2w.

Tg—Tioga silt loam, occasionally flooded. This nearly level, deep, well drained soil is on flood plains along the major streams. It is occasionally flooded for brief periods (fig. 7). Most areas are 200 to 1,000 feet wide and extend along streams for as much as several miles. They are 50 to 500 acres in size.

Typically, the surface layer is dark grayish brown and brown, very friable silt loam about 12 inches thick. The subsoil is about 13 inches of dark brown, friable silt loam and very friable sandy loam. The substratum to a depth of about 60 inches is yellowish brown and dark brown, loose stratified loamy sand and very gravelly loamy sand.

Figure 7.—Flooding on Tioga silt loam, occasionally flooded.

In some areas the subsoil and the upper part of the substratum contain more clay. In other areas the surface layer is loam.

Included with this soil in mapping are areas, generally less than 2 acres in size, of moderately well drained soils in slight depressions, especially along Hugle Run and along the part of Sandy Creek east of Pekin. Also included are some areas in the flood pools of the dams in the Muskingum Watershed Conservancy District. The soils in these areas are subject to controlled flooding. Included soils make up 10 to 15 percent of most mapped areas.

Permeability is moderate or moderately rapid in the Tioga soil. Available water capacity is moderate. Runoff is slow. The seasonal high water table is at a depth of 36 to 72 inches in winter and in spring and other extended wet periods. In the surface layer, the content of organic matter is moderate and tilth is good. The subsoil is strongly acid to neutral. The root zone is deep. The potential for frost action is moderate.

Most areas are used for cultivated crops or for hay and pasture. This soil is well suited to these uses. It is better suited to the crops planted after the normal period of flooding than to the crops planted early in spring. Row crops can be grown year after year if the soil is intensively managed and if flooding is controlled or crops are planted after the normal period of flooding. A surface crust forms after heavy rainfall, especially in tilled areas. Shallow cultivation of intertilled crops, however, breaks up the crust.

This soil generally is unsuited to building site development and septic tank absorption fields because of the flooding. It is well suited, however, to some kinds of recreational development. Local roads and streets can be constructed on fill material, above the expected high flood levels. Safety precautions are needed to prevent the caving of cutbanks in excavations.

The capability subclass is IIw; woodland suitability subclass 2o.

UpC2—Upshur silty clay loam, 8 to 15 percent slopes, eroded. This strongly sloping, deep, well drained soil is on ridgetops and the upper part of side slopes in the uplands. Most areas are long and narrow. They are 200 to 500 feet wide and are 3 to 30 acres in size.

Typically, the surface layer is reddish brown, firm silty clay loam about 8 inches thick. It is a mixture of the original surface layer and subsoil material. Erosion has removed part of the original surface layer. The subsoil is about 29 inches of dark reddish brown, plastic and sticky silty clay and clay. The substratum is dark reddish brown, plastic and sticky silty clay loam. Shale bedrock is at a depth of about 67 inches. In some areas the soil is moderately well drained and is yellowish brown or olive brown in the subsoil and substratum. In other areas the surface layer is silty clay. In places the slope is 5 to 8 percent.

Included with this soil in mapping are small areas of the moderately deep Berks and deep Westmoreland soils. These soils are yellower throughout than the Upshur soil. Also, they contain less clay in the subsoil. They make up about 15 percent of most mapped areas.

Permeability is slow in the Upshur soil. Available water capacity is moderate. Runoff is rapid. In the surface layer, the content of organic matter is moderately low and tilth is fair. The soil tends to dry out slowly and to crack at the surface. The subsoil is strongly acid to moderately alkaline. The root zone is deep, but root growth is restricted somewhat by the clayey subsoil. The shrink-swell potential is high in the subsoil. The potential for frost action is moderate.

Most areas are used for cultivated crops or for hay and pasture. This soil is suited to a crop rotation of corn, small grain, and hay. Controlling erosion and preventing deterioration of tilth are the main concerns of management. If the soil is cultivated, the hazard of further erosion is severe. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour stripcropping, and cover crops reduce the runoff rate and help to prevent excessive soil loss and deterioration of tilth. Tilling when the soil is wet causes surface compaction and cloddiness.

This soil is suited to pasture. If the pasture is overgrazed or is plowed during seedbed preparation, however, the hazard of further erosion is severe. Proper stocking rates and pasture rotation help to prevent overgrazing and excessive soil loss. No-till seeding also helps to prevent excessive soil loss. Mowing helps to control weeds. Timely applications of lime and fertilizer are needed. Restricted grazing during wet periods helps to prevent surface compaction.

Some areas are wooded. This soil is suited to woodland and to habitat for woodland wildlife. Erosion can be controlled by building logging roads and skid trails on the contour and by establishing water bars. The use of logging equipment is limited because the soil is soft and slippery when wet. The trees can be logged during the drier parts of the year. Planting seedlings that have been transplanted once or mulching reduces the seedling mortality rate. The windthrow hazard can be reduced by harvesting techniques that do not isolate the remaining trees or leave them widely spaced.

This soil is moderately well suited to building site development. The shrink-swell potential is the main limitation. Designing walls that have pilasters and are reinforced with concrete, supporting the walls with a large spread footing, and backfilling around foundations with material that has a low shrink-swell material help to prevent the damage to buildings caused by shrinking and swelling. Erosion can be controlled by removing as little vegetation as possible, mulching, or establishing a temporary plant cover on construction sites and by building local roads and streets on the contour and seeding road cuts. Cutting and filling increase the hazard of hillside slippage. Installing a drainage system in areas where water collects, however, reduces the hazard. The shrink-swell potential and low strength can result in damage to local roads and streets. Providing suitable base material, however, helps to prevent this damage. The soil has a highly corrosive affect on uncoated steel, but other material, such as concrete, can be substituted in water, sewer, or drain lines, particularly at boundaries with other soils.

Because of the slow permeability and the slope, this soil is poorly suited to septic tank absorption fields. Installing the leach lines on the contour helps to prevent seepage of the effluent to the surface. Enlarging the field or installing a double absorption field system helps to overcome the slow permeability.

This soil is poorly suited to most kinds of recreational development. Erosion is a hazard on trails. It can be controlled, however, by laying out the trails on the contour, establishing water bars, and building steps. Because of the content of clay in the surface layer, the soil is soft and sticky when wet. Covering picnic and play areas with gravel, bark, or wood chips, however, reduces the stickiness.

The capability subclass is IVe; woodland suitability subclass 3c.

WhB—Wellston silt loam, 3 to 8 percent slopes. This gently sloping, deep, well drained soil is on the tops of ridges in the uplands. Most areas are long and narrow or irregularly shaped. They are 200 to 350 feet wide and are 5 to 50 acres in size.

Typically, the surface layer is brown, friable silt loam about 8 inches thick. The subsoil is about 32 inches of dark yellowish brown and yellowish brown, friable silt loam and firm silty clay loam. It is mottled in the lower 5 inches. The substratum is yellowish brown, firm channery silt loam. Light olive brown, soft, weathered siltstone bedrock is at a depth of about 44 inches. In some areas the subsoil contains more sand. In a few areas the soil is less well drained and is mottled in the middle and lower parts of the subsoil.

Included with this soil in mapping are scattered areas, generally less than 2 acres in size, of the moderately deep Culleoka soils. These soils make up 10 to 15 percent of most mapped areas.

Permeability and available water capacity are moderate in the Wellston soil. Runoff is medium. In the surface layer, the content of organic matter is moderate and tilth is good. The subsoil is extremely acid to strongly acid unless the soil has been limed. The root zone is deep. The potential for frost action is high.

Most areas are used as cropland or pasture. This soil is suited to pasture and to a crop rotation of corn, small grain, and hay. Controlling erosion is the main concern of management. If the soil is cultivated, plowed during seedbed preparation, or overgrazed, the hazard of erosion is moderate. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour farming, and cover crops reduce the runoff rate and help to prevent excessive soil loss and deterioration of tilth. Crusting of the surface layer restricts moisture penetration and air movement, especially in tilled areas. Shallow cultivation of intertilled crops, however, breaks up the crust.

This soil is suited to woodland and to habitat for woodland wildlife. Plant competition can be controlled by spraying, mowing, or disking.

This soil is well suited to building site development and recreational development. Erosion can be controlled by removing as little vegetation as possible, mulching, and establishing a temporary plant cover on construction sites. The potential for frost action can result in damage to local roads and streets. Providing suitable base material, however, helps to prevent this damage. The soil has a highly corrosive effect on concrete, but other material, such as steel, can be substituted in water, sewer, or drain lines, particularly at boundaries with other soils.

This soil is well suited to septic tank absorption fields, but the depth to bedrock and the moderate permeability are limitations. Enlarging the field or installing a double absorption field system helps to overcome the moderate permeability. Providing suitable fill material helps to overcome the limited depth to bedrock.

The capability subclass is IIe; woodland suitability subclass 2o.

WkC—Westmoreland silt loam, 8 to 15 percent slopes. This strongly sloping, deep, well drained soil is on the upper part of hillsides and on the narrow tops of ridges in the uplands. Most areas are long, are 200 to 400 feet wide, and are 5 to 20 acres in size. Some large areas near Kilgore, however, are as wide as about 800 feet and extend for several miles.

Typically, the surface layer is dark brown, friable silt loam about 6 inches thick. The subsoil is about 26 inches of yellowish brown, firm silty clay loam and channery silty clay loam. The substratum is yellowish brown, firm channery silty clay loam. Siltstone bedrock is at a depth of about 60 inches. In some areas the subsoil contains more sand and less clay. In other areas the surface layer is loam. In a few areas the soil is less well drained and has gray mottles in the middle and lower parts of the subsoil.

Included with this soil in mapping are small areas of the moderately deep Culleoka and Berks soils on convex slopes. Also included are small areas of Hazleton soils, which have a higher content of sandstone fragments and a lower content of clay in the subsoil than the Westmoreland soil. Included soils make up 10 to 15 percent of most mapped areas.

Permeability and available water capacity are moderate in the Westmoreland soil. Runoff is medium or rapid. In the surface layer, the content of organic matter is moderate and tilth is good. The subsoil is very strongly acid to medium acid. The root zone is deep. The potential for frost action is moderate.

Most areas are used as cropland. Corn, small grain, and hay are the principal crops. This soil is suited to a rotation of these crops. Controlling erosion is the main concern of management. If the soil is cultivated, the hazard of erosion is severe. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour stripcropping, and cover crops reduce the runoff rate and help to prevent excessive soil loss and deterioration of tilth. Crusting of the surface layer restricts moisture penetration and air movement, especially in tilled areas. Shallow cultivation of intertilled crops, however, breaks up the crust.

This soil is suited to pasture. If the pasture is overgrazed or is plowed during seedbed preparation, however, the hazard of erosion is severe. Proper stocking rates and pasture rotation help to prevent overgrazing and excessive soil loss. No-till seeding also helps to prevent excessive soil loss. Mowing helps to control weeds. Timely applications of lime and fertilizer are needed.

This soil is suited to woodland and to habitat for woodland wildlife. Plant competition can be controlled by spraying, mowing, or disking.

This soil is moderately well suited to building site development and recreational development. The slope is the main limitation. Erosion can be controlled by removing as little vegetation as possible, mulching, or establishing a temporary plant cover on construction sites and by building local roads and streets on the contour and seeding road cuts. On sites for trails, it can be controlled by laying out the trails on the contour, establishing water bars, and building steps. Because bedrock is as shallow as 40 inches in some areas, the soil is better suited to dwellings without basements than to dwellings with basements. It has a highly corrosive effect on concrete, but other material, such as steel, can be substituted in water, sewer, or drain lines, particularly at boundaries with other soils. The potential for frost action and low strength can result in damage to local roads and streets. Providing suitable base material, however, helps to prevent this damage.

This soil is moderately well suited to septic tank absorption fields. The slope, the depth to bedrock, and the moderate permeability are limitations. Enlarging the field or installing a double absorption field system helps to overcome the moderate permeability. Providing suitable fill material helps to overcome the limited depth to bedrock. Laying out the leach lines on the contour helps to prevent seepage of the effluent to the surface.

The capability subclass is IIIe; woodland suitability subclass 3o.

WkD—Westmoreland silt loam, 15 to 25 percent slopes. This moderately steep, deep, well drained soil is on upland side slopes about 150 to 300 feet long. Most areas are long and narrow and are 5 to 20 acres in size.

Typically, the surface layer is brown, friable silt loam about 6 inches thick. The subsoil is about 26 inches thick. The upper part is yellowish brown, friable and firm silt loam and silty clay loam, and the lower part is yellowish brown and light olive brown, firm channery silty clay loam. The substratum is yellowish brown, firm channery silt loam. Siltstone bedrock is at a depth of about 61 inches. In some areas the subsoil contains more sand and less clay. In other areas the surface layer is loam or channery loam. In a few areas the soil is less well drained and has gray mottles in the middle and lower parts of the subsoil.

Included with this soil in mapping are small areas of the moderately deep Culleoka and Berks soils on the upper parts of the side slopes. Also included are scattered small areas of Hazleton soils, which have a higher content of sandstone fragments and a lower content of clay in the subsoil than the Westmoreland soil. Included soils make up 10 to 15 percent of most mapped areas.

Permeability and available water capacity are moderate in the Westmoreland soil. Runoff is rapid. In the surface layer, the content of organic matter is moderately low and tilth is good. The subsoil is very strongly acid to medium acid. The root zone is deep. The potential for frost action is moderate.

Many areas are pastured, but some are used for cultivated crops. This soil is suited to a crop rotation of corn, small grain, and hay. Commonly, a cultivated crop is included in the rotation about once every 4 years. If the soil is cultivated, the hazard of erosion is very severe. A permanent plant cover is the best means of controlling erosion. A system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and cover crops reduce the runoff rate and help to prevent excessive soil loss and deterioration of tilth. The moderately steep slope limits the use of some farm machinery. Crusting of the surface layer restricts moisture penetration and air movement, especially in tilled areas. Shallow cultivation of intertilled crops, however, breaks up the crust.

This soil is suited to pasture. If the pasture is overgrazed or is plowed during seedbed preparation, however, the hazard of erosion is very severe. Proper stocking rates and pasture rotation help to prevent overgrazing and excessive soil loss. No-till seeding also helps to prevent excessive soil loss. Mowing helps to control weeds. Timely applications of lime and fertilizer are needed.

Many areas are wooded. This soil is suited to woodland and to habitat for woodland wildlife. Erosion can be controlled by building logging roads and skid trails on the contour and by establishing water bars.

Mechanical tree planters and the mowers that control plant competition can be operated on this soil.

Mainly because of the slope, this soil is poorly suited to building site development and recreational development. Erosion can be controlled by removing as little vegetation as possible, mulching, and establishing a temporary plant cover on construction sites and by building local roads and streets on the contour and seeding road cuts. On sites for trails, it can be controlled by laying out the trails on the contour, establishing water bars or switchbacks, and building steps. Because bedrock is as shallow as 40 inches in some areas, the soil is better suited to dwellings without basements than to dwellings with basements. It has a highly corrosive effect on concrete, but other material, such as steel, can be substituted in water, sewer, or drain lines, particularly at boundaries with other soils. The potential for frost action and low strength can result in damage to local roads and streets. Providing suitable base material, however, helps to prevent this damage.

Mainly because of the slope and the moderate permeability, this soil is poorly suited to septic tank absorption fields. Laying out the leach lines on the contour helps to prevent seepage of the effluent to the surface. Enlarging the field or installing a double absorption field system helps to overcome the moderate permeability.

The capability subclass is IVe; woodland suitability subclass 2r on north aspects, 3r on south aspects.

WkE—Westmoreland silt loam, 25 to 40 percent slopes. This steep, deep, well drained soil is on the side slopes in V-shaped valleys or above less sloping areas. Most areas are 200 to 500 feet long and are 10 to several hundred acres in size. The larger areas extend for several miles along the major valleys.

Typically, the surface layer is dark brown, friable silt loam about 3 inches thick. The subsurface layer is yellowish brown, very friable silt loam about 4 inches thick. The subsoil is about 28 inches of yellowish brown, firm silty clay loam and channery silty clay loam. The substratum is yellowish brown, firm channery silt loam. Siltstone bedrock is at a depth of about 64 inches. In some areas the subsoil contains more sand and less clay. In other areas the surface layer is stony silt loam, loam, or channery loam.

Included with this soil in mapping are small areas of Hazleton soils and the moderately deep Culloeka and Berks soils on the upper parts of the side slopes and small areas of the moderately well drained Guernsey soils. The Hazleton soils have a higher content of sandstone fragments and a lower content of clay in the subsoil than the Westmoreland soil. The Guernsey soils are underlain by shale and limestone bedrock. They are in small seepy areas and are susceptible to slippage. Also included, on toe slopes, are areas in the flood pool of the Atwood and Leesville Dams. The soils in these areas are subject to flooding. Included soils make up about 15 percent of most mapped areas.

Permeability and available water capacity are moderate in the Westmoreland soil. Runoff is very rapid. In the surface layer, the content of organic matter is moderately low and tilth is good. The subsoil is very strongly acid to medium acid. The root zone is deep. The potential for frost action is moderate.

Some areas are pastured. This soil generally is unsuited to cultivation because of the steep slope and a severe hazard of erosion. It is poorly suited to pasture. Erosion is the major concern of management. A permanent plant cover is the best means of controlling erosion. If the pasture is plowed during seedbed preparation or overgrazed, the hazard of erosion is very severe. Proper stocking rates and pasture rotation help to prevent overgrazing and excessive soil loss. No-till seeding also helps to prevent excessive soil loss. The slope limits the use of equipment.

Most areas are wooded. This soil is suited to woodland and to habitat for woodland wildlife. Erosion can be controlled by building logging roads and skid trials on the contour and by establishing water bars. Operating mechanical tree planters and the mowers that control plant competition is very difficult because of the steep slope.

This soil generally is unsuited to building site development, septic tank absorption fields, and recreational development because of the steep slope. Cutting and filling increase the hazard of hillside slippage in the included areas of Guernsey soils. Installing a drainage system in the seepy areas reduces the hazard. On sites for local roads and streets, erosion can be controlled by building on the contour and seeding road cuts. On sites for trails, it can be controlled by laying out the trails on the contour, establishing water bars or switchbacks, and building steps. The soil has a highly corrosive effect on concrete, but other material, such as steel, can be substituted in water, sewer, or drain lines, particularly at boundaries with other soils.

The capability subclass is VIe; woodland suitability subclass 2r on north aspects, 3r on south aspects.

WmC—Westmoreland-Coshocton silt loams, 8 to 15 percent slopes. These deep, strongly sloping soils are on uplands. The well drained Westmoreland soil generally is in smooth or convex areas at the summit of ridges and on the upper part of hillsides. The moderately well drained Coshocton soil generally is in smooth or concave areas at the edge of ridgetops and on the lower part of side slopes. In some areas on hillsides, the soils occur as alternating parallel bands, which are associated with different bedrock strata. The hillside areas commonly are 150 to 500 feet wide and are 10 to several hundred acres in size. Most areas are 50 to 60 percent Westmoreland silt loam and 25 to 40 percent Coshocton silt loam. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Westmoreland soil has a surface layer of dark brown, friable silt loam about 6 inches thick. The subsoil is about 26 inches of yellowish brown, firm silty clay loam and channery silty clay loam. The substratum is yellowish brown, firm channery silt loam. Siltstone bedrock is at a depth of about 60 inches. In some areas the subsoil contains more sand and less clay. In other areas the surface layer is loam.

Typically, the Coshocton soil has a surface layer of brown, friable silt loam about 8 inches thick. The subsoil is about 37 inches thick. The upper part is yellowish brown, friable silt loam; the next part is yellowish brown and brown, mottled, friable and firm silty clay loam; and the lower part is brown, mottled, friable shaly clay loam and shaly silt loam. The substratum is yellowish brown, mottled, friable shaly silty clay loam. Shale bedrock is at a depth of about 66 inches. In some areas the subsoil has a lower content of sand and of shale fragments. In other areas the surface layer is loam.

Included with these soils in mapping are small areas of the moderately deep Culleoka and Berks soils on convex slopes, areas of Hazleton soils near the upper part of some side slopes, and small seepy areas of moderately well drained, moderately deep soils and the moderately fine textured Guernsey soils, which are susceptible to slippage. The subsoil of Hazleton soils has a lower content of clay and a higher content of sandstone fragments and sand than that of either the Westmoreland or Coshocton soil. Included soils make up 5 to 15 percent of most mapped areas.

Permeability is moderate in Westmoreland soil and slow or moderately slow in Coshocton soil. Available water capacity is moderate in both soils. Runoff is medium or rapid. The Coshocton soil has a perched seasonal high water table at a depth of 18 to 42 inches in winter and in spring and other extended wet periods. In the surface layer of both soils, the content of organic matter is moderate and tilth is good. The subsoil of the Westmoreland soil is very strongly acid to medium acid, and that of the Coshocton soil is strongly acid or very strongly acid. The root zone is deep in both soils. The shrink-swell potential is moderate in the Coshocton soil. The potential for frost action is moderate in the Westmoreland soil and high in the Coshocton soil.

Most areas are used as cropland. Corn, small grain, and hay are the principal crops. These soils are suited to a rotation of these crops. Erosion is the major concern of management. It is a severe hazard if the soils are cultivated. A system of conservation tillage that leaves crop residue on the surface, grassed waterways, contour stripcropping, and cover crops reduce the runoff rate and help to prevent excessive soil loss and deterioration of tilth. Scattered subsurface drains are needed in the seepy areas. Crusting of the surface layer restricts moisture penetration and air movement, especially in tilled areas. Shallow cultivation of intertilled crops, however, breaks up the crust.

These soils are suited to pasture. If the pasture is overgrazed or is plowed during seedbed preparation, however, the hazard of erosion is severe. Proper stocking rates and pasture rotation help to prevent overgrazing and excessive soil loss. No-till seeding also helps to prevent excessive soil loss. Mowing helps to control weeds. Timely applications of lime and fertilizer are needed.

Some areas support trees (fig. 8). These soils are suited to woodland and to habitat for woodland wildlife. Plant competition can be controlled by spraying, mowing, or disking.

These soils are moderately well suited to building site development and recreational development (fig. 9). Erosion can be controlled by removing as little vegetation as possible, mulching, or establishing a temporary plant cover on construction sites. On sites for paths and trails, it can be controlled by laying out the paths or trails on the contour, establishing water bars, and building steps. Because bedrock is as shallow as 40 inches in some areas, the soils are better suited to dwellings without basements than to dwellings with basements. The shrink-swell potential and seasonal wetness of the Coshocton soil are limitations on sites for dwellings. Waterproofing basements walls and installing drains at the base of footings help to keep water away from basements. Designing walls that have pilasters and are reinforced with concrete, supporting the walls with a large spread footing, and backfilling around foundations with material that has a low shrink-swell potential help to prevent the damage caused by shrinking and swelling. Cutting and filling increase the hazard of hillside slippage in the included seepy areas of Guernsey soils. Installing a drainage system in these areas, however, reduces the hazard.

The Coshocton soil has a highly corrosive effect on uncoated steel and concrete. As a result, coated steel should be used in water, sewer, or drain lines, particularly at boundaries with other soils. The Westmoreland soil has a highly corrosive effect on concrete, but other material, such as steel, can be used in the water, sewer, or drain lines.

Low strength and the potential for frost action in the Westmoreland and Coshocton soils and the shrink-swell potential of the Coshocton soil can result in damage to local roads and streets. Providing suitable base material and installing a drainage system, however, help to prevent this damage. Erosion can be controlled by building the roads and streets on the contour and by seeding road cuts.

These soils are moderately well suited to septic tank absorption fields. The main limitations are the slope, depth to bedrock, and moderate permeability of the Westmoreland soil and the seasonal wetness and slow or moderately slow permeability of the Coshocton soil.

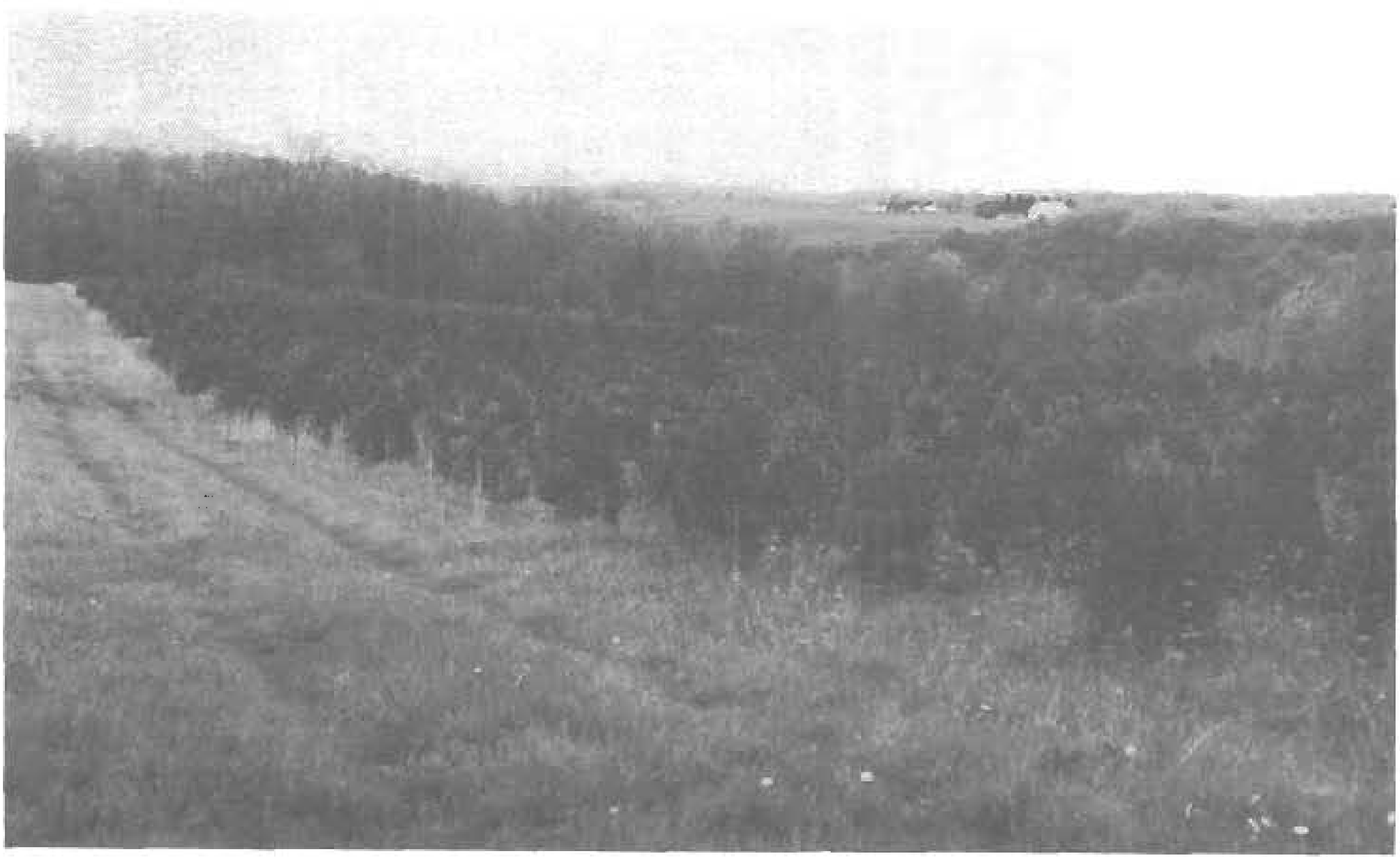

Figure 8.—Christmas trees on Westmoreland-Coshocton silt loams, 8 to 15 percent slopes.

Installing the leach lines on the contour helps to prevent seepage of the effluent to the surface. Providing suitable fill material helps to overcome the limited depth to bedrock in the Westmoreland soil. Perimeter drains reduce the wetness of the Coshocton soil. Enlarging the field or installing a double absorption field system helps to overcome the slow absorption of effluent.

The capability subclass is IIIe; the woodland suitability subclass of the Westmoreland soil is 3o, and that of the Coshocton soil is 2o.

WmD—Westmoreland-Coshocton silt loams, 15 to 25 percent slopes. These deep, moderately steep soils are on uplands. The well drained Westmoreland soil generally is on the middle and upper parts of smooth or convex side slopes and on convex shoulder slopes on hillsides. The moderately well drained Coshocton soil is in small seepy areas on side slopes. In some areas on hillsides, the soils occur as alternating bands, which are associated with different bedrock strata. Areas commonly are 150 to 500 feet wide and are 10 to several hundred acres in size. Most are 50 to 65 percent Westmoreland silt loam and 25 to 35 percent Coshocton silt loam. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Westmoreland soil has a surface layer of dark grayish brown, very friable silt loam about 5 inches thick. The subsoil is about 32 inches thick. The upper part is yellowish brown, friable silty clay loam, and the lower part is brown and yellowish brown, friable and firm shaly silty clay loam. The substratum is brown, firm very shaly silty clay loam. Shale bedrock is at a depth of about 65 inches. In some areas the subsoil contains more sand and less clay.

Typically, the Coshocton soil has a surface layer of dark grayish brown, friable silt loam about 3 inches thick. The subsoil is about 35 inches thick. The upper part is yellowish brown, friable silt loam, and the lower part is yellowish brown, mottled, firm silty clay loam and channery silty clay loam. The substratum is dark brown, firm channery silty clay loam. Siltstone or shale bedrock

Figure 9.—A golf course in an area of Westmoreland-Coshocton silt loams, 8 to 15 percent slopes.

is at a depth of about 72 inches. In some areas the surface layer is loam.

Included with these soils in mapping are small areas of the moderately deep Culleoka and Berks soils on the upper part of side slopes, areas of Hazleton soils near the upper part of some side slopes, and scattered small areas of moderately deep, moderately well drained soils and the moderately fine textured Guernsey soils, which are susceptible to slippage. The subsoil of Hazleton soils has a lower content of clay and a higher content of sandstone fragments and sand than that of either the Westmoreland or Coshocton soil. Also included, on toe slopes, are some areas in the flood pools of the dams in the Muskingum Watershed Conservancy District. The soils in these areas are subject to flooding. Included soils make up 5 to 15 percent of most mapped areas.

Permeability is moderate in Westmoreland soil and slow or moderately slow in Coshocton soil. Available water capacity is moderate in both soils. Runoff is rapid. The Coshocton soil has a perched seasonal high water table at a depth of 18 to 42 inches in winter and in spring and other extended wet periods. In the surface layer of both soils, the content of organic matter is moderately low and tilth is good. The subsoil of the Westmoreland soil is very strongly acid to medium acid, and that of the Coshocton soil is strongly acid or very strongly acid. The root zone is deep in both soils. The shrink-swell potential is moderate in the Coshocton soil. The potential for frost action is moderate in the Westmoreland soil and high in the Coshocton soil.

Some areas are used for cultivated crops. These soils are suited to a crop rotation of corn, small grain, and hay. Commonly, a cultivated crop is included in the rotation about once every 4 years. If the soils are cultivated, the hazard of erosion is very severe. A permanent plant cover is the best means of controlling erosion. A system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and cover crops reduce the runoff rate and help to prevent excessive soil loss and deterioration of tilth. The moderately steep slope hinders the use of some farm machinery. Scattered subsurface drains are needed in the seepy areas of the Coshocton soil. Crusting of the surface layer restricts moisture penetration and air movement, especially in tilled areas. Shallow cultivation of intertilled crops, however, breaks up the crust.

Many areas are pastured. These soils are suited to pasture. In overgrazed areas and in areas plowed during seedbed preparation, however, the hazard of erosion is very severe. Proper stocking rates and pasture rotation help to prevent overgrazing and excessive soil loss. No-till seeding also helps to prevent excessive soil loss. Mowing helps to control weeds. Timely applications of lime and fertilizer are needed.

Many areas are wooded (fig. 10). These soils are suited to woodland and to habitat for woodland wildlife. Erosion can be controlled by building logging roads and skid trails on the contour and by establishing water bars (fig. 11). Mechanical tree planters and the mowers used to control plant competition can be operated on these

Figure 10.—A well managed stand of yellow-poplar on Westmoreland-Coshocton silt loams, 15 to 25 percent slopes.

Figure 11.—Erosion on a skid trail in an area of Westmoreland-Coshocton silt loams, 15 to 25 percent slopes. Erosion control is needed.

soils. Planting seedlings that have been transplanted once or mulching reduces the seedling mortality rate in areas of the Coshocton soil on south aspects.

Mainly because of the slope, these soils are poorly suited to building site development and recreational development. Erosion can be controlled by removing as little vegetation as possible, mulching, and establishing a temporary plant cover on construction sites. On sites for paths and trails, it can be controlled by laying out the paths and trails on the contour, establishing water bars or switchbacks, and building steps. Because bedrock is as shallow as 40 inches in some areas, the soils are better suited to dwellings without basements than to dwellings with basements. The seasonal wetness and shrink-swell potential of the Coshocton soil are limitations on sites for dwellings. Waterproofing basement walls and installing drains at the base of footings help to keep water away from basements. Designing walls that have pilasters and are reinforced with concrete, supporting the walls with a large spread footing, and backfilling around foundations with material that has a low shrink-swell potential help to prevent the damage caused by shrinking and swelling. Cutting and filling increase the hazard of hillside slippage in the included areas of Guernsey soils. Installing a drainage system in the seepy areas, however, reduces the hazard.

The Coshocton soil has a highly corrosive effect on uncoated steel and concrete. As a result, coated steel should be used in water, sewer, and drain lines, particularly at boundaries with other soils. The Westmoreland soil has a highly corrosive effect on concrete, but other material, such as steel, can be used in the water, sewer, or drain lines.

Low strength and the potential for frost action in the Westmoreland and Coshocton soils and the shrink-swell potential of the Coshocton soil can result in damage to local roads and streets. Providing suitable base material and installing a drainage system, however, help to prevent this damage. Building the roads and streets on the contour and seeding road cuts help to control erosion.

These soils are poorly suited to septic tank absorption fields. The slope is the main limitation. Other limitations are the depth to bedrock and moderate permeability in the Westmoreland soil and the seasonal wetness and slow or moderately slow permeability in the Coshocton soil. Installing the leach lines on the contour helps to prevent seepage of the effluent to the surface. Providing suitable fill material helps to overcome the limited depth to bedrock in the Westmoreland soil. Perimeter drains reduce the wetness of the Coshocton soil. Enlarging the field or installing a double absorption field system helps to overcome the slow absorption of effluent.

The capability subclass is IVe; woodland suitability subclass 2r on north aspects, 3r on south aspects.

prime farmland

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

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

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

Less than 31,500 acres in Carroll County, or less than 13 percent of the total acreage, meets the requirements for prime farmland. This land occurs as scattered areas throughout the county, mostly of major or minor soils in the Westmoreland-Coshocton, Sebring-Fitchville-Glenford, and Chili-Boyer-Tioga associations, which are described under the heading "General soil map units." About 60 percent of the prime farmland occurs as areas of well drained and moderately well drained soils used for crops, mainly corn, wheat, oats, and hay. About 40 percent, or more than 13,500 acres, occurs as areas of poorly drained or somewhat poorly drained soils, mainly in the Sebring-Fitchville-Glenford association. The poorly drained and somewhat poorly drained soils are considered prime farmland only in areas where a drainage system has been installed. Onsite investigation is needed to determine whether or not the wetness has been overcome. Only about 10 percent of the acreage of these poorly drained and somewhat poorly drained soils is cropland.

In some parts of the county, the trend in land use has been a continuing loss of prime farmland to nonfarm uses. The loss of prime farmland to these uses puts pressure on marginal lands, which generally are more sloping and erodible, more droughty, less easily cultivated, and less productive.

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

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

Dan Ross and H. Wesley Beery, district conservationists, Soil Conservation Service, and Roger Amos, county agent, Cooperative Extension 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 "Detailed soil map units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

In 1980, about 129,000 acres in Carroll County, or 51 percent of the total acreage, was farmland (*21*). About 50,100 acres was used for crops. Of this cropland, about 29,500 acres was used for hay, 14,000 acres for corn, 3,500 acres for oats, and 3,100 acres for wheat. Small acreages were used for orchards and nursery crops.

The potential of the soils in Carroll County for increased production of food is excellent. According to the 1967 Conservation Needs Inventory, about 70,003 acres of potential cropland is woodland and about 28,978 acres is pasture (*14*). Food production could be increased by converting some of this land to cropland. It could also be increased by applying the latest technology for crop production.

Even though the acreage of farmland has decreased, the acreage used for crops increased by about 1,000 acres from 1975 to 1980. The acreage used for hay increased by 5,400 acres, and that used for corn increased by 2,400 acres. The acreage used for small grain decreased by 6,900 acres.

Cropping patterns have changed in recent years. In the past the cropping sequence on most of the cropland included 4 years or more of hay. This has changed somewhat because of a major increase in corn production. Although a system of conservation tillage that leaves crop residue on the surface has been applied in the areas used for corn, excessive erosion has resulted in areas where the protective cover of crop residue has not been adequate.

The management concerns on the cropland in the county are described in the paragraphs that follow. These concerns are erosion, fertility, soil moisture, natural drainage, and tilth.

Erosion is the major problem on the cropland in the county. It reduces soil productivity and can result in the pollution of lakes and streams by sediment. Productivity is reduced because the surface layer is lost and part of the subsoil is incorporated into a plow layer. Loss of the surface layer is especially damaging on soils with a clayey subsoil, such as Elba, Guernsey, and Upshur. Productivity also is reduced in soils that have a restricted root zone or are droughty, such as Berks, Hazleton, and Culleoka. Erosion control preserves not only the productivity of the soils but also the quality of municipal water supplies and the water in recreational areas and the areas used as habitat for fish and other kinds of wildlife.

Measures that control erosion provide a protective cover of crops or crop residue, reduce the runoff rate, and increase the rate of water intake. A cropping system that keeps a plant cover on the surface for extended periods can hold soil losses to an amount that will not reduce the productivity of the soils. A system of conservation tillage that leaves crop residue on the surface increases the infiltration rate and reduces the hazards of runoff and erosion. No-tillage is the most effetive method of conservation tillage in the areas used for corn. It is suited to most of the soils in the county but is not so successful on soils that have a silty clay loam surface layer, such as Elba, Guernsey, and Upshur, or on soils that are slowly or moderately slowly permeable, such as Fitchville, Lorain, Peoga, and Sebring.

According to the 1967 Conservation Needs Inventory, contour stripcropping is needed on about half of the cropland in the county (*14*). It is one of the best methods of erosion control in the county. Cover crops, which protect the surface, and grassed waterways also are effective. Grassed waterways are natural or constructed outlets that remove surface water at a nonerosive velocity. Natural drainageways are the best sites for waterways, mainly because a good channel commonly can be established with a minimum of shaping. The waterway can be designed so that it can be crossed by farm machinery.

Soil fertility is naturally low in most of the soils in Carroll County, especially in Berks, Bethesda, Fairpoint, Hazleton, Morristown, and Rigley soils. It is medium or high, however, in Elba, Guernsey, and other soils that commonly are adjacent to outcrops of limestone bedrock and in the somewhat poorly drained Fitchville and Orrville soils, the poorly drained Sebring soils, and the very poorly drained Holly and Lorain soils.

The surface layer is naturally acid in almost all of the soils in the county. It commonly is neutral or mildly alkaline, however, in Elba, Holly, Lorain, and Morristown soils. On the more acid soils, applications of ground limestone are needed to raise the pH level sufficiently for alfalfa and other crops that grow well on neutral soils. On all soils, additions of lime and fertilizer should be based on the results of soil tests, the needs of the crop, and the expected level of yields. Further information is available in the Ohio Agronomy Guide, which is published annually by the Agronomy Department of Ohio State University, the Ohio Agricultural Research and Development Center, and the Cooperative Extension Service.

Soil moisture is a critical management concern in Boyer, Hazleton, and other soils that have a high content of sand in the subsoil, in Berks, Culleoka, and other soils that have a restricted root zone, and in Bethesda, Fairpoint, and Morristown soils. Available water capacity is low or very low in these soils. Measures that reduce runoff and evaporation rates improve productivity. Examples are a system of conservation tillage that leaves crop residue on the surface, winter cover crops, contour stripcropping, and a cropping sequence that includes grasses and legumes.

Soil drainage is the major management concern in some areas, especially along tributaries of Sandy Creek and along Conotton Creek and its tributaries. Holly, Lorain, Sebring, and other poorly drained or very poorly drained soils are naturally so wet that the crops commonly grown in the county generally cannot be grown unless a drainage system is installed. Unless drained, somewhat poorly drained soils, such as Fitchville and Orrville, are so wet that crops are damaged during most years and planting or harvesting is delayed. Scattered subsurface drains are needed in Coshocton, Guernsey, and other soils on hillsides where seepy areas are common.

Installing a subsurface drainage system in Fitchville, Holly, Lorain, Orrville, and Sebring soils is difficult because natural drainage outlets commonly are not available. The effectiveness of surface drainage channels also is limited because of the scarcity of outlets. Pump drainage has not been used to any extent in the county because it is costly.

Soil tilth is an important factor affecting the germination of seeds and the infiltration of water into the soil. Soils with good tilth are granular and porous. In Carroll County most of the soils used for crops have a silt loam surface layer that is low to moderate in content of organic matter. Generally, the structure of these soils is weak or moderate, and intense rainfall causes the formation of a surface crust. When dry, the crust is hard and nearly impervious to water. It reduces the rate of water infiltration and thus increases the runoff rate. Measures that increase the content of organic matter can improve the soil structure. Examples are a cropping sequence that includes grasses and legumes, a system of conservation tillage that leaves crop residue on the surface, winter cover crops, and contour stripcropping.

Fall plowing on light colored soils that have a silt loam surface layer results in surface crusting and high erosion rates. If plowed in the fall, many of the soils are nearly as dense and hard at planting time as they were before they were plowed.

Special crops grown in Carroll County include nursery and orchard crops and Christmas trees. Well drained soils that warm up early in spring, such as Boyer, Chili, and Oshtemo soils on terraces and Hazleton, Rigley, and

Westmoreland on uplands, are well suited to nursery and orchard crops. If nursery crops are grown, however, irrigation is needed on some of these soils, especially on Boyer and Oshtemo soils.

Pasture is the dominant land use in many areas throughout the county, especially in areas where the slope ranges from 8 to 25 percent (fig. 12). According to the 1967 Conservation Needs Inventory, about 35,941 acres in the county is pastured (*14*). The most common pasture grasses are bluegrass and orchardgrass.

Pasture renovation through no-till seeding of grasses and legumes increases forage production and helps to prevent excessive erosion. Most of the soils in the county are suitable for no-till seeding. Applications of lime and fertilizer commonly are needed. The kinds and amounts to be applied should be determined by soil tests. The number of grazing animals in a specific area should be determined by the carrying capacity of the pasture. Excessive erosion can result from overgrazing. It can be prevented by rotation grazing, applications of lime and fertilizer, and pasture renovation.

yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The 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.

Figure 12.—A hilly area used as pasture. Berks soils are in the foreground and on the side slopes along the drainageway. Hazleton soils are on the broader ridgetop in the background.

The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

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 and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit (*18*). Only class and subclass are used in this survey.

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

Class I soils have 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, woodland, wildlife habitat, or recreation.

The acreage of soils in each capability class and subclass is shown in table 7. The capability classification of each map unit is given in the section "Detailed soil map units."

woodland management and productivity

Dan Ross, district conservationist, Soil Conservation Service, and Cloyce Riddle, service forester, Ohio Department of Natural Resources, helped prepare this section.

About 113,800 acres in Carroll County, or 46 percent of the total acreage, is wooded (*14*). The wooded acreage mainly occurs as privately owned stands of timber and farm woodlots, but several thousand acres of woodland near Atwood and Leesville Lakes are owned by the Muskingum Watershed Conservancy District. The most extensive wooded areas are in the eastern and southern parts of the county.

The woodland is mainly areas of mixed hardwoods. The major forest type is oak-hickory. The dominant woodland species are oak, hickory, ash, yellow-poplar, black cherry, and red maple. Most of the wooded areas occur as moderately steep to very steep soils that formed in material weathered from sandstone, shale, siltstone, and limestone. Westmoreland, Coshocton, Hazleton, Berks, and Rigley soils are common in these areas. Much of the woodland follows the slopes along streams and drainageways. Scattered areas of poorly drained or very poorly drained soils, such as Holly, Lorain, and Sebring, are used as woodland. The principal species in these areas are swamp white oak, blackgum, and pin oak.

Since the 1930's, many abandoned areas have been planted to pine, mainly because the topography was too steep for cropland and because erosion control was needed. These trees have reached a merchantable size. The principal species planted were Austrian pine, eastern white pine, red pine, and Scotch pine. Some other abandoned areas should be planted to pine.

Some of the woodland shows the results of poor management. The best trees are selected for cutting, and the diseased or damaged ones are left to occupy valuable growing space on excellent woodland soils. In many wooded areas grapevines have not been controlled. Grazing cattle have damaged some woodland by destroying leaf litter and desirable seedings, damaging roots, and compacting the soil. Good management can restore this woodland to a high level of production. Additional information on woodland management can be obtained from the local offices of the Soil Conservation Service and the Ohio Department of Natural Resources, Division of Forestry.

Woodland productivity varies widely from soil to soil. The factors influencing tree growth are almost the same as those influencing annual crops and pasture. The major difference is that tree roots penetrate the soil to a greater depth, especially around rock fragments in the lower part of the profile. Aspect and the position of the soil on the landscape also are important.

Aspect is the compass direction toward which the slope faces. Trees grow better on north and east aspects because of less exposure to the prevailing winds and the sun and because of more soil moisture. Some of the factors that make south and west aspects less suitable are a higher soil temperature, a result of more direct sunrays; a high evaporation rate, which is caused by prevailing winds; earlier snowmelt; and a greater degree of freezing and thawing.

The position of the soil on the landscape is important in determining the amount of moisture available for tree growth. The amount increases as elevation decreases, partly because of seepage downslope. On the lower part of the slopes, the soils generally are deeper than on the upper part, less soil moisture is lost through evaporation, and soil temperature is somewhat lower.

The steepness of the slopes is an important factor in woodland management. Steep and very steep slopes result in serious equipment limitations. As the percent of slope increases, the rate of water infiltration decreases and the rate of runoff and the hazard of erosion increase.

Erosion reduces the volume of soil available for water storage. In severely eroded areas, the surface layer is removed and the subsoil is exposed. Because the subsoil commonly is less porous than the surface layer, the runoff rate is increased and the water intake rate is decreased. Tree growth and natural reseeding are adversely affected.

Reaction and fertility affect the growth of different kinds of trees. For example, black walnut grows well on Tioga, Glenford, Elkinsville, and other soils naturally having a lime content in the subsoil that favors tree growth. Growth is slower on soils that are low in fertility.

Christmas trees are grown in some areas of the county. They can grow well on many of the soils but are adversely affected by various soil properties (*19*). Drainage and texture affect the species that can be successfully grown. For example, blue spruce and Fraser fir do not grow well on poorly drained and somewhat poorly drained soils, such as Fitchville, Jimtown, and Orrville. Fraser fir cannot grow well on Elba silty clay loams, which have a fine textured subsoil. Other factors are fertility, available water capacity, the potential for frost action, and the depth to bedrock. Westmoreland soils are better suited to spruce and fir than Berks soils because they are naturally more fertile, have a higher available water capacity, and are deeper to bedrock.

Table 8 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 8, *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 the 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 strong winds; *moderate*, that some trees will be blown down during periods of excessive soil wetness and strong winds; and *severe*, that many trees are blown 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 and those that can be grown as Christmas trees.

windbreaks and environmental plantings

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

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

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly deciduous shrubs and evergreen trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 9 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 9 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service, the Ohio Department of Natural Resources, Division of Forestry, and the Cooperative Extension Service or from a nursery.

recreation

Dan Ross, district conservationist, Soil Conservation Service, helped prepare this section.

Recreation is a big industry in Carroll County. The local Chamber of Commerce estimates that the influx of tourists nearly doubles the population of the county in the summer. One major reservoir and most of a second are in the western part of the county. These reservoirs, Leesville and Atwood Lakes, are part of the Muskingum Watershed Conservancy District (MWCD). They have 29 miles of shoreline. The MWCD owns a total of nearly 5,000 acres surrounding the lakes that is used for camping, hunting, picnicking, and other activities. The State of Ohio owns another 230 acres of adjacent lands that are used as hunting areas. Much of the remaining land is owned by people who reside outside of the county but who have constructed summer residences on sites near these lakes.

The county has a number of other outdoor recreation areas and summer youth campgrounds. These either are privately owned or are owned by service organizations, churches, or sportmen's clubs.

The soils in the county generally are moderately well suited to recreational development. Most are not wet for extended periods or subject to flooding. They commonly are deep and do not have large stones or a high content of smaller stones. The slope commonly is a limitation affecting certain types of recreational development. Because of the rolling topography, measures that control erosion and reduce wetness are needed both in intensive recreational areas, such as playgrounds and developed campsites, and in extensive recreational areas, such as trails and primitive campsites. Examples of these measures are critical area planting, diversions, waterways, and subsurface drains. More information about these conservation measures can be obtained from the local office of the Soil Conservation Service.

The soils of the survey area are rated in table 10 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 10, 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 10 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 13 and interpretations for dwellings without basements and for local roads and streets in table 12.

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

Dan Ross, district conservationist, Soil Conservation Service, and Thomas A. Henry, private land biologist, and Lester E. Jones, game protector, Ohio Department of Natural Resources, Division of Wildlife, helped prepare this section.

Carroll County has a wide variety of wildlife. Some of the birds inhabiting the county are pheasant, turkey, mourning dove, ruffled grouse, red-tailed hawks, crows, pileated woodpeckers, and songbirds. Some of the mammals are rabbits, squirrel, beaver, woodchuck, deer, fox, and racoon. This wide variety of wildlife is supported by diverse habitats, including cropland, openland, woodland, swamps, and ponds.

Large areas of wetlands are in the northern and southwestern parts of the county, mainly along the tributaries of Sandy Creek and along Conotton Creek and its tributaries. Lorain, Sebring, Peoga, Holly, Fitchville, and Orrville soils are common in these areas. Near the community of Specht, a wetland has been protected by Kent State University because of its unique vegetation and wildlife.

Most of the upland soils in the county are well suited to the plants used as wildlife food and cover. Nesting areas are needed. Planting grasses helps to create these areas. Also, shrubs can be planted in hedgerows and fence rows. Planting nut-producing trees and hollow den trees improves woodlots as habitat for wildlife. Cropland is an invaluable source of food for wildlife if it is managed properly. Ponds can be constructed in some areas. Landscaping the area around a newly constructed pond helps to provide habitat for wildlife. Additional information about improving wildife habitat can be obtained from the local office of the Soil Conservation Service and from the local game protector.

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 11, 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 milkweed.

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

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, duckweed, 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, pheasant, meadowlark, field sparrow, cottontail, and red fox.

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

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

engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. 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 12 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 13 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 13 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

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

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

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

Table 13 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 13 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 revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

construction materials

Table 14 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

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

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

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

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have 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 natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 14, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

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

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

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

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

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

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

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

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

water management

Table 15 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, 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 soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

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

soil properties

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

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

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

Table 16 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

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

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as 15 or 20 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*3*) and the system adopted by the American Association of State Highway and Transportation Officials (*2*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, 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 ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

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

physical and chemical properties

Table 17 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

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

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

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

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

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

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

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

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

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

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

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

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing 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 soil blowing are used.

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

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

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

5. Loamy soils that are less than 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 soil blowing 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 soil blowing.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 17, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

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

soil and water features

Table 18 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 are not considered flooding.

Table 18 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 is 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 18 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 18.

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

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

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

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

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe 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 Carroll 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 classifying and correlating the selected soils and in evaluating the behavior of the soils under various land uses. Three of the profiles were selected as representative of their respective series and two are described under the heading "Soil series and their morphology." The series names and the laboratory identification numbers are Culleoka (CA-2), and Fitchville (CA-35), and Rigley (CA-29).

In addition to the Carroll County data, laboratory data are also available from nearby counties in eastern Ohio that have many of the same soils. All the 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.

engineering index test data

Several of the soils in Carroll County were analyzed for engineering properties by the Ohio Department of Transportation, Division of Highways, Bureau of Testing, Soils and Foundation Section. Two of the series described in this publication were tested. The series names and the laboratory identification numbers are Fitchville (CA-35) and Rigley (CA-29).

In addition to the Carroll County data, engineering test data are also available from nearby counties that have many of the same soils. All the 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.

classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*20*). 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 19, 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 Udalf (*Ud*, meaning humid, plus *alf*, from Alfisol).

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

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Hapludalfs.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. 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 coarse-loamy, mixed, mesic Typic Hapludalfs.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

soil series and their morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. 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* (*17*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*20*). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed soil map units."

Berks series

The Berks series consists of moderately deep, well drained soils that formed in residuum of shale, siltstone, and fine grained sandstone on uplands. Permeability is moderate or moderately rapid. Slopes range from 3 to 70 percent.

Berks soils are similar to Culleoka and Hazleton soils and commonly are adjacent to Coshocton and Westmoreland soils. Coshocton, Culleoka, and Westmoreland soils have an argillic horizon and have a lower content of coarse fragments in the subsoil than the Berks soils. Coshocton, Hazleton, and Westmoreland soils are deep over bedrock. Coshocton soils are moderately well drained and have low chroma mottles in the subsoil.

Typical pedon of Berks shaly silt loam, 25 to 40 percent slopes, about 1 mile northeast of Wattsville, in Fox Township; about 1,500 feet east and 2,600 feet north of the southwest corner of sec. 14, T. 13 N., R. 4 W.

A—0 to 3 inches; brown (10YR 5/3) shaly silt loam, light gray (2.5Y 7/2) dry; moderate medium and fine granular structure; friable; many roots; dark gray (10YR 4/1) specks; about 15 percent coarse fragments; medium acid; clear smooth boundary.

BA—3 to 9 inches; brown (10YR 5/3) shaly silt loam; moderate medium and fine subangular blocky structure; friable; many roots; about 20 percent coarse fragments; very strongly acid; clear smooth boundary.

Bw1—9 to 13 inches; yellowish brown (10YR 5/4) shaly silt loam; moderate medium and fine subangular blocky structure; friable; many roots; very dark grayish brown (10YR 3/2) coatings in old root channels; about 25 percent coarse fragments; very strongly acid; clear smooth boundary.

Bw2—13 to 19 inches; yellowish brown (10YR 5/4) very shaly silt loam; moderate medium and fine subangular blocky structure; friable; common roots; about 60 percent coarse fragments; very strongly acid; gradual smooth boundary.

C—19 to 25 inches; yellowish brown (10YR 5/4) very shaly silt loam; massive; firm; few roots; about 75 percent coarse fragments; very strongly acid; clear smooth boundary.

Cr—25 to 27 inches; rippable siltstone bedrock.

The thickness of the solum ranges from 18 to 36 inches and the depth to bedrock from 20 to 40 inches. The content of coarse fragments ranges from 15 to 50 percent in the Bw1 horizon, from 35 to 75 percent in the Bw2 horizon, and from 50 to 90 percent in the C horizon.

The A horizon has hue of 10YR, value of 3 to 5, and chroma of 1 to 4. It is dominantly shaly silt loam but is silt loam in some pedons. The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 or 4. It is shaly or very shaly silt loam or silty clay loam in which the content of clay ranges from 18 to 26 percent. The B and C horizons range from extremely acid to medium acid. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 or 4.

Bethesda series

The Bethesda series consists of deep, well drained, moderately slowly permeable soils on uplands. These soils formed in a mixture of partly weathered fine earth and fragments of shale, siltstone, and sandstone in surface mined areas. Slopes range from 8 to 70 percent.

Bethesda soils are similar to Fairpoint and Morristown soils and commonly are adjacent to Fairpoint and Westmoreland soils. Fairpoint and Morristown soils are less acid in the substratum than the Bethesda soils. Westmoreland soils formed in colluvium and residuum derived from shale, siltstone, and sandstone in unmined areas. They have an argillic horizon.

Typical pedon of Bethesda channery clay loam, 25 to 70 percent slopes, about 3 miles west of Malvern, in Brown Township; about 400 feet south and 1,250 feet east of the northwest corner of sec. 14, T. 17 N., R. 7 W.

Ap—0 to 4 inches; dark grayish brown (10YR 4/2) channery clay loam, light gray (2.5Y 7/2) dry; weak coarse granular structure; friable; many roots; about 40 percent coarse fragments; extremely acid; clear smooth boundary.

C1—4 to 17 inches; yellowish brown (10YR 5/4) very channery clay loam; massive; friable; few roots; about 50 percent coarse fragments; strongly acid; clear smooth boundary.

C2—17 to 22 inches; about 50 percent variegated light gray (10YR 6/1), 30 percent very dark gray (N 3/0), and 20 percent yellowish brown (10YR 5/4) shaly silty clay loam; massive; firm; few roots; about 40 percent coarse fragments; extremely acid; clear smooth boundary.

C3—22 to 40 inches; about 70 percent variegated dark brown (7.5YR 4/4), 25 percent yellowish brown (10YR 5/4), and 5 percent very dark gray (N 3/0) very channery clay loam; massive; friable; about 50 percent coarse fragments; extremely acid; clear smooth boundary.

C4—40 to 60 inches; about 60 percent variegated light olive brown (2.5Y 5/4) and 40 percent yellowish brown (10YR 5/4) very channery clay loam; massive; friable; about 50 percent coarse fragments; extremely acid.

The content of coarse fragments in the part of the C horizon within a depth of 40 inches ranges from 35 to 60 percent. The rock fragments commonly are less than 10 inches in diameter, but some are stones.

The Ap horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 to 4. It is dominantly channery clay loam but is shaly clay loam in some pedons. The C horizon has hue of 7.5YR to 2.5Y or is neutral in hue. It has value of 3 to 6 and chroma of 0 to 6. It is extremely acid to strongly acid. The fine earth fraction is clay loam, silty clay loam, or loam.

Boyer series

The Boyer series consists of deep, well drained soils formed in loamy and sandy glacial outwash deposits on stream terraces. Permeability is moderately rapid in the subsoil and very rapid in the substratum. Slopes range from 0 to 4 percent.

These soils have a higher content of coarse fragments in the lower part of the solum and in the C horizon and typically are more acid in the C horizon than is definitive for the Boyer series. These differences, however, do not alter the use or behavior of the soils.

Boyer soils are similar to Chili and Oshtemo soils and commonly are adjacent to Chili and Tioga soils. Chili soils commonly are slightly higher on the terraces than the Boyer soils. Also, they contain more clay in the upper part of the subsoil and have a thicker solum. Oshtemo soils also have a thicker solum and contain less gravel in the C horizon. Tioga soils are on flood plains. They do not have an argillic horizon.

Typical pedon of Boyer loam, 0 to 4 percent slopes, directly west of Pekin, in Brown Township; about 280 feet west and 1,680 feet south of the northeast corner of sec. 10, T. 16 N., R. 6 W.

Ap—0 to 10 inches; dark brown (10YR 4/3) loam, yellowish brown (10YR 5/4) dry; weak coarse and medium granular structure; very friable; many roots; about 5 percent coarse fragments; neutral; abrupt smooth boundary.

Bt1—10 to 21 inches; dark brown (7.5YR 4.4) loam; moderate medium subangular blocky structure; friable; common roots; common brown (10YR 4/3) channel fillings; thin patchy brown (7.5YR 4/2) clay films on faces of peds; about 2 percent coarse fragments; neutral; clear wavy boundary.

2Bt2—21 to 29 inches; brown (7.5YR 4/4) gravelly loamy sand; weak coarse subangular blocky structure; very friable; few roots; thin very patchy brown (7.5YR 4/2) clay films bridging sand grains; about 45 percent coarse fragments; neutral; gradual wavy boundary.

2C1—29 to 42 inches; brown (10YR 5/3) very gravelly loamy sand; single grained; loose; about 55 percent coarse fragments; medium acid; clear wavy boundary.

2C2—42 to 53 inches; yellowish brown (10YR 5/4) very gravelly loamy sand; single grained; loose; black (10YR 2/1) coatings on about one-third of the sand grains; about 55 percent coarse fragments; strongly acid; clear wavy boundary.

2C3—53 to 60 inches; yellowish brown (10YR 5/4) very gravelly loamy sand; single grained; loose; about 55 percent coarse fragments; medium acid.

The thickness of the solum ranges from 20 to 40 inches. The content of coarse fragments ranges from 2 to 25 percent in the part of the B horizon within a depth of 20 inches and from 40 to 70 percent below a depth of 30 inches.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. It is dominantly loam but is sandy loam, gravelly loam, or gravelly sandy loam in some pedons. The B horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. It is loam, sandy loam, or gravelly sandy loam in the upper part and loam, sandy loam, gravelly sandy loam, or gravelly loamy sand in the lower part. It is medium acid to neutral. The C horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. It is stratified very gravelly loamy sand or very gravelly sand. It ranges from strongly acid to neutral.

Chili series

The Chili series consists of deep, well drained, moderately rapidly permeable soils on stream terraces. These soils formed in loamy sediments over gravelly and sandy glacial outwash. Slopes range from 0 to 15 percent.

Chili soils are similar to Boyer and Oshtemo soils and commonly are adjacent to Boyer, Glenford, and Tioga soils. Boyer and Oshtemo soils contain less clay in the upper part of the subsoil than the Chili soils. Also, Boyer soils have a thinner solum and are slightly lower on the terraces. Glenford soils contain less sand throughout than the Chili soils and do not have gravel in the C horizon. They commonly are on slack water terraces above areas of the Chili soils. Tioga soils are on flood plains. They do not have an argillic horizon.

Typical pedon of Chili silt loam, 3 to 8 percent slopes, 1 mile east of Magnolia, in Rose Township; 400 feet east and 600 feet south of the northwest corner of sec. 24, T. 16 N., R. 7 W.

Ap—0 to 6 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; moderate medium and fine granular structure; friable; many roots; about 3 percent coarse fragments; neutral; clear smooth boundary.

BA—6 to 12 inches; brown (10YR 4/3) loam; weak fine subangular blocky structure; friable; common roots; about 5 percent coarse fragments; slightly acid; abrupt smooth boundary.

Bt1—12 to 24 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium subangular blocky structure; friable; few roots; thin very patchy brown (7.5YR 4/4) clay films on faces of peds; about 7 percent coarse fragments; slightly acid; clear smooth boundary.

Bt2—24 to 28 inches; brown (7.5YR 4/4) gravelly sandy clay loam; weak medium subangular blocky structure; friable; few roots; thin very patchy brown (7.5YR 4/4) clay films bridging sand grains; about 20 percent coarse fragments; slightly acid; clear smooth boundary.

Bt3—28 to 32 inches; strong brown (7.5YR 5/6) gravelly sandy loam; weak medium subangular blocky structure; friable; thin very patchy brown (7.5YR 4/4) clay films bridging sand grains; about 20 percent coarse fragments; medium acid; clear smooth boundary.

Bt4—32 to 37 inches; strong brown (7.5YR 5/6) gravelly sandy clay loam; few fine distinct reddish brown (5YR 4/4) mottles; weak medium subangular blocky structure; friable; thin patchy brown (7.5YR 4/4) clay films bridging sand grains; about 30 percent coarse fragments; medium acid; clear smooth boundary.

Bt5—37 to 41 inches; yellowish brown (10YR 5/4) gravelly sandy loam; massive; friable; thin very patchy brown (7.5YR 4/4) clay films bridging sand grains; about 30 percent coarse fragments; strongly acid; clear smooth boundary.

C1—41 to 53 inches; yellowish brown (10YR 5/4) gravelly sand; single grained; loose; about 40 percent coarse fragments; strongly acid; clear smooth boundary.

C2—53 to 60 inches; yellowish brown (10YR 5/6) gravelly loamy sand; single grained; loose; about 25 percent coarse fragments; strongly acid.

The thickness of the solum ranges from 40 to 60 inches. The content of coarse fragments ranges from 1 to 15 percent in the upper 24 inches, from 15 to 40 percent between depths of 24 and 40 inches, and from 25 to 60 percent below a depth of 40 inches.

The Ap horizon has hue of 10YR, value of 4, and chroma of 2 or 3. It is dominantly silt loam but in some pedons is loam. The BA and Bt horizons have hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6. They are sandy loam, loam, clay loam, or sandy clay loam or the gravelly analogs of these textures. The content of clay in the Bt horizon ranges from 18 to 24 percent. The C horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6. It is gravelly or very gravelly sand or loamy sand. It is strongly acid or medium acid.

Coshocton series

The Coshocton series consists of deep, moderately well drained soils that formed in colluvium and in residuum of shale and siltstone on uplands. Permeability is slow or moderately slow. Slopes range from 3 to 25 percent.

Coshocton soils are similar to Keene and Westmoreland soils and commonly are adjacent to those soils and to Culleoka soils. Culleoka and Westmoreland soils are well drained and do not have low chroma mottles in the subsoil. Also, Culleoka soils are moderately deep over bedrock. Keene soils have a lower content of sand and of coarse fragments in the upper part of the solum than the Coshocton soils. Culleoka and Keene soils commonly are on broad ridgetops, and Westmoreland soils commonly are on narrow ridgetops and on side slopes.

Typical pedon of Coshocton silt loam, in an area of Westmoreland-Coshocton silt loams, 8 to 15 percent slopes, about 1.5 miles northeast of Carrollton, in Center Township; about 2,180 feet north and 625 feet west of the southeast corner of sec. 26, T. 14 N., R. 5 W.

Ap—0 to 8 inches; brown (10YR 4/3) silt loam, light gray (2.5Y 7/2) dry; weak medium and fine granular structure; friable; many roots; about 3 percent coarse fragments; slightly acid; abrupt smooth boundary.

BA—8 to 11 inches; yellowish brown (10YR 5/6) silt loam; weak medium subangular blocky structure; friable; common roots; about 2 percent coarse fragments; strongly acid; clear smooth boundary.

Bt1—11 to 18 inches; yellowish brown (10YR 5/6) silty clay loam; many medium distinct brown (7.5YR 4/4) and many fine distinct light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; friable; few roots; thin patchy light yellowish brown (10YR 6/4) and light brownish gray (10YR 6/2) clay films on faces of peds; about 8 percent coarse fragments; strongly acid; clear smooth boundary.

Bt2—18 to 26 inches; brown (7.5YR 4/4) silty clay loam; many fine distinct grayish brown (10YR 5/2) mottles; moderate medium angular and subangular blocky structure; friable; few roots; grayish brown (10YR 5/2) coatings and thin patchy clay films on faces of peds; about 3 percent coarse fragments; very strongly acid; clear smooth boundary.

Bt3—26 to 31 inches; brown (7.5YR 4/4) silty clay loam; many fine distinct grayish brown (10YR 5/2) mottles; moderate medium subangular blocky structure; firm; few roots; thin continuous grayish brown (10YR 5/2) clay films on faces of peds; about 3 percent coarse fragments; strongly acid; clear smooth boundary.

BC1—31 to 38 inches; brown (7.5YR 4/4) shaly clay loam; few fine distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; friable; about 15 percent coarse fragments; strongly acid; clear smooth boundary.

BC2—38 to 45 inches; brown (7.5YR 4/4) shaly silt loam; few fine distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; friable; about 15 percent coarse fragments; strongly acid; clear smooth boundary.

C—45 to 66 inches; yellowish brown (10YR 5/6) shaly silty clay loam; few fine faint yellowish brown (10YR 5/4) mottles; massive; friable; about 20 percent coarse fragments; strongly acid; clear wavy boundary.

Cr—66 to 68 inches; light olive brown (2.5Y 5/4) weathered shale bedrock.

The thickness of the solum ranges from 30 to 50 inches and the depth to bedrock from 40 to more than 72 inches. The content of coarse shale, siltstone, and sandstone fragments ranges from 2 to 15 percent in the upper part of the solum, from 15 to 35 percent in the lower part, and from 20 to 50 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 but is loam in some pedons. The BA and Bt horizons generally have hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6, but in some pedons the lower part of the Bt horizon has hue of 2.5Y and chroma of 2 or 3. The Bt horizon is strongly acid or very strongly acid. It is silty clay loam, silt loam, or clay loam in the upper part and silty clay, silty clay loam, or clay loam or the shaly or channery analogs of these textures in the lower part. The C horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 4 or 5, and chroma of 3 to 6. It is shaly or channery silty clay loam or silty clay. It ranges from extremely acid to medium acid.

Culleoka series

The Culleoka series consists of moderately deep, well drained, moderately permeable or moderately rapidly permeable soils on the tops of upland ridges. These soils formed in residuum of siltstone or of interbedded shale, siltstone, and fine grained sandstone. Slopes range from 3 to 8 percent.

Culleoka soils are similar to Berks soils and commonly are adjacent to Coshocton and Westmoreland soils. Berks soils have a cambic horizon and have a higher content of coarse fragments in the subsoil than the Culleoka soils. Coshocton and Westmoreland soils are deep over bedrock. Coshocton soils are moderately well drained and have low chroma mottles in the subsoil. They commonly are on ridgetops adjacent to areas of the Culleoka soils. Westmoreland soils are in the more sloping areas.

Typical pedon of Culleoka silt loam, 3 to 8 percent slopes, about 2.75 miles northeast of Malvern, in Brown Township; about 590 feet west and 2,010 feet south of the northeast corner of sec. 15, T. 16 N., R. 6 W.

Ap—0 to 8 inches; brown (10YR 4/3) silt loam, light yellowish brown (2.5Y 6/4) dry; weak medium and fine granular structure; very friable; many roots; about 2 percent coarse fragments; strongly acid; abrupt smooth boundary.

Bt1—8 to 20 inches; brown (7.5YR 5/4) silty clay loam; moderate medium and fine subangular blocky structure; friable; common roots; thin patchy dark brown (7.5YR 4/4) clay films on faces of peds; about 10 percent coarse fragments; strongly acid; clear smooth boundary.

Bt2—20 to 31 inches; yellowish brown (10YR 5/4) channery silty clay loam; moderate medium subangular blocky structure; firm; common roots; medium continuous dark yellowish brown (10YR 4/4) clay films on faces of peds; about 15 percent coarse fragments; strongly acid; clear smooth boundary.

C—31 to 35 inches; yellowish brown (10YR 5/4) very channery clay loam; massive; firm; few roots; about 70 percent coarse fragments; strongly acid; abrupt smooth boundary.

R—35 to 37 inches; interbedded siltstone and sandstone bedrock.

The thickness of the solum ranges from 20 to 37 inches and the depth to bedrock from 20 to 40 inches. The content of coarse shale, siltstone, or sandstone fragments ranges from 10 to 35 percent in the B horizon and from 25 to 80 percent in the C horizon.

The Ap horizon is dominantly silt loam but is loam in some pedons. The Bt horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. It is silt loam, loam, or silty clay loam or the shaly or channery analogs of these textures. The Bt and C horizons are strongly acid or medium acid. The C horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. It is channery, very channery, shaly, or very shaly loam, silt loam, or clay loam.

Elba series

The Elba series consists of deep, well drained, slowly permeable soils on the tops of ridges and the upper parts of side slopes in the uplands. These soils formed in residuum and colluvium derived from limestone and gray, calcareous shale. Slopes range from 3 to 25 percent.

Elba soils are similar to Guernsey and Upshur soils and commonly are adjacent to those soils and to Berks and Westmoreland soils. Berks and Westmoreland soils are on ridgetops and side slopes. Their subsoil contains less clay and is more acid than that of the Elba soils. Also, Berks soils have a higher content of coarse fragments in the subsoil and are moderately deep over bedrock. Guernsey and Upshur soils commonly are slightly lower on the landscape than the Elba soils. Also, Guernsey soils are deeper to carbonates and are moderately well drained, and Upshur soils have a redder hue in the subsoil.

Typical pedon of Elba silty clay loam, 3 to 8 percent slopes, directly north of Scroggsfield, in Fox Township; 1,300 feet west and 2,200 feet south of the northeast corner of sec. 32, T. 13 N., R. 4 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silty clay loam, light brownish gray (2.5Y 6/2) dry; weak medium subangular blocky structure parting to moderate medium granular; friable; many roots; about 2 percent coarse fragments; neutral; clear smooth boundary.

Bt1—6 to 12 inches; yellowish brown (10YR 5/4) silty clay; moderate medium subangular blocky structure; firm; common roots; thin patchy olive brown (2.5Y 4/4) clay films on faces of peds; slightly acid; clear smooth boundary.

Bt2—12 to 19 inches; light olive brown (2.5Y 5/4) silty clay; common fine faint light yellowish brown (2.5Y 6/4) mottles; moderate medium subangular blocky structure; firm; common roots; medium continuous olive brown (2.5Y 4/4) clay films on faces of peds; neutral; clear smooth boundary.

Bt3—19 to 22 inches; olive brown (2.5Y 4/4) silty clay; common fine distinct light yellowish brown (2.5Y 6/4) mottles; moderate medium subangular blocky structure; firm; common roots; medium continuous olive brown (2.5Y 4/4) clay films on faces of peds; few fine dark brown (7.5YR 3/2) accumulations (iron and manganese oxide); neutral; clear smooth boundary.

Bt4—22 to 29 inches; olive brown (2.5Y 4/4) silty clay; weak medium subangular blocky structure; firm; few roots; thin patchy olive brown (2.5Y 4/4) clay films on vertical faces of peds; common medium dark brown (7.5YR 3/2) accumlations (iron and manganese oxide); few white (N 8/0) limestone residuals; strong effervesence; mildly alkaline; clear smooth boundary.

Bt5—29 to 42 inhces; olive brown (2.5Y 4/4) silty clay between large limestone fragments; weak medium subangular blocky structure; firm; few roots; thin patchy gray (10YR 5/1) clay films on vertical faces of peds; common medium dark brown (7.5YR 4/2) accumulations (iron and manganese oxide); about 5 percent limestone fragments; strong effervescence; mildly alkaline; clear smooth boundary.

C1—42 to 51 inches; olive brown (2.5Y 4/4) silty clay between large limestone fragments; massive; firm; few roots; about 5 percent limestone fragments; strong effervescence; mildly alkaline; clear smooth boundary.

C2—51 to 71 inches; light olive brown (2.5Y 5/4) silty clay between large limestone fragments; common medium distinct strong brown (7.5YR 5/6) and grayish brown (2.5Y 5/2) mottles; massive; firm; common medium dark brown (7.5YR 3/2) accumulations (iron and manganese oxide); about 5 percent limestone fragments; strong effervescence; mildly alkaline; abrupt irregular boundary.

R—71 to 73 inches; limestone bedrock.

The thickness of the solum ranges from 24 to 48 inches and the depth to bedrock from 40 to 80 inches. The depth to carbonates ranges from 10 to 30 inches. The content of limestone and shale fragments ranges from 0 to 35 percent in the upper part of the solum and from 5 to 45 percent in the lower part and in the C horizon.

The Ap horizon has hue of 7.5YR or 10YR, value of 4, and chroma of 2 or 3. It is dominantly silty clay loam but is silty clay in some pedons. The B horizon has hue of 7.5YR to 2.5Y, value of 4 or 5, and chroma of 3 or 4. It is clay, silty clay, or silty clay loam or the channery analogs of these textures. It is medium acid to mildly alkaline in the upper part and neutral to moderately alkaline in the lower part. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 to 4. It is clay, silty clay, or silty clay loam or the channery analogs of these textures. It is mildly alkaline or moderately alkaline.

Elkinsville series

The Elkinsville series consists of deep, well drained, moderately permeable soils on low terraces along streams. These soils formed in alluvium. Slopes range from 0 to 3 percent.

Elkinsville soils commonly are adjacent to Glenford and Oshtemo soils in the slightly higher positions and to Peoga and Tioga soils in the slightly lower positions. Glenford and Peoga soils have grayish colors in the subsoil. Glenford soils are moderately well drained and Peoga soils poorly drained. Oshtemo and Tioga soils contain less clay and more sand in the subsoil than the Elkinsville soils. Tioga soils are on flood plains and do not have an argillic horizon.

Typical pedon of Elkinsville silt loam, rarely flooded, about 1.25 miles southeast of Sherrodsville, in Orange Township; about 1,130 feet east and 2,350 feet north of the southwest corner of sec. 1, T. 15 N., R. 7 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, light yellowish brown (2.5Y 6/4) dry; weak fine and medium granular structure; friable; many roots; slightly acid; abrupt smooth boundary.

BA—7 to 12 inches; brown (7.5YR 5/4) silt loam; weak medium and fine subangular blocky structure; friable; common roots; dark brown (7.5YR 4/4) coatings on faces of peds; dark grayish brown (10YR 4/2) organic coatings in root channels; very strongly acid; clear smooth boundary.

Bt1—12 to 28 inches; brown (7.5YR 5/4) silt loam; moderate medium subangular blocky structure; friable; common roots; thin continuous dark brown (7.5YR 4/4) clay films on faces of peds; very strongly acid; clear smooth boundary.

Bt2—28 to 40 inches; brown (7.5YR 5/4) silty clay loam; moderate medium subangular blocky structure; friable; few roots; pale brown (10YR 6/3) coatings and medium very patchy dark brown (7.5YR 4/4) clay films on faces of peds; very strongly acid; clear smooth boundary.

BC—40 to 47 inches; brown (7.5YR 5/4) silt loam; weak medium subangular blocky structure; friable; dark brown (7.5YR 4/4) and pale brown (10YR 6/3) coatings on faces of peds; very strongly acid; clear smooth boundary.

C1—47 to 52 inches; yellowish brown (10YR 5/4) loam; massive; friable; pale brown (10YR 6/3) coatings on faces of peds; very strongly acid; clear smooth boundary.

C2—52 to 60 inches; yellowish brown (10YR 5/4) loam; common medium distinct pale brown (10YR 6/3) mottles; massive; friable; strong brown (7.5YR 5/6) zones around mottles; very strongly acid.

The thickness of the solum ranges from 40 to 50 inches. The Ap horizon has hue of 10YR, value of 4, and chroma of 2 to 4. The BA and Bt horizons have hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4. They are strongly acid or very strongly acid. They are dominantly silt loam or silty clay loam, but in some pedons the lower part of the Bt horizon is loam. The C horizon has hue of 10YR, value of 5, and chroma of 3 or 4. It is silt loam, silty clay loam, loam, or sandy loam. It is very strongly acid to medium acid.

Fairpoint series

The Fairpoint series consists of deep, well drained, moderately slowly permeable soils that formed in a mixture of partly weathered fine earth and fragments of shale, siltstone, and sandstone in surface mined areas. Slopes range from 8 to 70 percent.

Fairpoint soils are similar to Bethesda and Morristown soils and commonly are adjacent to Bethesda and Westmoreland soils. The C horizon of Bethesda soils is extremely acid to strongly acid, and that of Morristown soils is mildly alkaline or moderately alkaline. Westmoreland soils formed in colluvium and residuum derived from shale, siltstone, and sandstone in unmined areas. They have an argillic horizon.

Typical pedon of Fairpoint channery clay loam, 25 to 70 percent slopes, about 2.25 miles northwest of Malvern, in Brown Township; 870 feet north and 1,260 feet east of the southwest corner of sec. 1, T. 17 N., R. 7 W.

Ap—0 to 3 inches; yellowish brown (10YR 5/4) channery clay loam, light gray (2.5Y 7/2) dry; weak medium and coarse granular structure; friable; many roots; about 25 percent coarse fragments; medium acid; abrupt smooth boundary.

C1—3 to 25 inches; yellowish brown (10YR 5/4) very channery clay loam; common medium distinct light yellowish brown (10YR 6/4) mottles; massive; friable; common roots; about 55 percent coarse fragments; neutral; gradual smooth boundary.

C2—25 to 40 inches; brown (10YR 5/3) channery clay loam; few fine distinct yellowish brown (10YR 5/6) and few fine faint light olive brown (2.5Y 5/4) mottles; massive; friable; few roots; about 45 percent coarse fragments; medium acid; gradual smooth boundary.

C3—40 to 60 inches; 60 percent variegated brown (10YR 5/3) and 40 percent grayish brown (10YR 5/2) very channery clay loam; few fine faint yellowish brown (10YR 5/4) mottles; massive; friable; about 50 percent coarse fragments; neutral.

The content of coarse fragments in the part of the C horizon within a depth of 40 inches ranges from 35 to 60 percent. The rock fragments commonly are less than 10 inches in diameter, but some are stones.

The Ap horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 to 4. It is dominantly channery clay loam but is shaly clay loam or shaly silty clay loam in some pedons. The C horizon has hue of 10YR or 2.5Y or is neutral in hue. It has value of 4 or 5 and chroma of 0 to 4. It is channery, very channery, shaly, or very shaly clay loam or silty clay loam. It is medium acid to neutral.

Fitchville series

The Fitchville series consists of deep, somewhat poorly drained, moderately slowly permeable soils on slack water terraces along streams. These soils formed in stratified lacustrine sediments. Slopes range from 0 to 8 percent.

Fitchville soils are similar to Jimtown and Orrville soils and commonly are adjacent to Glenford and Sebring soils. Jimtown and Orrville soils contain more sand and less silt in the subsoil than the Fitchville soils. Also, Jimtown soils contain more gravel in the subsoil, and Orrville soils do not have an argillic horizon. Glenford soils are moderately well drained and do not have low chroma mottles directly below the Ap horizon. They are on toe slopes and are slightly higher on the terraces than the Fitchville soils. Sebring soils are poorly drained and are in depressions. They have dominantly low chroma colors in the subsoil.

Typical pedon of Fitchville silt loam, 0 to 3 percent slopes, about 2.75 miles southeast of Minerva, in Augusta Township; about 760 feet west and 990 feet south of the northeast corner of sec. 18, T. 15 N., R. 5 W.

Ap—0 to 9 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (2.5Y 6/2) dry; moderate medium and fine granular structure; very friable; many roots; common dark brown (7.5YR 3/2) concretions (iron and manganese oxide); medium acid; abrupt smooth boundary.

Bt1—9 to 13 inches; yellowish brown (10YR 5/4) silty clay loam; common fine distinct light brownish gray (10YR 6/2) and few fine faint yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; common roots; thin patchy grayish brown (10YR 5/2) clay films on faces of peds; few dark grayish brown (10YR 4/2) fillings in root and worm channels; few dark brown (7.5YR 3/2) concretions (iron and manganese oxide); very strongly acid; clear smooth boundary.

Bt2—13 to 25 inches; brown (7.5YR 5/4) silty clay loam; common fine distinct light brownish gray (10YR 6/2) mottles; moderate medium prismatic structure parting to moderate coarse angular blocky; friable; few roots; grayish brown (10YR 5/2) coatings and medium patchy clay films on faces of peds; few dark brown (7.5YR 3/2) accumulations (iron and manganese oxide); very strongly acid; clear smooth boundary.

Bt3—25 to 35 inches; brown (7.5YR 5/4) silty clay loam; common fine distinct light brownish gray (10YR 6/2) mottles; weak coarse prismatic structure parting to weak coarse angular blocky; friable; few roots; grayish brown (10YR 5/2) coatings and medium patchy clay films on faces of peds; common dark brown (7.5YR 3/2) accumulations (iron and mananese oxide); medium acid; clear smooth boundary.

BC—35 to 43 inches; yellowish brown (10YR 5/4) silty clay loam; few fine faint grayish brown (10YR 5/2) and common medium distinct yellowish brown (10YR 5/6) mottles; weak coarse prismatic structure; friable; few roots; grayish brown (10YR 5/2) coatings on faces of peds; few dark brown (7.5YR 3/2) accumulations (iron and manganese oxide); neutral; clear smooth boundary.

C1—43 to 48 inches; dark yellowish brown (10YR 4/4) silt loam; few fine distinct yellowish brown (10YR 5/6) and few fine distinct grayish brown (10YR 5/2) mottles; massive; friable; continuous grayish brown (10YR 5/2) vertical seams; few dark brown (7.5YR 3/2) accumulations (iron and manganese oxide) and common white (10YR 8/1) accumulations (carbonates); slight effervescence; mildly alkaline; clear smooth boundary.

C2—48 to 60 inches; dark yellowish brown (10YR 4/4) silty clay loam; few fine distinct yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) mottles; massive; friable; continuous grayish brown (10YR 5/2) vertical seams; few dark brown (7.5YR 3/2) accumulations (iron and manganese oxide); common white (10YR 8/1) concretions (carbonates); slight effervescence; moderately alkaline.

The thickness of the solum ranges from 30 to 60 inches. The B horizon has hue of 7.5YR to 2.5Y, value of 4 or 5, and chroma of 1 to 6. It is very strongly acid to medium acid in the upper part and strongly acid or medium acid in the lower part. It is dominantly silty clay loam but in some pedons is silt loam and in others has thin subhorizons of loam and clay loam. The weighted average clay content ranges from 25 to 35 percent. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. It is dominantly silt loam or silty clay loam but in some pedons has thin strata of loam or fine sandy loam. It ranges from slightly acid to moderately alkaline.

Glenford series

The Glenford series consists of deep, moderately well drained, moderately slowly permeable soils on slack water terraces along streams. These soils formed in stratified lacustrine sediments. Slopes range from 3 to 15 percent.

Glenford soils are similar to Keene soils and commonly are adjacent to Chili, Fitchville, Sebring, and Tioga soils. Chili and Tioga soils are well drained. Their subsoil contains more sand and less clay than that of the Glenford soils. Chili soils have gravel in the lower part of the subsoil and in the substratum. They are on stream terraces. Tioga soils have a cambic horizon. They are on flood plains. The somewhat poorly drained Fitchville and poorly drained Sebring soils are slightly lower on the landscape than the Glenford soils. Also, low chroma colors are more extensive in their subsoil. Keene soils are on uplands. They have a higher content of coarse fragments in the lower part than the Glenford soils.

Typical pedon of Glenford silt loam, 3 to 8 percent slopes, about 3 miles east of Magnolia, in Brown Township; about 700 feet east and 1,650 feet south of the northwest corner of sec. 26, T. 17 N., R. 7 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, light yellowish brown (2.5Y 6/4) dry; moderate medium and fine granular structure; friable; many roots; neutral; abrupt smooth boundary.

BA—8 to 12 inches; yellowish brown (10YR 5/4) silt loam; moderate medium subangular blocky structure; friable; common roots; dark grayish brown (10YR 4/2) organic coatings in root channels; medium acid; clear smooth boundary.

Bt1—12 to 18 inches; yellowish brown (10YR 5/4) silty clay loam; moderate medium subangular blocky structure; friable; common roots; thin patchy dark yellowish brown (10YR 4/4) clay films on faces of peds; very strongly acid; clear smooth boundary.

Bt2—18 to 24 inches; yellowish brown (10YR 5/4) silty clay loam; common medium faint grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; common roots; yellowish brown (10YR 5/4) coatings and thin patchy clay films on faces of peds; very strongly acid; clear smooth boundary.

Bt3—24 to 35 inches; yellowish brown (10YR 5/4) silty clay loam; common medium faint grayish brown (10YR 5/2) and strong brown (7.5YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; few roots; grayish brown (10YR 5/2) coatings and thin patchy clay films on faces of peds; very strongly acid; clear smooth boundary.

Bt4—35 to 44 inches; strong brown (7.5YR 5/6) silty clay loam; common medium distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; firm; few roots; grayish brown (10YR 5/2) coatings and thin patchy clay films on faces of peds; very strongly acid; clear smooth boundary.

C—44 to 60 inches; yellowish brown (10YR 5/6) silty clay loam; common medium distinct grayish brown (10YR 5/2) mottles; massive; firm; few fine very dark grayish brown (10YR 3/2) accumulations (iron and manganese oxide); thin strata of silt loam; strongly acid.

The thickness of the solum ranges from 35 to 60 inches. These soils commonly have no coarse fragments, but in some pedons the content of these fragments is as much as 2 percent in the solum.

The A horizon has hue of 10YR, value of 4, and chroma of 2 or 3. The BA and Bt horizons have hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6. They are silty clay loam or silt loam. A thin layer of slightly brittle material is in the middle or lower part of the Bt horizon in some pedons. This horizon ranges from very strongly acid to medium acid. The C horizon has hue of 10YR, value of 5, and chroma of 3 to 6. It is dominantly silt loam or silty clay loam but in some pedons has thin strata of loam, fine sandy loam, or silty clay. It is strongly acid or medium acid.

Guernsey series

The Guernsey series consists of deep, moderately well drained, slowly permeable or moderately slowly permeable soils on ridgetops, on the upper parts of side slopes, and on foot slopes in the uplands. These soils formed in residuum and in colluvium derived from slightly acid to calcareous siltstone or shale and thin strata of limestone. Slopes range from 3 to 15 percent.

Guernsey soils are similar to Elba and Upshur soils and commonly are adjacent to Berks, Coshocton, Elba, and Westmoreland soils. Berks, Coshocton, and Westmoreland soils contain less clay in the subsoil than the Guernsey soils. Berks and Westmoreland soils are on side slopes below areas of the Guernsey soils, are well drained, and do not have low chroma mottles in the subsoil. Berks soils are moderately deep over bedrock. Their subsoil has a higher content of coarse fragments than that of the Guernsey soils. Coshocton soils commonly are in the lower lying areas, directly below convex areas of Guernsey soils on broad ridgetops. Elba soils have carbonates at a depth of 10 to 30 inches. They are well drained and do not have low chroma mottles in the subsoil. They commonly are in convex areas slightly higher than areas of the Guernsey soils. Upshur soils are well drained and are on ridgetops and the upper parts of side slopes. Their subsoil has a redder hue than that of the Guernsey soils.

Typical pedon of Guernsey silty clay loam, 8 to 15 percent slopes, eroded, about 3 miles east of Carrollton, in Center Township; about 990 feet north and 2,500 feet west of the southeast corner of sec. 13, T. 14 N., R. 5 W.

Ap—0 to 6 inches; brown (10YR 4/3) silty clay loam, light yellowish brown (2.5Y 6/4) dry; moderate medium and coarse granular structure; friable; many roots; about 2 percent coarse fragments; yellowish brown (10YR 5/4) specks; medium acid; abrupt smooth boundary.

Bt1—6 to 10 inches; yellowish brown (10YR 5/4) silty clay loam; weak medium subangular blocky structure; firm; common roots; thin continuous brown (10YR 5/3) clay films on faces of peds; about 2 percent coarse fragments; medium acid; clear smooth boundary.

Bt2—10 to 14 inches; yellowish brown (10YR 5/4) silty clay loam; moderate medium subangular blocky structure; firm; few roots; medium patchy yellowish brown (10YR 5/4) clay films on faces of peds; many fine and medium black (10YR 2/1) nodules (iron and manganese oxide); about 2 percent coarse fragments; medium acid; clear smooth boundary.

Bt3—14 to 20 inches; yellowish brown (10YR 5/4) silty clay; common fine distinct light brownish gray (10YR 6/2) mottles; weak coarse subangular blocky structure; firm; few roots; medium patchy yellowish brown (10YR 5/4) clay films on faces of peds; common fine distinct black (10YR 2/1) nodules (iron and manganese oxide); about 2 percent coarse fragments; strongly acid; clear smooth boundary.

Bt4—20 to 25 inches; yellowish brown (10YR 5/4) silty clay; common fine distinct light brownish gray (10YR 6/2) mottles; weak coarse subangular blocky structure; firm; medium patchy yellowish brown (10YR 5/4) clay films on faces of peds; many fine distinct black (10YR 2/1) nodules (iron and manganese oxide); about 2 percent coarse fragments; medium acid; clear smooth boundary.

Bt5—25 to 31 inches; grayish brown (2.5Y 5/2) silty clay; many medium distinct yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; firm; thin very patchy yellowish brown (10YR 5/4) clay films on faces of peds; about 2 percent coarse fragments; slightly acid; clear smooth boundary.

BC—31 to 40 inches; grayish brown (2.5Y 5/2) silty clay loam; many medium distinct yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; firm; about 5 percent coarse fragments; slight effervescence; mildly alkaline; clear smooth boundary.

C1—40 to 51 inches; about 60 percent grayish brown (2.5Y 5/2) and 40 percent light yellowish brown (2.5Y 6/4) silty clay loam; weak platy structure inherited from the soft shale; firm; about 5 percent coarse fragments; strong effervescence; mildly alkaline; clear smooth boundary.

C2—51 to 69 inches; about 60 percent grayish brown (2.5Y 5/2) and 40 percent light olive brown (2.5Y 5/4) silty clay loam; weak platy structure inherited from the soft shale; firm; about 5 percent coarse fragments; strong effervescence; mildly alkaline; clear smooth boundary.

Cr—69 to 71 inches; about 60 percent olive yellow (2.5Y 6/6) and 40 percent light gray (10YR 6/1) weathered shale bedrock.

The thickness of the solum ranges from 36 to 50 inches and the depth to bedrock from 50 to 80 inches. Carbonates are at a depth of more than 30 inches. The content of limestone or shale fragments ranges from 2 to 20 percent in the Bt horizon and from 5 to 35 percent in the BC and C horizons.

The Ap horizon has hue of 10YR, value of 4, and chroma of 2 or 3. It is dominantly silty clay loam but is silt loam in some pedons. The B horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6 in the upper part and hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 6 in the lower part. It is silty clay loam in the upper part and clay, silty clay, or silty clay loam or the shaly analogs of these textures in the lower part. The upper part is very strongly acid to medium acid, and the lower part ranges from strongly acid to mildly alkaline. The C horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 2 to 4. It is silty clay or silty clay loam or the shaly or channery analogs of these textures. It ranges from strongly acid to mildly alkaline.

Hazleton series

The Hazleton series consists of deep, well drained, rapidly permeable or moderately rapidly permeable soils on uplands. These soils formed in residuum and colluvium derived from sandstone. Slopes range from 3 to 40 percent.

Hazleton soils are similar to Berks and Rigley soils and commonly are adjacent to Westmoreland soils. Berks soils are moderately deep over bedrock. Their subsoil contains more silt and clay and less sand than that of the Hazleton soils. Westmoreland and Rigley soils have an argillic horizon. Their subsoil has a lower content of coarse fragments than that of the Hazleton soils. Westmoreland soils commonly are on side slopes below areas of the Hazleton soils.

Typical pedon of Hazleton loam, 8 to 15 percent slopes, about 2.25 miles south of Malvern, in Brown Township; about 85 feet south and 1,150 feet east of the northwest corner of sec. 24, T. 17 N., R. 7 W.

Ap—0 to 4 inches; dark grayish brown (10YR 4/2) loam, light brownish gray (2.5Y 6/2) dry; weak medium and fine granular structure; friable; many roots; about 10 percent coarse fragments; very strongly acid; abrupt smooth boundary.

Bw1—4 to 15 inches; yellowish brown (10YR 5/4) loam; moderate medium subangular blocky structure; friable; common roots; about 10 percent coarse fragments; very strongly acid; clear smooth boundary.

Bw2—15 to 22 inches; yellowish brown (10YR 5/4) sandy loam; moderate medium subangular blocky structure; friable; common roots; about 10 percent coarse fragments; very strongly acid; clear smooth boundary.

Bw3—22 to 26 inches; yellowish brown (10YR 5/4) channery sandy loam; weak medium subangular blocky structure; friable; few roots; about 45 percent coarse fragments; very strongly acid; clear smooth boundary.

Bw4—26 to 36 inches; yellowish brown (10YR 5/4) very channery sandy loam; weak medium subangular blocky structure; friable; few roots; about 60 percent coarse fragments; very strongly acid; gradual wavy boundary.

BC—36 to 45 inches; yellowish brown (10YR 5/4) very channery sandy loam; weak medium subangular blocky structure; friable; few roots; about 50 percent coarse fragments; strongly acid; gradual wavy boundary.

C1—45 to 49 inches; yellowish brown (10YR 5/4) very channery loamy sand; massive; friable; about 70 percent coarse fragments; strongly acid; clear smooth boundary.

C2—49 to 54 inches; brown (7.5YR 4/4) very channery loamy sand; massive; friable; about 75 percent coarse fragments; strongly acid; clear smooth boundary.

C3—54 to 62 inches; light yellowish brown (10YR 6/4) very channery loamy sand; massive; friable; about 75 percent coarse fragments; strongly acid; clear wavy boundary.

R—62 to 64 inches; yellowish brown (10YR 5/4) sandstone bedrock.

The thickness of the solum ranges from 25 to 50 inches and the depth to bedrock from 40 to more than 72 inches. The content of sandstone fragments ranges from 5 to 40 percent in the upper part of the B horizon, from 35 to 70 percent in the lower part, and from 50 to 80 percent in the C horizon.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. It is dominantly loam but in some pedons is channery loam. The B horizon has hue of 7.5YR or 10YR and value and chroma of 4 to 6. It is sandy loam or loam or the channery analogs of these textures in the upper part and channery or very channery sandy loam or loam in the lower part. The content of clay in this horizon ranges from 7 to 18 percent. The B and C horizons are extremely acid to strongly acid. The C horizon has hue of 5YR, 7.5YR, or 10YR and value and chroma of 4 to 6. It is very channery sandy loam or very channery loamy sand.

Holly series

The Holly series consists of deep, very poorly drained, moderately permeable or moderately slowly permeable soils on flood plains. These soils formed in alluvium. Slopes range from 0 to 3 percent.

Holly soils are similar to Peoga and Sebring soils and commonly are adjacent to Orrville soils on flood plains and to Fitchville and Sebring soils on the slightly higher slack water terraces. Fitchville and Orrville soils are somewhat poorly drained. The low chroma colors in their subsoil are not so extensive as those in the subsoil of the Holly soils. Fitchville, Peoga, and Sebring soils have an argillic horizon. Their subsoil contains more clay and less sand than that of the Holly soils.

Typical pedon of Holly silt loam, ponded, about 2.5 miles north of Malvern, in Brown Township; about 1,150 feet north and 1,700 feet west of the southeast corner of sec. 6, T. 16 N., R. 6 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, light gray (10YR 6/1) dry; weak medium and fine granular structure; very friable; many roots; reddish brown (5YR 4/4) coatings in root channels; neutral; clear smooth boundary.

Bg1—7 to 16 inches; olive gray (5Y 5/2) silt loam; common fine distinct dark brown (7.5YR 4/4) mottles; weak medium subangular blocky structure; friable; common roots; neutral; clear smooth boundary.

Bg2—16 to 21 inches; olive gray (5Y 5/2) silt loam; many medium distinct dark brown (7.5YR 4/4) mottles; weak medium subangular blocky structure; friable; few roots; neutral; clear smooth boundary.

Cg—21 to 60 inches; dark greenish gray (5GY 4/1) silt loam; massive; friable; few roots to a depth of 38 inches; mildly alkaline.

The thickness of the solum ranges from 20 to 40 inches. The content of coarse fragments ranges from 0 to 10 percent in the solum and from 0 to 25 percent in the C horizon.

The Ap horizon has hue of 10YR, value of 4, and chroma of 1 or 2. The B horizon has hue of 10YR to 5Y or is neutral in hue. It has value of 4 to 6 and chroma of 0 to 2. It is dominantly silt loam or loam but has thin strata with coarser or finer textures in some pedons. It is slightly acid or neutral. The C horizon has hue of 10YR to 5GY or is neutral in hue. It has value of 4 to 6 and chroma of 0 or 1. It is dominantly silt loam, loam, or sandy loam but in some pedons has strata with coarser textures, including gravelly analogs. It is neutral or mildly alkaline.

Jimtown series

The Jimtown series consists of deep, somewhat poorly drained, moderately permeable soils on stream terraces. These soils formed in loamy sediments over gravelly and sandy glacial outwash. Slope ranges from 0 to 3 percent.

Jimtown soils are similar to Fitchville and Orrville soils and commonly are adjacent to Boyer and Chili soils on terraces and to Tioga soils on flood plains. Boyer, Chili, and Tioga soils are well drained and do not have low chroma mottles in the subsoil. Also, Boyer soils contain less clay in the upper part of the subsoil than the Jimtown soils. Fitchville soils contain less sand in the subsoil and less gravel in the C horizon than the Jimtown soils. Orrville and Tioga soils do not have an argillic horizon.

Typical pedon of Jimtown silt loam, 0 to 3 percent slopes, about 0.75 mile south of Minerva, in Brown Township; about 350 feet south and 900 feet west of the northeast corner of sec. 11, T. 16 N., R. 6 W.

Ap—0 to 12 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (2.5Y 6/2) dry; common medium distinct brown (10YR 5/3) mottles; moderate medium and fine granular structure; friable; many roots; many medium very dark grayish brown (10YR 3/2) nodules (iron and manganese oxide); about 2 percent coarse fragments; neutral; clear smooth boundary.

Bt1—12 to 18 inches; yellowish brown (10YR 5/4) clay loam; many medium faint grayish brown (10YR 5/2) and common medium faint yellowish brown (10YR 5/6) mottles; moderate medium and fine subangular blocky structure; friable; common roots; grayish brown (10YR 5/2) coatings and thin patchy clay films on faces of peds; about 5 percent coarse fragments; slightly acid; clear smooth boundary.

Bt2—18 to 26 inches; dark yellowish brown (10YR 4/4) sandy clay loam; many medium distinct yellowish red (5YR 5/6) and common medium distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; friable; few roots; grayish brown (10YR 5/2) coatings and medium patchy clay films on faces of peds; about 2 percent coarse fragments; slightly acid; clear smooth boundary.

Bt3—26 to 32 inches; dark yellowish brown (10YR 4/4) sandy loam; many medium distinct yellowish red (5YR 5/6) and common medium distinct grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; friable; few roots; grayish brown (10YR 5/2) coatings and medium patchy clay films on faces of peds; about 12 percent coarse fragments; slightly acid; clear smooth boundary.

Cg—32 to 60 inches; grayish brown (10YR 5/2) very gravelly loamy sand; few fine distinct dark yellowish brown (10YR 4/4) mottles; single grained; loose; about 60 percent coarse fragments; slightly acid.

The thickness of the solum ranges from 25 to 40 inches. The content of coarse fragments ranges from 0 to 20 percent in the part of the Bt horizon within a depth of 26 inches and from 10 to 60 percent in individual subhorizons below a depth of 26 inches.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2. The B horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 4. It is dominantly loam, clay loam, or sandy clay loam or the gravelly analogs of these textures. In some pedons, however, it has thin subhorizons of sandy loam or silt loam. The C horizon has hue of 10YR, value of 5, and chroma of 2 or 3. It is gravelly or very gravelly sand or loamy sand. It is slightly acid or neutral.

Keene series

The Keene series consists of deep, moderately well drained, slowly permeable or moderately slowly permeable soils on the broad tops of upland ridges. These soils formed in a silty mantle and in the underlying residuum of shale and siltstone. Slopes range from 3 to 8 percent.

Keene soils are similar to Coshocton, Glenford, and Wellston soils and commonly are adjacent to Coshocton, Culleoka, Guernsey, and Library Variant soils. Coshocton, Culleoka, and Library Variant soils have a higher content of sand and of coarse fragments in the upper part of the subsoil than the Keene soils. Culleoka soils are moderately deep over bedrock. Culleoka and Wellston soils are well drained and do not have low chroma mottles in the upper part of the subsoil. Library Variant soils are somewhat poorly drained and have low chroma mottles directly below the Ap horizon. They commonly are in concave areas. Glenford soils formed in lacustrine sediments on slack water terraces along streams. They have a lower content of coarse fragments in the lower part than the Keene soils. Guernsey soils are in convex areas. Their subsoil contains more clay than that of the Keene soils.

Typical pedon of Keene silt loam, in an area of Coshocton-Keene silt loams, 3 to 8 percent slopes, about 1 mile north of New Harrisburg, in Harrison Township; about 700 feet east and 800 feet north of the southwest corner of sec. 18, T. 15 N., R. 6 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (2.5Y 6/2) dry; weak fine and medium granular structure; friable; many roots; neutral; abrupt smooth boundary.

BA—8 to 13 inches; yellowish brown (10YR 5/4) silt loam; weak medium subangular blocky structure; friable; common roots; dark grayish brown (10YR 4/2) organic stains in root channels; medium acid; clear smooth boundary.

Bt1—13 to 22 inches; yellowish brown (10YR 5/4) silty clay loam; few fine distinct light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; friable; common roots; thin patchy dark yellowish brown (10YR 4/4) clay films on faces of peds; few fine dark brown (7.5YR 3/2) concretions (iron and manganese oxide); very strongly acid; clear smooth boundary.

2Bt2—22 to 28 inches; yellowish brown (10YR 5/4) silty clay loam; common medium distinct light brownish gray (10YR 6/2) and strong brown (7.5YR 5/8) mottles; moderate medium prismatic structure parting to weak coarse subangular blocky; firm; common roots; thick continuous and thin patchy grayish brown (10YR 5/2) clay films on vertical and horizontal faces of peds, respectively; few fine dark brown (7.5YR 3/2) concretions (iron and manganese oxide); about 1 percent coarse fragments; very strongly acid; clear smooth boundary.

2BC—28 to 32 inches; dark yellowish brown (10YR 4/4) silty clay loam; weak coarse subangular blocky structure; firm; few roots; thin patchy brown (10YR 5/3) clay films on faces of peds; few fine dark brown (7.5YR 3/2) concretions (iron and manganese oxide); about 5 percent coarse fragments; very strongly acid; clear smooth boundary.

2C1—32 to 38 inches; yellowish brown (10YR 5/4) silty clay loam; common medium faint yellowish brown (10YR 5/6) and brown (10YR 5/3) mottles; massive; firm; common fine dark brown (7.5YR 3/2) concretions (iron and manganese oxide); about 10 percent coarse fragments; strongly acid; clear smooth boundary.

2C2—38 to 60 inches; light olive brown (2.5Y 5/4) shaly silty clay loam; common medium distinct light gray (10YR 6/1) and strong brown (7.5YR 5/8) mottles; massive; firm; common fine dark brown (7.5YR 3/2) concretions and accumulations (iron and manganese oxide); about 15 percent coarse fragments; medium acid; clear smooth boundary.

2Cr—60 to 62 inches; yellowish brown (10YR 5/6) and dark yellowish brown (10YR 4/4) weathered shale bedrock.

The thickness of the solum ranges from 30 to 48 inches and the depth to bedrock from 40 to 84 inches. The content of coarse fragments ranges from 0 to 1 percent in the upper part of the solum and from 5 to 15 percent in the lower part and in the C horizon.

The Ap horizon has hue of 10YR, value of 4, and chroma of 2 or 3. The BA and Bt horizons have hue of 7.5YR or 10YR, value of 5, and chroma of 4 to 6. The weighted average clay content in the Bt horizon ranges from 28 to 35 percent. This horizon is strongly acid or very strongly acid. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 or 4. It is silty clay loam or silty clay or the shaly analogs of these textures. It is very strongly acid to medium acid.

Library Variant

The Library Variant consists of deep, somewhat poorly drained, slowly permeable or moderately slowly permeable soils on broad ridgetops and at the base of moderately steep or steep slopes on uplands. These soils formed in residuum of shale and siltstone and in an overlying silt mantle in some areas. Slopes range from 3 to 8 percent.

Library Variant soils commonly are adjacent to Berks, Coshocton, Culleoka, and Keene Soils. Berks and Culleoka soils are well drained and do not have low chroma mottles in the subsoil. They are moderately deep. Also, Berks soils have a cambic horizon and have a higher content of coarse fragments in the subsoil than the Library Variant soils. Coshocton and Keene soils are moderately well drained and do not have low chroma mottles directly below the Ap horizon. Also, Keene soils have a lower content of sand and of coarse fragments in the upper part of the subsoil than the Library Variant soils. Berks soils are on isolated hills on ridgetops, and Coshocton, Culleoka, and Keene soils are in the less concave areas.

Typical pedon of Library Variant silt loam, 3 to 8 percent slopes, about 1.75 miles south of Carrollton, in Union Township; about 925 feet west and 540 feet north of the southeast corner of sec. 36, T. 13 N., R. 5 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, light gray (2.5Y 7/2) dry; moderate medium and fine granular structure; very friable; many roots; few very dark gray (10YR 3/1) nodules (iron and manganese oxide); about 2 percent coarse fragments; slightly acid; abrupt smooth boundary.

BA—8 to 13 inches; light olive brown (2.5Y 5/4) silty clay loam; common fine distinct grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; common roots; brown (10YR 5/3) coatings on faces of peds; dark grayish brown (10YR 4/2) channel fillings; about 2 percent coarse fragments; strongly acid; clear smooth boundary.

Bt1—13 to 17 inches; light olive brown (2.5Y 5/4) silty clay loam; common fine distinct grayish brown (10YR 5/2) and strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; common roots; grayish brown (10YR 5/2) and brown (10YR 5/3) coatings and thin patchy brown (10YR 5/3) clay films on faces of peds; about 4 percent coarse fragments; strongly acid; clear smooth boundary.

Bt2—17 to 23 inches; yellowish brown (10YR 5/4) silty clay loam; common fine distinct grayish brown (10YR 5/2) and strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; few roots; grayish brown (10YR 5/2) and brown (10YR 5/3) coatings and thin patchy grayish brown (10YR 5/2) clay films on faces of peds; about 4 percent coarse fragments; strongly acid; clear smooth boundary.

Bt3—23 to 30 inches; yellowish brown (10YR 5/4) silty clay loam; common fine distinct grayish brown (10YR 5/2) mottles; weak medium and coarse subangular blocky structure; firm; few roots; grayish brown (10YR 5/2) and brown (10YR 5/3) coatings and medium patchy grayish brown (10YR 5/2) clay films on faces of peds; about 6 percent coarse fragments; very strongly acid; clear smooth boundary.

Bt4—30 to 37 inches; yellowish brown (10YR 5/4) silty clay loam; common fine distinct grayish brown (10YR 5/2) mottles; weak medium and coarse subangular blocky structure; firm; grayish brown (10YR 5/2) and brown (10YR 5/3) coatings and thin patchy grayish brown (10YR 5/2) clay films on faces of peds; about 8 percent coarse fragments; very strongly acid; clear smooth boundary.

BC—37 to 43 inches; yellowish brown (10YR 5/4) silty clay loam; common fine distinct grayish brown (10YR 5/2) mottles; weak medium and coarse subangular blocky structure; firm; about 10 percent coarse fragments; strongly acid; clear smooth boundary.

C1—43 to 54 inches; light olive brown (2.5Y 5/4) silty clay loam; massive; firm; about 10 percent coarse fragments; medium acid; clear smooth boundary.

C2—54 to 60 inches; light olive brown (2.5Y 5/4) channery silt loam; massive; friable; about 25 percent coarse fragments; slightly acid; clear wavy boundary.

Cr—60 to 62 inches; light olive brown (2.5Y 5/4) weathered shale bedrock.

The thickness of the solum ranges from 32 to 50 inches and the depth to bedrock from 40 to more than 72 inches. The content of coarse shale, siltstone, and sandstone fragments ranges from 2 to 5 percent in the upper part of the solum and from 5 to 30 percent in the lower part and in the C horizon.

The B horizon has hue of 7.5YR to 2.5Y, value of 4 or 5, and chroma of 2 to 6. It is strongly acid or very strongly acid. It is dominantly silty clay loam, but in some pedons the upper part is silt loam and in others the lower is part silty clay. The weighted average clay content ranges from 28 to 35 percent. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 6. It is silty clay loam or silt loam or the shaly or channery analogs of these textures. It ranges from very strongly acid to slightly acid.

Lorain series

The Lorain series consists of deep, very poorly drained, slowly permeable soils in lake basins and on slack water terraces along streams. These soils formed in stratified lacustrine sediments. Slopes are 0 to 1 percent.

Lorain soils commonly are adjacent to Fitchville and Sebring soils. The adjacent soils are slightly higher on the landscape than the Lorain soils, have a lighter colored surface layer, and contain less clay in the subsoil. Also, Fitchville soils have less extensive low chroma colors in the upper part of the subsoil.

Typical pedon of Lorain silty clay loam, silty substratum, about 0.3 mile south of Specht, in Washington Township; about 12 feet south and 400 feet west of the northeast corner of sec. 18, T. 14 N., R. 5 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; few fine distinct dark brown (7.5YR 4/4) mottles; moderate medium granular structure; friable; many roots; neutral; clear smooth boundary.

Btg1—9 to 13 inches; dark gray (10YR 4/1) silty clay, light brownish gray (10YR 6/2) dry; common medium distinct dark brown (7.5YR 4/4) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; common roots; very dark gray (10YR 3/1) coatings and thin patchy dark gray (10YR 4/1) clay films on faces of peds; slightly acid; abrupt smooth boundary.

Btg2—13 to 19 inches; dark gray (10YR 4/1) silty clay; few medium distinct strong brown (7.5YR 5/6) and common medium distinct yellowish brown (10YR 5/4) mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few roots; dark gray (10YR 4/1) coatings and thin patchy clay films on faces of peds; dark brown (7.5YR 4/4) coatings in old root channels; slightly acid; abrupt smooth boundary.

Btg3—19 to 25 inches; gray (10YR 5/1) silty clay; common medium distinct yellowish brown (10YR 5/4) and few medium distinct strong brown (7.5YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; few roots; thin continuous dark gray (N 4/0) clay films on faces of peds and in old root channels; slightly acid; clear smooth boundary.

Btg4—25 to 30 inches; gray (10YR 5/1) silty clay loam; many medium distinct yellowish brown (10YR 5/4) and common medium distinct strong brown (7.5YR 5/6) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; few roots; dark gray (N 4/0) coatings and thin patchy clay films on faces of peds and in old root channels; neutral; clear smooth boundary.

BCg1—30 to 35 inches; gray (10YR 5/1) silty clay loam; common medium distinct strong brown (7.5YR 5/6) and many medium distinct yellowish brown (10YR 5/4) mottles; weak medium prismatic structure; firm; few roots; dark gray (N 4/0) coatings on faces of peds and in old root channels; neutral; clear smooth boundary.

BCg2—35 to 42 inches; grayish brown (10YR 5/2) silty clay loam; many medium distinct yellowish brown (10YR 5/4) and common medium distinct strong brown (7.5YR 5/6) mottles; weak medium prismatic structure; firm; few roots; dark gray (N 4/0) coatings on faces of peds and in old root channels; neutral; clear smooth boundary.

BC—42 to 47 inches; yellowish brown (10YR 5/4) silt loam; common medium faint yellowish brown (10YR 5/6) and common medium distinct grayish brown (10YR 5/2) mottles; weak medium prismatic structure; firm; dark gray (N 4/0) coatings in old root channels; about 1 percent coarse fragments; neutral; clear smooth boundary.

C—47 to 60 inches; yellowish brown (10YR 5/4) silt loam; many medium distinct grayish brown (10YR 5/2) mottles; massive; friable; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 30 to 54 inches. The Ap horizon has hue of 10YR, value of 3, and chroma of 1 or 2. It is dominantly silty clay loam but is silty clay in some pedons. The B horizon has hue of 10YR, value of 4 or 5, and chroma of 1 or 2. It is neutral or slightly acid. It is silty clay loam or silty clay. The weighted average clay content in this horizon ranges from 35 to 50 percent. The C horizon has hue of 10YR, value of 5, and chroma of 1 to 4. It is dominantly silt loam or silty clay loam but in some pedons has thin strata of fine and very fine sandy loam.

Morristown series

The Morristown series consists of deep, well drained, moderately slowly permeable soils that formed in calcareous, partly weathered fine earth and fragments of limestone and shale in surface mined areas. Slopes range from 8 to 25 percent.

Morristown soils are similar to Bethesda and Fairpoint soils and commonly are adjacent to Coshocton, Elba, and Westmoreland soils. Bethesda and Fairpoint soils do not have free carbonates in the substratum. Coshocton, Elba, and Westmoreland soils have an argillic horizon. They are in unmined areas.

Typical pedon of Morristown shaly silty clay loam, 8 to 25 percent slopes, about 0.75 mile southwest of Lindentree, in Rose Township; about 30 feet north and 1,810 feet west of the southeast corner of sec. 33, T. 16 N., R. 7 W.

Ap—0 to 3 inches; dark gray (10YR 4/1) shaly silty clay loam, light gray (10YR 6/1) dry; weak medium granular structure; friable; many roots; about 25 percent coarse fragments; slight effervescence; mildly alkaline; abrupt smooth boundary.

C1—3 to 16 inches; variegated brown (10YR 5/3) and gray (10YR 5/1) shaly silty clay loam; massive; friable; common roots; about 40 percent coarse fragments; slight effervescence; mildly alkaline; gradual smooth boundary.

C2—16 to 27 inches; variegated brown (10YR 5/3) and gray (10YR 5/1) very channery silty clay loam; massive; friable; few roots; about 50 percent coarse fragments; slight effervescence; mildly alkaline; gradual smooth boundary.

C3—27 to 60 inches; brown (10YR 5/3) very channery silty clay loam; massive; friable; few roots in the upper part; about 50 percent coarse fragments; slight effervescence; mildly alkaline.

The content of coarse fragments in the part of the C horizon within a depth of 40 inches ranges from 35 to 60 percent. The rock fragments commonly are less than 10 inches in diameter, but some are stones.

The Ap horizon has hue of 10YR or 2.5Y, value of 4, and chroma of 1 to 4. It is dominantly shaly silty clay loam but is channery clay loam in some pedons. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 to 4. It is shaly, very shaly, channery, or very channery silty clay loam or clay loam. It is mildly alkaline or moderately alkaline.

Orrville series

The Orrville series consists of deep, somewhat poorly drained, moderately permeable soils that formed in alluvium on flood plains. Slopes range from 0 to 3 percent.

Orrville soils are similar to Fitchville and Jimtown soils and commonly are adjacent to Glenford, Holly, and Westmoreland soils. Fitchville, Glenford, Jimtown, and Westmoreland soils have an argillic horizon. Fitchville and Glenford soils contain less sand in the subsoil than the Orrville soils. Glenford soils commonly are on slack water terraces above areas of the Orrville soils. They are moderately well drained and do not have low chroma mottles directly below the Ap horizon. Westmoreland soils are on upland side slopes adjacent to flood plains. They are well drained and do not have low chroma mottles in the subsoil. Holly soils are very poorly drained and have more extensive low chroma colors in the subsoil than the Orrville soils.

Typical pedon of Orrville silt loam, occasionally flooded, about 2 miles northwest of Carrollton, in Center Township; about 860 feet east and 2,000 feet north of the southwest corner of sec. 3, T. 15 N., R. 6 W.

Ap—0 to 7 inches; dark grayish brown (2.5Y 4/2) silt loam, light brownish gray (2.5Y 6/2) dry; common fine distinct dark yellowish brown (10YR 4/4) mottles near roots and root channels; weak medium and fine granular structure; friable; many roots; few fine distinct very dark gray (N 3/0) nodules (iron and manganese oxide); medium acid; abrupt smooth boundary.

Bw—7 to 13 inches; brown (10YR 5/3) loam; common fine distinct brown (7.5YR 4/4) and few fine faint grayish brown (10YR 5/2) mottles; weak medium subangular blocky structure; friable; common roots; grayish brown (10YR 5/2) coatings on faces of peds; few fine very dark gray (N 3/0) nodules (iron and manganese oxide); medium acid; clear smooth boundary.

Bg1—13 to 25 inches; grayish brown (10YR 5/2) silt loam; common medium distinct yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; friable; few roots; medium acid; clear smooth boundary.

Bg2—25 to 32 inches; grayish brown (10YR 5/2) silt loam; common medium distinct yellowish brown (10YR 5/6) mottles; weak coarse subangular blocky structure; friable; few roots; strong brown (7.5YR 5/6) stains along roots and old root channels; medium acid; clear smooth boundary.

Cg1—32 to 52 inches; gray (N 5/0) loam; common medium distinct greenish gray (5GY 5/1) mottles; massive; friable; slightly acid; clear smooth boundary.

Cg2—52 to 60 inches; gray (N 5/0) gravelly sandy loam; common medium distinct greenish gray (5GY 5/1) mottles; massive; friable; about 25 percent coarse fragments; slightly acid.

The thickness of the solum ranges from 24 to 40 inches. The content of coarse fragments ranges from 0 to 15 percent in the B horizon and from 0 to 25 percent in the C horizon.

The Ap horizon has hue of 10YR or 2.5Y, value of 4, and chroma of 2. The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 to 4. It is dominantly loam or silt loam but in some pedons has thin strata of sandy loam or loamy sand. It is strongly acid to slightly acid. The C horizon has hue of 10YR to 5Y or is neutral in hue. It has value of 4 or 5 and chroma of 0 to 4. It ranges from strongly acid to neutral. It is dominantly loam, silt loam, or sandy loam, but some pedons have strata of loamy sand or clay loam or the gravelly analogs of any of these textures below a depth of 40 inches.

Oshtemo series

The Oshtemo series consists of deep, well drained soils that formed in loamy and sandy sediments on stream terraces. Permeability is moderately rapid in the subsoil and moderately slow to rapid in the substratum. Slopes range from 3 to 8 percent.

Oshtemo soils are similar to Boyer and Chili soils and commonly are adjacent to Chili and Glenford soils on terraces and to Tioga soils on flood plains. Boyer soils have a solum that is 20 to 40 inches thick. Their C horizon is very gravelly. Chili and Glenford soils contain more clay in the upper part of the subsoil than the Oshtemo soils. Also, Glenford soils contain less sand in the subsoil. They are moderately well drained and have low chroma mottles in the middle and lower parts of the subsoil. Tioga soils do not have an argillic horizon.

Typical pedon of Oshtemo sandy loam, 3 to 8 percent slopes, about 0.5 mile southeast of Magnolia, in Rose Township; about 2,020 feet south and 2,470 feet east of the northwest corner of sec. 30, T. 16 N., R. 7 W.

Ap—0 to 9 inches; dark brown (10YR 3/3) sandy loam, brown (10YR 4/3) rubbed, pale brown (10YR 6/3) dry; weak medium granular structure; very friable; many roots; about 2 percent coarse fragments; medium acid; abrupt smooth boundary.

BA—9 to 13 inches; yellowish brown (10YR 5/4) sandy loam; weak coarse subangular blocky structure; very friable; common roots; dark yellowish brown (10YR 4/4) coatings on faces of peds; brown (10YR 4/3) fillings in root and worm channels; about 1 percent coarse fragments; medium acid; clear smooth boundary.

Bt1—13 to 18 inches; yellowish brown (10YR 5/4) sandy loam; weak medium and coarse subangular blocky structure; friable; common roots; thin very patchy dark yellowish brown (10YR 4/4) clay films bridging sand grains; about 1 percent coarse fragments; strongly acid; clear smooth boundary.

Bt2—18 to 24 inches; yellowish brown (10YR 5/4) sandy loam; weak coarse subangular blocky structure; friable; few roots; thin patchy dark yellowish brown (10YR 4/4) clay films bridging sand grains; about 1 percent coarse fragments; strongly acid; clear smooth boundary.

Bt3—24 to 31 inches; yellowish brown (10YR 5/4) sandy loam; weak coarse subangular blocky structure; friable; few roots; thin very patchy dark yellowish brown (10YR 4/4) clay films bridging sand grains; about 10 percent coarse fragments; strongly acid; clear smooth boundary.

2BC1—31 to 36 inches; yellowish brown (10YR 5/4) gravelly coarse sandy loam; weak coarse subangular blocky structure; very friable; thin very patchy dark yellowish brown (10YR 4/4) clay films bridging sand grains; about 20 percent coarse fragments; strongly acid; clear smooth boundary.

2BC2—36 to 44 inches; yellowish brown (10YR 5/4) gravelly loamy coarse sand; weak coarse subangular blocky structure; very friable; about 20 percent coarse fragments; medium acid; gradual smooth boundary.

2C—44 to 60 inches; yellowish brown (10YR 5/4) loamy coarse sand; single grained; loose; about 12 percent coarse fragments; medium acid.

The thickness of the solum ranges from 40 to 50 inches. The content of coarse fragments averages 1 to 10 percent in the solum but is as much as 30 percent in individual subhorizons. It ranges from 1 to 30 percent in the C horizon.

The B horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 to 6. It is sandy loam, sandy clay loam, gravelly sandy loam, or gravelly coarse sandy loam. The B and C horizons are strongly acid or medium acid. The C horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or 4. It is dominantly sand, loamy sand, or loamy coarse sand or the gravelly analogs of these textures. In the loamy substratum phase, however, the strata range from sandy loam and gravelly sandy loam to silty clay loam.

Peoga series

The Peoga series consists of deep, poorly drained, slowly permeable soils that formed in alluvium on low terraces along streams. Slopes range from 0 to 3 percent.

Peoga soils are similar to Holly and Sebring soils and commonly are adjacent to Glenford and Oshtemo soils on the slightly higher stream terraces, to Elkinsville soils on low terraces, and to Tioga soils on flood plains. Elkinsville, Glenford, Oshtemo, and Tioga soils do not have low chroma mottles in the upper part of the subsoil and are better drained than the Peoga soils. Also, Oshtemo and Tioga soils contain less clay and more sand in the subsoil. Holly and Tioga soils do not have an argillic horizon. Sebring soils are less acid in the lower part of the subsoil and in the substratum than the Peoga soils.

Typical pedon of Peoga silt loam, rarely flooded, about 1.25 miles southeast of Sherrodsville, in Orange Township; about 1,650 feet east and 2,540 feet south of the northwest corner of sec. 1, T. 15 N., R. 7 W.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (2.5Y 6/2) dry; weak medium and fine granular structure; friable; many roots; neutral; few fine distinct dark brown (7.5YR 3/2) nodules (iron and manganese oxide); slightly acid; abrupt smooth boundary.

Btg1—10 to 14 inches; grayish brown (10YR 5/2) silty clay loam; many medium distinct yellowish brown (10YR 5/6) mottles; weak medium and fine subangular blocky structure; friable; common roots; thin very patchy grayish brown (10YR 5/2) clay films on faces of peds; common medium distinct dark brown (7.5YR 3/2) concretions (iron and manganese oxide); strongly acid; clear smooth boundary.

Btg2—14 to 21 inches; light brownish gray (10YR 6/2) silty clay loam; many medium distinct yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; firm; common roots; medium continuous grayish brown (10YR 5/2) clay films on faces of peds; common medium distinct dark brown (7.5YR 3/2) concretions (iron and manganese oxide); very strongly acid; clear smooth boundary.

Btg3—21 to 28 inches; light brownish gray (10YR 6/2) silty clay loam; many medium distinct yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; firm; few roots; medium continuous grayish brown (10YR 5/2) clay films on faces of peds; many coarse distinct dark brown (7.5YR 3/2) concretions (iron and manganese oxide); very strongly acid; clear smooth boundary.

Btg4—28 to 36 inches; light brownish gray (10YR 6/2) silty clay loam; many medium distinct yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; firm; few roots; medium patchy grayish brown (10YR 5/2) clay films on faces of peds; many coarse distinct dark brown (7.5YR 3/2) concretions (iron and manganese oxide); very strongly acid; clear smooth boundary.

BCg—36 to 48 inches; light brownish gray (10YR 6/2) silty clay loam; many medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; friable; thin very patchy grayish brown (10YR 5/2) clay films on faces of peds; common medium distinct dark brown (7.5YR 3/2) concretions (iron and manganese oxide); very strongly acid; clear smooth boundary.

C1—48 to 53 inches; dark yellowish brown (10YR 4/4) silt loam; common medium distinct yellowish brown (10YR 5/6) and common medium distinct grayish brown (10YR 5/2) mottles; massive; friable; continuous grayish brown (10YR 5/2) vertical seams; few medium distinct dark brown (7.5YR 3/2) concretions (iron and manganese oxide); strongly acid; clear smooth boundary.

C2—53 to 60 inches; dark yellowish brown (10YR 4/4) silty clay loam; common medium distinct strong brown (7.5YR 5/6) and common medium distinct grayish brown (10YR 5/2) mottles; massive; firm; continuous grayish brown (10YR 5/2) vertical seams; common medium distinct dark brown (7.5YR 3/2) concretions (iron and manganese oxide); medium acid.

The thickness of the solum ranges from 48 to 54 inches. The Ap horizon has hue of 10YR, value of 4, and chroma of 1 or 2. The B horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. It is silty clay loam or silt loam. It is strongly acid or very strongly acid. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 4. It is silt loam, silty clay loam, clay loam, or loam. It is strongly acid to slightly acid.

Rigley series

The Rigley series consists of deep, well drained, moderately rapidly permeable soils on uplands. These soils formed in colluvium and residuum derived from weakly cemented sandstone. Slopes range from 3 to 40 percent.

Rigley soils are similar to Hazleton and Westmoreland soils and commonly are adjacent to Coshocton and Westmoreland soils. Coshocton and Westmoreland soils contain more clay and less sand in the subsoil than the Rigley soils. They commonly are on toe slopes below areas of the Rigley soils on side slopes. Westmoreland soils are also on ridgetops. Coshocton soils are moderately well drained and have low chroma mottles in the subsoil. Hazleton soils have a cambic horizon and have a higher content of sandstone fragments in the lower part of the subsoil than the Rigley soils.

Typical pedon of Rigley sandy loam, 8 to 15 percent slopes, about 0.75 mile east of Kilgore, in Loudon Township; about 1,280 feet south and 1,500 feet west of the northeast corner of sec. 6, T. 12 N., R. 5 W.

Ap—0 to 6 inches; brown (10YR 4/3) sandy loam; weak medium granular structure; very friable; many roots; about 8 percent coarse fragments; strongly acid; abrupt smooth boundary.

Bt1—6 to 24 inches; dark brown (7.5YR 4/4) fine sandy loam; weak medium subangular blocky structure; friable; common roots; thin patchy dark brown (7.5YR 4/4) clay films bridging sand grains; few fine very dark grayish brown (10YR 3/2) accumulations (iron and manganese oxide); about 8 percent coarse fragments; strongly acid; clear smooth boundary.

Bt2—24 to 33 inches; yellowish brown (10YR 5/6) channery loamy sand; many coarse distinct dark brown (7.5YR 4/4) mottles; weak coarse subangular blocky structure; very friable; common roots; thin very patchy dark brown (7.5YR 4/4) clay films bridging sand grains; about 15 percent coarse fragments; strongly acid; clear smooth boundary.

Bt3—33 to 38 inches; dark brown (7.5YR 4/4) channery loamy sand; many coarse distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; very friable; common roots; thin patchy dark brown (7.5YR 4/4) clay films bridging sand grains; few fine very dark grayish brown (10YR 3/2) accumulations (iron and manganese oxide); about 25 percent coarse fragments; very strongly acid; clear wavy boundary.

BC—38 to 50 inches; yellowish brown (10YR 5/6) channery loamy sand; common medium distinct dark brown (7.5YR 4/4) mottles; weak coarse subangular blocky structure; very friable; common roots; thin very patchy dark brown (7.5YR 4/4) clay films bridging sand grains; few fine very dark grayish brown (10YR 3/2) accumulations (iron and manganese oxide); about 35 percent coarse fragments; very strongly acid; clear smooth boundary.

C—50 to 60 inches; yellowish brown (10YR 5/6) very channery sand; massive; very friable; common roots; about 50 percent coarse fragments; very strongly acid.

The thickness of the solum ranges from 40 to 54 inches and the depth to bedrock from 60 to more than 100 inches. The content of sandstone fragments ranges from 5 to 35 percent in the B horizon and from 20 to 70 percent in the C horizon.

The Ap horizon has hue of 10YR, value of 4, and chroma of 2 or 3. It is dominantly sandy loam but is loam in some pedons. The B horizon has hue of 7.5YR or 10YR and value and chroma of 4 to 6. It is extremely acid to strongly acid. It is loam, sandy loam, loamy sand, or fine sandy loam or the channery analogs of these textures. The loamy sand or channery loamy sand layers are in the lower part. The content of clay in the upper part ranges from 10 to 18 percent. The C horizon has hue 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. It is channery or very channery sandy loam, fine sandy loam, loamy sand, or sand. It is strongly acid or very strongly acid.

Sebring series

The Sebring series consists of deep, poorly drained, moderately slowly permeable soils that formed in stratified lacustrine sediments on low slack water terraces along streams. Slopes range from 0 to 3 percent.

Sebring soils are similar to Holly and Peoga soils and commonly are adjacent to Lorain soils in the slightly lower positions and to Fitchville and Glenford soils in the slightly higher positions. Fitchville and Glenford soils are not so poorly drained as the Sebring soils. Also, the low chroma colors in their subsoil are not so extensive. Holly soils do not have an argillic horizon and contain more sand in the subsoil than the Sebring soils. Lorain soils contain more clay in the subsoil than the Sebring soils. Also, they have a darker surface layer. Peoga soils are more acid in the lower part of the subsoil and in the substratum than the Sebring soils.

Typical pedon of Sebring silt loam, about 1.75 miles southeast of Specht, in Washington Township; about 1,140 feet west and 2,240 feet south of the northeast corner of sec. 11, T. 14 N., R. 5 W.

Ap—0 to 8 inches; gray (10YR 5/1) silt loam, light gray (10YR 7/1) dry; common medium distinct reddish brown (5YR 4/4) mottles; moderate medium and fine granular structure; very friable; many roots; slightly acid; clear smooth boundary.

BAg—8 to 13 inches; gray (10YR 5/1) silt loam; few medium distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; many roots; thin continuous gray (10YR 6/1) silt coatings on faces of peds; medium acid; abrupt smooth boundary.

Btg1—13 to 18 inches; light gray (10YR 6/1) silty clay loam; many medium distinct yellowish brown (10YR 5/6) mottles; moderate medium subangular blocky structure; friable; common roots; thin patchy light gray (10YR 6/1) clay films on faces of peds; grayish brown (10YR 5/2) coatings in old root channels; medium acid; clear smooth boundary.

Btg2—18 to 22 inches; gray (10YR 5/1) silty clay loam; many medium distinct yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; friable; common roots; gray (10YR 6/1) coatings and thin patchy clay films on faces of peds; slightly acid; clear smooth boundary.

Btg3—22 to 32 inches; gray (10YR 5/1) silty clay loam; common medium distinct yellowish brown (10YR 5/4) mottles; weak medium prismatic structure parting to moderate medium angular blocky; firm; few roots; light gray (10YR 6/1) coatings and thin patchy clay films on faces of peds; slightly acid; clear smooth boundary.

Btg4—32 to 44 inches; gray (10YR 5/1) silty clay loam; common medium distinct yellowish brown (10YR 5/4) mottles; moderate medium angular and subangular blocky structure; firm; few roots; gray (N 5/0) coatings and thin patchy clay films on faces of peds; gray (N 5/0) coatings in old root channels; neutral; clear smooth boundary.

Cg—44 to 60 inches; gray (10YR 5/1) silty clay loam; many medium distinct yellowish brown (10YR 5/6) mottles; massive; firm; few fine black (10YR 2/1) concretions (iron and manganese oxide); slight effervescence; mildly alkaline.

The thickness of the solum ranges from 30 to 50 inches. The Ap horizon has hue of 10YR, value of 4 or 5, and chroma of 1 or 2. It is dominantly silt loam but is silty clay loam in some pedons. The B horizon has hue of 10YR or 2.5Y or is neutral in hue. It has value of 4 to 6 and chroma of 0 to 2. It is strongly acid or medium acid in the upper part and medium acid to neutral in the lower part. It is silty clay loam or silt loam in which the content of clay, by weighted average, ranges from 22 to 35 percent. The C horizon has hue of 10YR or 2.5Y or is neutral in hue. It has value of 4 or 5 and chroma of 0 to 6. It is dominantly silt loam or silty clay loam but in some pedons has thin strata of clay loam or loam. It ranges from slightly acid to moderately alkaline.

Tioga series

The Tioga series consists of deep, well drained soils that formed in alluvium on flood plains. Permeability is moderate or moderately rapid. Slopes range from 0 to 3 percent.

Tioga soils commonly are adjacent to Boyer, Glenford, and Oshtemo soils on terraces. All of the adjacent soils have an argillic horizon. Glenford soils contain more clay and less sand in the subsoil than the Tioga soils. They are moderately well drained and have low chroma mottles in the subsoil.

Typical pedon of Tioga silt loam, occasionally flooded, directly east of Oneida, in Brown Township; about 1,110 feet west and 1,300 feet south of the northeast corner of sec. 16, T. 16 N., R. 6 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, pale brown (10YR 6/3) dry; moderate medium and fine granular structure; very friable; many roots; about 2 percent coarse fragments; slightly acid; abrupt smooth boundary.

A—8 to 12 inches; brown (10YR 4/3) silt loam; moderate medium and fine granular structure; very friable; common roots; neutral; clear smooth boundary.

Bw1—12 to 21 inches; dark brown (7.5YR 4/4) silt loam; weak medium subangular blocky structure; friable; common roots; slightly acid; clear smooth boundary.

Bw2—21 to 25 inches; dark brown (7.5YR 4/4) sandy loam; common medium distinct brown (10YR 5/3) mottles; weak medium subangular blocky structure; very friable; few roots; medium acid; clear smooth boundary.

C1—25 to 31 inches; yellowish brown (10YR 5/4) loamy sand; common medium distinct dark brown (7.5YR 4/4) mottles; single grained; loose; about 1 percent coarse fragments; slightly acid; clear smooth boundary.

C2—31 to 50 inches; dark brown (7.5YR 4/4) very gravelly loamy sand; single grained; loose; about 50 percent coarse fragments; slightly acid; clear smooth boundary.

C3—50 to 55 inches; dark brown (7.5YR 4/4) loamy sand; single grained; loose; about 2 percent coarse fragments; neutral; clear smooth boundary.

C4—55 to 60 inches; dark brown (7.5YR 4/4) very gravelly loamy sand; single grained; loose; about 50 percent coarse fragments; neutral.

The thickness of the solum ranges from 20 to 40 inches. The content of coarse fragments ranges from 0 to 5 percent in the solum and from 0 to 60 percent in the C horizon.

The Ap and A horizons have hue of 10YR, value of 3 or 4, and chroma of 2 or 3. They are dominantly silt loam, but the range includes loam. The B horizon has hue of 7.5YR or 10YR and value and chroma of 4. It is dominantly silt loam, loam, or sandy loam but in some pedons has layers of loamy sand. It ranges from strongly acid to neutral. The C horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 to 4. It is stratified sandy loam, fine sandy loam, or loamy sand or the gravelly or very gravelly analogs of these textures. It is medium acid to neutral.

Upshur series

The Upshur series consists of deep, well drained, slowly permeable soils on the tops of ridges and the upper parts of side slopes in the uplands. These soils formed in residuum and colluvium derived from shale and mudstone. Slopes range from 8 to 25 percent.

Upshur soils are similar to Elba and Guernsey soils and commonly are adjacent to those soils and to Berks and Westmoreland soils. All of the adjacent soils have a yellower hue in the subsoil than the Upshur soils. Berks and Westmoreland soils are on the upper parts of side slopes. Their subsoil contains less clay than that of the Upshur soils. The moderately deep Berks soils have a cambic horizon and have a higher content of coarse fragments in the subsoil than the Upshur soils. Elba soils have carbonates close to the surface. Guernsey soils are moderately well drained and have low chroma mottles in the subsoil.

Typical pedon of Upshur silty clay loam, 8 to 15 percent slopes, eroded, about 1.5 miles southwest of Mechanicstown, in Fox Township; about 1,100 feet south and 1,900 feet east of the northwest corner of sec. 33, T. 13 N., R. 4 W.

Ap—0 to 8 inches; reddish brown (5YR 4/4) silty clay loam, brown (7.5YR 5/4) dry; weak fine subangular blocky structure; firm; many roots; neutral; abrupt smooth boundary.

Bt1—8 to 13 inches; dark reddish brown (2.5YR 3/4) silty clay; moderate medium subangular blocky structure; plastic and sticky; common roots; thin patchy dark reddish brown (2.5YR 3/4) clay films on faces of peds; slightly acid; clear smooth boundary.

Bt2—13 to 21 inches; dark reddish brown (2.5YR 3/4) silty clay; moderate medium subangular blocky structure; plastic and sticky; common roots; medium continuous dark reddish brown (2.5YR 3/4) clay films on faces of peds; about 4 percent coarse fragments; slightly acid; clear smooth boundary.

Bt3—21 to 28 inches; dark reddish brown (2.5YR 3/4) clay; moderate medium subangular blocky structure; plastic and sticky; few roots; medium continuous dark reddish brown (2.5YR 3/4) clay films on faces of peds; about 4 percent coarse fragments; slightly acid; clear smooth boundary.

BC—28 to 37 inches; dark reddish brown (2.5YR 3/4) silty clay; weak coarse subangular blocky structure; plastic and sticky; few roots; medium patchy light brownish gray (10YR 6/2) clay films on faces of peds; about 10 percent coarse fragments; slight effervescence; moderately alkaline; clear smooth boundary.

C—37 to 67 inches; dark reddish brown (2.5YR 3/4) silty clay loam; many coarse distinct pale brown (10YR 6/3) mottles; massive; plastic and sticky; about 12 percent coarse fragments; strong effervescence; moderately alkaline; clear wavy boundary.

Cr—67 to 69 inches; about 75 percent reddish brown (2.5YR 4/4) and 25 percent grayish brown (2.5Y 5/2) weathered shale bedrock.

The thickness of the solum ranges from 26 to 42 inches and the depth to bedrock from 40 to more than 72 inches. The content of coarse fragments ranges from 0 to 5 percent in the upper part of the solum, from 0 to 15 percent in the lower part, and from 5 to 35 percent in the C horizon.

The Ap horizon has hue of 5YR or 7.5YR, value of 4, and chroma of 2 to 4. It is dominantly silty clay loam but is silty clay in some pedons. The B horizon has hue of 10R to 5YR, value of 3 or 4, and chroma of 4 to 6. It is silty clay or clay. It is strongly acid to slightly acid. The C horizon dominantly has hue of 2.5YR or 5YR, value of 3 or 4, and chroma of 4, but some pedons have variegations of olive, olive brown, or yellow. This horizon is silty clay or silty clay loam or the shaly analogs of these textures. It is neutral to moderately alkaline.

Wellston series

The Wellston series consists of deep, well drained, moderately permeable soils on the tops of upland ridges. These soils formed in a thin layer of loess and in the underlying residuum of siltstone and sandstone. Slopes range from 3 to 8 percent.

Wellston soils are similar to Keene and Westmoreland soils and commonly are adjacent to those soils and to Coshocton, Culleoka, and Rigley soils. All of the adjacent soils, except for Rigley soils, are on broad ridgetops. Rigley soils are on the steeper side slopes. Coshocton, Culleoka, Rigley, and Westmoreland soils have a higher content of sand and of coarse fragments in the subsoil than the Wellston soils. Culleoka soils are moderately deep over bedrock. Rigley soils contain less clay in the subsoil than the Wellston soils. Coshocton and Keene soils are moderately well drained and have low chroma mottles in the middle and lower parts of the subsoil.

Typical pedon of Wellston silt loam, 3 to 8 percent slopes, about 1.25 miles west of New Harrisburg, in Harrison Township; about 1,500 feet west and 2,700 feet south of the northeast corner of sec. 29, T. 15 N., R. 6 W.

Ap—0 to 8 inches; brown (10YR 4/3) silt loam, light yellowish brown (2.5Y 6/4) dry; moderate medium and fine granular structure; friable; many roots; about 1 percent coarse fragments; neutral; abrupt smooth boundary.

BA—8 to 14 inches; dark yellowish brown (10YR 4/4) silt loam; moderate medium subangular blocky structure; friable; common roots; dark grayish brown (10YR 4/2) coatings in old root channels; about 2 percent coarse fragments; neutral; clear smooth boundary.

Bt1—14 to 18 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate medium subangular blocky structure; firm; common roots; thin very patchy brown (7.5YR 4/4) clay films on faces of peds; about 2 percent coarse fragments; very strongly acid; clear smooth boundary.

Bt2—18 to 23 inches; yellowish brown (10YR 5/4) silty clay loam; moderate medium subangular blocky structure; firm; common roots; thin patchy brown (7.5YR 4/4) clay films on faces of peds; about 5 percent coarse fragments; very strongly acid; clear smooth boundary.

2Bt3—23 to 29 inches; yellowish brown (10YR 5/4) silty clay loam; moderate medium platy structure parting to moderate medium subangular blocky; firm; few roots; thin patchy brown (7.5YR 4/4) clay films on faces of peds; few fine black (10YR 2/1) concretions (iron and manganese oxide); about 8 percent coarse fragments; very strongly acid; clear smooth boundary.

2Bt4—29 to 35 inches; yellowish brown (10YR 5/4) silty clay loam; moderate medium subangular blocky structure; firm; few roots; thin very patchy brown (7.5YR 4/4) clay films on faces of peds; common medium black (10YR 2/1) concretions (iron and manganese oxide); about 10 percent coarse fragments; very strongly acid; clear smooth boundary.

2Bt5—35 to 40 inches; yellowish brown (10YR 5/4 and 10YR 5/6) silty clay loam; many medium distinct light brownish gray (10YR 6/2) mottles; weak medium subangular blocky structure; firm; few roots; thin very patchy dark brown (7.5YR 4/4) clay films on faces of peds; about 10 percent coarse fragments; very strongly acid; clear smooth boundary.

2C—40 to 44 inches; yellowish brown (10YR 5/4) channery silt loam; massive; firm; about 25 percent coarse fragments; very strongly acid; clear smooth boundary.

2Cr—44 to 46 inches; light olive brown (2.5Y 5/4) soft, weathered siltstone bedrock.

The thickness of the solum ranges from 32 to 50 inches and the depth to bedrock from 40 to 72 inches. The content of coarse fragments is 0 to 2 percent in the upper part of the solum, 0 to 15 percent in the lower part, and 2 to 60 percent in the C horizon.

The Ap horizon has hue of 10YR, value of 4, and chroma of 2 or 3. The B horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. It is silt loam or silty clay loam. It is extremely acid to strongly acid in the upper part and is very strongly acid or strongly acid in the lower part. The C horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 4 or 5, and chroma of 3 to 6. It is loam or silt loam or the channery or very channery analogs of these textures. It is very strongly acid to medium acid.

Westmoreland series

The Westmoreland series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in colluvium and residuum derived from shale, siltstone, and sandstone. Slopes range from 8 to 40 percent.

Westmoreland soils are similar to Coshocton, Rigley, and Wellston soils and commonly are adjacent to Coshocton and Rigley soils. Coshocton soils are moderately well drained and have low chroma mottles in the subsoil. Rigley soils contain more sand and less clay in the subsoil than the Westmoreland soils. Wellston soils have a higher content of silt and a lower content of sand and of coarse fragments in the upper part of the subsoil than the Westmoreland soils.

Typical pedon of Westmoreland silt loam, 15 to 25 percent slopes, about 2.75 miles northwest of Malvern, in Brown Township; about 400 feet east and 880 feet south of the northwest corner of sec. 1, T. 17 N., R. 7 W.

Ap—0 to 6 inches; brown (10YR 4/3) silt loam, light yellowish brown (2.5Y 6/4) dry; weak medium and fine granular structure; friable; many roots; about 5 percent coarse fragments; strongly acid; abrupt smooth boundary.

BA—6 to 9 inches; yellowish brown (10YR 5/4) silt loam; moderate medium and fine subangular blocky structure; friable; many roots; about 8 percent coarse fragments; very strongly acid; clear smooth boundary.

Bt1—9 to 17 inches; yellowish brown (10YR 5/4) silty clay loam; moderate medium subangular blocky structure; firm; common roots; thin patchy yellowish brown (10YR 5/4) clay films on horizontal and vertical faces of peds; about 20 percent coarse fragments; strongly acid; clear smooth boundary.

Bt2—17 to 29 inches; yellowish brown (10YR 5/4) channery silty clay loam; moderate medium subangular blocky structure; firm; common roots; thin patchy light olive brown (2.5Y 5/4) clay films on horizontal and vertical faces of peds; about 30 percent coarse fragments; strongly acid; clear smooth boundary.

BC—29 to 32 inches; light olive brown (2.5Y 5/4) channery silty clay loam; weak medium subangular blocky structure; firm; few roots; grayish brown (2.5Y 5/2) coatings on rock fragments; about 30 percent coarse fragments; strongly acid; clear smooth boundary.

C—32 to 61 inches; yellowish brown (10YR 5/4) channery silt loam; massive; firm; about 45 coarse fragments; strongly acid; clear smooth boundary.

R—61 to 63 inches; fractured light olive brown (2.5Y 5/4) siltstone bedrock.

The thickness of the solum ranges from 24 to 40 inches. The depth to bedrock ranges from 40 to more than 72 inches. It generally is more than 55 inches. The content of coarse shale, siltstone, or sandstone fragments ranges from 2 to 30 percent in the solum and from 45 to 90 percent in the C horizon.

The Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. It is dominantly silt loam but is loam or channery loam in some pedons. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 6. It is silt loam, silty clay loam, clay loam, or loam or the shaly or channery analogs of these textures. It is very strongly acid to medium acid. The C horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 or 4. It is strongly acid or medium acid. The fine earth fraction of this horizon is silt loam, silty clay loam, clay loam, or loam.

formation of the soils

This section describes the effects of the major factors of soil formation on the soils in Carroll County and explains some of the processes in soil formation.

factors of soil formation

Soil-forming processes act on deposited or accumulated geologic material. The major factors of soil formation are parent material, climate, relief, living organisms, and time.

Climate and living organisms, particularly plants, are active forces in soil formation. Their effect on the parent material is modified by relief and by the length of time that the parent material has been acted upon. The relative importance of each factor differs from place to place. The interaction of all five factors generally determines the kind of soil that forms, but in some areas one dominant factor determines most of the soil properties.

parent material

The soils in Carroll County formed in residuum, residuum and loess, residuum and colluvium, strip mine spoil, glacial outwash, lacustrine sediments, and alluvium.

Residuum of bedrock is the most extensive parent material in the county. Most of the soils on ridgetops formed in residuum or in residuum and an overlying mantle of loess. Berks and Culleoka soils, which are moderately deep over bedrock, formed in residuum of shale, siltstone, and sandstone. Keene and Wellston soils formed in as much as 24 inches of loess and in the underlying residuum.

Most of the soils on side slopes formed in residuum and colluvium. Colluvium is weathered bedrock and soil material that has been moved downhill by gravity. Residuum and colluvium weathered from sandstone bedrock are coarse textured or moderately coarse textured. The soils that formed in this combination of parent materials dominantly are coarse textured to medium textured in the subsoil. Hazleton and Rigley soils are examples. Residuum and colluvium weathered from clayey shale, mudstone, or limestone are fine textured or moderately fine textured. The soils that formed in this combination of parent materials dominantly are fine textured or moderately fine textured in the subsoil. Elba, Guernsey, and Upshur soils are examples. Residuum and collvuium weathered from siltstone, shale, and sandstone are medium textured or moderately fine textured. The soils that formed in this combination of parent materials, such as Westmoreland soils, dominantly are medium textured or moderately fine textured in the subsoil.

The thin solum of Bethesda, Fairpoint, and Morristown soils formed in strip mine spoil in areas that were surface mined more than a decade ago. This parent material is shale, siltstone, sandstone, and limestone mixed with lesser amounts of partly weathered fine earth.

Gravelly and sandy glacial outwash was deposited in the areas along Sandy Creek from Minerva to Magnolia. Terraces formed in these areas. Some of this fairly well sorted coarse textured outwash was covered by finer textured silty or loamy outwash. Chili and Jimtown soils formed in this material.

Lacustrine sediments, or lake bottom deposits, are on low and high terraces along the major streams in the county. Most strata of these sediments are silty or clayey, and the soils that formed in them, such as Glenford, Lorain, and Sebring soils, are dominantly medium textured to fine textured in the subsoil.

Alluvium, which is deposited by floodwater, is the youngest natural parent material in the county. It is still accumulating because fresh sediments are added by the overflowing streams. These sediments are from the surface layer of the higher lying soils in the county. The occasionally or frequently flooded Holly, Orrville, and Tioga soils formed in recent alluvium on flood plains. The rarely flooded Elkinsville and Peoga soils generally formed in much older alluvium on low terraces.

climate

The climate in Carroll County is uniform enough that it has not greatly contributed to differences among the soils. It has favored physical change and chemical weathering of the parent material and the activity of living organisms.

Rainfall has been adequate to leach from the upper part of the subsoil any carbonates that were in the parent material of some of the soils on uplands and terraces. All of the soils, except for those that formed in recent alluvium and strip mine spoil, have a lower base saturation in the middle part of the subsoil than in the substratum. Wetting and drying cycles have resulted in the translocation of clay minerals and the formation of soil structure.

The range in temperature has favored both physical change and chemical weathering of the parent material. Freezing and thawing aided the formation of soil structure. Warm temperatures in summer favored chemical reactions in the weathering of primary minerals. Rainfall and temperature have been conducive to plant growth and the accumulation of organic matter in all of the soils.

More information about the climate is available under the heading "General nature of the county."

relief

Relief affects the natural drainage of soils through its effect on the amount of runoff and the depth to a seasonal high water table. Water that runs off the more sloping soils collects in depressions or is removed through a drainage system. From an equal amount of rainfall, the more sloping soils receive less water than depressional or nearly level soils. Gently sloping soils generally show the most evidence of profile development because they are neither saturated nor droughty. Soil formation on steep slopes tends to be inhibited by erosion and the reduced amount of water entering the soil.

Relief can result in the formation of different soils from the same kind of parent material. Glenford and Sebring soils, for example, both formed in lacustrine sediments. The moderately well drained Glenford soils are on the higher, more sloping parts of terraces. Their seasonal high water table generally is not close to the surface. The poorly drained Sebring soils are in lower, nearly level areas along streams. Their seasonal high water table is near or above the surface.

living organisms

Plants, animals, bacteria, fungi, and other living organisms affect soil formation. At the time that the county was settled, the vegetation was dominantly hardwood forest of oak, hickory, maple, yellow-poplar, and ash. The soils that formed in these forested areas are subject to acid leaching. As a result, the subsoil generally is lower in exchangeable bases than the substratum.

Small animals, insects, earthworms, and burrowing animals leave channels in the soil and make it more rapidly permeable. Animals also mix the soil material and contribute organic matter. Worm channels or casts are common in the surface layer of well drained soils, such as Culleoka and Westmoreland. Crawfish channels are evident in poorly drained soils, such as Sebring.

Human activities also affect soil formation. Examples of these activities are cultivation, seeding, artificial drainage, irrigation, cutting and filling, and surface mining. Another example is the application of lime and fertilizer, which affects soil chemistry.

time

Time is needed for the other factors of soil formation to produce their effects. The age of a soil is indicated, to some extent, by the degree of profile development. If the parent material weathers slowly, the profile forms slowly. In many areas, however, factors other than time have been responsible for most of the differences in the kind and distinctness of layers in the different soils.

Most of the soils in the county are old and have a strongly expressed profile. The youngest soils are those that formed in strip mine spoil, namely Bethesda, Fairpoint, and Morristown soils. On flood plains deposits of fresh sediments periodically interrupt soil formation. As a result, Holly and Orrville soils do not have a strongly exposed profile.

processes of soil formation

Most soils in Carroll County have a strongly expressed profile because the processes of soil formation have distinctly changed the parent material. These are the upland soils on ridgetops and side slopes and the soils on terraces along the major streams. In contrast, the parent material on flood plains and in surface mined areas is only slightly modified.

All the factors of soil formation act in unison to control the processes that form different layers in the soil. These processes are additions, removals, transfers, and transformations (*15*). Some processes result in differences among the surface layer, subsoil, and substratum.

In this county the most important addition to the soil is that of organic matter to the surface layer. A thin layer of organic matter accumulates under forest vegetation. If the soil is cleared and cultivated, this organic matter is mixed with underlying mineral material. In some severely eroded areas, all evidence of this addition has been removed.

Leaching of carbonates from calcareous parent material is one of the most significant removals. It precedes many other chemical changes in the soil. The limestone and calcareous shale underlying undisturbed soils and combinations of these materials underlying surface mined soils have a high content of carbonates when first exposed to leaching. The soils that formed in residuum of limestone and calcareous shale bedrock, such as Elba soils, still have carbonates 10 to 30 inches below the surface. Most of the soils on uplands and terraces do not have carbonates within 5 feet of the surface and are very strongly acid to medium acid in the subsoil. Other minerals in the soil are subject to the chemical weathering that results from leaching, but their resistance is higher and their removal is slower.

Seasonal wetting and drying of the soil are largely responsible for the transfer of clay from the surface layer to the faces of peds in the subsoil. The fine clay particles are suspended in the percolating water moving through the surface layer and then are deposited in the subsoil. This transfer of fine clay accounts for the patchy or nearly continuous clay films on the faces of peds in the subsoil of most of the soils on uplands and terraces.

Transformations of mineral compounds occur in most soils. The results are most apparent if the formation of layers is not affected by rapid erosion or by accumulation of material at the surface. When the primary silicate minerals are weathered chemically, secondary minerals, mainly layer lattice silicate clays, are produced. Most of the layer lattice clays remain in the subsoil.

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glossary

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

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

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

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.

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

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

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

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15.2 to 38.1 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

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

Complex slope. Irregular or variable slope. Planning or 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.

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

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

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

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the removal of water from the soil. Drainage classes are determined on the basis of an overall evaluation of water removal as influenced by climate, slope, and position on the landscape. Precipitation, runoff, amount of moisture infiltrating the soil, and rate of water movement through the soil affect the degree and duration of wetness. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. The soils in this class generally are free of mottles throughout. They commonly are shallow, very porous, or steep, or a combination of these.

Somewhat excessively drained.—Water is removed from the soil rapidly. The soils in this class generally are free of mottles throughout. They commonly are shallow or moderately deep, very porous, or steep, or a combination of these.

Well drained.—Water is removed from the soil so readily that the upper 40 inches generally does not have the mottles or dull colors related to wetness.

Moderately well drained.—Water is removed from the soil so slowly that the upper 20 to 40 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Somewhat poorly drained.—Water is removed from the soil so slowly that the upper 10 to 20 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Poorly drained.—Water is removed so slowly that either the soil is periodically saturated or the upper 10 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water is at or on the surface most of the time. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 38 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

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.

Graded stripcropping. Growing crops in strips that grade toward a protected waterway.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of 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.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of another horizon.

E horizon.—The mineral horizon below an O or A horizon and above a B horizon. The E horizon is characterized by a loss of some combination of silicate clay, iron, and aluminum and by a remaining concentration of sand and common silt particles of quartz or other resistant minerals.

B horizon.—The mineral horizon below an A, E, or O 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 angular or subangular blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A, E, and B horizons are generally called the solum. 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 overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

R layer.—Hard bedrock beneath the soil. The bedrock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

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.

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.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

North aspects. North- and east-facing slopes of from 355 to 95 degrees azimuth.

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by glacial melt water.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Perimeter drain. A drain installed around the perimeter of a septic tank absorption field to lower the water table.

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, 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 filter (in tables). Because of rapid permeability or an impermeable layer near the surface, the soil may not adequately filter effluent from a waste disposal system.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and 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.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

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.

Slope (in tables). Slope is great enough that special practices are required to insure satisfactory performance of the soil for a specific use.

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, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

South aspects. South- and west-facing slopes of from 96 to 354 degrees azimuth.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded and 6 to 15 inches (15 to 38 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the profile below plow depth.

Subsoiling. Breaking up a compact subsoil by pulling a special chisel through the soil.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. Includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial melt water. In nonglaciated regions, alluvium deposited by heavily loaded 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 bar. A shallow trench and a mound of earth constructed at an angle across a road or trail to intercept and direct surface runoff and control erosion.

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.