# SOIL SURVEY OF

# Monroe County, Ohio

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

Issued March 1974

**Major fieldwork for this soil survey was done in the period 1960–66. Soil names and descriptions were approved in 1970. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1966. This survey was made cooperatively by the Soil Conservation Service, the Forest 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 Monroe Soil and Water Conservation District.**

**Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington, D.C. 20250.**

# HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

## Locating Soils

All the soils of Monroe County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside, and a pointer shows where the symbol belongs.

## Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the capability unit and the woodland suitability group in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

*Farmers and those who work with farmers* can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units.

*Foresters and others* can refer to the section "Use of the Soils for Woodland," where the soils of the county are grouped according to their suitability for trees.

*Game managers, sportsmen, and others* can find information about soils and wildlife in the section "Use of the Soils for Wildlife."

*Community planners and others* can read about soil properties that affect the choice of sites for nonindustrial buildings and for recreation areas in the section "Soils and Land Use Planning."

*Engineers and builders* can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

*Scientists and others* can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

*Newcomers in Monroe County* may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given in the section "General Nature of the County."

***Cover picture:*** **Area of the Gilpin-Upshur-Wellston soil association.**

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# SOIL SURVEY OF MONROE COUNTY, OHIO

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THE OHIO DEPARTMENT OF NATURAL RESOURCES, DIVISION OF LANDS AND SOIL, AND THE OHIO AGRICULTURAL RESEARCH AND DEVELOPMENT CENTER IN COOPERATION WITH THE UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE AND FOREST SERVICE

MONROE COUNTY is in the southeastern part of Ohio (fig. 1) and occupies 455 square miles, or 291,200 acres. Woodsfield is the county seat and largest town. Smaller villages are Antioch, Beallsville, Brownsville, Cameron, Clarington, Fly, Graysville, Hannibal, Jerusalem, Lewisville, Malaga, Miltonsburg, Sardis, Stafford, and Wilson. In 1960 the population of the county was 15,268, and the population at Woodsfield was 2,956.

The county is located entirely within the unglaciated Allegheny Plateau physiographic region of Ohio. The county is throughly dissected, and many of the soils are steep to very steep.

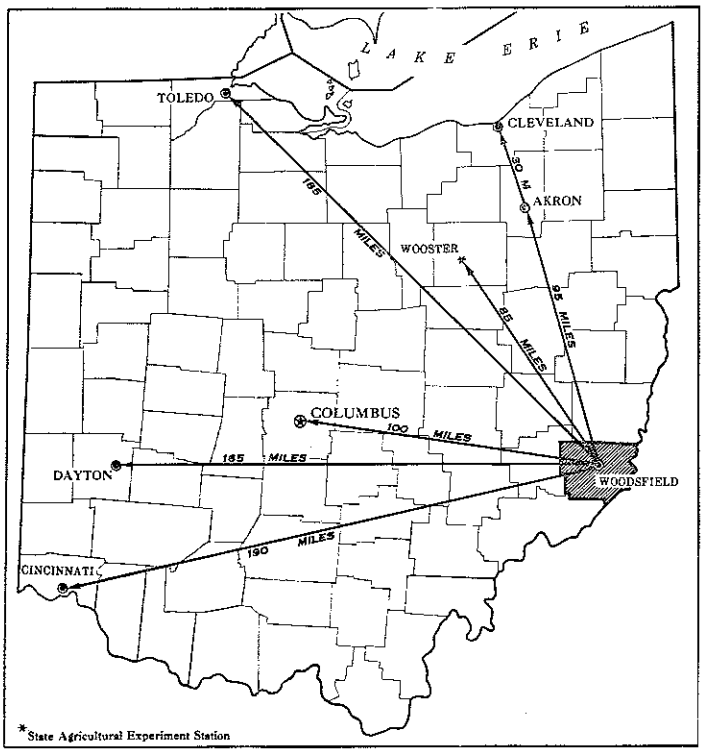


*Figure 1.*—Location of Monroe County in Ohio.

Monroe County is mainly rural. Most farms are general farms on which there are several kinds of farming enterprises. In recent years some industry has moved into the Woodsfield area, particularly along the Ohio River. These industries have provided either full-time or part-time employment for several hundred persons.

## How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Monroe County, where they are located, and how they can be used. The soil scientists went into the county knowing they were likely to find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rocks, and many facts about the soils. They dug many holes to expose 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 that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The soil series and the soil phase are the categories of soil classification most used in a local survey (*13*).[1]

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Upshur and Woodsfield, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such difference, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Upshur silt loam, 6 to 12 percent slopes, moderately eroded, is one of several phases within the Upshur series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries

[1] Italic numbers in parentheses refer to Literature Cited, p. 121.

accurately. The soil map at the back of this survey was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Two such kinds of mapping units shown on the soil map of Monroe County are soil complexes and undifferentiated groups.

A soil complex consists of areas of two or more soils so intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Gilpin-Westmoreland silt loams, 2 to 6 percent slopes, moderately eroded, is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. The name of an undifferentiated group consists of the names of the dominant soils joined by "and." Gilpin and Dekalb very stony soils, 12 to 35 percent slopes, is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, or so severely eroded that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Gullied land, Gilpin-Upshur material, is a land type in Monroe County.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of readers, among them farmers, managers of woodland, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others; then they adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

## General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Monroe County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The soil associations in Monroe County are discussed in the following pages.

### 1. Huntington-Wheeling-Sciotoville association

*Deep, well drained and moderately well drained soils that are loamy throughout; on flood plains and terraces along the Ohio River*

This association (fig. 2) occupies a narow band along the Ohio River. In most places this band is less than one-fourth mile wide. It is characterized locally by having four distinct levels that rise above the normal flow of the Ohio River. The major soils in this association formed in alluvial materials of varying age and composition. These materials have been deposited along the river by flooding. The association makes up about 1 percent of the county.

The Huntington soils are deep, dark colored, loamy, and well drained. They are on the present flood plains and in some areas of the terraces above normal river level. They make up about 45 percent of the association. The lighter colored Wheeling soils are deep, loamy, and well drained. They are generally on higher terrace levels than Huntington soils. They make up about 30 percent of the association. The Sciotoville soils also are lighter colored than Huntington soils and are deep, loamy, and moderately well drained. They make up about 10 percent of the association and are mostly on the highest terrace level in the association. Less extensive soils in the association include Lindside, Newark, Hackers, and Conotton soils.

Huntington, Lindside, Newark, and some of the lower areas of Hackers and Wheeling soils are subject to flooding. The major soils are well suited to cultivated crops. Most of the crops common in the county grow well on these soils. Specialty crops such as tomatoes do well on the Wheeling, Sciotoville, and Conotton soils. Late corn is commonly planted in low areas that are subject to flooding.

A large part of this association is owned by industrial interests. Some of the acreage is rented for farming, and some has been abandoned for farming. Most areas of the

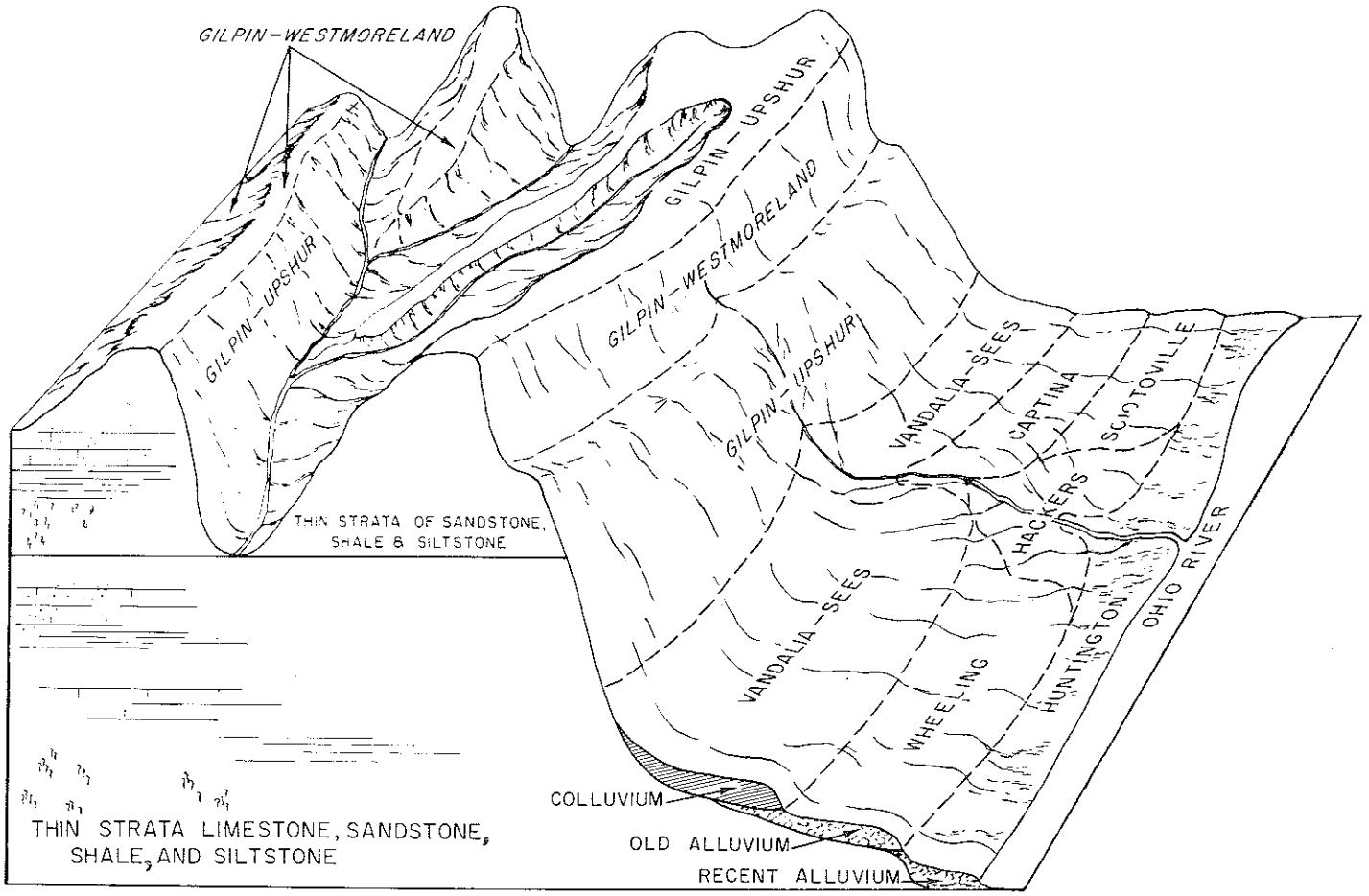


*Figure 2.*—**Relationships of soils in associations 1 and 6 to topography and underlying materials along the Ohio River.**

Wheeling, Sciotoville, and Conotton soils are good sources of sand and gravel.

This association has few limitations for building sites, except in areas that are subject to flooding. The town of Sardis, Ohio, is mainly on Conotton soils. There is a danger of underground water pollution from septic tank systems and industrial wastes disposal in the Sciotoville, Wheeling, and Conotton soils.

### 2. *Chagrin-Lindside association*

*Deep, well drained and moderately well drained soils that are loamy throughout; on flood plains of tributaries to the Ohio River*

This association (fig. 3) consists of narrow flood plains (fig. 4) and included stream terraces along tributaries of the Muskingum and Ohio Rivers. Among these tributaries are Wills Creek, Sunfish Creek, and the Little Muskingum River. The greater acreage of these soils is on the flood plains. This association makes up about 3 percent of the county.

The Chagrin soils are deep and loamy and are well drained. They are on bottom lands that are subject to flooding; they make up about 60 percent of the association. The Lindside soils are deep, loamy, and moderately well drained; they make up about 15 percent of the association. They also are subject to flooding. Minor soils in this association include Newark soils on the flood plains and Ashton and Captina soils on the stream terraces. In the Wills Creek valley, Chagrin soils are less extensive than Lindside and Newark soils. Ashton soils

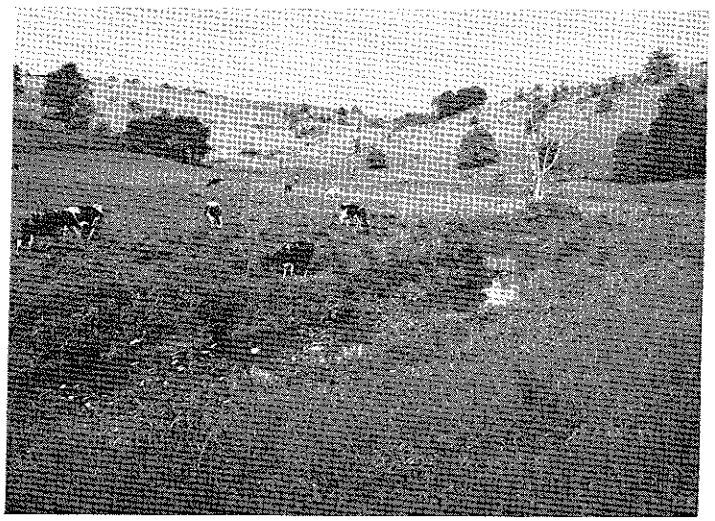

*Figure 3.*—**Soils of association 2 on flood plains along Clear Fork Creek and soils of association 8 on the side slopes.**

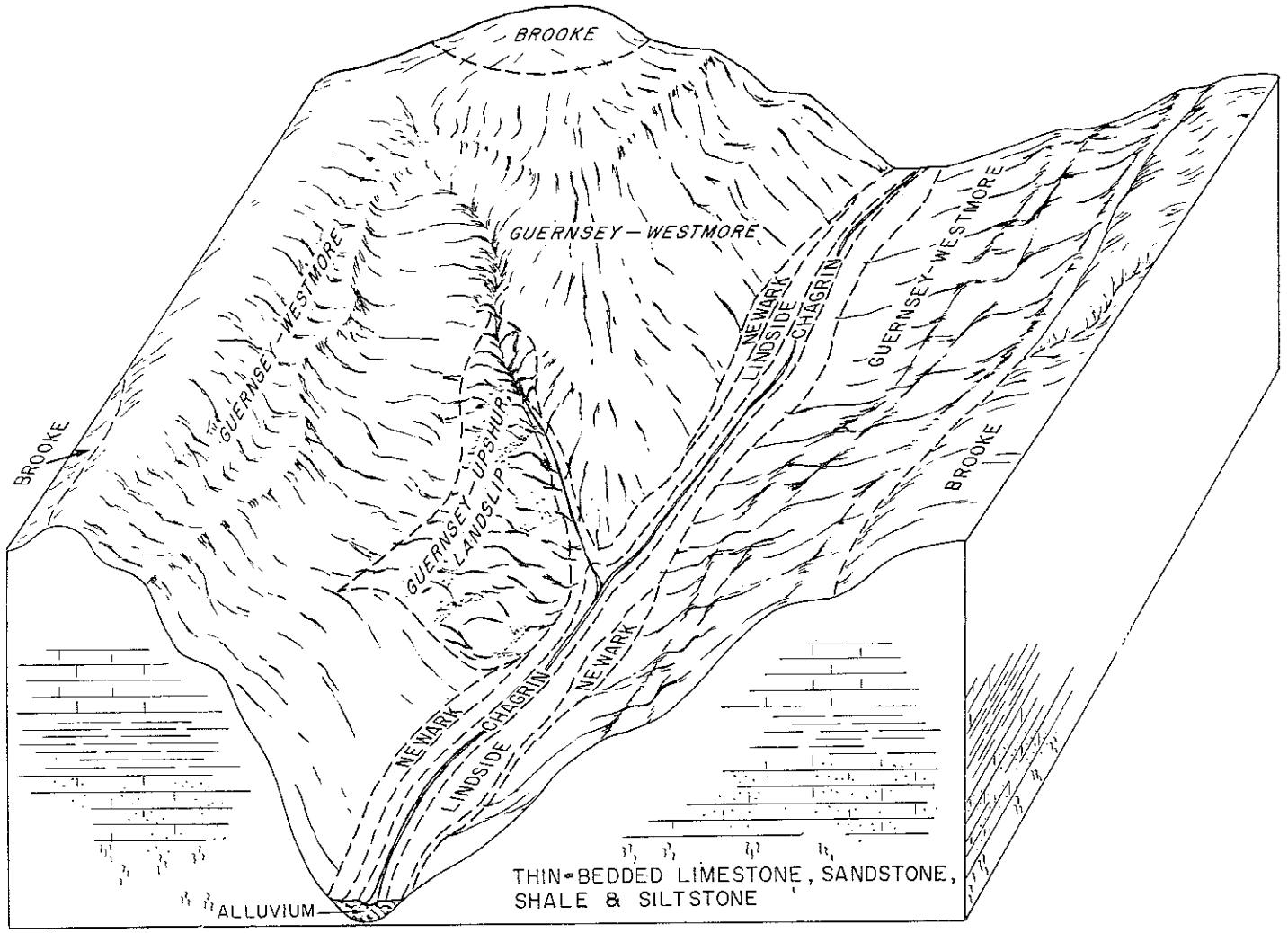


*Figure 4.*—**Relationships of soils in associations 2 and 7 to topography and underlying materials.**

are subject to occasional flooding, but the Captina soils lie above known flood levels.

The major soils in this association are used mainly for farming. They are well suited to summer-grown row crops such as corn. Flooding is the dominant hazard in this association. The valleys are flooded an average of one to five times a year, generally late in winter and in spring. This is a severe limitation for most nonfarm development in this association. The only potential building sites in the association that are free from the risk of flooding are in areas of Captina soils and in some high areas of the Ashton soils.

### *3. Zanesville-Gilpin-Wellston-Westmoreland association*

*Deep and moderately deep, well drained and moderately well drained soils that are loamy throughout; on uplands*

This association is on uplands in the north-central part of the county. The elevation ranges from about 1,200 to 1,300 feet. Most of the association has been cleared of trees, and the soils are farmed. This part of the county is noted for having slopes most favorable for farming. This association makes up about 4 percent of the county.

The Zanesville soils are deep and loamy and make up about 30 percent of the association. They are moderately well drained and have a dense fragipan in the subsoil. The Gilpin soils make up about 20 percent of this association. They are well drained and loamy and are underlain, at a depth of less than 40 inches, by interbedded siltstone, shale, and sandstone bedrock. In this association the Gilpin soils are in intricate patterns on the landscape with the Westmoreland soils. Westmoreland soils are well drained and loamy and are underlain, at a depth of more than 40 inches, by interbedded siltstone, shale, and sandstone. The Gilpin and Westmoreland soils range from gently sloping to moderately steep. The Wellston soils make up about 20 percent of this association. They are deep, loamy, and well drained. Less extensive in the association are the minor Upshur soils, which are in intricate patterns with Gilpin soils. Upshur soils have a reddish clayey subsoil.

Most of this association is used for general farming. The steeper slopes are mainly wooded. The major soils are acid and have a moderate to high lime requirement, but crops respond well to optimum management. The dense pan in the subsoil of Zanesville soils limits the downward growth of plant roots and the downward movement of soil water. Deep-rooted crops, such as alfalfa, generally do not last more than 1 to 3 years on Zanesville soils.

Erosion is the main hazard on soils in this association. A moderate depth to bedrock is a limitation of the Gilpin soils for basements, but the bedrock generally is easily rippable. Soil slippage is not a major problem in this association, but steeper areas of the Upshur soils are susceptible to slippage.

### *4. Zanesville-Gilpin-Woodsfield-Westmoreland association*

*Deep and moderately deep, well drained and moderately well drained soils that are loamy throughout and deep, well drained soils that have a clayey subsoil; on uplands*

This association is characterized by a rolling landscape that has some steep to very steep side slopes. It consists of four areas in the north and central parts of Monroe County and makes up about 13 percent of the county. The towns of Woodsfield, Jerusalem, Laings, and Antioch are in this association.

Zanesville soils make up about 35 percent of this association. These soils are loamy and deep, are moderately well drained, and have a dense fragipan in the subsoil. They occupy the broader ridgetops and some of the side benches. In most places Zanesville soils are in intricate patterns with the Woodsfield soils. In a few places they occur in individual areas. The Woodsfield soils make about 10 percent of the association. They are well drained and have a loamy surface layer and reddish clayey lower layers. Gilpin soils make up about 20 percent of this association. They are loamy and well drained and are underlain, at a depth of less than 40 inches, by siltstone, shale, and sandstone bedrock. They occupy the narrow ridgetops and the steeper side slopes, where they are in intricate patterns with Westmoreland soils. The Westmoreland soils make up about 10 percent of the association. They also are well drained and loamy, but they differ from Gilpin soils because they are more than 40 inches deep to siltstone and shale bedrock. The Upshur soils, which have a reddish, clayey subsoil, are less extensive, but they are distinctive minor soils in this association.

The gently sloping and sloping soils of this association are suited to general farming. Erosion is the dominant hazard to farming. Deep-rooted crops, such as alfalfa, last only from 1 to 3 years on Zanesville soils, which have a dense compact subsoil. Limited depth to bedrock in the Gilpin soils causes some problems for homesites, pipelines, highways, and other excavations. The Woodsfield and Upshur soils have a high shrink-swell potential, which is a limitation for foundations and highways. Some areas of the Upshur soils are subject to slippage. The Zanesville, Gilpin, and Westmoreland soils are used extensively for purposes other than farming.

### *5. Gilpin-Upshur-Wellston association*

*Moderately deep and deep, well-drained soils that are loamy throughout and deep, well-drained soils that have a reddish, clayey subsoil; on ridge and valley uplands*

This association consists dominantly of steep to very steep side slopes and of ridges and valleys. The side slopes are wooded or used for pasture. Farms and scattered homesites are limited mainly to the valleys, ridgetops, and less steep benches on side slopes. Bedrock underlying the soils consists of thin layers of sandstone, siltstone, and shale. As a result, the soils are in intricate patterns throughout the association. This association occupies about 30 percent of the county.

The Gilpin soils are moderately deep and well drained and make up about 50 percent of the association. These soils are closely intermingled with Upshur and other soils. They are loamy and, in most places, are underlain by siltstone, shale, and sandstone bedrock at a depth of about 30 inches. The distinctive Upshur soils make up about 20 percent of the association. They are deep and well drained and have a reddish, plastic, clayey subsoil. They are subject to slippage. The Wellston soils make up about 5 percent of the association. They are similar to the Gilpin soils, except that they are deep to bedrock and have fewer coarse fragments in the subsoil. The rest of the association is made up of Zanesville, Woodsfield, Coolville, Rarden, and Keene soils on uplands and Chagrin, Lindside, and Hartshorn soils on narrow flood plains.

The major soils in this association are suitable for farming where slopes are not too steep. These soils erode easily, and this is the major soil limitation for farming. Most of the farms in this association are livestock farms. Hay, pasture, and woodland products are the main crops.

Homesite locations in this association are scattered, and both household water and sewage systems must be developed locally. Wells, springs, and cisterns provide water for domestic use.

### *6. Gilpin-Upshur association*

*Moderately deep, well-drained soils that are loamy throughout and deep, well-drained soils that have a reddish, clayey subsoil; on narrow ridgetops and side slopes*

This association (see fig. 2) is characterized by steep and very steep slopes, narrow ridgetops, side slope benches, and narrow bottom lands (fig. 5). It is adjacent to the Ohio River valley in the eastern part of the county and makes up about 19 percent of the county. Some of the hillsides are stony or rough or are subject to slippage. A large part of this association is wooded.

The Gilpin and Upshur soils are dominant on the upper parts of the slopes. Gilpin soils are well drained and loamy and make up about 45 percent of this association. These soils are moderately deep to interbedded siltstone, shale, and sandstone. The Upshur soils make up about 25 percent of the association. They are deep and well drained and have a reddish, clayey subsoil. In some places in this association, the Upshur soils are in intricate patterns with the Gilpin soils; in other places they are continuous over broad areas.

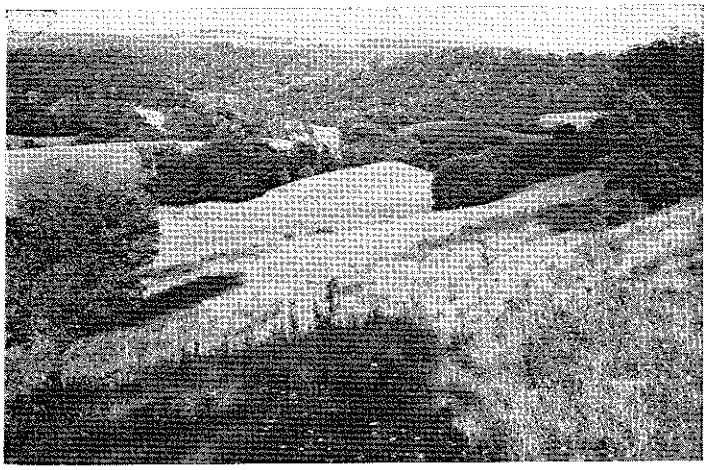

*Figure 5.*—**Area of rough, irregular topography in association 6. A general view of the Sunfish Creek valley.**

The less extensive, well drained Vandalia soils and the moderately well drained Sees soils are on the lower parts of the slopes. These deep soils formed in colluvial materials. In this association the Vandalia and Sees soils occur together in intricate patterns in most places. Other less extensive soils in the association are Guernsey, Westmore, Wellston, Woolper, and Dekalb soils.

The major soils in the association have a low to medium available moisture capacity. The soils are well suited to trees. Where slopes are steep, the soils are not suited to cultivated crops, but some areas are used for hay and pasture. There are relatively few livestock farms within the association, however.

Soil slippage is a definite hazard for residential use and highway sites. Slip areas normally have their beginnings in or near Upshur soils and extend for a considerable distance in places. Slippage is responsible for many problems affecting road maintenance in the association.

### 7. *Guernsey-Westmore-Brooke association*

*Deep and moderately deep, moderately well drained and well drained soils that have a clayey subsoil; on narrow ridgetops and side slopes*

This association (see fig. 4) is in the northwestern corner of the county, where the topography consists of narrow ridgetops and steep or very steep side slopes. The side slopes are generally broken by one or more narrow benches. These benches roughly follow the contour and extend around the hillsides for considerable distances. The bedrock in this association is stratified limestone, shale, siltstone, and sandstone. This association makes up about 4 percent of the county.

The Guernsey soils are deep and moderately well drained and are clayey in the lower part of the subsoil. They make up about 40 percent of the association. The Westmore soils are deep and well drained and are generally clayey in the lower part of the subsoil. They make up about 30 percent of the association. In this association the Guernsey and Westmore soils occur together in intricate patterns. The Brooke soils are well drained and moderately deep. They have a dark-colored surface layer and a clayey subsoil. They make up about 7 percent of the association. All of the dominant soils formed in materials weathered from limestone or interbedded limestone and shale, siltstone, or sandstone.

The major soils in this association have a medium or high available moisture capacity. Soil slips and seep spots are common. The slip areas are readily observable by their rough and uneven surface. Steep slopes, sheet erosion, and gullying are hazards to farming in this association. Soil slips are a definite hazard to buildings and roads.

This association has been farmed intensively in the past, but livestock farms now predominate. The least sloping areas are used for pasture and woodland. The major soils can produce excellent bluegrass pasture, and there is a good potential for pasture improvement. Numerous springs provide a good source of fresh water for households and livestock. Previously farmed areas that have been abandoned are reverting to stands of hardwood trees that contain a high proportion of tulip-poplar.

### 8. *Gilpin-Westmoreland-Guernsey-Westmore association*

*Moderately deep and deep, well drained soils that are loamy throughout and deep, moderately well drained and well drained soils that have a clayey subsoil; on narrow ridgetops and side slopes*

This association (see fig. 3) is on narrow ridgetops and steep side slopes in the west-central and southwestern parts of the county. The hillsides commonly have a narrow bench that tends to form a boundary between the dominant soils on the upper slopes and ridgetops and those soils that are dominant on the lower slopes. This association occupies about 18 percent of the county.

The Gilpin and Westmoreland soils are dominant on the upper slopes and ridgetops. They formed principally in material weathered from thin layers of interbedded siltstone, shale, and sandstone. In this association small areas of Gilpin and Westmoreland soils are intermingled in intricate patterns. The Gilpin soils make up about 35 percent of the association. They are well drained and are underlain by bedrock at a depth of less than 40 inches. The Westmoreland soils make up about 15 percent of the association. They are well drained and are underlain by bedrock at a depth of more than 40 inches. Minor areas of deep, well drained Wellston and Upshur soils and moderately well drained Zanesville soils are on the upper slopes.

The Guernsey and Westmore soils are dominant on the narrow benches and lower slopes. These deep soils formed in material weathered from layers of limestone, siltstone, shale, and sandstone. In this association small areas of Guernsey and Westmore soils are intermingled in intricate patterns. The limestone has had a greater influence on these soils than on those on the upper slopes and ridgetops. Both the Guernsey and Westmore soils are clayey in the lower part of the subsoil. The Guernsey soils are moderately well drained. They make up about 15 percent of the association. The Westmore soils are well drained and make up about 5 percent of the association. Other soils of minor extent, including some that are subject to flooding, make up the rest of the association.

The major soils in this association have a medium or

high available moisture capacity. The soils on the upper slopes tend to be more droughty than those on the lower slopes. Steep slopes and an erosion hazard are limitations to farming in this association. The areas suitable for cultivation are small. Small livestock farms are typical. Cultivated crops are generally confined to gently sloping ridgetops, benches, and narrow flood plains. The steeper benches and side slopes are used for pasture, hay, or woodland. Abandoned cropland quickly reverts to woodland that has a high percentage of tulip-poplar. Soil slips and severely eroded areas are common, particularly on the Guernsey and Upshur soils. Much of the erosion occurred when cultivation of the land was more widespread.

Roads and buildings are located mainly in the narrow valleys and on the ridgetops. Soil slips are a serious hazard to both roads and buildings. Springs, wells, and cisterns provide the major source of water for domestic use.

### *9. Guernsey-Gilpin-Westmore-Upshur association*

*Moderately deep, well drained soils that are loamy throughout and deep, moderately well drained and well drained soils that have a clayey subsoil; on side slopes along the Little Muskingum River and its tributaries*

This soil association is on steep side slopes adjacent to Whitten Run, Straight Fork, and the Little Muskingum River. The association is mostly steep and has some stony, rough, or slipped areas. It makes up about 6 percent of the county.

The Guernsey and Westmore soils are dominant on the lower slopes. In this association small areas of Guernsey and Westmore soils are intermingled in intricate patterns. The Guernsey soils are deep and moderately well drained. They are clayey in the lower part of the subsoil. They make up about 25 percent of the association. The Westmore soils are deep and well drained. They make up about 10 percent of the association. The Gilpin and Upshur soils are dominant on the upper slopes, where they occur together in intricate patterns. The Gilpin soils are well drained and are moderately deep. They make up about 25 percent of the association. The Upshur soils are well drained and deep and have a reddish, clayey subsoil. They make up about 10 percent of the association. Some Upshur soils also are on the lower slopes in complex patterns with Guernsey soils. The rest of the association is mainly Brooke soils on the lower slopes and Wellston and Westmoreland soils on the upper slopes.

The soils on the lower slopes in this association generally have a medium or high available moisture capacity. The Guernsey, Westmore, and Brooke soils are well suited to bluegrass pasture. The soils on the upper slopes have a low to medium available moisture capacity. They tend to be more droughtly than those on the lower slopes. The Guernsey and Upshur soils are commonly difficult to till where they are seriously eroded.

Farming is generally declining in this association, although there are some livestock farms. The soils are erodible and generally too steep for safe cultivation; they are well suited to trees, however. Previously farmed areas that have been abandoned revert to hardwood trees and Virginia pine in a short time. Roads and buildings are located mainly in the narrow valleys.

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### *10. Gilpin-Upshur-Guernsey association*

*Moderately deep, well drained soils that are loamy throughout and deep, well drained and moderately well drained soils that have a clayey subsoil; on ridgetops and side slopes*

This soil association makes up the rolling ridgetops and steep slopes in Switzerland Township. The ridgetops are at an elevation ranging from about 1,100 to 1,400 feet. Most of this association has been cleared of trees. Pasture, meadow, and production of small grain are the principal land uses. The association occupies about 2 percent of the county.

The Gilpin soils are well drained and loamy and make up about 30 percent of this association. They are moderately deep to interbedded siltstone, shale, and sandstone. The Upshur soils make up about 25 percent of this association. They are well drained and deep and have a reddish, clayey subsoil. In this association small areas of the Upshur soils are in intricate patterns with both the Gilpin and Guernsey soils. The Guernsey soils make up about 15 percent of the association. They are deep and moderately well drained and are clayey in the lower part of the subsoil. The rest of the association consists of the less extensive Wellston, Dekalb, Zanesville, and Brooke soils.

The Guernsey soils are well suited to alfalfa and bluegrass. Preparing a good seedbed is commonly difficult on the eroded Guernsey and Upshur soils. Also, frost heaving is severe at times on these soils. Beef and dairy farms are the main farm enterprises. The association is generally well suited to grassland farming, but steep areas are better suited to trees. Susceptibility to erosion is the dominant limitation of the soils for farming.

Seep spots and slipped areas are common in this association. Good springs have been developed in some of the slipped, seepy areas, and the potential for developing additional springs is good. Slipped areas and susceptibility to slippage of the Upshur and Guernsey soils are serious limitations for roads and buildings.

## *Use and Management of the Soils*

This section explains the system of capability grouping used by the Soil Conservation Service and discusses the management of soils in Monroe County by capability units. Estimated yields of the principal crops are given. Also discussed is the management of soils for cultivated crops, for pasture, for specialty crops, and for woodland and wildlife. The properties and features that affect engineering practices and the limitations that affect land use planning are given, mainly in tables.

### General Management Practices

There are wide variations in the use and management of the soils in Monroe County. Field crops, pasture, and specialty crops are grown. Information about suitable crop varieties, erosion control, artificial drainage, and other management practices can be obtained from the nearest office of the Soil Conservation Service or the Ohio Cooperative Extension Service.

### *Management for cultivated crops*

Among the field crops commonly grown in this county are corn, oats, wheat, and barley. Some of the practices needed in the management of field crops are discussed in the following paragraphs.

TILLAGE.—The effects of tillage on soils in Monroe County vary widely with differences in soil texture, moisture content, organic-matter content, and kind and amount of tillage. Most of the light-colored, well drained or moderately well drained soils, such as the Zanesville, Gilpin-Westmoreland, and Guernsey-Westmore, are subject to surface crusting and generally have a low organic-matter content. They also have a silt loam surface layer that generally has weak structure. Heavy rains cause these soils to form a rather hard crust. The need on such soils is to perform tillage sufficient for aeration of the soil and establishment of plants but to avoid excessive tillage that tends further to break down soil structure. Regardless of the kind of weed control, chemical or mechanical for example, shallow cultivation is generally necessary on light-colored soils to help control crusting.

Dark-colored soils, such as the Ashton, Huntington, Sees-Woolper, and Vandalia, are less subject to damaging crusting than the light-colored soils. Their organic-matter content is generally 1 to 3 percent higher than that of the light-colored soils. Research indicates that optimum crop yields on these soils require less cultivation than many farmers presently practice. In the absence of weeds, cultivation is not needed for top yields (*6*). Keeping tillage to a minimum tends to increase infiltration and to reduce runoff and erosion. Plow planting or no-till planting of corn is feasible on most soils in the county that are now cultivated.

Tillage of soils that have a high clay content in the plow layer is best done at an optimum moisture level. During wet periods in spring, this practice is difficult on such soils as the eroded Upshur, Guernsey, and Keene-Latham soils. Upshur clay and severely eroded Guernsey and Westmore soils present very difficult problems for tillage. If tillage is performed while these finer textured soils are too wet, excessive soil compaction results. If plowing is done when the soils are too dry, they are likely to become hard and cloddy. Conotton gravelly loam is one of the few soils on which tillage is relatively easy. Locally, however, the gravel interferes with good cultivation.

For best crop growth, the soils should be tested and lime and fertilizer should be applied as indicated by the results of the tests.

CROP RESIDUE UTILIZATION.—Many of the soils in Monroe County are low in organic-matter content. This is true of all the light-colored soils, such as the Gilpin and Wellston. In the dark-colored soils, such as those of the Huntington and Vandalia series, the organic-matter content commonly is 3 to 6 percent, which is an adequate amount. It is important that an adequate supply of organic matter be added to the soils regularly, particularly to the light-colored soils. All crop residue should be returned to the soil. Row crops, such as soybeans, that supply low amounts of crop residue should be supplemented with sod crops.

EROSION CONTROL.—About 85 percent of the acreage of soils in the county is subject to erosion if the soils are not protected. The erodibility of a particular soil depends in part on its physical properties. For example, Upshur soils are more susceptible to erosion than Dekalb soils having comparable slopes and vegetative cover. The hazard of erosion on all the soils increases as the percentage of slope increases. Most of the soils that have slopes of less than 2 percent are subject to little or no water erosion, and there is little or no hazard of soil blowing on any of the soils. The hazard of erosion on any particular soil is more severe with increasing intensity of use; for example, cultivated areas are more susceptible to erosion than woodland areas. Erosion control practices commonly used in the county include diversions, grassed waterways (fig. 6), contour stripcropping, contour tillage, minimum tillage, using crop residue, and using sod crops for vegetative cover.

DRAINAGE.—Most of the soils in Monroe County are either well drained or moderately well drained. They generally do not need to be artificially drained for crop production. Exceptions to this are small, wet, seepy spots. By draining these wet spots, some fields are made more usable and productive. The somewhat poorly drained soils are on bottom lands in the county. They are wet because they receive excess surface runoff from the adjacent upland areas or because of seeps and springs in the nearby hillsides. Artificial drainage is needed on the Newark soils and Hartshorn soils, wet variant. These soils can be drained by tile if suitable outlets can be located.

### *Management for pasture*

Nearly one third of the land area in the county is used for pasture. Pasture and hay plants commonly grown include alfalfa, red clover, white clover, bluegrass, orchard grass, tall fescue, timothy, and bromegrass. In most of the areas, pasture can be improved by using the practices discussed in the following paragraphs.

The ability of a pasture to produce forage and to provide surface protection to the soils is influenced by the number of livestock, the length of time they graze, the season they graze, and the availability of water. Practices that contribute to good pasture management are proper stocking rates to maintain key forage species, rotation of pastures and deferred grazing, grazing in the proper season, mowing for weed control, and ample water supplies (fig. 7) that are strategically located.

Erosion control is a major need because many of the soils used for pasture are steep and already eroded. Control of erosion is particularly important during seeding operations. Mulch seeding or use of a small grain as a companion crop can help prevent further erosion.

The need for lime and fertilizer should be determined by soil tests, and adequate amounts should be supplied to meet the requirements of the crop to be grown.

Soil compaction is caused by grazing when the soils are wet. It can greatly reduce the vigor of pasture plants. This is particularly true on soils of the Brooke, Guernsey, Latham, Rarden, and Upshur series. Tillage within the proper range of moisture content also helps to reduce soil compaction.

*Figure 6.*—Grassed waterways on a Zanesville silt loam.

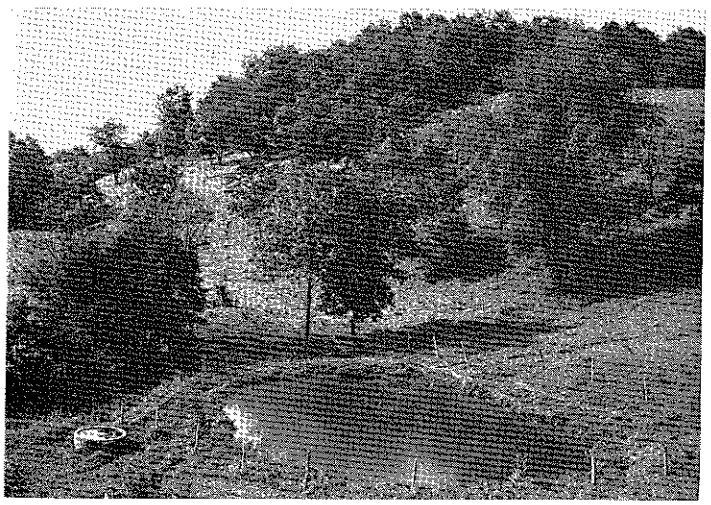

*Figure 7.*—Farm pond and watering tank on soils of a Gilpin-Upshur complex.

### *Management for specialty crops*

There are a few acres in the county used for orchards and specialty crops, such as tomatoes, sweet corn, and small fruits. Such crops require intensive management for profitable production. There are some soils in the county that are especially suitable for selected specialty crops. Among these soils are Ashton silt loam; Conotton gravelly loam; Dekalb loam, 6 to 12 percent slopes, moderately eroded; Gilpin-Upshur complex, 6 to 12 percent slopes, moderately eroded (Gilpin part only); Gilpin-Westmoreland silt loams, 6 to 12 percent slopes, moderately eroded; Hackers silt loam, 3 to 8 percent slopes; Huntington silt loam; Lindside silt loam; Wellston silt loam, 6 to 12 percent slopes, moderately eroded; Wheeling silt loam, 6 to 18 percent slopes, moderately eroded (normally up to 12 percent slopes); and Woolper silt loam, 2 to 6 percent slopes.

### *Irrigation*

Some of the soils in the county are suitable for sprinkler irrigation. Features that affect the suitability of a soil for sprinkler irrigation are slope, natural drainage, texture, movement of water within the soil, and the hazard of flooding. Soils that have slopes of more than 6 percent are difficult to irrigate without excessive soil losses. There are about 22,000 acres in the county where slopes are suitable for irrigation. Many of the soils that have suitable slopes have other undesirable characteristics.

Generally, the soils in the Ashton, Conotton, Gilpin, Wellston, Westmoreland, and Wheeling series that have slopes of less than 6 percent are suitable for sprinkler irrigation. Many areas of the less sloping Gilpin, Wellston, and Westmoreland soils, however, are small and may not be practical to irrigate.

### *Capability grouping*

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive land-forming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and

does not apply to rice, cranberries, horticultural crops, or other crops that require special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for forest trees, or for engineering.

In the capability system, the soils are grouped at three levels: the capability class, subclass, and unit. These are discussed in the following paragraphs.

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

Class I soils have few limitations that restrict their use.

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

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

Class IV soils have very severe limitations that reduce the choice of plants, 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 largely to pasture, woodland, or wildlife habitat. (None in Monroe County)

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to hay or pasture, woodland, or wildlife habitat.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture, woodland, or wildlife habitat.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife habitat, or water supply, or to esthetic purposes. (None in Monroe County)

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main 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, but not in Monroe County, shows that the chief limitation is climate that is too cold or too dry.

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

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIw–1 or IIIe–4. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

### *Management by capability units*

In the following pages each of the capability units in Monroe County is described and suggestions for the use and management of the soils are given. The names of the soil series represented are mentioned in the description of each capability unit, but the listing of the series name does not necessarily indicate that all the soils of a given series are in the capability unit. The capability classification of the soils is given in the "Guide to Mapping Units" at the back of this survey. Made land is not assigned a capability classification.

These descriptions stress improved management only. Suggestions for use and management of the soils are given, and features that limit the use of the soils for crops or pasture are pointed out. One or two soils have been included in some capability units even though they have some properties that differ from those of the rest of the soils in the unit. Generally, the acreage is so small that a separate description of these soils is not justified. The available moisture capacity ratings apply to the normal rooting zone of the commonly grown field crops, for example, corn and small grain. Additional information concerning erosion control, artificial drainage, suitable crop varieties, or other management practices can be obtained from the nearest office of the Soil Conservation Service or the Ohio Cooperative Extension Service.

#### CAPABILITY UNIT I–1

This unit consists of well-drained, level or nearly level soils of the Ashton and Wheeling series. These soils are level or nearly level (0 to 3 percent slopes) and occupy stream terraces that are generally high enough to escape flooding. Some low areas, however, are subject to occasional flooding. The soils have a deep rooting zone, moderate permeability, and a loamy texture throughout. Their available moisture capacity is high. Sandy and gravelly material is at depths of 48 inches or more. The Ashton soil has a dark-colored surface layer.

These soils are among the best soils for farming in the county. There are no soil features that limit use for field crops or pasture. There is little or no hazard of erosion on these soils under either average or improved management. Good soil structure can be maintained by using crops that supply large amounts of crop residue.

The soils are suited to all cultivated crops and all hay or pasture plants commonly grown in the county, and they are suited to continuous use for cultivated crops if improved management is used. Irrigation is not a common practice in the county, but these soils are well suited

to irrigation. Normally, an adequate supply of water is located nearby. The Ashton soil generally has soil reactions that are above a pH of 6.0. It requires little or no lime if common cultivated crops are grown. The Wheeling soil has an acid subsoil. Its lime requirements are normally moderate or high.

#### CAPABILITY UNIT IIe–1

This unit consists of well-drained soils of the Gilpin, Upshur, Wellston, and Westmoreland series. These are gently sloping soils (2 to 6 percent slopes) that lie on ridgetops and sidehill benches in scattered small areas throughout the county. All are moderately eroded. The rooting zone of these soils is moderately deep or deep. The Gilpin, Wellston, and Westmoreland soils are moderately permeable; the Upshur soils have a clayey subsoil and are slowly permeable. The rooting zone of all these soils is strongly acid where lime has not been applied.

A moderate hazard of erosion is the main limitation of these soils for cultivated crops. Surface runoff is medium. Good tilth is difficult to maintain if the soils are frequently cultivated. Returning crop residue to the soil and minimizing tillage help to maintain good tilth. All the soils are subject to crusting.

The soils are well suited to all the field crops and hay and pasture plants commonly grown in the county. They can be cultivated frequently if good management practices are used.

#### CAPABILITY UNIT IIe–2

This unit consists of well-drained soils on alluvial fans and stream terraces. These soils are in the Hackers, Wheeling, and Woolper series. Slopes are mostly 2 to 6 percent but range to 8 percent. The Hackers and Woolper soils occupy alluvial fans that are flooded from time to time, but flooding is not as serious on these soils as it is on the nearby flood plains. The soils in this unit have a deep rooting zone, their permeability is moderate or moderately slow, and their available moisture capacity is high. Reaction in the rooting zone is strongly acid to very strongly acid in Hackers and Wheeling soils and slightly acid to neutral in the Woolper soil. The hazard of erosion is the major limitation of these soils if they are used for cultivated crops. Some areas are subject to brief periods of flooding. The Woolper soil has a higher organic-matter content and is less subject to surface crusting than the Wheeling and Hackers soils.

These soils are well suited to all the field crops and hay and pasture plants commonly grown in the county. The surface layer is generally friable and easily tilled. The soils can be cultivated frequently or continuously if erosion is controlled. The hazard of erosion is difficult to control on slopes over 4 percent if they are continuously cultivated. Flooding on the alluvial fans can be minimized by channel maintenance.

#### CAPABILITY UNIT IIe–3

This unit consists mostly of moderately well drained soils on uplands or high terraces. The soils are of the Captina, Keene, Sciotoville, Woodsfield, and Zanesville series. The Woodsfield soils in the Zanesville-Woodsfield complex are well drained. The soils range in slope from 0 to 6 percent, but most slopes are 2 to 6 percent. The soils have either a fragipan or a restrictive clayey subsoil, and their rooting zone is only moderately deep in most places. Available moisture capacity is medium, and reaction is strongly acid or very strongly acid. Permeability is slow or moderately slow.

A moderate hazard of erosion is the major limitation if these soils are used for row crops. Surface runoff is medium. A perched water table during wet periods in spring causes these soils to dry out more slowly than well-drained soils. There are seeps or wet spots in places. All of these soils are susceptible to surface crusting and compaction if they are tilled or grazed when wet.

These soils are suited to most field crops commonly grown in the county. They can be cultivated frequently if improved management is used. All of the soils are well suited to hay or pasture plants commonly grown in the county. The moderately eroded soils require more careful management than the uneroded soils because erosion has reduced the effective rooting zone.

#### CAPABILITY UNIT IIw–1

This unit consists of soils of the Chagrin, Hartshorn, Huntington, and Lindside series. The Huntington soils and some areas of Lindside soils are on flood plains along the Ohio River. The Chagrin soils and some areas of Lindside soils are along major streams other than the Ohio River, and the Hartshorn soils are on narrow flood plains throughout the county. All the soils in this unit are subject to flooding. They are well drained or moderately well drained. The Huntington soils are dark colored; the others are lighter colored. The Hartshorn soils are coarser textured, less deep to sand and gravel, and more droughty than the other soils. All the soils are nearly level (0 to 2 percent slope). They are medium acid to neutral and rarely require lime. Most of the soils have a deep rooting zone, high available moisture capacity, and moderate permeability. The rooting system is more shallow in the Hartshorn soil, however, and the available moisture capacity is low.

Seasonal flooding is the major limitation of these soils. The hazard of erosion is slight, although some areas are subject to scouring. The Huntington soils along the Ohio River are flooded so frequently late in spring that they are generally only used for late-planted, short-season corn.

Except that they are subject to flooding, these soils are well suited to all the crops commonly grown in the county. Flooding, however, limits their use largely to summer-grown row crops. Row crops can be grown year after year without significant damage if improved management is used. Chagrin, Lindside, and Hartshorn soils are well suited to pasture of native bluegrass and Ladino clover. Many areas of these soils are used for permanent pasture in this county. Areas subject to frequent flooding are better suited to trees or grass than to row crops.

#### CAPABILITY UNIT IIw–2

This unit consists of poorly drained soils of the Newark series and the Hartshorn series, wet variant. These soils are on low-lying flood plains. The Hartshorn soil, wet variant, is mainly on narrow flood plains along small streams; the Newark soil is along the larger streams where the flood plains are wider. Both soils have a seasonal high water table that results mainly from runoff

and seep water from the adjacent higher areas. The soils are also subject to flooding, particularly in winter and spring. Whether or not they are flooded, the soils stay wet until late in spring or early in summer unless they are artificially drained. The rooting zone is moderately deep early in the season but deep later in summer. The available moisture capacity is medium or high. The Hartshorn soil, wet variant, is sometimes droughty in summer.

Wetness is the major limitation of these soils. Maintaining good soil structure is difficult if the soils are tilled or grazed when wet. Excess water from adjacent slopes can generally be intercepted by tile or diversions. The seasonable high water table can be lowered by tile drains if outlets are available. There is little or no hazard of erosion.

These soils are used mainly for pasture but can be continuously cultivated if improved management is used. Where adequately drained, the soils are suited to most of the commonly grown field crops and hay or pasture plants that will tolerate wetness. In some areas, flooding is so frequent that the soils should be continuously protected by trees or grass.

#### CAPABILITY UNIT IIIe–1

This unit consists of well-drained, light-colored soils of the Conotton, Dekalb, Gilpin, Upshur, Wellston, and Westmoreland series. Most of these soils are sloping (6 to 12 percent slopes), but the Conotton soils occupy sloping to moderately steep terraces (6 to 18 percent slopes), mainly along the Ohio River. Conotton soils are underlain by sandy and gravelly substrata at a depth below 20 inches. The other soils are underlain by sandstone, siltstone, or clay shale. In all the soils the rooting zone is moderately deep or deep and the available moisture capacity is medium or low. Water movement in these soils ranges from slow in the Upshur part of the Gilpin-Upshur complex to moderately rapid in Conotton and Dekalb soils. All the soils are strongly acid or very strongly acid.

A severe hazard of erosion is the major limitation if these soils are used for cultivated crops. Surface runoff generally is rapid. The Dekalb and Conotton soils are more droughty than the soils that have a silt loam surface layer, but crusting is not a problem on the Dekalb and Conotton soils. The other soils are susceptible to crusting.

Soils in this unit are suited to all the field crops and the hay and pasture plants that are commonly grown in the county. It is more difficult to establish a thick plant cover on the Upshur soils of the Gilpin-Upshur complex than on the other soils. Cultivated crops can be grown frequently if improved management is used, but erosion is generally difficult to control on these slopes. These soils are suited to pasture of bluegrass and white clover, but tall grasses and legumes generally are more suitable.

#### CAPABILITY UNIT IIIe–2

This unit consists of well drained or moderately well drained soils of the Captina, Woodsfield, and Zanesville series. These soils are sloping (0 to 12 percent slopes). The Captina soil is on stream terraces; the Zanesville and Woodsfield soils are on ridgetops and side benches throughout the county.

These soils are predominantly loamy throughout, except for the Woodsfield soil, which is clayey beginning at a depth of about 22 inches. The Captina and Zanesville soils have a very firm fragipan at a depth of about 24 inches. It ranges in thickness from about 10 to 42 inches. The substratum of the Captina soil is commonly sandy and gravelly. Interbedded bedrock underlies the Zanesville and Woodsfield soils at depths ranging from 30 to about 66 inches.

The rooting zone is moderately deep in most of these soils, but the Woodsfield soil has a deep rooting zone in some areas. The available moisture capacity is medium in most places. The surface layer is generally friable and easy to till. Permeability is slow or moderately slow, and reaction is strongly acid or very strongly acid. The soils that have a fragipan in their subsoil have a perched water table above this pan during extended wet periods, particularly in winter and spring. For this reason, these soils are slow to dry out and warm up in the spring. Small seep spots occur in some places.

A severe hazard of erosion is the major limitation if the soils in this unit are used for cultivated crops. Maintaining fertility, good tilth, and the organic-matter content are management concerns when the soils are frequently cultivated.

These soils are suited to all of the field crops and hay and pasture plants that are commonly grown in the county. Good stands of deep-rooted crops, such as alfalfa, grown on Captina and Zanesville soils are difficult to maintain in long rotations because the fragipan and the seasonal high water table restrict root growth.

#### CAPABILITY UNIT IIIe–3

This unit consists of moderately well drained or well drained, sloping (6 to 12 percent slopes) soils of the Coolville, Guernsey, Keene, Rarden, Upshur, Westmore, and Woodsfield series. All of these soils are underlain by interbedded bedrock. The Coolville, Keene, Rarden, and Woodsfield soils have clay shale substrata in most places. The Guernsey and Westmore soils have limestone and shale substrata in most places. All of these soils have clayey layers in their subsoil. The rooting zone is deep or moderately deep, and the available moisture capacity ranges from medium to high. Permeability is slow. Reaction generally is strongly acid to extremely acid, but in some areas the Guernsey soils are only medium acid.

A severe hazard of erosion is the major limitation if the soils in this unit are used for cultivated crops. Surface runoff is rapid, and all the soils are moderately eroded. Small wet spots are common in some areas and are a minor limitation.

These soils are suited to most field crops commonly grown in the county. Maintaining fertility, good tilth, and organic-matter content are management concerns if the soils are frequently cultivated. Some areas of these soils are used for pasture, hay, or trees. The Guernsey, Upshur, and Westmore soils are suitable for improved pasture and are well suited to bluegrass.

#### CAPABILITY UNIT IIIe–4

This unit consists of Wheeling silt loam, 6 to 18 percent slopes, moderately eroded, and Woolper and Sees silt loams, 6 to 12 percent slopes. The Wheeling soil is

well drained and is on stream terraces. The Woolper soil is well drained, the Sees soil is moderately well drained, and both are on colluvial foot slopes. The rooting zone of all these soils is deep, and the available moisture capacity is medium or high. Permeability ranges from moderate in the Wheeling soil to slow in the Sees soil. Reaction in the rooting zone is strongly acid to very strongly acid in the Wheeling soil, but it is generally less acid in Woolper and Sees soils.

The hazard of erosion is severe if the soils in this unit are used for cultivated crops. Some lower lying areas of the Wheeling soil are subject to occasional flooding. The Sees soil is seepy and slow to dry in spring.

These soils are suited to the field crops commonly grown in the county and can be cultivated frequently if improved management is used. The Woolper and Sees silt loams are well suited to alfalfa, but artificial drainage generally is needed. Erosion control is difficult if the soils are frequently cultivated, even with improved management. All of these soils are well suited to native or improved pasture.

#### CAPABILITY UNIT IIIs–1

The only soil in this unit is Conotton gravelly loam, 0 to 2 percent slopes. This nearly level soil is on terraces, mostly along the Ohio River. The rooting zone is gravelly and moderately deep, and the available moisture capacity is low. Reaction is very strongly acid to medium acid.

The low available moisture capacity is the dominant limitation of this soil for cultivated crops. There is a slight hazard of erosion under average or improved level of management. Tilth generally is good, though the organic-matter content is low.

This soil is suited to most field crops and pasture plants commonly grown in the county. It is better suited to small grains than to corn because of droughtiness. Because this soil dries out and warms up quickly in spring, it is well suited to short-season crops. It also is well suited to irrigation. Most of the common pasture plants grow well on this soil, but their growth declines in summer unless irrigation water is applied.

#### CAPABILITY UNIT IVe–1

This unit consists of moderately steep, well drained or moderately well drained soils of the Brooke, Guernsey, Sees, Upshur, Vandalia, Westmore, and Woolper series. These soils are on ridgetops, at the base of colluvial slopes, and in other positions on uplands. Most of them have clayey layers in their subsoil, and all are influenced by limestone or seepage from higher lying limestone strata. They have a moderately deep to deep rooting zone, and permeability is moderately slow or slow. Available moisture capacity generally is high. In the Sees and Woolper soils, reaction generally is slightly acid to medium acid. Reaction in the other soils is strongly acid or very strongly acid in the upper part of the rooting zone and is less acid with increasing depth.

Rapid to very rapid surface runoff causes a very severe hazard of erosion if these soils are cultivated. Seepy spots are common in some areas.

These soils are well suited to the field crops commonly grown in the county, but erosion is difficult to control if the soils are cultivated. They are suited to occasional cultivation. Improved management is needed in cultivated areas; otherwise, erosion losses are likely to be excessive. These soils generally are well suited to native bluegrass pasture and to improved tall grass-legume pasture. The Upshur soils of the Guernsey-Upshur complex are not so well suited to improved pasture.

#### CAPABILITY UNIT IVe–2

This unit consists of loamy, well-drained soils of the DeKalb, Gilpin, Wellston, and Westmoreland series. It also includes Upshur soils that have a clayey subsoil. All the soils are moderately steep (12 to 18 percent slopes) and are on uplands. They are underlain by bedrock. In general, Dekalb soils have sandstone substrata, and soils of the Gilpin-Upshur complex and Wellston soils have a siltstone, shale, or sandstone substratum. The rooting zone of these soils is mostly moderately deep, and available moisture capacity is medium to low. Permeability is moderate in most of the soils but is moderately rapid in Dekalb soils and slow in Upshur soils. The rooting zone is very strongly acid in most places, and the requirement for lime is moderate to high.

A severe hazard of erosion is the main concern if these soils are used for cultivated crops. Surface runoff is very rapid. Maintaining fertility, good tilth, and the organic-matter content are management concerns if the soils are cultivated. These soils are more droughty than other soils on uplands.

The soils are suited to all the field crops and hay and pasture plants that are commonly grown in the county. They are suited to occasional cultivation if improved management is used. More than occasional cultivation commonly results in excessive soil losses through erosion.

#### CAPABILITY UNIT IVe–3

This unit consists of moderately well drained or well drained soils of the Captina, Woodsfield, and Zanesville series. These soils are moderately steep (12 to 18 percent slopes). The Captina soil is on stream terraces, and the Zanesville and Woodsfield soils are on ridgetops and side benches throughout the county.

These soils are mostly loamy throughout, but the lower part of the subsoil is clayey in the Woodsfield soil. The Captina and Zanesville soils have a very firm, compact fragipan in their subsoil. The fragipan commonly begins at a depth of about 24 inches. The fragipan in Captina and Zanesville soils and the clayey subsoil in the Woodsfield soil restrict water movement. The substratum of the Captina soil contains some sand and gravel. Interbedded bedrock underlies the Zanesville and Woodsfield soils at depths ranging from about 40 to 66 inches.

The rooting zone is moderately deep in most areas of these soils. Some areas of the Woodsfield soil have a deep rooting zone. The soils in this unit have a medium to low available moisture capacity. The surface layer is friable and easy to till. Permeability is slow. The soils that have a fragipan have a perched water table above this pan during extended wet periods, particularly in winter and spring. Reaction is strongly acid to very strongly acid.

A severe hazard of erosion is the major concern if these soils are used for cultivated crops. Maintaining fertility, good tilth, and the organic-matter content are important where the soils are cultivated.

These soils are suited to most of the field crops and hay and pasture plants that are commonly grown in the

county. Good stands of deep-rooted crops, such as alfalfa, are difficult to maintain in long rotations on Captina and Zanesville soils. The soils in this unit are suited to occasional cultivation if improved management is used. More than occasional cultivation commonly results in excessive soil losses through erosion. The small seep spots in these soils can normally be drained by random tile.

#### CAPABILITY UNIT IVe–4

This unit consists of soils in the Coolville, Keene, Latham, Rarden, and Upshur series. These soils are moderately deep to deep and well drained or moderately well drained. They occupy a variety of positions on uplands, from narrow rounded ridgetops to side slopes and narrow benches. They are mostly moderately steep, but the Upshur soils are sloping. Most of these soils have a relatively thin silt loam surface layer over a clayey subsoil. The silt loam surface layer is thin because of past erosion. The severely eroded Upshur soil is clayey to the surface. All of the soils formed on weathered clay shales. Most have a moderately deep rooting zone and slow permeability. They have a medium to low available moisture capacity, and the rooting zone is very strongly acid to extremely acid. The organic-matter content is generally low.

Rapid surface runoff causes a very severe hazard of erosion on these soils. Seepy spots are common. The acidity of this group of soils is also a limitation; lime requirements are generally high.

These soils are suited to field crops commonly grown in the county but are poorly suited to other than occasional cultivation. Erosion is difficult to control on these slopes. Improved management is needed for cultivated areas to check soil losses through erosion. These soils are suited to native bluegrass pastures and to improved tall grass-legume pastures.

#### CAPABILITY UNIT VIe–1

This unit consists of well drained or moderately well drained, steep to very steep (18 to 35 percent slopes) soils of the Brooke, Guernsey, Keene, Latham, Sees, Upshur, Westmore, Woolper, and Vandalia series. Moderately steep (12 to 18 percent slopes) Upshur soils are also included in the unit. All these soils have a clayey subsoil. They occur on side slopes, narrow ridgetops, and benches. The Brooke, Guernsey, Westmore, Sees, and Woolper soils are influenced by limestone or seepage from limestone. They are less acid as depth increases. Keene and Latham soils formed in residuum from weathered, acid, clay shale. They have high lime requirements. Upshur soils formed in weathered, red clay shale, and Vandalia soils are in colluvial positions downslope from Upshur soils. Water movement in all the soils is moderately slow to slow. The rooting zone is moderately deep to deep, and the available moisture capacity is medium to high.

Surface runoff is very rapid during winter and spring when the soils are likely to be saturated. Consequently, there is a severe hazard of erosion unless a thick protective plant cover is maintained. Some areas of these soils are subject to cracking and slippage.

The hazard of erosion is too great for these soils to be cultivated. They are, however, well suited to permanent hay or pasture. The Brooke, Guernsey, Westmore, Sees, and Woolper soils are well suited to alfalfa and to tallgrass pasture. The Latham, Keene, Vandalia, and Upshur soils are more strongly acid and have a high lime requirement. Seep spots are common in some of these soils, and some of the seep spots provide enough water for the development of springs.

#### CAPABILITY UNIT VIe–2

This unit consists of steep to moderately steep (12 to 35 percent slopes) soils of the Dekalb, Gilpin, Upshur, and Westmoreland series. All of these soils are on uplands, and all except the Upshur are mostly loamy throughout. The Upshur soils have a clayey subsoil. The substratum of these soils is siltstone, sandstone, or clay shale. The rooting zone is mostly moderately deep. The available moisture capacity is low or medium; it is generally low in the severely eroded Gilpin and Westmoreland soils. Permeability in the dominant soils is moderate, but the Upshur soils have slow permeability. Surface runoff is rapid to very rapid in winter and early in spring when the soils are wet.

The soils in this unit are generally unsuitable for cultivation because erosion is a severe hazard if protective cover is not maintained. They are droughty during periods of limited rainfall.

These soils are suited to permanent hay (fig. 8), pasture, or woodland. Overgrazing, grazing when the soils are wet, and the failure to maintain a high level of fertility are some of the major causes of poor growth of hay and pasture plants on these soils. Under improved management, these soils produce satisfactory forage. Seep spots in some areas of these soils provide sufficient water for the development of springs.

#### CAPABILITY UNIT VIs–1

This unit consists of very stony, moderately steep to very steep soils of the Dekalb, Gilpin, Sees, Upshur, and Vandalia series. Stones on these soils make tillage impractical, and most of the acreage is wooded. In some areas, however, farm machinery could be used for mowing and fertilizing.

Stoniness and slope are the major limitations to the use of these soils. Surface runoff is rapid, and there is a severe hazard of erosion unless a thick plant cover is maintained.

These soils are well suited to native grass pasture or woodland. Bluegrass grows well on these soils, but mowing for weed control is difficult in most areas because of the stones.

#### CAPABILITY UNIT VIIe–1

This unit consists of well drained or moderately well drained soils of the Gilpin, Guernsey, Upshur, Westmore, and Westmoreland series. Also in the unit is Gullied land, Gilpin-Upshur material. These soils are steep or very steep (18 to 35 percent or 35 to 70 percent slopes) and are severely eroded. They generally are on the warmer slopes that face southeast to west. The texture and depth of the soils and the kinds of underlying bedrock are variable. The rooting zone in most places is shallow to moderately deep, and the available moisture capacity is low. Surface runoff is very rapid in most places.

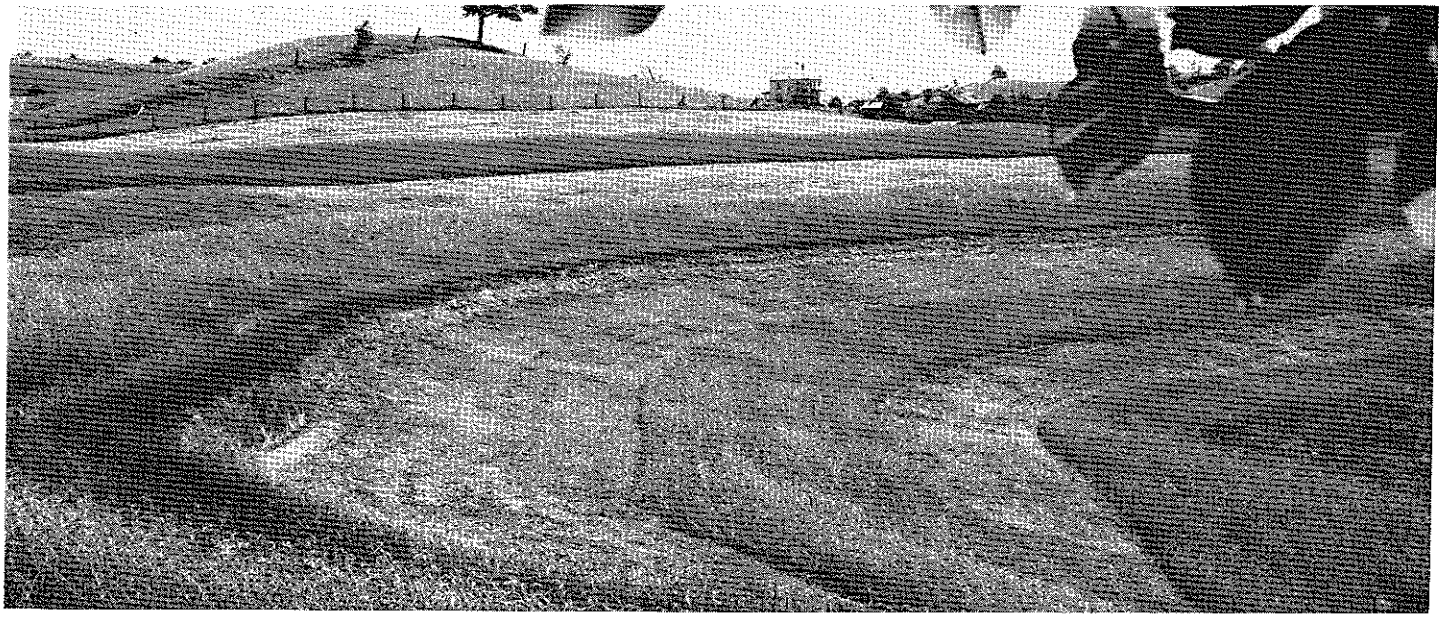

*Figure 8.*—**Contour stripcropping on Gilpin-Westmoreland silt loams, 18 to 35 percent slopes, moderately eroded, which is in capability unit VIe–2. The strips consist of small grain and hay.**

Past erosion (fig. 9) and slope are the major limitations of the soils in this unit. The use of machinery is limited by gullies that are 10 to 15 feet deep in places. There are also landslips and seep spots. All the soils have been cleared of trees, and excessive tillage or poor pasture management has contributed to the severe erosion.

These soils are suited to permanent vegetation, either grass or trees. Some areas have been planted to trees. Other areas have been left idle, and natural vegetation has satisfactorily checked active erosion in some areas. This vegetation generally is a combination of broomsedge, povertygrass, and native trees. The tree species are

*Figure 9.*—**Rill and sheet erosion on Guernsey-Westmore silt loams, 18 to 35 percent slopes, severely eroded, which is in capability unit VIIe–1.**

commonly undesirable, and stands generally are poor. An exception is the good stands of Virginia pine that grow in some areas of these soils in the southern part of the county. Improved management is required if pasture on these soils is renovated.

CAPABILITY UNIT VIIe–2

This unit consists of well drained or moderately well drained soils of the Gilpin, Guernsey, Upshur, Westmore, and Westmoreland series. Strip mine spoils, a land type, is also in this unit. Some areas of strip mine spoils have slopes that range from 2 to 12 percent. Generally, the rooting zone in the soils is moderately deep, and the available moisture capacity is medium to low. Lime requirements are commonly high.

A severe hazard of erosion is the main concern if a thick protective plant cover is not maintained on these soils. Other limitations are the very steep slopes and danger of landslips. The landslips occur mainly in the soils that have a clayey subsoil and substratum. Seep spots are common, and they provide water for the development of springs.

Soils in this unit are suited to trees or permanent pasture. Because of the very steep slopes, the soils are difficult to manage for the production of pasture plants.

CAPABILITY UNIT VIIs–1

This unit consists of well-drained, very steep, very stony soils of the Dekalb, Gilpin, and Upshur series. All the very stony soils that are on uplands of the county and have slopes of 35 to 70 percent are in this unit. They have mostly a moderately deep rooting zone, have a medium to low available moisture capacity, and are very strongly acid or extremely acid.

The major limitations of these soils are stoniness and slope. Erosion is a hazard if a thick plant cover is not maintained. Because of these limitations, the soils in this unit are used mostly for woodland. The stones and very steep slopes hinder logging operations. The soils have very limited use for pasture.

## Estimated Yields [2]

Table 1 shows, for each soil in the county, the estimated average acre yields of principal crops. The yields are averages of those expected over a period of several years under two levels of management. Yields in columns A are obtained under the average level of management. Those in columns B are obtained under improved management. The two levels of management are defined as follows:

*Improved management.*—Practices are used that increase the intake of water and the available moisture capacity of the soil. Excess water is disposed of by safe and appropriate means. Practices also are used that help to control erosion. Appropriate tillage practices, including plowing, seedbed preparation, and weed and insect control, are used. The fertility and pH of the soil are kept at an optimum level, and trace elements are applied as needed. Adapted high-yielding crop varieties are used. All practices are done at the proper time.

*Average management.*—That level of management under which one or more of the basic intensive management practices are not used or are applied inadequately.

The yields in table 1 do not apply directly to any specific field for any particular year, because the soils vary from place to place, management practices differ from farm to farm, and weather conditions are variable from year to year. The estimates are intended only as a guide that shows relative productivity of the soils, the response of the soils to management, and the relationship of soils to each other.

The estimates of yields given in table 1 are based on information obtained from farmers and on observations and field trials made by the county agricultural extension agent and district conservationists of the Soil Conservation Service.

Many of the soils in Monroe County are mapped in complexes in which the two soils have significantly different productivity. It is not possible to give yield estimates for these mapping units as a whole because of varying proportions of the two soils in a given area. Thus, yields are listed in table 1 for each of the specific soil series that is represented. The mapping units are listed alphabetically in table 1. Estimates for mapping units that consist of one soil can be obtained directly from the table. To derive the estimate for a complex, it is necessary to average the estimated yields of each soil series according to percentage of each series in the complex. The reader should refer to the "Descriptions of the Soils" to determine the percentages of each soil that can occur in a given complex.

## Use of the Soils for Woodland [3]

Approximately 60 percent of the acreage of Monroe County is wooded. More than 90 percent of the wooded acreage consists of privately owned stands and farm woodlots that average about 55 acres in size. The larger privately owned tracts are along the Little Muskingum River, Sunfish Creek, Opossum Creek, and the very steep bluffs in the central and southern part of Monroe County. The State also owns land in the newly formed Sunfish Creek State Forest. The southwestern part of the county is in the Wayne National Forest purchase area.

Monroe County is in the central hardwood forest region where there are many different kinds of trees and several different forest types. In general, the forest types vary with the site, but hardwoods are dominant.

In places, the woodlands show the results of abuse and neglect. Heavy cutting in the past without planning for future timber crops has resulted in understocked stands of mature trees. "High grading" has continually removed the best and left the worst. Culls and low-value trees have accumulated and occupy valuable growing space on excellent woodland soils. Low-value white elm, cull beech, poorly formed black cherry, and soft maple now occupy thousands of acres where yellow-poplar, oak,

[2] NEAL C. BERRY, CLARENCE W. MCKNIGHT, Soil Conservation Service, and DONALD W. POLLACK, Monroe County extension agent, helped prepare this section.

[3] WILLIAM SAUERWEIN, woodland conservationist, Soil Conservation Service, helped prepare this section.

TABLE 1.—*Estimated average yields per acre of principal crops under two levels of management*

[Yields in columns A are those to be expected under common management; those in columns B are those to be expected under improved management. Dashes indicate that the crop is not well suited to the soil or is not commonly grown. Gullied land, Gilpin-Upshur material; Made land; and Strip mine spoils are not listed, because they are not suited to crops]

| Soil | Corn | | Oats | | Wheat | | Barley | | Clover-grass hay | | Pasture | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Bluegrass | | Tall grass-legume |
| | A | B | A | B | A | B | A | B | A | B | A | B | B |
| | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Tons* | *Tons* | *Cow-acre-days* [1] | *Cow-acre-days* [1] | *Cow-acre-days* [1] |
| Ashton silt loam, 0 to 3 percent slopes | 90 | 130 | 50 | 74 | 30 | 46 | 50 | 65 | 3.5 | 5.0 | 140 | 160 | 220 |
| Brooke silty clay loam, 12 to 18 percent slopes, moderately eroded | 38 | 78 | 42 | 52 | 20 | 31 | 40 | 50 | 2.3 | 4.0 | 92 | 105 | 180 |
| Brooke silty clay loam, 18 to 35 percent slopes, moderately eroded | | | | | | | | | 2.1 | 3.8 | 84 | 96 | 160 |
| Captina silt loam, 2 to 6 percent slopes | 65 | 90 | 45 | 68 | 25 | 38 | 45 | 60 | 2.3 | 4.2 | 92 | 105 | 200 |
| Captina silt loam, 6 to 12 percent slopes, moderately eroded | 60 | 86 | 38 | 65 | 23 | 36 | 45 | 60 | 2.1 | 3.9 | 84 | 96 | 200 |
| Captina silt loam, 12 to 18 percent slopes, moderately eroded | 55 | 84 | 36 | 63 | 22 | 35 | 45 | 60 | 2.0 | 3.7 | 80 | 91 | 180 |
| Chagrin silt loam | 80 | 120 | 48 | 70 | 30 | 40 | 45 | 60 | 3.0 | 4.5 | 120 | 137 | 210 |
| Conotton gravelly loam, 0 to 2 percent slopes | 65 | 85 | 47 | 65 | 25 | 35 | 45 | 60 | 2.9 | 3.7 | 116 | 132 | 180 |
| Conotton gravelly loam, 6 to 18 percent slopes | 55 | 80 | 43 | 60 | 23 | 33 | 40 | 55 | 2.7 | 3.5 | 108 | 123 | 180 |
| Coolville-Rarden silt loams, 6 to 12 percent slopes, moderately eroded | 65 | 90 | 39 | 58 | 21 | 34 | 40 | 55 | 2.1 | 3.3 | 84 | 96 | 160 |
| Coolville-Rarden silt loam, 12 to 18 percent slopes, moderately eroded | 65 | 90 | 37 | 57 | 20 | 33 | 40 | 55 | 2.0 | 3.2 | 80 | 91 | 160 |
| Dekalb loam, 6 to 12 percent slopes, moderately eroded | 60 | 80 | 40 | 54 | 23 | 33 | 35 | 50 | 2.5 | 3.3 | 100 | 114 | 160 |
| Dekalb loam, 12 to 18 percent slopes, moderately eroded | 50 | 75 | 38 | 50 | 20 | 32 | 35 | 50 | 2.2 | 3.4 | 88 | 101 | 150 |
| Dekalb loam, 18 to 35 percent slopes, moderately eroded | | | | | | | | | 2.0 | 3.2 | 80 | 91 | 140 |
| Gilpin and Dekalb very stony soils, 12 to 35 percent slopes | | | | | | | | | | | 68 | 78 | |
| Gilpin and Dekalb very stony soils, 35 to 70 percent slopes | | | | | | | | | | | 45 | 50 | |
| Gilpin-Upshur complex, 2 to 6 percent slopes, moderately eroded: | | | | | | | | | | | | | |
| Gilpin part | 70 | 95 | 46 | 60 | 25 | 40 | 40 | 55 | 2.5 | 4.4 | 100 | 114 | 200 |
| Upshur part | 60 | 90 | 38 | 55 | 22 | 35 | 33 | 48 | 2.1 | 3.5 | 68 | 78 | 180 |
| Gilpin-Upshur complex, 6 to 12 percent slopes, moderately eroded: | | | | | | | | | | | | | |
| Gilpin part | 70 | 90 | 44 | 58 | 23 | 38 | 40 | 55 | 2.4 | 4.3 | 96 | 110 | 200 |
| Upshur part | 58 | 85 | 34 | 50 | 20 | 33 | 30 | 45 | 2.0 | 3.3 | 68 | 78 | 180 |
| Gilpin-Upshur complex, 12 to 18 percent slopes: | | | | | | | | | | | | | |
| Gilpin part | 70 | 93 | 43 | 57 | 22 | 37 | 40 | 55 | 2.3 | 4.3 | 92 | 105 | 200 |
| Upshur part | 55 | 80 | 35 | 48 | 19 | 32 | 28 | 43 | 1.7 | 3.0 | 68 | 78 | 180 |
| Gilpin-Upshur complex, 12 to 18 percent slopes, moderately eroded: | | | | | | | | | | | | | |
| Gilpin part | 65 | 85 | 41 | 55 | 21 | 35 | 35 | 50 | 2.2 | 4.2 | 88 | 101 | 190 |
| Upshur part | 50 | 75 | 33 | 45 | 19 | 32 | 25 | 40 | 1.6 | 2.8 | 64 | 73 | 160 |
| Gilpin-Upshur complex, 18 to 35 percent slopes, moderately eroded: | | | | | | | | | | | | | |
| Gilpin part | | | | | | | | | 2.0 | 3.9 | 80 | 91 | 180 |
| Upshur part | | | | | | | | | 1.4 | 2.5 | 56 | 64 | 150 |

See footnote at end of table.

TABLE 1.—*Estimated average yields per acre of principal crops under two levels of management*—Continued

| Soil | Corn | | Oats | | Wheat | | Barley | | Clover-grass hay | | Pasture | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Bluegrass | | Tall grass-legume |
| | A | B | A | B | A | B | A | B | A | B | A | B | B |
| | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Tons* | *Tons* | *Cow-acre-days* [1] | *Cow-acre-days* [1] | *Cow-acre-days* [1] |
| Gilpin-Upshur complex, 18 to 35 percent slopes, severely eroded: | | | | | | | | | | | | | |
| Gilpin part | | | | | | | | | | | 30 | 34 | |
| Upshur part | | | | | | | | | | | 52 | 59 | |
| Gilpin-Upshur complex, 35 to 70 percent slopes: | | | | | | | | | | | | | |
| Gilpin part | | | | | | | | | | | 65 | 75 | |
| Upshur part | | | | | | | | | | | 50 | 60 | |
| Gilpin-Upshur complex, 35 to 70 percent slopes, severely eroded: | | | | | | | | | | | | | |
| Gilpin part | | | | | | | | | | | 55 | 65 | |
| Upshur part | | | | | | | | | | | 45 | 55 | |
| Gilpin-Upshur complex, steep, benched: | | | | | | | | | | | | | |
| Gilpin part | | | | | | | | | 2. 1 | 4. 0 | 84 | 96 | 180 |
| Upshur part | | | | | | | | | 1. 4 | 2. 5 | 56 | 64 | 150 |
| Gilpin-Upshur complex, very steep, benched: | | | | | | | | | | | | | |
| Gilpin part | | | | | | | | | | | 66 | 75 | |
| Upshur part | | | | | | | | | | | 50 | 60 | |
| Gilpin-Upshur very stony complex, 12 to 35 percent slopes | | | | | | | | | | | 76 | 87 | |
| Gilpin-Upshur very stony complex, 35 to 70 percent slopes | | | | | | | | | | | 45 | 50 | |
| Gilpin-Westmoreland silt loams, 2 to 6 percent slopes, moderately eroded: | | | | | | | | | | | | | |
| Gilpin part | 70 | 95 | 46 | 60 | 25 | 40 | 40 | 55 | 2. 5 | 4. 4 | 100 | 114 | 200 |
| Westmoreland part | 75 | 100 | 46 | 60 | 25 | 40 | 40 | 55 | 2. 5 | 4. 4 | 100 | 114 | 220 |
| Gilpin-Westmoreland silt loams, 6 to 12 percent slopes, moderately eroded: | | | | | | | | | | | | | |
| Gilpin part | 70 | 90 | 44 | 58 | 23 | 38 | 40 | 55 | 2. 4 | 4. 3 | 96 | 110 | 200 |
| Westmoreland part | 70 | 90 | 44 | 58 | 23 | 38 | 40 | 55 | 2. 4 | 4. 3 | 96 | 110 | 220 |
| Gilpin-Westmoreland silt loams, 12 to 18 percent slopes, moderately eroded: | | | | | | | | | | | | | |
| Gilpin part | 65 | 85 | 41 | 55 | 21 | 35 | 35 | 50 | 2. 2 | 4. 2 | 88 | 101 | 200 |
| Westmoreland part | 70 | 90 | 41 | 55 | 21 | 35 | 35 | 50 | 2. 2 | 4. 2 | 88 | 101 | 220 |
| Gilpin-Westmoreland silt loams, 12 to 18 percent slopes, severely eroded | | | | | | | | | 1. 8 | 2. 5 | 32 | 36 | 160 |
| Gilpin-Westmoreland silt loams, 18 to 35 percent slopes, moderately eroded | | | | | | | | | 2. 0 | 3. 9 | 80 | 91 | 180 |
| Gilpin-Westmoreland silt loams, 18 to 35 percent slopes, severely eroded | | | | | | | | | | | 30 | 34 | |
| Gilpin-Westmoreland silt loams, 35 to 70 percent slopes, moderately eroded: | | | | | | | | | | | | | |
| Gilpin part | | | | | | | | | | | 55 | 65 | |
| Westmoreland part | | | | | | | | | | | 55 | 65 | |
| Gilpin-Westmoreland silt loams, very steep, benched: | | | | | | | | | | | | | |
| Gilpin part | | | | | | | | | | | 65 | 75 | |
| Westmoreland part | | | | | | | | | | | 65 | 75 | |

See footnote at end of table.

TABLE 1.—*Estimated average yields per acre of principal crops under two levels of management*—Continued

| Soil | Corn | | Oats | | Wheat | | Barley | | Clover-grass hay | | Pasture | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Bluegrass | | Tall grass-legume |
| | A | B | A | B | A | B | A | B | A | B | A | B | B |
| | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Tons* | *Tons* | *Cow-acre-days* [1] | *Cow-acre-days* [1] | *Cow-acre-days* [1] |
| Guernsey-Upshur complex, 6 to 12 percent slopes, moderately eroded: | | | | | | | | | | | | | |
| Guernsey part | 65 | 95 | 45 | 60 | 25 | 40 | 40 | 55 | 2.3 | 4.5 | 92 | 105 | 200 |
| Upshur part | 58 | 85 | 36 | 50 | 20 | 33 | 30 | 45 | 2.0 | 3.3 | 68 | 78 | 180 |
| Guernsey-Upshur complex, 12 to 18 percent slopes, moderately eroded: | | | | | | | | | | | | | |
| Guernsey part | 65 | 90 | 40 | 56 | 21 | 36 | 35 | 50 | 2.1 | 4.3 | 84 | 96 | 200 |
| Upshur part | 50 | 75 | 33 | 45 | 19 | 32 | 25 | 40 | 1.6 | 2.8 | 64 | 73 | 160 |
| Guernsey-Upshur complex, 18 to 35 percent slopes, moderately eroded: | | | | | | | | | | | | | |
| Guernsey part | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 1.9 | 4.0 | 76 | 87 | 180 |
| Upshur part | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 1.4 | 2.5 | 56 | 64 | 150 |
| Guernsey-Upshur complex, 35 to 70 percent slopes, moderately eroded: | | | | | | | | | | | | | |
| Guernsey part | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 65 | 75 | ---- |
| Upshur part | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 50 | 60 | ---- |
| Guernsey-Upshur complex, 18 to 70 percent slopes, landslip | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 65 | 75 | ---- |
| Guernsey-Upshur complex, steep, benched | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 2.0 | 4.1 | 80 | 91 | ---- |
| Guernsey-Upshur complex, very steep, benched | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 65 | 75 | ---- |
| Guernsey-Westmore silt loams, 6 to 12 percent slopes, moderately eroded | 65 | 95 | 45 | 60 | 25 | 40 | 40 | 55 | 2.3 | 4.5 | 92 | 105 | 200 |
| Guernsey-Westmore silt loams, 12 to 18 percent slopes, moderately eroded | 65 | 90 | 40 | 56 | 21 | 36 | 35 | 50 | 2.1 | 4.3 | 84 | 96 | 200 |
| Guernsey-Westmore, silt loams 18 to 35 percent slopes, moderately eroded | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 1.9 | 4.0 | 76 | 87 | 180 |
| Guernsey-Westmore silt loams, 18 to 35 percent slopes, severely eroded | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 65 | 75 | ---- |
| Guernsey-Westmore silt loams, 35 to 70 percent slopes, moderately eroded | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 65 | 75 | ---- |
| Hackers silt loam, 3 to 8 percent slopes | 90 | 130 | 45 | 57 | 28 | 40 | 40 | 55 | 3.3 | 4.5 | 132 | 151 | 220 |
| Hartshorn silt loam | 75 | 100 | 45 | 60 | 28 | 38 | 40 | 55 | 3.1 | 4.2 | 124 | 142 | 200 |
| Hartshorn silt loam, wet variant | 70 | 90 | 44 | 55 | 22 | 36 | 35 | 50 | 2.5 | 3.0 | 100 | 114 | 180 |
| Huntington silt loam | 90 | 130 | ---- | ---- | ---- | ---- | ---- | ---- | 3.8 | 4.2 | 152 | 174 | 220 |
| Keene silt loam, 2 to 6 percent slopes | 70 | 95 | 40 | 60 | 23 | 36 | 40 | 55 | 2.3 | 4.0 | 92 | 105 | 200 |
| Keene silt loam, 6 to 12 percent slopes, moderately eroded | 65 | 90 | 38 | 58 | 20 | 34 | 40 | 55 | 2.0 | 3.8 | 80 | 91 | 200 |
| Keene-Latham silt loams, 12 to 18 percent slopes, moderately eroded: | | | | | | | | | | | | | |
| Keene part | 65 | 90 | 36 | 56 | 18 | 32 | 35 | 50 | 1.8 | 3.6 | 72 | 82 | 190 |
| Latham part | 45 | 80 | ---- | ---- | 16 | 30 | 35 | 50 | 1.3 | 3.2 | 52 | 59 | 160 |

See footnote at end of table.

TABLE 1.—*Estimated average yields per acre of principal crops under two levels of management*—Continued

| Soil | Corn | | Oats | | Wheat | | Barley | | Clover-grass hay | | Pasture | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Bluegrass | | Tall grass-legume |
| | A | B | A | B | A | B | A | B | A | B | A | B | B |
| | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Tons* | *Tons* | *Cow-acre-days* | *Cow-acre-days* | *Cow-acre-days* [1] |
| Latham-Keene silt loams, 18 to 35 percent slopes moderately eroded: | | | | | | | | | | | | | |
| Latham part | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 1. 1 | 3. 0 | 44 | 50 | 160 |
| Keene part | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 1. 7 | 3. 5 | 68 | 78 | 180 |
| Lindside silt loam | 90 | 130 | 44 | 73 | 28 | 37 | 50 | 65 | 3. 2 | 4. 5 | 128 | 146 | 220 |
| Newark silt loam | 90 | 120 | 40 | 60 | 15 | 36 | 40 | 55 | 2. 0 | 3. 3 | 80 | 91 | 200 |
| Rarden-Coolville silt loams, 12 to 18 percent slopes, moderately eroded. | 60 | 85 | 28 | 55 | 17 | 30 | 34 | 48 | 1. 4 | 3. 2 | 56 | 64 | 160 |
| Sciotoville silt loam, 0 to 4 percent slopes | 75 | 110 | 45 | 70 | 28 | 42 | 50 | 65 | 2. 8 | 4. 5 | 112 | 128 | 220 |
| Sees-Woolper silt loams, 12 to 18 percent slopes | 70 | 96 | 40 | 60 | 24 | 40 | 40 | 55 | 2. 4 | 4. 5 | 96 | 110 | 220 |
| Sees-Woolper silt loams, 18 to 35 percent slopes | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 2. 3 | 4. 4 | 92 | 105 | 200 |
| Upshur silt loam, 6 to 12 percent slopes, moderately eroded | 58 | 85 | 36 | 50 | 20 | 33 | 30 | 45 | 2. 0 | 3. 3 | 68 | 78 | 180 |
| Upshur silt loam, 12 to 18 percent slopes, moderately eroded | 50 | 75 | 33 | 45 | 19 | 32 | 25 | 40 | 1. 6 | 2. 8 | 64 | 73 | 160 |
| Upshur clay, 6 to 12 percent slopes, severely eroded | 50 | 70 | 20 | 35 | 14 | 23 | 20 | 35 | 1. 7 | 3. 0 | 45 | 50 | 160 |
| Upshur clay, 12 to 18 percent slopes, severely eroded | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 1. 0 | 2. 0 | 40 | 46 | 150 |
| Vandalia silt loam, 12 to 18 percent slopes | 70 | 105 | 45 | 60 | 24 | 40 | 30 | 55 | 2. 4 | 4. 5 | 96 | 110 | 220 |
| Vandalia-Sees silt loams, 18 to 35 percent slopes | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 90 | 100 | ---- |
| Vandalia-Sees very stony silt loams, 18 to 35 percent slopes, moderately eroded: | | | | | | | | | | | | | |
| Vandalia part | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 2. 3 | 4. 4 | 92 | 105 | 200 |
| Sees part | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 2. 3 | 4. 4 | 92 | 105 | 200 |
| Wellston silt loam, 2 to 6 percent slopes, moderately eroded | 75 | 105 | 50 | 66 | 28 | 44 | 45 | 60 | 2. 7 | 4. 6 | 100 | 114 | 220 |
| Wellston silt loam, 6 to 12 percent slopes, moderately eroded | 75 | 100 | 48 | 64 | 26 | 42 | 45 | 60 | 2. 6 | 4. 5 | 98 | 112 | 220 |
| Wellston silt loam, 12 to 18 percent slopes, moderately eroded | 70 | 90 | 45 | 60 | 23 | 40 | 40 | 55 | 2. 4 | 4. 4 | 95 | 105 | 220 |
| Wheeling silt loam, 0 to 2 percent slopes | 80 | 125 | 47 | 72 | 29 | 44 | 50 | 65 | 3. 0 | 4. 8 | 120 | 139 | 220 |
| Wheeling silt loam, 2 to 6 percent slopes | 80 | 125 | 46 | 71 | 28 | 43 | 50 | 65 | 2. 9 | 4. 7 | 116 | 132 | 220 |
| Wheeling silt loam, 6 to 18 percent slopes, moderately eroded | 70 | 110 | 42 | 67 | 25 | 39 | 50 | 65 | 2. 7 | 4. 5 | 108 | 123 | 220 |
| Woodsfield silt loam, 2 to 6 percent slopes | 70 | 102 | 46 | 65 | 26 | 43 | 45 | 60 | 2. 5 | 4. 5 | 100 | 114 | 220 |
| Woodsfield silt loam, 6 to 12 percent slopes, moderately eroded | 65 | 95 | 43 | 60 | 24 | 40 | 40 | 55 | 2. 3 | 4. 4 | 92 | 105 | 220 |
| Woodsfield silt loam, 12 to 18 percent slopes, moderately eroded | 65 | 90 | 40 | 58 | 23 | 38 | 40 | 55 | 2. 2 | 4. 3 | 88 | 101 | 220 |
| Woolper silt loam, 2 to 6 percent slopes | 80 | 115 | 47 | 70 | 28 | 45 | 50 | 65 | 3. 3 | 4. 7 | 132 | 151 | 220 |
| Woolper and Sees silt loams, 6 to 12 percent slopes | 80 | 112 | 46 | 68 | 27 | 44 | 50 | 65 | 3. 2 | 4. 6 | 128 | 146 | 220 |
| Zanesville silt loam, 2 to 6 percent slopes | 65 | 90 | 40 | 62 | 25 | 39 | 45 | 60 | 2. 3 | 4. 2 | 92 | 105 | 200 |

See footnote at end of table.

TABLE 1.—*Estimated average yields per acre of principal crops under two levels of management*—Continued

| Soil | Corn | | Oats | | Wheat | | Barley | | Clover-grass hay | | Pasture | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Bluegrass | | Tall grass-legume |
| | A | B | A | B | A | B | A | B | A | B | A | B | B |
| | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Bu.* | *Tons* | *Tons* | *Cow-acre-days* [1] | *Cow-acre-days* [1] | *Cow-acre-days* [1] |
| Zanesville silt loam, 2 to 6 percent slopes, moderately eroded | 60 | 85 | 39 | 60 | 24 | 37 | 45 | 60 | 2. 2 | 4. 0 | 88 | 100 | 200 |
| Zanesville silt loam, 6 to 12 percent slopes | 60 | 85 | 39 | 55 | 24 | 37 | 45 | 60 | 2. 2 | 4. 0 | 88 | 100 | 200 |
| Zanesville silt loam, 6 to 12 percent slopes, moderately eroded | 60 | 86 | 38 | 65 | 23 | 36 | 45 | 60 | 2. 0 | 4. 0 | 84 | 96 | 200 |
| Zanesville silt loam, 12 to 18 percent slopes, moderately eroded | 60 | 85 | 36 | 63 | 22 | 35 | 45 | 60 | 2. 0 | 3. 7 | 80 | 91 | 190 |
| Zanesville-Woodsfield silt loams, 2 to 6 percent slopes: | | | | | | | | | | | | | |
| Zanesville part | 65 | 90 | 40 | 65 | 25 | 40 | 45 | 60 | 2. 3 | 4. 2 | 92 | 105 | 200 |
| Woodsfield part | 70 | 102 | 46 | 65 | 26 | 43 | 45 | 60 | 2. 5 | 4. 5 | 100 | 114 | 220 |
| Zanesville-Woodsfield silt loams, 2 to 6 percent slopes, moderately eroded: | | | | | | | | | | | | | |
| Zanesville part | 60 | 85 | 39 | 60 | 24 | 37 | 45 | 60 | 2. 2 | 4. 0 | 88 | 101 | 200 |
| Woodsfield part | 68 | 100 | 45 | 63 | 25 | 42 | 44 | 58 | 2. 4 | 4. 5 | 96 | 110 | 220 |
| Zanesville-Woodsfield silt loams, 6 to 12 percent slopes: | | | | | | | | | | | | | |
| Zanesville part | 60 | 85 | 39 | 55 | 24 | 37 | 45 | 60 | 2. 2 | 4. 0 | 88 | 100 | 200 |
| Woodsfield part | 70 | 100 | 45 | 62 | 25 | 42 | 45 | 60 | 2. 4 | 4. 5 | 96 | 110 | 220 |
| Zanesville-Woodsfield silt loams, 6 to 12 percent slopes, moderately eroded: | | | | | | | | | | | | | |
| Zanesville part | 60 | 86 | 38 | 65 | 23 | 36 | 45 | 60 | 2. 0 | 4. 0 | 84 | 96 | 200 |
| Woodsfield part | 65 | 95 | 43 | 60 | 24 | 40 | 40 | 55 | 2. 3 | 4. 4 | 92 | 105 | 220 |
| Zanesville-Woodsfield silt loams, 12 to 18 percent slopes, moderately eroded: | | | | | | | | | | | | | |
| Zanesville part | 60 | 85 | 36 | 63 | 22 | 35 | 45 | 60 | 2. 0 | 3. 7 | 80 | 91 | 190 |
| Woodsfield part | 65 | 90 | 40 | 58 | 23 | 38 | 40 | 55 | 2. 2 | 4. 3 | 88 | 101 | 220 |

[1] Cow-acre-days is a term used to express the carrying capacity of pasture. It is the number of animal units carried per acre multiplied by the number of days the pasture is grazed during a single grazing season without injury to the sod. An acre of pasture that provides 30 days of grazing for 2 cows has a carrying capacity of 60 cow-acre-days.

and sugar maple once grew. Grazing livestock have destroyed leaf litter and desirable young trees, damaged roots, and packed the soil. Forest fires have damaged large trees, interfered with natural seeding, and destroyed leaf litter that increases water storage and protects the soil from erosion. Simple conservation practices, in time, can restore good soil conditions and return these woodlands to a higher level of desirable production.

All of the soils in Monroe County support good growth of timber, except for the severely eroded soils and the shallow soils near the crests of the steep areas that have south and west exposures. There is a management problem on the very steep and stony soils where the use of mechanized equipment is limited.

Soils differ greatly in productivity for woodland just as they do for other crops. The soil factors influencing tree growth are somewhat different from those influencing annual crops or pasture. The capacity of a soil to supply moisture is very important in tree growth. The moisture-holding capacity of a soil is influenced by depth, texture, permeability, and internal drainage. The position on the side slope and direction of exposure (aspect) are very important. Other properties important in evaluating a soil for woodland use are slope, thickness of surface soil, acidity, and fertility. The effect of some of the more important soil properties are discussed in the following paragraphs.

Aspect is the compass direction toward which the slope faces. Trees grow better and soil moisture is higher on north and east aspects. Some of the factors that make south and west aspects less suitable are higher soil temperature because of more direct sun rays, high evaporation of moisture by prevailing winds, earlier melting of snow, and more freezing and thawing. Aspects on azimuths of 120° to 300° are considered warm, exposed sites. Those on azimuths of 300° to 120° are considered

cool, protected sites. Soils on ridgetops or those that have slopes no greater than 12 percent are considered intermediate sites.

The position of woodland sites on long side slopes is important in determining moisture supply for tree growth. The supply of surface water and ground water increases with increasing distance downslope. On the lower part of side slopes, the soils are generally deeper than those on the upper part. Loss of soil moisture by evaporation is less, and soil temperature is somewhat lower on the lower slopes.

Slope is an evaluation factor because, as slope increases, woodland management becomes more difficult. The rate of water infiltration decreases, runoff increases, and the hazard of erosion becomes greater. Soils tend to be somewhat shallower in steeper areas. In Monroe County, the soils have been grouped into three broad groups for woodland management purposes. The soils in one group have slopes of 0 to 12 percent; in a second group, they have slopes of 12 to 35 percent; and in a third group, they have slopes of 35 to 70 percent.

Erosion reduces the total depth of soil available for water storage. Severe erosion removes the protective surface layer and exposes the less porous subsoil, thus contributing to increased runoff and a lower water-intake rate. Both tree growth and natural reseeding are adversely affected.

Soil reaction and fertility are factors that have some influence on the growth and adaption of different kinds of trees. For example, walnut and locust trees do better on such soils as those of the Huntington and Guernsey series. Fertility does not have a major effect on tree production, but growth is slower on soils having low fertility.

With use of the soil survey map, the landowners can use the information in table 2 in planning the future uses of their soils. The soil survey map shows the different mapping units and the aspect. Aspect and slope position can also be determined from aerial photographs, or, more accurately, by field inspection. Thus, the potential of the land for timber production can be approximated close enough for planning purposes.

Table 2 shows the woodland suitability groups in which the soils have been placed. For the soils of each group, the management problems, suitable species, and potential productivity are similar. Each group is indicated by a combination of numbers and letters, such as 1o1 and 4r1. The initial number broadly indicates the suitability of the soils in the group. Soils in groups such as 1o and 1w have a higher productivity than soils in groups 2, 3, or 4. The letter in each group symbol broadly indicates the soil properties associated with important hazards or limitations for woodland use or management. The letter *o* indicates no significant limitations, *w* indicates wetness, *c* indicates clayey soils, *f* indicates sandy or gravelly soils, and *r* indicates slope or relief limitations. The third digit in the woodland suitability group symbols differentiates groups of soils that have the same class and subclass; 3r1 and 3r2 are examples. Each group symbol in the table is followed by a list of the soil series and mapping units that have been placed in that particular group.

The column headings in table 2 are discussed in the following paragraphs.

Erosion hazard refers to the risk of water erosion once the protective cover has been removed from the soil surface. The ratings are based upon differences in slope and other soil characteristics that relate to surface runoff. For a slope of specified dimensions, the tons of soil loss per acre per unit of rainfall can be computed and is designated as the K factor. The rating is slight if no problem exists; moderate if some attention must be given to erosion control; and severe if considerable attention must be given to erosion control measures.

Equipment limitations refer to the difficulty of using machinery normally employed in woodland management operations. The ratings are based on soil characteristics that limit equipment operation. Among the characteristics considered are soil texture, contrasting horizonation, slope, wetness, and the number of stones on the surface. The rating is slight if there are no restrictions on the kind of equipment or the time of year that it can be used. It is moderate if the use of heavy equipment is restricted by one or more soil characteristics during a part of the year. It is severe if special equipment may be needed or heavy equipment can be used for only a few months.

Seedling mortality refers to losses to be expected among natural or planted tree seedlings. This mortality is influenced by kind of soil or by topographic position, assuming that plant competition is not a limiting factor. Soil characteristics that contribute to this hazard are degree of internal drainage, effective rooting depth, texture of the surface layer, and aspect. The rating is slight if expected mortality is only 0 to 25 percent, moderate if expected mortality is 25 to 50 percent, and severe if mortality is expected to exceed 50 percent. If the rating is severe, reinforcement plantings may have to be made for 2 or 3 years or special measures taken to insure adequate seedling survival.

Plant competition refers to the competition that desired seedlings receive from other plants while attempting to emerge. Separate ratings are made for broad-leaf tree species and for conifers. These ratings are based upon soil characteristics that relate to internal drainage and upon the measured productivity class. The rating is slight if competing vegetation does not prevent adequate natural regeneration, successful direct seeding, or development of planted seedlings; moderate if competing vegetation delays but does not prevent the establishment of a fully stocked, normal stand of trees; and severe if competing vegetation prevents adequate regeneration unless intensive site preparations and followup maintenance practices are undertaken.

Windthrow hazard refers to losses of crop trees to be expected during high velocity winds. The ratings are based on effective rooting depth and wetness. The rating is slight if no loss of trees is expected from blowdown, moderate if some trees may blow down during extended periods of rain and high winds, severe if excessive blowdown of trees is expected during extended rainy and windy periods and during periods of high velocity winds. A competent professional forester should be engaged to supervise thinnings and harvest cuttings in timber stands on soils rated moderate and to supervise harvesting on

soils rated severe. No thinnings should be attempted on soils rated severe.

Under the heading "Suitable" are lists of the most desired tree species to which the soils of that particular woodland group are suited. The kinds of trees to be favored in existing stands and the kinds to be favored for planting are listed. They were selected on the basis of growth rate, quality, value, and marketability.

Potential productivity refers to the relative expected capacity of a soil to produce wood for economic use in quantitative terms. This capacity is expressed in each of two ways: site index (height of dominant and codominant trees at age 50 years) (*9*), or yield either expressed in board feet per acre at stated 10-year intervals or as average annual yield per acre. These two expressions of productive capacity are based on research for which data have been published. These data relate to even-aged, fully stocked, unmanaged stands on soils similar to ones for which estimated site indexes are given in table 2. If these data are applied to existing stands, allowances must be made for poor management, substandard stocking, or both. Increased yields may be expected if improved management is used.

## Use of the Soils for Wildlife

This section rates the soils according to their suitability for eight elements of wildlife habitat and for three classes of wildlife (*1*). Also, it explains the ratings, the habitat elements, and the classes of wildlife.

Information in this section is useful in—

1. Broad-scale planning for wildlife habitat in parks, wildlife refuges, nature study areas, and other recreation developments.
2. Selecting soils that are most suitable for creating, improving, or maintaining specific kinds of wildlife habitat elements.
3. Determining the intensity of management required for individual habitat elements.
4. Eliminating sites that are difficult or not feasible to manage for specific kinds of wildlife.
5. Determining areas that are suitable for acquiring and developing as wildlife habitats.

Table 3 lists the soils in the county and rates their suitability for elements of wildlife habitat and for classes or groups of wildlife. Soils that are well suited have few limitations; those that are suited have moderate limitations; and those that are poorly suited have severe limitations. Not considered in the ratings are present land use, the location of a soil in relation to other soils, and the mobility of wildlife.

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

### *Habitat elements*

Each soil is rated in table 3 according to its suitability for various kinds of plants and other elements that make up wildlife habitat.

Grain and seed crops include such seed-producing annuals as corn, wheat, barley, oats, rye, and buckwheat. Soils well suited to these plants are deep, nearly level or very gently sloping, medium textured, well drained, and free or nearly free of stones. They have a high available moisture capacity and are not subject to frequent flooding. These soils can be safely planted to the named crops each year, but the ones that are not so well suited require intensive management.

Grasses and legumes are domestic grasses and legumes that are established by planting. Among the plants are bluegrass, fescue, brome, timothy, redtop, orchardgrass, clover, trefoil, and alfalfa. On soils that are rated well suited, many kinds of plants that are suited to the climate can be maintained in adequate stands for at least 10 years. These soils have slopes of 0 to 15 percent, are well drained or moderately well drained, and have medium or high available moisture capacity. Occasional flooding and surface stones are not of serious concern, for the soils are seldom tilled.

Wild herbaceous upland plants are perennial grasses and weeds that generally are established naturally. They include milkweed, daisies, goldenrod, strawberries, nightshade, and dandelion. Soils that are well suited to these plants vary widely in texture, drainage, and slope. If drainage ranges between good and somewhat poor, slope is not limiting. Stoniness and occasional flooding are not of serious concern.

Hardwood woody plants are nonconiferous trees, shrubs, and woody vines that produce nuts or other fruits, buds, catkins, twigs, or foliage that wildlife eat. They generally are established naturally but may be planted. Among the native kinds are oak, cherry, maple, hickory, tulip-poplar, bigtooth aspen, walnut, dogwood, roses, and briers. Soils well suited to these plants are deep or moderately deep, medium textured or moderately fine textured, and moderately well drained to somewhat excessively drained. Slope and surface stoniness are of little significance.

Also in this group are several varieties of fruiting shrubs that are raised commercially for planting. Autumn-olive, Amur honeysuckle, Tatarian honeysuckle, crab apple, hawthorn, and dogwoods are some of the shrubs that generally are available and can be planted on soils that are rated well suited. Hardwoods that are not available commercially can commonly be transplanted successfully.

Coniferous woody plants are cone-bearing evergreen trees and shrubs that are used by wildlife primarily as cover, though they also provide browse and seeds. Among these are Norway spruce, white pine, arborvitae, redcedar, and juniper. Generally, the plants are established naturally in areas where the cover of weeds and sod is thin. The soils that are well suited for coniferous wildlife habitat are those that cause plants to grow slowly and delay closure of the canopy. It is important that branches be maintained close to the ground so that food and cover are readily available to rabbit, quail, and other small animals. If the trees quickly form a dense canopy that shuts out the light, the lower branches die.

On soils rated poorly suited for coniferous wildlife habitat, widely spaced plants may quickly but temporarily produce desired growth characteristics. The establishment or maintenance, however, is difficult because these soils are well suited to competing hardwoods. Unless the stand is carefully managed, hardwoods invade and commonly overtop the conifers.

TABLE 2.—*Soil interpretations*

[Strip mine spoils and Made land are not

| Woodland suitability group, series, and map symbols | Management problems | | | | | |
|---|---|---|---|---|---|---|
| | Erosion hazard | Equipment limitations | Seedling mortality | Plant competition | | Windthrow hazard |
| | | | | Conifers | Hardwoods | |
| Group 1o1. Soils of this group are on all aspects<br>Ashton: AsA.<br>Chagrin: Cg.<br>Hartshorn: He.<br>Huntington: Hu.<br>Wheeling: WrA, WrB, WrC2. | Slight | Slight | Slight | Severe | Moderate | Slight |
| Group 2o1. Soils of this group are on all aspects<br>Hackers: HcB.<br>Wellston: WhB2, WhC2.<br>Woodsfield: WtB, WtC2. | Slight | Slight | Slight | Severe | Moderate | Slight |
| Group 2r1. Soils of this group are on north and east aspects.<br>Dekalb: DkD2, DkE2.<br>Gilpin: GdE, GkD, GkD2, GkE2, GlE, GoD2, GoE2.<br>Wellston: WhD2.<br>Woodsfield: WtD2. | Slight | Moderate | Slight | Severe | Moderate | Slight |
| Group 2r2. Soils of this group are on north and east aspects.<br>Gilpin: GkG, GlG, GoG2, GpG. | Severe | Severe | Slight | Severe | Moderate | Slight |
| Group 2c1. Soils of this group are on all aspects<br>Woolper: WxB, WyC. | Slight | Moderate | Slight | Severe | Moderate | Slight |
| Group 2c2. Soils of this group are on all aspects<br>Vandalia: VaD, VdE, VsE2. | Severe | Severe | Moderate | Severe | Moderate | Slight |
| Group 2w1. Soils of this group are on all aspects<br>Captina: CaB, CaC2.<br>Hartshorn, wet variant: Hr.<br>Lindside: Lh.<br>Newark: Nn.<br>Sciotoville: ScB.<br>Zanesville: ZnB, ZnB2, ZnC, ZnC2, ZoB, ZoB2, ZoC, ZoC2, ZoD2. | Slight | Moderate | Moderate | Severe | Severe | Severe |
| Group 2w2. Soils of this group are on all aspects<br>Guernsey: GrC2, GwC2.<br>Keene: KeB, KeC2. | Moderate | Moderate | Moderate | Severe | Severe | Moderate |
| Group 2w3. Soils of this group are on all aspects<br>Captina: CaD2.<br>Guernsey: GrD2, GrE2, GuE, GwD2, GwE2, GwE3.<br>Keene: KlD2.<br>Sees: SsD, SsE.<br>Zanesville: ZnD2. | Severe | Moderate | Slight | Severe | Severe | Slight |
| Group 2w4. Soils of this group are on all aspects<br>Guernsey: GrG2, GsG, GuG, GwG2. | Severe | Severe | Slight | Severe | Severe | Slight |

*for woodland use*

placed in a woodland suitability group]

| Suitable species | | Potential productivity | | |
|---|---|---|---|---|
| To favor in existing stands | For planting | Species | Estimated site index | Annual growth |
| | | | | *Bd. ft./acre* |
| Red oak, white oak, black oak, tulip-poplar, white pine, black walnut, sugar maple, white ash. | White pine, black walnut, tulip-poplar, Norway spruce, white ash. | Upland oaks | 85+ | 346+ |
| | | Tulip-poplar | 95+ | ---------- |
| | | Sugar maple | 85+ | ---------- |
| Tulip-poplar, black walnut, red oak, white oak. | White pine, black walnut, tulip-poplar. | Upland oaks | 75–85 | 309 |
| Tulip-poplar, black walnut, red oak, white oak. | White pine, black walnut, tulip-poplar. | Upland oaks | 75–85 | 309 |
| | | Tulip-poplar | 85–95 | 441 |
| Tulip-poplar, black walnut, red oak, white oak. | White pine, black walnut, tulip-poplar. | Upland oaks | 75–85 | 309 |
| | | Tulip-poplar | 85–95 | ---------- |
| Tulip-poplar, black walnut, red oak, white oak, white ash. | White pine, tulip-poplar, black walnut. | Upland oaks | 75–85 | 309 |
| Tulip-poplar, black walnut, red oak, white oak on north aspects.<br>Red oak, white oak, white pine on south aspects. | White pine, tulip-poplar, black walnut. | Upland oaks | 75–85 | 309 |
| Red oak, black oak, tulip-poplar, sugar maple, black walnut, red maple. | White pine, tulip-poplar, black walnut. | Wetland oaks | 80–90 | ---------- |
| | | Upland oaks | 75–85 | 309 |
| | | Tulip-poplar | 85–95 | 441 |
| | | Sugar maple | 75–85 | ---------- |
| | | White pine | 85–95 | ---------- |
| Red oak, black oak, tulip-poplar, sugar maple, black walnut, red maple. | White pine, tulip-poplar, black walnut. | Wetland oaks | 80–90 | ---------- |
| | | Upland oaks | 75–85 | 309 |
| | | Tulip-poplar | 85–95 | 441 |
| | | Sugar maple | 75–85 | ---------- |
| | | White pine | 85–95 | ---------- |
| Red oak, black walnut, tulip-poplar, red maple on north apects. | White pine, tulip-poplar, black walnut. | Upland oaks | 75–85 | 309 |
| Red oak, black walnut, tulip-poplar, sugar maple on south aspects. | White pine, tulip-poplar, Virginia pine. | Tulip-poplar | 85–95 | 441 |
| Red oak, black walnut, red pine, red maple on north aspects. | White pine, tulip-poplar, black walnut. | Upland oaks | 75–85 | 309 |
| Red oak, black walnut, tulip-poplar, sugar maple on south aspects. | White pine, tulip-poplar, Virginia pine. | Tulip-poplar | 85–95 | 441 |

TABLE 2.—*Soil interpretations*

| Woodland suitability group, series, and map symbols | Management problems | | | | | |
|---|---|---|---|---|---|---|
| | Erosion hazard | Equipment limitations | Seedling mortality | Plant competition | | Windthrow hazard |
| | | | | Conifers | Hardwoods | |
| Group 3o1. Soils of this group are on all aspects.<br>Dekalb: DkC2.<br>Gilpin: GkB2, GkC2, GoB2, GoC2. | Slight | Slight | Slight | Moderate | Slight | Slight |
| Group 3r1. In this group the following soils are on north and east aspects: GkE3, GnE, GoD3, GoE3. All other soils in this group are on south and west aspects.<br>Dekalb: DkD2, DkE2.<br>Gilpin: GkD, GkD2, GkE2, GkE3, GlE, GnE, GoD2, GoD3, GoE2, GoE3.<br>Wellston: WhD2.<br>Woodsfield: WtD2. | Moderate | Moderate | Slight | Moderate | Slight | Slight |
| Group 3r2. In this group the following soils are on north and east aspects: GdG, GkG3, GnG. All other soils in this group are on south and west aspects.<br>Gilpin: GdG, GkG, GkG3, GlG, GnG, GoG2, GpG. | Severe | Severe | Slight | Moderate | Slight | Slight |
| Group 3f1. Soils of this group are on all aspects.<br>Conotton: CoA, CoD. | Slight | Slight | Moderate | Moderate | Slight | Slight |
| Group 3c1. In this group the following soils are on north and east aspects: LdE2, RcD2, UpD2, UrD3. All other soils in this group are on all aspects.<br>Brooke: BwD2, BwE2.<br>Latham: LdE2.<br>Rarden: RcD2.<br>Upshur: UpC2, UrC3, UpD2, UrD3. | Slight | Moderate | Slight | Moderate | Slight | Slight |
| Group 3w1. The soils of this group are on all aspects.<br>Coolville: CrC2, CrD2. | Slight | Moderate | Slight | Moderate | Slight | Slight |
| Group 4r1. In this group the following soils are on all aspects: Gy. All other soils in this group are on south and west aspects.<br>Gullied land: Gy.<br>Gilpin: GkE3, GnE, GoD3, GoE3. | Moderate | Moderate | Slight | Slight | Slight | Slight |
| Group 4r2. Soils of this group are on south and west aspects.<br>Gilpin: GdG, GkG3, GnG. | Severe | Severe | Slight | Slight | Slight | Slight |
| Group 4c1. Soils of this group are on south and west aspects.<br>Latham: LdE2.<br>Rarden: RcD2.<br>Upshur: UpD2, UrD3. | Moderate | Moderate | Slight | Slight | Slight | Slight |

*for woodland use*—Continued

| Suitable species | | Potential productivity | | |
|---|---|---|---|---|
| To favor in existing stands | For planting | Species | Estimated site index | Annual growth |
| Red oak, white oak, tulip-poplar, black walnut. | White oak, tulip-poplar, Virginia pine. | Upland oaks<br>Tulip-poplar<br>White pine | 65–75<br>75–85<br>75–85 | *Bd. ft./acre*<br>239<br>318 |
| Red oak, white oak, tulip-poplar, black walnut on north aspects.<br>White oak, chestnut oak, red oak on south aspects. | White pine, tulip-poplar, Virginia pine.<br>White pine, Virginia pine. | Upland oaks | 65–75 | 239 |
| Red oak, white oak, tulip-poplar, black walnut on north aspects.<br>White oak, chestnut oak on south aspects. | White pine, tulip-poplar.<br>White pine, Virginia pine. | Upland oaks | 65–75 | 239 |
| Red oak, white oak, black oak, tulip-poplar, black walnut. | White pine, Virginia pine, tulip-poplar. | Upland oaks | 65–75 | 239 |
| Red oak, white oak, black oak, tulip-poplar, black walnut. | White pine, tulip-poplar, Virginia pine. | Upland oaks | 65–75 | 239 |
| Red oak, white oak, black oak, tulip-poplar, black walnut, red maple. | White pine, tulip-poplar. | Upland oaks | 65–75 | 239 |
| Red oak, white oak, black oak, tulip-poplar, black walnut, red maple. | White pine, tulip-poplar. | Upland oaks | 55–65 | 178 |
| Red oak, white oak, black oak, tulip-poplar, black walnut, red maple. | White pine, shortleaf pine, Virginia pine. | Upland oaks | 55–65 | 208 |
| Red oak, black oak, shortleaf pine | White pine, shortleaf pine, Virginia pine. | Upland oaks | 55–65 | 178 |

TABLE 3.—*Suitability of the soils for elements of*

[Suitability ratings for Made land (Ma) and

| Soil series and map symbols | Elements of wildlife habitat | | | |
|---|---|---|---|---|
| | Grain and seed crops | Grasses and legumes | Wild herbaceous upland plants | Hardwood woody plants |
| Ashton: AsA | Well suited | Well suited | Well suited | Well suited |
| Brooke: BwD2, BwE2 | Poorly suited to not suited. | Suited | Suited | Well suited |
| Captina: | | | | |
| CaB, CaC2 | Suited | Well suited | Well suited | Well suited |
| CaD2 | Poorly suited | Suited | Well suited | Well suited |
| Chagrin: Cg | Suited | Well suited | Well suited | Well suited |
| Conotton: | | | | |
| CoA | Suited | Suited | Well suited | Suited |
| CoD | Not suited | Poorly suited | Well suited | Suited |
| Coolville: | | | | |
| CrC2 | Suited | Suited | Well suited | Suited |
| CrD2 | Poorly suited | Suited | Well suited | Suited |
| For Rarden part of CrC2 and CrD2, see Rarden series. | | | | |
| Dekalb: | | | | |
| DkC2 | Suited | Suited | Suited | Suited |
| DkD2, DkE2 | Poorly suited to not suited. | Suited to poorly suited. | Suited | Suited |
| Gilpin: | | | | |
| GdE, GdG | Not suited | Not suited | Suited | Suited |
| GkB2, GkC2, GoB2, GoC2 | Suited | Suited | Suited | Suited |
| For Upshur part of GkB2 and GkC2, see UpC2 in the Upshur series. | | | | |
| GkD, GkD2, GkE2, GkE3, GkG, GkG3, GlE, GlG, GnE, GnG, GoD2, GoD3, GoE2, GoE3, GoG2, GpG. | Poorly suited to not suited.[1] | Suited to not suited.[1] | Suited | Suited |
| For Upshur part of GkD through GnG, see UpD2, UrC3, and UrD3 in the Upshur series. Gilpin and Westmoreland soils are rated the same. | | | | |
| Guernsey: | | | | |
| GrC2, GwC2 | Suited | Well suited | Well suited | Well suited |
| For Upshur part of GrC2, see UpC2 in the Upshur series. | | | | |
| GrD2, GrE2, GrG2, GsG, GuE, GuG | Not suited | Poorly suited to not suited.[1] | Well suited to suited.[1] | Well suited to suited.[1] |
| For Upshur part of these units, see UpD2, UrC3, and UrD3 in the Upshur series. | | | | |
| GwD2, GwE2, GwE3, GwG2 | Suited to not suited.[1] | Well suited to poorly suited.[1] | Well suited | Well suited |
| Guernsey and Westmore soils are rated the same. | | | | |
| Gullied land, Gilpin-Upshur material: Gy. | | | | |
| Suitability of Gullied land is not shown; for Gilpin material, see GkD through GpG in the Gilpin series; for Upshur material, see UpD2, UrC3, and UrD3 in the Upshur series. | | | | |
| Hackers: HcB | Suited | Well suited | Well suited | Well suited |
| Hartshorn: | | | | |
| He | Suited | Well suited | Well suited | Well suited |
| Hr | Suited | Well suited | Well suited | Well suited |
| Huntington: Hu | Suited | Well suited | Well suited | Well suited |

See footnote at end of table.

*wildlife habitat and kinds of wildlife*

Strip mine spoils (St) are not shown]

| Elements of wildlife habitat—Continued | | | | Kinds of wildlife | | |
|---|---|---|---|---|---|---|
| Coniferous woody plants | Wetland food and cover plants | Shallow water developments | Excavated ponds | Openland | Woodland | Wetland |
| Poorly suited | Not suited | Not suited | Not suited | Well suited | Well suited | Not suited. |
| Poorly suited | Not suited | Not suited | Not suited | Suited to poorly suited. | Suited | Not suited. |
| Poorly suited<br>Poorly suited | Not suited<br>Not suited | Not suited<br>Not suited | Not suited<br>Not suited | Well suited<br>Suited | Well suited<br>Suited | Not suited.<br>Not suited. |
| Poorly suited | Not suited | Not suited | Not suited | Well suited | Well suited | Not suited. |
| Suited<br>Suited | Not suited<br>Not suited | Not suited<br>Not suited | Not suited<br>Not suited | Well suited<br>Poorly suited | Suited<br>Suited | Not suited.<br>Not suited. |
| Poorly suited<br>Poorly suited | Not suited<br>Not suited | Not suited<br>Not suited | Not suited<br>Not suited | Well suited<br>Suited | Suited<br>Suited | Not suited.<br>Not suited. |
| Suited<br>Suited | Not suited<br>Not suited | Not suited<br>Not suited | Not suited<br>Not suited | Suited<br>Suited to poorly suited. | Suited<br>Suited | Not suited.<br>Not suited. |
| Suited | Not suited | Not suited | Not suited | Poorly suited | Poorly suited | Not suited. |
| Suited | Not suited | Not suited | Not suited | Suited | Suited | Not suited. |
| Suited | Not suited | Not suited | Not suited | Poorly suited | Suited | Not suited. |
| Poorly suited | Not suited | Not suited | Not suited | Well suited | Well suited | Not suited. |
| Poorly suited | Not suited | Not suited | Not suited | Poorly suited to not suited.[1] | Suited to poorly suited.[1] | Not suited. |
| Poorly suited | Not suited | Not suited | Not suited | Poorly suited to not suited.[1] | Suited to poorly suited.[1] | Not suited. |
| Poorly suited | Not suited | Not suited | Not suited | Well suited | Well suited | Not suited. |
| Poorly suited<br>Poorly suited | Not suited<br>Suited | Not suited<br>Suited | Not suited<br>Poorly suited | Well suited<br>Well suited | Well suited<br>Well suited | Not suited.<br>Poorly suited. |
| Poorly suited | Not suited | Not suited | Not suited | Well suited | Well suited | Not suited. |

TABLE 3.—*Suitability of the soils for elements of wildlife*

| Soil series and map symbols | Elements of wildlife habitat | | | |
|---|---|---|---|---|
| | Grain and seed crops | Grasses and legumes | Wild herbaceous upland plants | Hardwood woody plants |
| Keene: | | | | |
| KeB, KeC2 | Suited | Well suited | Well suited | Suited |
| KID2 | Poorly suited | Suited | Well suited | Suited |
| For Latham part of KID2, see the Latham series. | | | | |
| Latham: LdE2 | Not suited | Suited | Suited | Suited |
| Lindside: Lh | Suited | Well suited | Well suited | Well suited |
| Newark: Nn | Suited | Well suited | Well suited | Well suited |
| Rarden: RcD2 | Poorly suited | Suited | Well suited | Suited |
| For Coolville part of this unit, see CrD2 in the Coolville series. | | | | |
| Sciotoville: ScB | Suited | Well suited | Well suited | Well suited |
| Sees: SsD, SsE | Not suited | Suited | Well suited | Well suited |
| For Woolper part of these units, see the Woolper series. | | | | |
| Upshur: | | | | |
| UpC2 | Suited | Well suited | Well suited | Well suited |
| UpD2, UrC3, UrD3 | Poorly suited | Suited | Well suited | Well suited |
| Vandalia: | | | | |
| VaD, VdE, VsE2 | Poorly suited | Suited | Well suited | Well suited |
| For Sees part of VdE and VsE2, see SsD and SsE in the Sees series. | | | | |
| Wellston: | | | | |
| WhB2, WhC2 | Suited | Well suited | Well suited | Well suited |
| WhD2 | Poorly suited | Suited | Well suited | Well suited |
| Westmore. | | | | |
| See Guernsey series. | | | | |
| Westmoreland. | | | | |
| See Gilpin series. | | | | |
| Wheeling: | | | | |
| WrA | Well suited | Well suited | Well suited | Well suited |
| WrB, WrC2 | Suited | Well suited | Well suited | Well suited |
| Woodsfield: | | | | |
| WtB, WtC2 | Well suited | Well suited | Well suited | Well suited |
| WtD2 | Poorly suited | Suited | Well suited | Well suited |
| Woolper: | | | | |
| WxB, WyC | Well suited | Well suited | Well suited | Well suited |
| SsD, SsE | Poorly suited | Suited | Well suited | Well suited |
| Woolper part only. | | | | |
| Zanesville: | | | | |
| ZnB, ZnB2, ZnC, ZnC2, ZoB, ZoB2, ZoC, ZoC2 | Suited | Well suited | Well suited | Well suited |
| For Woodsfield part of ZoB, ZoB2, ZoC and ZoC2, see WtB and WtC2 in the Woodsfield series. | | | | |
| ZnD2, ZoD2 | Poorly suited | Suited | Well suited | Well suited |
| For Woodsfield part of ZoD2, see WtD2 in the Woodsfield series. | | | | |

[1] D slopes are more suitable than E and G slopes.

*habitat and kinds of wildlife*—Continued

| Elements of wildlife habitat—Continued | | | | Kinds of wildlife | | |
|---|---|---|---|---|---|---|
| Coniferous woody plants | Wetland food and cover plants | Shallow water developments | Excavated ponds | Openland | Woodland | Wetland |
| Poorly suited | Not suited | Not suited | Not suited | Well suited | Suited | Not suited. |
| Poorly suited | Not suited | Not suited | Not suited | Suited | Suited | Not suited. |
| Poorly suited | Not suited | Not suited | Not suited | Poorly suited | Poorly suited | Not suited. |
| Poorly suited | Poorly suited | Poorly suited | Poorly suited | Well suited | Well suited | Poorly suited. |
| Poorly suited | Suited | Suited | Poorly suited | Well suited | Well suited | Poorly suited. |
| Suited | Not suited | Not suited | Not suited | Suited | Suited | Not suited. |
| Poorly suited | Not suited | Not suited | Not suited | Well suited | Well suited | Not suited. |
| Poorly suited | Not suited | Not suited | Not suited | Suited | Suited | Not suited. |
| Suited | Not suited | Not suited | Not suited | Well suited | Well suited | Not suited. |
| Suited | Not suited | Not suited | Not suited | Suited | Well suited | Not suited. |
| Suited | Not suited | Not suited | Not suited | Suited | Well suited | Not suited. |
| Poorly suited | Not suited | Not suited | Not suited | Well suited | Well suited | Not suited. |
| Poorly suited | Not suited | Not suited | Not suited | Suited | Suited | Not suited. |
| Poorly suited | Not suited | Not suited | Not suited | Well suited | Well suited | Not suited. |
| Poorly suited | Not suited | Not suited | Not suited | Well suited | Well suited | Not suited. |
| Suited | Not suited | Not suited | Not suited | Well suited | Well suited | Not suited. |
| Suited | Not suited | Not suited | Not suited | Suited | Well suited | Not suited. |
| Poorly suited | Not suited | Not suited | Not suited | Well suited | Well suited | Not suited. |
| Suited | Not suited | Not suited | Not suited | Suited | Well suited | Not suited. |
| Poorly suited | Not suited | Not suited | Not suited | Well suited | Well suited | Not suited. |
| Poorly suited | Not suited | Not suited | Not suited | Suited | Suited | Not suited. |

Wetland food and cover plants are wild, herbaceous, annual and perennial plants that grow on moist to wet sites. They include smartweed, wild millet, bulrush, spikerush, sedges, burreed, rice cutgrass, and cattails. Soils that have a rating of well suited are nearly level and poorly drained or very poorly drained. Soils that have a rating of suited are nearly level and somewhat poorly drained or frequently flooded. Depth, stoniness, and texture of the surface layer are of little concern.

Shallow water developments are impoundments or excavations that provide areas of shallow water near food and cover for wetland wildlife. Examples of such developments are shallow dugouts, level ditches, blasted potholes, and devices that keep the water 6 to 24 inches deep in marshes. Soils that are rated well suited to this use are nearly level (0 to 1 percent slopes), more than 36 inches deep to bedrock, and poorly drained or very poorly drained. Soils that have a rating of suited are nearly level and somewhat poorly drained. They may be only 20 to 36 inches deep to bedrock.

Excavated impoundments are dug-out water areas or a combination of these and impoundments behind low dikes in which the water is at a depth suitable for the production of fish or wildlife. If fish are produced, part of the pond should be at least 8 feet deep. Soils that are rated well suited are nearly level, more than 72 inches deep, and poorly drained or very poorly drained.

### *Classes of wildlife*

Table 3 rates the soils according to their suitability for three classes of wildlife in the county—openland, woodland, and wetland wildlife.

Examples of openland wildlife are pheasant, quail, meadowlark, field sparrows, doves, cottontail rabbit, red fox, and woodchuck. These birds and mammals normally make their home in areas of cropland, pasture, meadow, lawns, and in areas overgrown with grasses, herbs, and shrubs.

Among the birds and mammals that prefer woodland are ruffed grouse, woodcock, thrushes, vireos, scarlet tanagers, gray squirrels, fox squirrels, gray foxes, white-tailed deer, raccoon, oppossum, and woodpeckers. They obtain food and cover in stands of hardwoods, coniferous trees, shrubs, or a mixture of these plants.

Wetland wildlife are ducks, geese, rail, heron, shore birds, mink, muskrat, and other familiar birds and mammals that normally make their home in wet areas, such as ponds, marshes, and swamps. Areas suited for these species are extremely limited in Monroe County.

Each rating under "Kinds of wildlife" in table 3 is based on the ratings listed for the habitat elements in the first part of the table. For openland wildlife the rating is based on the ratings shown for grain and seed crops, grasses and legumes, wild herbaceous upland plants, hardwood plants, and coniferous wildlife habitat. The rating for woodland wildlife is based on the ratings listed for all the elements except grain and seed crops. For wetland wildlife the rating is based on those shown for wetland food and cover plants, shallow water developments, and excavated ponds.

## Engineering Uses of the Soils [4]

Some soil properties are of special interest to engineers because they affect the construction and maintenance of roads, airports, pipelines, building foundations, facilities for water storage, erosion control structures, drainage systems, and sewage disposal systems. Among the properties most important to engineers are permeability to water, shear strength, compaction characteristics, drainage, shrink-swell characteristics, grain size, plasticity, and pH. Depth to water table, depth to bedrock, and topography are also dominant. Results of tests on soil samples from Monroe County are given in table 4; estimates of the soil properties significant in engineering are given in table 5; and interpretations relating to engineering uses of the soils are shown in table 6. The estimates and interpretations of soil properties in these tables can be used to—

1. Make soil and land use studies that will aid in selecting and developing industrial, business, residential, and recreational sites.
2. Make preliminary estimates of soil properties that are significant in the planning of farm drainage systems, farm ponds, irrigation systems, and diversion terraces.
3. Make preliminary evaluations that will aid in selecting locations for highways, airports, pipelines, cables, and in planning detailed investigations at the selected locations.
4. Locate probable sources of gravel and other construction materials.
5. Correlate performance of engineering structures with soil mapping units to develop information for overall planning that will be useful in designing and maintaining certain engineering structures.
6. Determine the suitability of soils for cross-country movement of vehicles and construction equipment.
7. Supplement the information obtained from other published maps and reports and aerial photographs to make maps and reports that can be used readily by engineers.

With the use of the soil map for identification, the engineering interpretations reported here can be useful for many purposes. They do not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads and excavations deeper than the depths of layers here reported. Even in these situations, the soil map is useful for planning more detailed field investigations and for suggesting the kinds of problems that may be expected.

Some of the terms used by the soil scientists may be unfamiliar to the engineer, and some words, for example, soil, sand, silt, clay, topsoil, subsoil, and solum, have special meanings in soil science. These terms and others are defined in the Glossary.

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[4] LLOYD GILLOGLY, construction engineer, Soil Conservation Service, helped prepare this section.

### *Engineering classification systems*

Two systems of classifying soils are in general use among engineers.

Most highway engineers classify soil materials according to the system approved by the American Association of State Highway Officials (AASHO) (*2*). This system of classification is based on grain-size gradation, liquid limit, plasticity index, and field performance in highways. In the AASHO system, soil materials are classified in seven principal groups. The groups range from A–1, which consists of gravelly soils having high bearing strength (the best soils for subgrade), to A–7, which consists of clayey soils having low strength when wet (the poorest soils for subgrade). Within each group, the relative engineering value of a soil is indicated by group index numbers that range from 0 for the best material to 20 for the poorest. The group index number is given in parentheses after the soil group symbol, for example, A–7–5(17) in table 4.

Some engineers prefer to use the Unified Soil Classification System (*17*). In this system the soils are identified according to texture and plasticity and are grouped according to their performance as engineering construction materials. Soil materials are identified as coarse grained (eight classes), fine grained (six classes), and highly organic.

### *Engineering test data*

Samples of 12 soil series in Monroe County were tested according to standard procedures to help evaluate the soils for engineering purposes. The results of these tests are shown on table 4. The following paragraphs discuss the columns listed in table 4.

MOISTURE-DENSITY.—If a soil material is compacted at a successively higher moisture content, assuming that the compaction effort remains constant, the density of the compacted material increases until the optimum moisture content is reached. After that, the density decreases with an increase in moisture content. The highest dry density obtained in the compaction test is termed "maximum dry density." Moisture-density data are important in earthwork, for as a rule, optimum stability is obtained if the soil is compacted to about the maximum dry density when it is at approximately the optimum moisture content.

MECHANICAL ANALYSIS.—This analysis was made by combined sieve and hydrometer methods. Percentages of clay obtained by the hydrometer method should not be used in naming textural class for soil classification.

TESTS FOR LIQUID LIMIT AND PLASTIC LIMIT.—These tests measure the effect of water on the consistence of the soil material. As the moisture content of a soil increases from a very dry state, the material changes from a semisolid to a plastic state. As the moisture is further increased, the material changes from a plastic state to a liquid state. The plastic limit is the moisture content at which the soil material passes from a semisolid to a plastic state. The liquid limit is the moisture content at which the material passes from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is in a plastic condition. Some silty and sandy soils are nonplastic; that is, they will not become plastic at any moisture content.

### *Estimated properties*

The estimated properties shown in table 5 are based on the soil test data in table 4 and on field experience with the same kinds of soil in other counties. The following paragraphs briefly describe the column headings in table 5.

SEASONALLY HIGH WATER TABLE.—The highest level to which the soil is saturated in winter and in spring because of a perched or other ground water table. Soil conditions immediately after heavy precipitation are not considered. In all soils, particularly in sloping soils on uplands, the depth to the water table is generally greater late in spring, in summer, and in fall than is indicated in this column.

DEPTH TO BEDROCK.—The depth to bedrock is based on observations made during the course of the survey. From place to place, the depth to bedrock may vary considerably. Many of the soils in the county are only moderately deep to bedrock. In some of these, the bedrock is relatively hard. Hard bedrock is most likely in soils in the Brooke, Dekalb, Guernsey, Wellston, and Westmore series. Easily rippable bedrock generally underlies the Coolville, Gilpin, Keene, Latham, Rarden, and Upshur series.

DEPTH FROM SURFACE.—The depth from the surface is the depth to the major distinctive layers of the soil profile. This profile is the one described as representative for each series in the section "Descriptions of the Soils."

PERCENTAGE PASSING SIEVE.—These columns show estimated particle-size distribution according to standard size sieves (fig. 10, p. 56).

CLASSIFICATION.—USDA texture corresponds to the texture given in the technical description of each soil. The Unified and AASHO classifications are based on actual test data from this county and other survey areas. See "Engineering Classification Systems" for explanation of these headings.

PERMEABILITY.—The values are estimates of the range in rates of downward water movement in the major soil horizons when they are saturated above a true water table. They are estimates based on soil texture, soil structure, porosity, permeability, and infiltration tests. In any given soil, infiltration (or percolation) through the surface layer varies considerably according to land use and management as well as initial moisture conditions.

AVAILABLE MOISTURE CAPACITY.—The available water capacity in inches per inch of soil depth is the approximate amount of capillary water in the soil when wet to field capacity. When the soil is "air dry" this amount of water will wet the soil horizon described to a depth of 1 inch without deeper percolation. Available water capacity is a measure of the maximum amount of moisture a particular soil can store for use by plants. The estimated values listed are based on the difference in percent moisture retained at 1/3 and 15 atmospheres of tension for soils of medium and fine texture. For sandy soils, the estimated values are based on the difference between 1/10 and 15 atmospheres of tension. The available water capac-

TABLE 4.—*Engineering*

[Tests performed by the Ohio Department of Highways in accordance with standard

| Soil name and location | Parent material | Ohio Report No. | Depth from surface | Moisture-density data [1] | | Fragments larger than 3 inches in diameter discarded in field sampling (estimate) |
|---|---|---|---|---|---|---|
| | | | | Maximum dry density | Optimum moisture | |
| | | | *In.* | *Lb. per. cu. ft.* | *Pct.* | |
| Brooke silty clay loam: | | | | | | |
| NW¼ sec. 2; Franklin Township (Mn–23). | Limestone. | 45396 | 3–9½ | 96 | 18 | |
| | | 43323 | 9½–15 | 95 | 26 | 15 |
| | | 43324 | 28–43 | 119 | 14 | |
| Chagrin silt loam: | | | | | | |
| NW¼ sec. 21; Seneca Township (Mn–31) (modal). | Recent alluvium (flood plain). | 45398 | 0–5½ | 94 | 24 | |
| | | 43327 | 11–28 | 104 | 19 | |
| | | 43328 | 48–61 | 107 | 18 | |
| Gilpin silt loam: | | | | | | |
| NW¼ sec. 1; Bethel Township (Mn–W38). | Sandstone and shale. | 45401 | 2½–7 | 100 | 21 | |
| | | 43333 | 7–16 | 112 | 16 | 10 |
| | | 43334 | 25–36 | 116 | 13 | 25 |
| SE¼ sec. 29; Perry Township (Mn–24). | Sandstone and shale. | 45404 | 0–3½ | 97 | 23 | 4 |
| | | 43340 | 8–15 | 108 | 20 | 5 |
| Guernsey silt loam: | | | | | | |
| NE¼ sec. 9; Seneca Township (Mn–24). | Limestone and sandstone. | 45397 | 2–6 | 103 | 20 | 5 |
| | | 43325 | 6–20 | 104 | 20 | 5 |
| | | 43326 | 32–39 | 112 | 15 | |
| Hartshorn silt loam: | | | | | | |
| SE¼ sec. 4; Lee Township (Mn–49) | Alluvium (narrow flood plain). | 45408 | 0–5 | 112 | 16 | 5 |
| | | 43348 | 5–15 | 115 | 12 | 5 |
| | | 43349 | 25–32 | 123 | 11 | 20 |
| Huntington silt loam: | | | | | | |
| SW¼ sec. 18; Jackson Township (Mn–45) (finer textured than modal). | Recent alluvium (flood plain). | 45403 | 0–9 | 76 | 39 | |
| | | 43338 | 9–38 | 88 | 30 | |
| | | 43339 | 44–65 | 89 | 30 | |
| Sciotoville silt loam: | | | | | | |
| 275 feet northwest and 125 feet northeast of Salt Well, sec. 18; Jackson Township (Mn–44). | Water-deposited sediments (high terrace). | 45402 | 0–10 | 108 | 16 | |
| | | 43335 | 14–27 | 117 | 14 | |
| | | 43336 | 27–41 | 117 | 13 | |
| | | 43337 | 47–62 | 115 | 13 | |
| Upshur silt loam: | | | | | | |
| NW¼ sec. 11; Benton Township (Mn–48). | Red shale. | 45407 | 1½–5 | 100 | 22 | |
| | | 43346 | 10–17 | 97 | 24 | |
| | | 43347 | 35–46 | 109 | 17 | |
| Westmore silt loam: | | | | | | |
| NE¼ sec. 11; Seneca Township (Mn–W34). | Sandstone, siltstone, and limestone. | 45400 | 2–8 | 94 | 24 | 15 |
| | | 43331 | 12–26 | 108 | 18 | 15 |
| | | 43332 | 60–75 | 99 | 23 | 35 |
| Westmoreland silt loam: | | | | | | |
| SE¼ sec. 10; Wayne Township (Mn–W31). | Sandstone and siltstone. | 45399 | 1–9 | 97 | 23 | |
| | | 43329 | 18–26 | 107 | 18 | |
| | | 43330 | 33–38 | 112 | 16 | |
| Wheeling silt loam: | | | | | | |
| SE¼ sec. 24; Jackson Township (Mn–47). | Stratified alluvial deposits from limestone, sandstone, and shale. | 45406 | 0–9 | 107 | 17 | |
| | | 43344 | 13–22 | 110 | 17 | |
| | | 43345 | 44–60 | 117 | 14 | |

See footnotes at end of table.

*test data*

procedures of the American Association of State Highway Officials (AASHO) (*2*)]

| Mechanical analysis [2] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Percentage passing sieve— | | | | | | Percentage smaller than 0.005 mm. | Liquid limit | Plasticity index | Classification | | |
| 1½-in. | ¾-in. | No. 4 (4.7 mm.) | No. 10 (2.0 mm.) | No. 40 (0.42 mm.) | No. 200 (0.074 mm.) | | | | AASHO [3] | Unified [4] | Ohio [5] |
| | 95 | 78 | 68 | 67 | 65 | 38 | 51 | 23 | A–7–6(13) | MH–CH | A–7–6 |
| | 100 | 95 | 81 | 80 | 79 | 49 | 60 | 32 | A–7–6(20) | CH | A–7–6 |
| | | | 100 | 98 | 93 | 41 | 32 | 12 | A–6(9) | CL | A–6a |
| | | | | 100 | 99 | 46 | 50 | 17 | A–7–5(13) | ML | A–7–5 |
| | | | | 100 | 98 | 39 | 39 | 14 | A–6(10) | ML–CL | A–6a |
| | | | | 100 | 71 | 36 | 33 | 12 | A–6(8) | CL | A–6a |
| | | | 100 | 96 | 82 | 39 | 38 | 11 | A–6(8) | ML–CL | A–6a |
| 100 | 92 | 76 | 73 | 64 | 53 | 22 | 27 | 6 | A–4(4) | ML–CL | A–4a |
| 100 | 90 | 58 | 50 | 45 | 39 | 20 | 33 | 11 | A–6(1) | GM–GC | A–6a |
| | 100 | 94 | 80 | 76 | 73 | 23 | 40 | 10 | A–4(8) | ML | A–4b |
| 100 | 90 | 59 | 45 | 39 | 37 | 23 | 41 | 15 | A–7–6(2) | GM–GC | A–7–6 |
| | 100 | 90 | 81 | 78 | 73 | 39 | 40 | 14 | A–6(9) | ML–CL | A–6a |
| | | | 100 | 98 | 96 | 58 | 48 | 28 | A–7–6(15) | CL | A–7–6 |
| | 100 | 96 | 77 | 73 | 72 | 39 | 59 | 37 | A–7–6(18) | CH | A–7–6 |
| | 100 | 84 | 76 | 70 | 50 | 24 | (6) | (6) | A–4(3) | SM | A–4(3) |
| 100 | 93 | 71 | 64 | 57 | 40 | 18 | 29 | 7 | A–4(1) | SM–SC | A–4a |
| 100 | 82 | 49 | 33 | 25 | 17 | 8 | 28 | 7 | A–2–4(0) | GM–GC | A–2–4 |
| | | | | 100 | 98 | 50 | 61 | 15 | A–7–5(14) | MH | A–7–5 |
| | | | | 100 | 91 | 51 | 48 | 17 | A–7–5(12) | ML | A–7–5 |
| | | | | 100 | 98 | 52 | 51 | 18 | A–7–5(13) | MH | A–7–5 |
| | 100 | 98 | 98 | 97 | 62 | 25 | (6) | (6) | A–4(5) | ML | A–4a |
| | | | | 100 | 66 | 22 | (6) | (6) | A–4(6) | ML–CL | A–4a |
| | | | | 100 | 66 | 22 | (6) | (6) | A–4(6) | ML | A–4a |
| | | | 100 | 100 | 62 | 15 | (6) | (6) | A–4(5) | ML | A–4a |
| | | | 100 | 99 | 98 | 47 | 33 | 9 | A–4(8) | ML–CL | A–4b |
| | | | | | 100 | 67 | 63 | 37 | A–7–6(20) | CH | A–7–6 |
| | | | | | 100 | 49 | 38 | 14 | A–6(10) | ML–CL | A–6a |
| | | | 100 | 95 | 90 | 48 | 49 | 15 | A–7–5(12) | ML | A–7–5 |
| 100 | 96 | 94 | 92 | 84 | 79 | 46 | 40 | 15 | A–6(10) | ML–CL | A–6(10) |
| | | 100 | 92 | 76 | 68 | 43 | 47 | 19 | A–7–6(11) | ML–CL | A–7–6 |
| | 100 | 88 | 79 | 73 | 66 | 31 | 41 | 10 | A–5(6) | ML | A–5 |
| | 100 | 98 | 89 | 82 | 78 | 32 | 32 | 11 | A–6(8) | CL–ML | A–6a |
| | 100 | 97 | 94 | 87 | 81 | 32 | 34 | 11 | A–6(8) | ML–CL | A–6a |
| | | | | 100 | 78 | 33 | (6) | (6) | A–4(8) | ML | A–4a |
| | | | | 100 | 84 | 24 | 30 | 8 | A–4(8) | ML–CL | A–4b |
| | | | | 100 | 51 | 22 | (6) | (6) | A–4(3) | ML | A–4a |

TABLE 4.—*Engineering*

| Soil name and location | Parent material | Ohio Report No. | Depth from surface | Moisture-density data [1] | | Fragments larger than 3 inches in diameter discarded in field sampling (estimate) |
|---|---|---|---|---|---|---|
| | | | | Maximum dry density | Optimum moisture | |
| | | | *In.* | *Lb. per. cu. ft.* | *Pct.* | |
| Woodsfield silt loam: | | | | | | |
| SW¼ sec. 11; Benton Township (Mn-50). | Red shale. | 45409 | 0–8 | 119 | 19 | |
| | | 43350 | 14–23 | 103 | 20 | |
| | | 43351 | 29–47 | 99 | 22 | |
| | | 43352 | 47–58 | 106 | 19 | |
| Zanesville silt loam: | | | | | | |
| NE ¼ sec. 14; Benton Township (Mn-46). | Thinly stratified sandstone, siltstone, and shale. | 45405 | 0–7 | 98 | 21 | |
| | | 43341 | 12–18 | 105 | 20 | |
| | | 43342 | 26–36 | 107 | 18 | |
| | | 43343 | 43–50 | 113 | 14 | |

[1] Based on AASHO Designation T 99–57 Methods A and C (*2*).

[2] Mechanical analysis according to the AASHO Designation T 88. Results by this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analysis data used in this table are not suitable for use in naming textural classes for soil.

TABLE 5.—*Estimated properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soil for referring to other series that appear in the first column of this

| Soil series and map symbols | Depth to— | | Depth from surface | Coarse fraction greater than 3 inches | Percentage passing sieve— | | | |
|---|---|---|---|---|---|---|---|---|
| | Seasonally high water table | Bedrock | | | No. 4 (4.7 mm.) | No. 10 (2.0 mm.) | No. 40 (0.42 mm.) | No. 200 (0.074 mm.) |
| | *Ft.* | *Ft.* | *In.* | *Pct.* | | | | |
| Ashton: AsA | >3 | >10 | 0–17 | | 100 | 100 | 90–100 | 75–90 |
| Subject to occasional brief flooding. | | | 17–44 | | 100 | 90–100 | 90–100 | 80–95 |
| | | | 44–95 | | 90–100 | 90–100 | 65–90 | 40–60 |
| | | | 95–100 | <5 | 50–90 | 50–75 | 35–60 | 4–25 |
| Brooke: BwD2, BwE2 | >3 | 1½–3½ | 0–7 | 1–5 | 75–90 | 65–90 | 65–85 | 60–80 |
| | | | 7–40 | 5–20 | 90–100 | 80–100 | 80–100 | 75–95 |
| | | | 40–50 | | | | | |
| Captina: CaB, CaC2, CaD2 | 1½–3 | 4–12 | 0–21 | | 95–100 | 90–100 | 85–95 | 80–90 |
| | | | 21–57 | | 95–100 | 90–100 | 80–95 | 75–90 |
| | | | 57–94 | | 85–100 | 80–100 | 60–80 | 40–65 |

See footnote at end of table.

*test data*—Continued

| Mechanical analysis [2] | | | | | | | Liquid limit | Plasticity index | Classification | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Percentage passing sieve— | | | | | | Percentage smaller than 0.005 mm. | | | | | |
| 1½-in. | ¾-in. | No. 4 (4.7 mm.) | No. 10 (2.0 mm.) | No. 40 (0.42 mm.) | No. 200 (0.074 mm.) | | | | AASHO [3] | Unified [4] | Ohio [5] |
| | | | 100 | 99 | 96 | 37 | 31 | 5 | A–4(8) | ML | A–4(8) |
| | | | 100 | 99 | 94 | 57 | 43 | 19 | A–7–6(12) | CL–ML | A–7–6 |
| | | | | 100 | 97 | 63 | 51 | 25 | A–7–6(16) | CH–MH | A–7–6 |
| | | | 100 | 99 | 95 | 47 | 41 | 19 | A–7–6(12) | CL | A–7–6 |
| | | | 100 | 97 | 94 | 32 | 36 | 8 | A–4(8) | ML | A–4b |
| | | | 100 | 98 | 96 | 43 | 37 | 9 | A–4(8) | ML | A–6a |
| | 100 | 94 | 90 | 83 | 79 | 39 | 35 | 11 | A–6(8) | ML–CL | A–6a |
| | 100 | 89 | 85 | 83 | 79 | 33 | 38 | 12 | A–6(9) | ML–CL | A–6a |

[3] Based on AASHO Designation M 145–49 (*2*).
[4] Based on the Unified Soil Classification System (*17*). SCS and Bureau of Public Roads have agreed that any soil having a plasticity index within 2 points of A–line is to be given a borderline classification. ML–CL is an example of such a classification.
[5] Based on Classification of Soils, Ohio State Testing Laboratory, February 1, 1955.
[6] Nonplastic.

*significant in engineering*

in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions table. The symbol < means less than; the symbol > means more than]

| Classification | | | Permeability | Available moisture capacity | Reaction | Shrink-swell potential | Corrosion potential | |
|---|---|---|---|---|---|---|---|---|
| USDA texture | Unified | AASHO | | | | | Steel | Concrete |
| | | | *Inches per hour* | *Inches per inch of soil* | *pH* | | | |
| Silt loam | ML, ML-CL | A–4 | 0. 63–2. 0 | 0. 18–0. 24 | 5. 6–7. 3 | Low | Low | Low to moderate. |
| Silty clay loam and silt loam. | CL, ML-CL | A–4, A–6 | 0. 63–2. 0 | 0. 16–0. 19 | 5. 6–7. 3 | Low | Low | Low to moderate. |
| Loam to sandy clay loam. | ML, CL, SC | A–4, A–6 | 0. 63–2. 0 | 0. 14–0. 18 | 5. 6–7. 3 | Low | Low | Low to moderate. |
| Loose sand and gravel. | SW, SM, GW, GM | A–1 | 6. 3–12. 0 | 0. 02–0. 04 | 6. 1–7. 3 | Low | Low | Low. |
| Silty clay loam | ML-CL, MH-CH | A–6, A–7 | 0. 2–0. 63 | 0. 18–0. 24 | 6. 1–7 3 | Moderate | High | Low. |
| Silty clay and clay. | CL, CH | A–6, A–7 | 0. 06–0. 2 | 0. 13–0. 15 | [1] 6. 1–7. 8 | High | High | Low. |
| Limestone bedrock. | | | | | | | | |
| Silt loam | ML, ML-CL | A–4 | 0. 63–2. 0 | 0. 18–0. 22 | 4. 6–5. 5 | Low | Moderate | High. |
| Light silty clay loam and loam. | ML, ML-CL | A–4, A–6 | 0. 06–0. 2 | 0. 06–0. 10 | 4. 6–5. 5 | Low | High | High. |
| Loam | ML, SM | A–4 | 0. 63–6. 3 | 0. 14–0. 17 | 4. 6–5. 5 | Low | High | High. |

TABLE 5.—*Estimated properties*

| Soil series and map symbols | Depth to— | | Depth from surface | Coarse fraction greater than 3 inches | Percentage passing sieve— | | | |
|---|---|---|---|---|---|---|---|---|
| | Seasonally high water table | Bedrock | | | No. 4 (4.7 mm.) | No. 10 (2.0 mm.) | No. 40 (0.42 mm.) | No. 200 (0.074 mm.) |
| | *Ft.* | *Ft.* | *In.* | *Pct.* | | | | |
| Chagrin: Cg<br>Subject to flooding. | >3 | 2½–10 | 0–48 | | 100 | 90–100 | 80–100 | 70–100 |
| | | | 48–120 | | 90–100 | 90–100 | 75–100 | 65–85 |
| Conotton: CoA, CoD | >3 | >6 | 0–10 | | 75–90 | 55–75 | 40–70 | 35–60 |
| | | | 10–28 | 0–5 | 75–90 | 50–75 | 25–55 | 20–30 |
| | | | 28–96 | 5–10 | 50–85 | 45–65 | 30–50 | 4–12 |
| *Coolville: CrC2, CrD2<br>For Rarden part of these units, see Rarden series. | 1½–3 | 3½–6 | 0–6 | | 100 | 90–100 | 80–90 | 70–90 |
| | | | 6–19 | | 100 | 90–100 | 80–90 | 80–90 |
| | | | 19–55 | | 90–100 | 85–100 | 85–95 | 80–90 |
| | | | 55–60 | | | | | |
| Dekalb: DkC2, DkD2, DkE2 | >3 | 2–3½ | 0–20 | 1–15 | 80–95 | 75–95 | 40–60 | 30–55 |
| | | | 20–32 | 10–30 | 55–80 | 50–60 | 40–55 | 20–40 |
| | | | 32–40 | | | | | |
| *Gilpin: GdE, GdG, GkB2, GkC2, GkD, GkD2, GkE2, GkE3, GkG, GkG3, G1E, G1G, GnE, GnG, GoB2, GoC2, GoD2, GoD3, GoE2, GoE3, GoG2, GpG.<br>For the Dekalb part of GdE and GdG, see the Dekalb series; for the Upshur part of GkB2 through GnG, see the Upshur series; for the Westmoreland part of GoB2 through GpG, see the Westmoreland series. | >3 | 1½–3½ | 0–14 | 1–10 | 85–100 | 80–90 | 70–85 | 65–85 |
| | | | 14–30 | 5–20 | 70–90 | 65–85 | 50–80 | 40–70 |
| | | | 30–40 | | | | | |
| *Guernsey: GrC2, GrD2, GrE2, GrG2, GsG, GuE, GuG, GwC2, GwD2, GwE2, GwE3, GwG2.<br>For Upshur part of GrC2 through GuG, see Upshur series; for Westmore part of GwC2 through GwG2, see Westmore series. | 1½–3 | 3½–7 | 0–13 | | 90–100 | 80–100 | 75–95 | 70–95 |
| | | | 13–32 | | 100 | 90–100 | 90–100 | 75–100 |
| | | | 32–80 | | 95–100 | 75–95 | 70–90 | 65–90 |
| | | | 80–90+ | | | | | |
| Gullied land, Gilpin-Upshur material: Gy.<br>No estimates of properties for Gullied land. For Gilpin and Upshur parts, refer to their respective series. | | | | | | | | |
| Hackers: HcB | >3 | 8–12 | 0–11 | 1–5 | 85–100 | 80–100 | 70–90 | 60–90 |
| | | | 11–50 | 5–10 | 75–90 | 55–70 | 50–65 | 40–55 |
| | | | 50–96 | 1–5 | 85–100 | 80–100 | 70–90 | 60–90 |

See footnote at end of table.

*significant in engineering*—Continued

| Classification | | | Permeability | Available moisture capacity | Reaction | Shrink-swell potential | Corrosion potential | |
|---|---|---|---|---|---|---|---|---|
| USDA texture | Unified | AASHO | | | | | Steel | Concrete |
| | | | *Inches per hour* | *Inches per inch of soil* | *pH* | | | |
| Silt loam | ML, ML-CL | A-4, A-6, A-7 | 0. 63–2. 0 | 0. 18–0. 24 | 6. 1–7. 3 | Low | Low | Low. |
| Loam | ML, CL | A-4, A-6 | 0. 63–2. 0 | 0. 16–0. 19 | 5. 6–7. 3 | Low | Low | Moderate to low. |
| Gravelly loam | SM, ML | A-4 | 6. 3–12. 0 | 0. 12–0. 16 | 5. 1–6. 0 | Low | Low | Moderate. |
| Gravelly sandy loam. | SM | A-1, A-2 | 6. 3–12. 0 | 0. 06–0. 10 | 4. 6–6. 0 | Low | Low | Moderate. |
| Sand and gravel. | GW, SW GW-GM SW-SM | A-1 | 6. 3–12. 0+ | 0. 02–0. 06 | 6. 1–7. 3 | Low | Low | Moderate to low. |
| Silt loam | ML, ML-CL | A-4 | 0. 63–2. 0 | 0. 18–0. 22 | 4. 6–5. 0 | Low | High | High. |
| Silty clay loam | CL, ML-CL | A-6 | 0. 63–2. 0 | 0. 16–0. 19 | 4. 6–5. 0 | Moderate | High | High. |
| Clay | CH | A-7 | 0. 06–0. 20 | 0. 13–0. 15 | 4. 1–5. 0 | High | High | High. |
| Clay shale bedrock. | | | | | | | | |
| Loam and channery loam. | ML, SM | A-2, A-4 | 2. 0–6. 3 | 0. 13–0. 17 | 4. 1–5. 5 | Low | Low | High. |
| Channery sandy loam. | SM, GM | A-1, A-2, A-4 | 2. 0–6. 3 | 0. 10–0. 15 | 4. 1–5. 0 | Low | Low | High. |
| Sandstone bedrock. | | | | | | | | |
| Silt loam | ML, ML-CL | A-4 | 0. 63–2. 0 | 0. 17–0. 22 | 4. 1–5. 5 | Low | Low | High. |
| Channery silt loam. | ML-CL, GM-GC, SM-SC | A-4, A-6 | 0. 63–2. 0 | 0. 13–0. 17 | 4. 1–5. 5 | Low | Low | High. |
| Sandstone, siltstone, and shale. | | | | | | | | |
| Silt loam | ML, ML-CL | A-4, A-6 | 0. 63–2. 0 | 0. 18–0. 24 | 4. 6–6. 5 | Low | Moderate | High. |
| Silty clay loam | CL, ML-CL | A-6, A-7 | 0. 63–2. 0 | 0. 16–0. 19 | 4. 6–6. 5 | Moderate | High | High. |
| Silty clay and clay. | CH | A-7 | 0. 06–0. 2 | 0. 13–0. 16 | 5. 6–7. 3 | High | High | Moderate. |
| Interbedded limestone, siltstone, or shale. | | | | | | | | |
| Silt loam | ML, ML-CL | A-4 | 0. 63–2. 0 | 0. 18–0. 23 | 5. 1–6. 0 | Low | Moderate | Moderate. |
| Channery silt loam and channery light clay loam. | SM, SC, ML, CL | A-4, A-6 | 0. 63–2. 0 | 0. 16–0. 19 | 5. 1–6. 0 | Low to moderate. | Moderate | Moderate. |
| Silt loam and light clay loam. | ML, CL | A-4, A-6 | 0. 63–2. 0 | 0. 17–0. 20 | 5. 1–6. 5 | Low to moderate. | Moderate | Moderate. |

TABLE 5.—*Estimated properties*

| Soil series and map symbols | Depth to— | | Depth from surface | Coarse fraction greater than 3 inches | Percentage passing sieve— | | | |
|---|---|---|---|---|---|---|---|---|
| | Seasonally high water table | Bedrock | | | No. 4 (4.7 mm.) | No. 10 (2.0 mm.) | No. 40 (0.42 mm.) | No. 200 (0.074 mm.) |
| | *Ft.* | *Ft.* | *In.* | *Pct.* | | | | |
| Hartshorn: He<br>Subject to flooding. | 1½–3 | >3½ | 0–10 | 1–5 | 80–100 | 75–100 | 60–90 | 45–80 |
| | | | 10–19 | 1–5 | 70–95 | 55–85 | 45–75 | 35–60 |
| | | | 19–56 | 1–5 | 45–80 | 30–60 | 25–50 | 12–25 |
| Hartshorn, wet variant: Hr | ½–1½ | 2½–5 | 0–23 | ---- | 90–100 | 80–95 | 70–90 | 65–90 |
| | | | 23–32 | 1–5 | 80–100 | 60–75 | 50–70 | 35–65 |
| | | | 32+ | ---- | ---- | ---- | ---- | ---- |
| Huntington: Hu<br>Subject to flooding. | >3 | >6 | 0–69 | ---- | 95–100 | 90–100 | 80–100 | 60–100 |
| | | | 69–114 | ---- | ---- | ---- | ---- | ---- |
| *Keene: KeB, KeC2, KlD2<br>For Latham part of KlD2, see Latham series. | 1½–3 | 3½–5 | 0–7 | ---- | 90–100 | 85–100 | 70–90 | 60–90 |
| | | | 7–24 | ---- | 90–100 | 85–100 | 85–95 | 80–90 |
| | | | 24–48 | ---- | 90–100 | 95–100 | 85–95 | 80–95 |
| | | | 48–56 | ---- | 70–90 | 65–80 | 55–75 | 50–75 |
| | | | 56 | ---- | ---- | ---- | ---- | ---- |
| Latham: LdE2<br>For Keene part of this unit, see Keene series. | 1–2½ | 3½–5 | 0–6 | ---- | 90–100 | 85–100 | 80–90 | 70–90 |
| | | | 6–12 | ---- | 90–100 | 85–100 | 80–100 | 80–95 |
| | | | 12–56 | ---- | 100 | 95–100 | 90–100 | 85–95 |
| | | | 56 | ---- | ---- | ---- | ---- | ---- |
| Lindside: Ln<br>Subject to flooding. | 1½–3 | >5 | 0–72 | ---- | 95–100 | 90–100 | 70–90 | 60–90 |
| | | | 72–100 | ---- | ---- | ---- | ---- | ---- |
| Made land: Ma.<br>No estimates of properties. | | | | | | | | |
| Newark: Nn<br>Subject to flooding. | ½–1½ | >5 | 0–60 | ---- | 95–100 | 90–100 | 80–90 | 60–90 |
| | | | 60–90 | ---- | 95–100 | 85–100 | 80–95 | 80–90 |

See footnote at end of table.

*significant in engineering*—Continued

| Classification | | | Permeability | Available moisture capacity | Reaction | Shrink-swell potential | Corrosion potential | |
|---|---|---|---|---|---|---|---|---|
| USDA texture | Unified | AASHO | | | | | Steel | Concrete |
| | | | *Inches per hour* | *Inches per inch of soil* | *pH* | | | |
| Silt loam | ML, ML-CL, SM | A-4 | 0. 63-2. 0 | 0. 16-0. 20 | 5. 6-7. 3 | Low | Low | Moderate to low. |
| Gravelly silt loam and gravelly loam. | SM, ML, SM-SC | A-4 | 2. 0-6. 3 | 0. 14-0. 18 | 5. 1-7. 3 | Low | Low | Moderate. |
| Gravel and sand | GM, SM, GM-GC | A-1, A-2 | 2. 0-6. 3 | 0. 02-0. 05 | 5. 6-7. 3 | Low | Low | Moderate to low. |
| Silt loam | ML, ML-CL | A-4 | 2. 0-6. 3 | 0. 17-0. 22 | 4. 6-6. 1 | Low | High | High. |
| Gravelly silt loam. Siltstone bedrock. | SM, ML | A-4 | 2. 0-6. 3 | 0. 13-0. 16 | 5. 1-6. 5 | Low | High | Moderate. |
| Silt loam. Stratified silt loam, sandy loam, and loamy sand. | ML, ML-CL, MH | A-6, A-7 | 0. 63-2. 0 | 0. 17-0. 22 | 6. 1-7. 8 | Low | Moderate | Low. |
| Silt loam | ML, ML-CL | A-4 | 0. 63-2. 0 | 0. 18-0. 22 | 4. 1-5. 5 | Low | High | High. |
| Silty clay loam. | CL, ML-CL | A-6 | 0. 63-2. 0 | 0. 16-0. 19 | 4. 1-5. 5 | Moderate | High | High. |
| Silty clay and clay. | CH | A-7 | 0. 06-0. 2 | 0. 14-0. 18 | 4. 1-5. 5 | High | High | High. |
| Silty clay loam. Clay, shale, and siltstone. | CL, CH | A-7 | 0. 2-0. 63 | 0. 14-0. 16 | 4. 1-5. 5 | High | High | High. |
| Silt loam | ML, ML-CL | A-4 | 0. 63-2. 0 | 0. 18-0. 22 | 4. 1-5. 5 | Low | High | High. |
| Silty clay loam. | CL, ML-CL | A-6 | 0. 2-0. 63 | 0. 16-0. 19 | 4. 1-5. 5 | Moderate | High | High. |
| Clay. Clay, shale, and siltstone. | CH | A-7 | <0. 2 | 0. 12-0. 15 | 4. 1-5. 5 | High | High | High. |
| Silt loam. Stratified silt and sand (variable). | ML, ML-CL | A-4, A-6 | 0. 63-2. 0 | 0. 17-0. 22 | 5. 6-7. 3 | Low | Moderate | Moderate. |
| Silt loam | ML, ML-CL | A-4, A-6 | 0. 63-2. 0 | 0. 17-0. 22 | 5. 6-7. 8 | Low | High | Moderate. |
| Silty clay loam | CL, ML-CL | A-6 | 0. 2-0. 63 | 0. 15-0. 18 | 6. 1-7. 8 | Moderate | High | Low. |

TABLE 5.—*Estimated properties*

| Soil series and map symbols | Depth to— | | Depth from surface | Coarse fraction greater than 3 inches | Percentage passing sieve— | | | |
|---|---|---|---|---|---|---|---|---|
| | Seasonally high water table | Bedrock | | | No. 4 (4.7 mm.) | No. 10 (2.0 mm.) | No. 40 (0.42 mm.) | No. 200 (0.074 mm.) |
| | *Ft.* | *Ft.* | *In.* | *Pct.* | | | | |
| *Rarden: RcD2<br>For Coolville part of this unit, see Coolville Series. | 1½–3 | 3½–5 | 0–6 | | 95–100 | 90–100 | 90–100 | 80–90 |
| | | | 6–42 | | 95–100 | 90–100 | 90–100 | 85–95 |
| | | | 42–54 | | 95–100 | 90–100 | 85–95 | 80–90 |
| | | | 54+ | | | | | |
| Sciotoville: ScB | 1½–3 | >6 | 0–15 | | 95–100 | 90–100 | 70–90 | 60–90 |
| | | | 15–55 | | 100 | 90–100 | 75–90 | 65–90 |
| | | | 55–75 | | 90–100 | 85–100 | 65–80 | 40–60 |
| *Sees: SsD, SsE<br>For Woolper part of these units, see Woolper series. | 1½–3 | >6 | 0–9 | 1–5 | 90–100 | 85–100 | 80–100 | 65–90 |
| | | | 9–30 | 1–10 | 90–100 | 75–100 | 70–90 | 70–95 |
| | | | 30–70 | 1–20 | 80–100 | 75–100 | 70–90 | 70–90 |
| Strip mine spoils: St.<br>No estimates of properties. | | | | | | | | |
| Upshur: UpC2, UpD2, UrC3, UrD3 | >3 | 3½–6 | 0–5 | | 100 | 100 | 90–100 | 90–100 |
| | | | 5–35 | | 100 | 100 | 90–100 | 80–100 |
| | | | 35–46 | 1–5 | 80–90 | 55–75 | | 50–70 |
| | | | 46+ | | | | | |
| *Vandalia: VaD, VdE, VsE2<br>For Sees part of VsE2 and VdE, see Sees series. | >3 | 6–20 | 0–8 | | 80–90 | 75–90 | 70–85 | 65–80 |
| | | | 8–17 | | 100 | 75–90 | 70–85 | 65–80 |
| | | | 17–70 | 1–5 | 70–100 | 65–100 | 60–100 | 55–95 |
| Wellston: WhB2, WhC2, WhD2 | >3 | 3½–5 | 0–12 | | 90–100 | 85–95 | 70–90 | 65–90 |
| | | | 12–38 | <5 | 70–95 | 65–95 | 60–90 | 55–85 |
| | | | 38–45 | | | | | |
| Westmore<br>Mapped only in complexes with Guernsey soils. | >3 | 3½–6 | 0–9 | | 100 | 90–100 | 80–100 | 70–95 |
| | | | 9–51 | 1–10 | 100 | 90–100 | 85–100 | 80–95 |
| | | | 51–68 | 1–15 | 90–100 | 90–95 | 70–90 | 60–90 |
| | | | 68 | | | | | |

See footnote at end of table.

*significant in engineering*—Continued

| Classification | | | Permeability | Available moisture capacity | Reaction | Shrink-swell potential | Corrosion potential | |
|---|---|---|---|---|---|---|---|---|
| USDA texture | Unified | AASHO | | | | | Steel | Concrete |
| | | | *Inches per hour* | *Inches per inch of soil* | *pH* | | | |
| Silt loam | CL, ML–CL | A–6 | 0. 2–0. 63 | 0. 17–0. 21 | 4. 1–5. 0 | Moderate | High | High. |
| Clay | CH | A–7 | 0. 06–0. 2 | 0. 14–0. 17 | 4. 1–5. 0 | High | High | High. |
| Silty clay loam | CL, ML–CL | A–6, A–7 | 0. 06–0. 2 | 0. 14–0. 17 | 4. 1–5. 0 | Moderate | High | High. |
| Clay, shale, and siltstone. | | | | | | | | |
| Silt loam | ML, ML–CL | A–4 | 0. 63–2. 0 | 0. 17–0. 22 | 4. 6–6. 0 | Low | Moderate | Moderate. |
| Loam | ML, ML–CL | A–4 | 0. 2–0. 63 | 0. 08–0. 12 | 4. 6–5. 5 | Low | Moderate | Moderate to high. |
| Sandy loam | SM, ML | A–4 | 2. 0–6. 3+ | 0. 10–0. 14 | 4. 6–6. 0 | Low | Moderate | Moderate to high. |
| Silt loam | ML, ML–CL | A–4 | 0. 63–2. 0 | 0. 18–0. 23 | 5. 1–6. 0 | Low | Moderate | Moderate. |
| Silty clay loam | CL, ML–CL | A–6, A–7 | 0. 2–0. 63 | 0. 16–0. 20 | 5. 1–6. 0 | Moderate | High | Moderate. |
| Silty clay | CH | A–7 | 0. 06–0. 2 | 0. 14–0. 17 | 5. 6–7. 3 | High | High | Moderate to low. |
| Silt loam | ML, ML–CL | A–4 | 0. 63–2. 0 | 0. 18–0. 22 | 4. 6–6. 0 | Low | High | Moderate to high. |
| Silty clay and clay. | CH, ML–CL | A–7 | 0. 06–0. 2 | 0. 14–0. 17 | 4. 1–5. 5 | High | High | Moderate to high. |
| Channery silty clay loam. Red clay shale. | ML–CL, CH | A–6, A–7 | 0. 06–0. 2 | 0. 10–0. 14 | 5. 1–7. 3 | High | High | Moderate to low. |
| Silt loam | ML, ML–CL | A–4, A–6 | 0. 63–2. 0 | 0. 18–0. 22 | 5. 1–6. 0 | Low | Moderate | Moderate. |
| Silty clay loam | CL, ML–CL, CH | A–6, A–7 | 0. 2–0. 63 | 0. 16–0. 19 | 4. 6–5. 5 | Moderate to high. | High | Moderate to high. |
| Clay | CL, CH | A–7 | 0. 06–0. 2 | 0. 08–0. 12 | 5. 6–6. 5 | High | High | Moderate. |
| Silt loam | ML, ML–CL | A–4 | 0. 63–2. 0 | 0. 18–0. 23 | 5. 1–6. 5 | Low | Moderate | Moderate. |
| Silt loam | CL, ML–CL | A–6 | 0. 63–2. 0 | 0. 16–0. 19 | 4. 6–5. 5 | Low to moderate. | Moderate | High. |
| Fractured siltstone and sandstone over sandstone bedrock. | | | | | | | | |
| Silt loam | ML, ML–CL | A–4, A–6, A–7 | 0. 63–2. 0 | 0. 18–0. 23 | 5. 1–6. 5 | Low | Moderate | Moderate. |
| Silty clay loam | CL, ML–CL | A–6 | 0. 2–2. 0 | 0. 16–0. 19 | 4. 6–6. 5 | Moderate | High | High. |
| Clay | CH | A–7 | 0. 06–0. 2 | 0. 14–0. 17 | 5. 6–7. 8 | High | High | High. |
| Interbedded limestone, sandstone, and shale. | | | | | | | | |

TABLE 5.—*Estimated properties*

| Soil series and map symbols | Depth to— | | Depth from surface | Coarse fraction greater than 3 inches | Percentage passing sieve— | | | |
|---|---|---|---|---|---|---|---|---|
| | Seasonally high water table | Bedrock | | | No. 4 (4.7 mm.) | No. 10 (2.0 mm.) | No. 40 (0.42 mm.) | No. 200 (0.074 mm.) |
| | *Ft.* | *Ft.* | *In.* | *Pct.* | | | | |
| Westmoreland | >3 | 3½–5 | 0–9 | | 90–100 | 80–100 | 70–95 | 60–90 |
| Mapped only in complexes with Gilpin series. | | | 9–20 | | 90–100 | 75–95 | 70–90 | 65–90 |
| | | | 20–38 | >5 | 80–90 | 60–75 | 55–70 | 40–60 |
| | | | 38–56 | 5–15 | 70–80 | 45–50 | 35–50 | 30–50 |
| | | | 56 | | | | | |
| Wheeling: WrA, WrB, WrC2 | >3 | 10+ | 0–10 | | 95–100 | 95–100 | 75–100 | 60–90 |
| | | | 10–62 | | 95–100 | 90–100 | 80–100 | 50–95 |
| | | | 62–110 | | 90–100 | 85–100 | 75–90 | 60–80 |
| Woodsfield: WtB, WtC2, WtD2 | 1½–3 | 3–6 | 0–7 | | 95–100 | 90–100 | | 70–90 |
| | | | 7–24 | | 95–100 | 90–100 | | 80–90 |
| | | | 24–50 | | 100 | 90–100 | | 85–95 |
| | | | 50–56 | 0–10 | 95–100 | 90–100 | | 80–90 |
| | | | 56 | | | | | |
| *Woolper: WxB, WyC | >3 | 6–20 | 0–7 | | 90–100 | 75–95 | 70–90 | 60–90 |
| For Sees part of WyC, see Sees series. | | | 7–64 | 0–10 | 85–100 | 75–90 | 65–85 | 55–85 |
| *Zanesville: ZnB, ZnB2, ZnC, ZnC2, ZnD2, ZoB, ZoB2, ZoC, ZoC2, ZoD2. | 1½–3 | 4–5½ | 0–13 | | 100 | 90–100 | 85–100 | 80–95 |
| For Woodsfield part of ZoB through ZoD2, see Woodsfield series. | | | 13–25 | | 100 | 90–100 | 90–100 | 80–100 |
| | | | 25–40 | | 90–100 | 90–100 | 80–90 | 65–85 |
| | | | 40–55 | | 90–100 | 75–90 | 70–85 | 68–5 |
| | | | 55–60 | | | | | |

[1] Calcareous.

*significant in engineering*—Continued

| Classification | | | Permeability | Available moisture capacity | Reaction | Shrink-swell potential | Corrosion potential | |
|---|---|---|---|---|---|---|---|---|
| USDA texture | Unified | AASHO | | | | | Steel | Concrete |
| | | | *Inches per hour* | *Inches per inch of soil* | *pH* | | | |
| Silt loam | ML, ML–CL | A–4, A–5 | 0. 63–2. 0 | 0. 17–0. 22 | 4. 6–5. 5 | Low | Low | High. |
| Silt loam | ML, CL | A–4, A–6 | 0. 63–2. 0 | 0. 13–0. 17 | 4. 6–5. 5 | Low | Low | High. |
| Channery silt loam. | SC, ML, ML–CL | A–4, A–6 | 0. 63–2. 0 | 0. 10–0. 14 | 4. 6–5. 5 | Low | Low | High. |
| Very channery silt loam. | GM, SM | A–2, A–4 | 0. 63–2. 0 | 0. 08–0. 10 | 4. 6–5. 5 | Low | Low | High. |
| Sandstone bedrock. | | | | | | | | |
| Silt loam | ML, ML–CL | A–4 | 0. 63–2. 0 | 0. 18–0. 23 | 5. 1–6. 5 | Low | Moderate | Moderate. |
| Silt loam and silty clay loam. | ML, CL | A–4, A–6 | 0. 63–2. 0 | 0. 16–0. 20 | 4. 6–6. 0 | Low to moderate. | Moderate | High to moderate. |
| Loam | ML, ML–CL | A–4 | 2. 0–6. 3 | 0. 14–0. 18 | 4. 6–6. 0 | Low | Moderate | High to moderate. |
| Silt loam | ML, ML–CL | A–4 | 0. 63–2. 0 | 0. 18–0. 22 | 4. 6–6. 0 | Low | High | Moderate to high. |
| Silty clay loam. | CL, ML–CL | A–6, A–7 | 0. 63–2. 0 | 0. 16–0. 20 | 4. 6–5. 5 | Moderate | High | Moderate to high. |
| Silty clay | CH–MH, CH | A–6, A–7 | 0. 06–0. 2 | 0. 10–0. 14 | 4. 6–6. 0 | High | High | Moderate to high. |
| Silty clay loam. Interbedded shale and sandstone. | CL, ML–CL | A–6, A–7 | 0. 06–0. 2 | 0. 10–0. 14 | 4. 6–6. 0 | Moderate | High | Moderate. |
| Silt loam | ML, ML–CL | A–4 | 0. 63–2. 0 | 0. 18–0. 24 | 5. 1–7. 3 | Low | Moderate | Moderate. |
| Silty clay loam. | CL, ML–CL | A–6, A–7 | 0. 2–0. 63 | 0. 16–0. 20 | 5. 1–7. 3 | Moderate | Moderate | Moderate. |
| Silt loam | ML, ML–CL | A–4 | 0. 63–2. 0 | 0. 18–0. 22 | 4. 6–5. 5 | Low | Moderate | High. |
| Silty clay loam. | ML, CL | A–6, A–4 | 0. 63–2. 0 | 0. 16–0. 19 | 4. 6–5. 5 | Moderate | Moderate | High. |
| Silt loam, silty clay loam, and clay loam. | ML, CL | A–4, A–6 | 0. 06–0. 2 | 0. 08–0. 10 | 4. 6–5. 5 | Low | Moderate | High. |
| Silt loam Siltstone. | ML, CL | A–4, A–6 | 0. 2–0. 63 | 0. 14–0. 17 | 4. 6–5. 5 | Low | Moderate | High. |

TABLE 6.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in for referring to other series that appear

| Soil series and map symbols | Suitability for winter grading | Susceptibility to frost action | Suitability as source of— | | | | Soil features affecting— |
|---|---|---|---|---|---|---|---|
| | | | Topsoil | Sand and gravel | Roadfill | | Highway location |
| | | | | | Solum | Substratum | |
| Ashton: AsA | Fair to good: subject to flooding. | Moderate to low. | Good | Not suited to a depth of 6 feet. Good locally at a depth below 6 feet. | Fair to poor: loamy material. | Good: sand and gravel at a depth below 6 feet. | Subject to flooding; nearly level. |
| Brooke: BwD2, BwE2. | Poor: clayey subsoil material. | Moderate | Fair: thin layer of silty clay loam. | Not suited, but is a source of limestone in places. | Poor: clayey plastic subsoil. | Not suited: limestone-shale bedrock. | Moderately steep to very steep; possible slippage where steep; moderately deep to rock; high shrink-swell potential. |
| Captina: CaB, CaC2, CaD2. | Poor: seasonally wet. | High | Good to a depth of 12 inches; fair 12 to 20 inches. | Not suited | Fair to poor: loamy material. | Good to poor: variable material. | Seepage on fragipan; gently sloping to moderately steep. |
| Chagrin: Cg | Fair to good: subject to flooding. | Moderate to low. | Good to a depth of 24 inches. | Not suited | Fair to poor: loamy material. | Fair to poor: loamy material. | Nearly level; subject to flooding; well drained. |
| Conotton: CoA, CoD | Good: well drained, gravelly. | Low | Poor: gravelly material. | Good below a depth of 14 to 30 inches; well-graded sand and gravel. | Good | Good | Cut slopes are droughty; moderately steep in some places. |
| *Coolville: CrC2, CrD2. For Rarden part of these units, see Rarden series. | Poor: sticky, clayey subsoil. | Moderate | Fair: thin layer of suitable material. | Not suited | Poor: clayey subsoil. | Poor: clay shale. | Sloping to moderately steep; cuts are clayey and sticky; plastic subsoil material; high shrink-swell potential. |
| Dekalb: DkC2, DkD2, DkE2. | Good: some steep to very steep slopes. | Low | Fair: low organic-matter content. | Not suited, but is a source of sandstone in places. | Good | Not suited: sandstone bedrock. | Moderately deep to rock; steep and very steep in some places. |

See footnote at end of table.

*interpretations*

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions in the first column of this table]

| Soil features affecting—Continued | | | | | | |
|---|---|---|---|---|---|---|
| Pipeline construction and maintenance | Farm ponds | | Agricultural drainage | Sprinkler irrigation | Terraces and diversions | Waterways |
| | Reservoir area | Embankment [1] | | | | |
| Well drained; subject to flooding. | Subject to flooding; pervious substratum. | Upper 6 feet has fair stability and compaction characteristics; medium compressibility; pervious at a depth below 6 feet; subject to piping. | Not needed; well drained. | High available moisture capacity; nearly level; subject to flooding. | Not generally used; nearly level; well drained; subject to flooding. | Well drained; deep; subject to flooding; nearly level. |
| Moderately steep and steep; possible slippage where steep; moderately deep to rock; high shrink-swell potential. | Moderately deep to rock; moderately steep and steep. | Fair to poor stability and compaction characteristics; high compressibility; moderately deep to rock; high shrink-swell potential; subject to cracking. | Not generally needed, except in seep spots; well drained. | Moderately steep and steep; slow permeability. | Too steep for terraces; moderately deep to rock; clayey subsoil. | Moderately steep to steep; clayey subsoil; erosion hazard. |
| Seasonally wet; seepage on fragipan. | Pervious substratum in some places. | Fair stability and compaction characteristics; medium compressibility; possibility of piping. | Drainage not generally needed, except in seep spots; fragipan in subsoil. | Medium available moisture capacity; erosion hazard. | Moderately steep in some places; seepage in channels and possible on fragipan. | Seepage on fragipan; erosion hazard. |
| Nearly level; well drained; subject to flooding. | Subject to flooding; excessive seepage losses. | Fair stability and compaction characteristics; moderate to low permeability; medium compressibility; possibility of piping. | Not needed; well drained. | High available moisture capacity; good infiltration; subject to flooding; nearly level. | Not generally needed; nearly level; subject to flooding. | Deep; well drained; nearly level; subject to flooding. |
| Well drained; gravelly. | Pervious soil and substratum; high seepage losses. | Good stability and compaction characteristics; high permeability; slight compressibility. | Not needed; well drained. | Low available moisture capacity; good infiltration; erosion hazard on slopes. | Difficult to vegetate: gravelly material; too steep for terraces in some places. | Cut channels are droughty and hard to vegetate; erosion hazard on slopes. |
| Plastic, clayey subsoil; depth to shale from 42 to 70 inches; high shrink-swell potential. | Limited depth to shale; low seepage losses likely. | Fair to poor stability and compaction characteristics; low permeability; medium to high compressibility; high shrink-swell potential. | Not needed; well drained. | Slow permeability; medium available moisture capacity; erosion hazard on slopes. | Cut channels are clayey and hard to vegetate. | Cut channels are clayey and hard to vegetate; erosion hazard on slopes. |
| Moderately deep to rock; very steep in some places. | Moderately deep to rock; high seepage losses; steep and very steep in some places. | Pervious material; limited amount of material; very steep in some places. | Not needed; well drained. | Low available moisture capacity; erosion hazard. | Moderately deep to rock; steep in some places. | Moderately deep to rock; erodible on steep slopes; droughty. |

TABLE 6.—*Engineering*

| Soil series and map symbols | Suitability for winter grading | Susceptibility to frost action | Suitability as source of— | | | | Soil features affecting— |
|---|---|---|---|---|---|---|---|
| | | | Topsoil | Sand and gravel | Roadfill | | Highway location |
| | | | | | Solum | Substratum | |
| *Gilpin: GdE, GdG, GkB2, GkC2, GkD, GkD2, GkE2, GkE3, GkG, GkG3, GlE, GlG, GnE, GnG, GoB2, GoC2, GoD2, GoD3, GoE2, GoE3, GoG2, GpG. For Dekalb part of GdE and GdG, see Dekalb series; for Upshur part of GkB2 through GnG, see Upshur series; for Westmoreland part of GoB2 through GpG, see Westmoreland series. | Fair: loamy material. | Low to moderate. | Fair: low organic-matter content; poor in severely eroded soils. | Not suited | Fair: loamy material. | Not suited: siltstone and shale bedrock. | Moderately deep to shale; some steep slopes; well drained; stable; some soils stony. |
| *Guernsey: GrC2, GrD2, GrE2, GrG2, GsG, GuE, GuG, GwC2, GwD2, GwE2, GwE3, GwG2. For Upshur part of GrC2 through GuG, see Upshur series; for Westmore part of GwC2 through GwG2, see Westmore series. | Poor: seasonally wet; sticky and clayey in lower subsoil. | High | Good to a depth of 12 inches. | Not suited | Fair to poor: clayey in lower part of subsoil. | Not suited: limestone and shale rock. | Some steep to very steep slopes; slips are common; seepage in cuts; plastic clay in cuts; high shrink-swell potential. |
| Gullied land, Gilpin-Upshur material: Gy. Properties too variable for reliable evaluation. Onsite investigation required. | | | | | | | |
| Hackers: HcB | Fair to poor: subject to occasional flooding. | Moderate | Good to a depth of 12 inches, channery below 12 inches. | Generally not suited; may be good locally. | Fair to good: loamy material. | Variable alluvial material. | Subject to occasional flooding; well drained. |
| Hartshorn: He | Fair: subject to flooding. | Moderate | Fair: gravelly below depth of 10 to 20 inches. | Fair below depth of 2 feet, sand and gravel with high content of fines. | Good | Good | Subject to flooding; nearly level. |

See footnote at end of table.

*interpretations*—Continued

| Soil features affecting—Continued | | | | | | |
|---|---|---|---|---|---|---|
| Pipeline construction and maintenance | Farm ponds | | Agricultural drainage | Sprinkler irrigation | Terraces and diversions | Waterways |
| | Reservoir area | Embankment [1] | | | | |
| Moderately deep to shale; some steep to very steep slopes; stable soil. | High seepage losses; moderately deep to shale. | Fair compaction characteristics and stability; susceptible to piping; moderately deep to shale. | Not needed; well drained. | Moderately deep to bedrock; low to medium water storage; erosion hazard on slopes. | Some slopes too steep for terraces; moderately deep to bedrock; cut channels are droughty. | Erosion hazard on slopes; cut channels are droughty; moderately deep to bedrock. |
| Subject to slippage; some steep to very steep slopes; seasonally wet; seepage in trench; high shrink-swell potential. | Low seepage losses; slips common; bedrock at depth of 3½ to 7 feet. | Fair to poor stability and compaction characteristics; low permeability; high compressibility; high shrink-swell potential; subject to cracking. | Generally not needed, except in seep spots. | Some steep slopes; medium to high available moisture capacity; good infiltration rate. | Some slopes too steep for terraces; cut channels may be clayey; erosion hazard. | Channels may be clayey; steep and very steep slopes; high surface runoff; erodible on steep slopes. |
| Subject to occasional flooding; well drained. | Subject to occasional flooding; moderate to high seepage losses in subsoil and substratum. | Fair stability and compaction characteristics; medium compressibility; medium to low permeability. | Not needed; well drained. | High available moisture capacity; good infiltration rate; subject to flooding. | Cut channels may be channery; erosion hazard. | Cut channels may be channery; erosion hazard. |
| Nearly level; subject to flooding. | Subject to flooding; pervious substratum. | Pervious material for embankments. | Not generally needed. | Low available moisture capacity; good infiltration rate. | Not generally needed; nearly level; subject to flooding. | Nearly level; subject to flooding. |

TABLE 6.—*Engineering*

| Soil series and map symbols | Suitability for winter grading | Susceptibility to frost action | Suitability as source of— | | | | Soil features affecting— |
|---|---|---|---|---|---|---|---|
| | | | Topsoil | Sand and gravel | Roadfill | | Highway location |
| | | | | | Solum | Substratum | |
| Hartshorn, wet variant: Hr. | Poor: seasonally wet; subject to flooding. | Moderate to high. | Fair: gravelly below depth of 10 to 20 inches. | Fair below depth of 2 feet, sand and gravel with high content of fines. | Good | Good | Seasonally wet; nearly level; subject to flooding. |
| Huntington: Hu | Fair: subject to flooding. | Moderate | Good | Not suited | Fair to poor: loamy material. | Variable alluvial material. | Subject to flooding; well drained; nearly level. |
| *Keene: KeB, KeC2, KlD2. For Latham part of KlD2, see Latham series. | Poor: seasonally wet; clayey subsoil. | High | Fair: limited suitable material. | Not suited | Poor; plastic clayey subsoil. | Not suited: siltstone and shale. | Some steep slopes; high shrink-swell potential; plastic clay subsoil; possibility of slippage. |
| *Latham: LdE2 For Keene part of this unit, see Keene series. | Poor: seasonally wet; claycy. | High | Fair: limited suitable material. | Not suited | Poor: plastic clayey subsoil. | Not suited: siltstone and shale. | Some steep to very steep slopes; high shrink-swell potential; plastic clay subsoil; subject to slippage; somewhat poorly drained. |
| Lindside: Lh | Poor: subject to flooding; seasonally wet. | High | Good | Not suited | Fair to poor: loamy material. | Variable alluvial material. | Subject to flooding; seasonal high water table; nearly level. |
| Made land: Ma No estimates of properties. On site investigation required. | | | | | | | |
| Newark: Nn | Poor: seasonally wet; subject to flooding. | Moderate to high. | Fair to good; seasonally wet. | Fair locally below depth of 3 to 10 feet, sand and gravel with high content of fines. | Fair: loamy material. | Fair: loamy material. | Seasonally wet; nearly level; subject to flooding. |

See footnote at end of table.

*interpretations*—Continued

| Soil features affecting—Continued | | | | | | |
|---|---|---|---|---|---|---|
| Pipeline construction and maintenance | Farm ponds | | Agricultural drainage | Sprinkler irrigation | Terraces and diversions | Waterways |
| | Reservoir area | Embankment [1] | | | | |
| Nearly level; subject to flooding; somewhat poorly drained. | Subject to flooding; pervious substratum. | Pervious material for embankments. | Outlets may be hard to establish; water table seasonally high. | Low available moisture capacity; good infiltration rate. | Not generally needed; nearly level; subject to flooding. | Nearly level; subject to flooding. |
| Subject to flooding; well drained; nearly level. | Moderate to high seepage loss; subject to flooding. | Fair stability and compaction characteristics; medium compressibility; medium to low permeability. | Not needed; well drained. | High available moisture capacity; good infiltration rate; nearly level; subject to flooding. | Not generally needed; nearly level; subject to flooding. | Nearly level; subject to flooding. |
| Some steep slopes; high shrink-swell potential; seepage in trench; possibility of slips. | Slow rate of seepage; some steep slopes; possibility of slippage. | Fair to poor stability and compaction characteristics; high compressibility; low permeability. | Not generally needed except in seep spots; slow permeability. | Some steep slopes; medium available moisture capacity; slow to moderate infiltration rate; erosion hazard. | Some slopes too steep for terraces; cut channels are clayey; some seep spots. | Some seep spots; cut channels are clayey; erosion hazard. |
| Some steep to very steep slopes; subject to slippage; high shrink-swell potential; seepage in trench. | Slow rate of seepage; subject to slippage, some steep to very steep slopes. | Fair to poor stability and compaction characteristics; high compressibility; low permeability. | Seasonally wet; seepy; slow permeability; steep to very steep slopes. | Steep to very steep slopes; erosion hazard. | Too steep for terraces; cut channels are clayey; some seep spots. | Some seep spots; cut channels are clayey; erosion hazard. |
| Subject to flooding; seasonal high water table; nearly level. | Subject to flooding; seasonal high water table; excessive rate of seepage in places. | Fair stability and compaction characteristics; medium compressibility; low permeability; possibility of piping. | Not generally needed; moderate permeability; subject to flooding. | High available moisture capacity; rapid infiltration; subject to flooding. | Not needed; nearly level; subject to flooding. | Nearly level; subject to flooding. |
| Nearly level; subject to flooding; somewhat poorly drained; seasonally wet. | Subject to flooding; pervious substratum. | Pervious material---- | Subject to flooding; seasonally wet. | High available moisture capacity; rapid infiltration; subject to flooding. | Not generally needed; nearly level; subject to flooding. | Nearly level; subject to flooding. |

TABLE 6.—*Engineering*

| Soil series and map symbols | Suitability for winter grading | Susceptibility to frost action | Suitability as source of— | | | | Soil features affecting— |
|---|---|---|---|---|---|---|---|
| | | | Topsoil | Sand and gravel | Roadfill | | Highway location |
| | | | | | Solum | Substratum | |
| *Rarden: RcD2. For Coolville part of this unit, see Coolville series. | Poor: sticky, clayey subsoil. | Moderate | Fair; limited suitable material. | Not suited | Poor: clayey subsoil. | Poor: clay shale. | Sloping to moderately steep; cuts are clayey and sticky; plastic soil material. |
| Sciotoville: ScB | Poor: seasonally wet. | High | Good to a depth of 20 inches. | Fair to good below depth of 5 to 10 feet. | Fair to poor: loamy material. | Variable alluvial material. | Gently sloping; some seepage in cuts; seasonal high water table; seepage on fragipan. |
| *Sees: SsD, SsE. For Woolper part of these units, see Woolper series. | Poor: seasonally wet; seepy clayey subsoil. | High | Good in the upper 10 inches. | Not suited | Poor: clayey material. | Poor: clayey material. | Some steep to very steep slopes; high shrink-swell potential; subject to slippage and seepage; subject to cracking. |
| Strip mine spoils: St. No estimate of properties. On-site investigation required. | | | | | | | |
| Upshur: UpC2, UpD2, UrC3, UrD3. | Poor: clayey soil material. | Moderate | Poor: clay surface layer or limited suitable material. | Not suited | Poor: clay material. | Poor: siltstone and clay shale. | Plastic clay, subject to slippage; some steep to very steep slopes; high shrink-swell potential. |
| *Vandalia: VaD, VdE, VsE2. For Sees part of VdE and VsE2, see Sees series. | Poor: clayey soil. | Moderate | Fair: limited suitable material. | Not suited | Poor: clayey material. | Poor: siltstone and clay shale. | Plastic clay; subject to slippage; some steep to very steep slopes; high shrink-swell potential. |
| Wellston: WhB2, WhC2, WhD2. | Fair: loamy material. | Low to moderate. | Good to a depth of 12 inches, fair to 30 inches. | Not suited | Fair to poor: loamy material. | Not suited: shale and sandstone rock. | Bedrock below depth of 3½ to 5 feet; cut slopes are erodible; well drained. |

See footnote at end of table.

*interpretations*—Continued

| Soil features affecting—Continued | | | | | | |
|---|---|---|---|---|---|---|
| Pipeline construction and maintenance | Farm ponds | | Agricultural drainage | Sprinkler irrigation | Terraces and diversions | Waterways |
| | Reservoir area | Embankment [1] | | | | |
| Plastic, clayey subsoil; depth to shale from 42 to 70 inches. | Limited depth to shale; slow rate of seepage likely. | Fair to poor stability and poor compaction characteristics; low permeability; medium to high compressibility. | Not generally needed; moderately well drained. | Slow permeability; medium available moisture capacity; erosion hazard on slopes. | Cut channels are clayey and hard to vegetate. | Cut channels are clayey and hard to vegetate; erosion hazard on slopes. |
| Gently sloping; some seepage in cuts; seasonal high water table. | Pervious substratum below depth of 5 feet. | Fair stability and compaction characteristics; medium compressibility; medium to low permeability; susceptible to piping. | Not generally needed; fragipan below depth of 20 inches; slow permeability. | Medium available moisture capacity; erosion hazard on slopes; moderate infiltration; slow permeability in fragipan. | Seepage in channels; erodible loamy material; gently sloping. | Seepage in channels; erodible loamy material; low slopes. |
| Some steep to very steep slopes; subject to slippage and seepage; high shrink-swell potential. | Slow rate of seepage; subject to slippage. | High shrink-swell potential; fair to poor stability and compaction characteristics; low permeability; high compressibility; subject to cracking. | Not generally needed except for common seep spots; slow permeability. | Some steep to very steep slopes; erosion hazard; rapid infiltration; high available moisture capacity. | Some slopes too steep for terraces; subject to seepage and slippage. | Clayey subsoil; subject to slippage, seepage, and cracking; erodible on steep slopes. |
| Some steep slopes; subject to slippage and seepage; high shrink-swell potential. | Slow rate of seepage; subject to slippage; limited depth to clay shale. | High shrink-swell potential; fair to poor stability and compaction characteristics; low permeability; high compressibility. | Not generally needed except for common seep spots; slow permeability. | Some steep slopes; erosion hazard; slow infiltration rate; medium available moisture capacity; slow permeability. | Some slopes too steep for terraces; subject to seepage, slippage, and cracking. | Clayey subsoil; subject to slippage, seepage, and cracking. |
| Plastic clay; subject to slippage; some steep to very steep slopes; high shrink-swell potential. | Slow rate of seepage; subject to slippage. | High shrink-swell potential; fair to poor stability and compaction characteristics; low permeability; high compressibility. | Not generally needed except for seep spots; slow permeability. | Some steep to very steep slopes; medium available moisture capacity. | Slopes are generally too steep for terraces; subject to slippage, seepage, and cracking. | Clayey subsoil; subject to slippage, seepage, and cracking. |
| Shale and sandstone bedrock below depth of 3½ to 5 feet; well drained. | In places, excessive rate of seepage in substratum; bedrock below depth of 3½ to 5 feet. | Fair stability and compaction characteristics; moderate permeability; medium compressibility; subject to piping. | Not needed; well drained. | Medium available moisture capacity; moderate infiltration rate; erosion hazard. | Erosion hazard; bedrock at a depth of 3½ to 5 feet; WhD2 too steep for terraces. | Erosion hazard on slopes. |

TABLE 6.—*Engineering*

| Soil series and map symbols | Suitability for winter grading | Susceptibility to frost action | Suitability as source of— | | | | Soil features affecting— |
|---|---|---|---|---|---|---|---|
| | | | Topsoil | Sand and gravel | Roadfill | | Highway location |
| | | | | | Solum | Substratum | |
| Westmore<br>Mapped only in complexes with Guernsey soils. | Fair to poor: clayey in lower part of subsoil. | Moderate | Fair to good: limited suitable material. | Not suited | Fair to poor: silty over clayey material. | Not suited: limestone and shale bedrock. | Some very steep slopes; possible slippage; plastic clay in subsoil; high shrink-swell potential. |
| Westmoreland<br>Mapped only in complexes with Gilpin soils. | Fair: loamy material. | Low to moderate. | Fair: organic-matter content is low in severely eroded soils. | Not suited | Fair to poor: loamy material. | Not suited: siltstone and shale bedrock. | 3½ to 5 feet to shale; some steep to very steep slopes; well drained; good stability. |
| Wheeling: WrA, WrB, WrC2. | Fair: locally subject to flooding. | Moderate to low. | Good | Good below depth of 7 to 12 feet. | Fair to poor: loamy material. | Good: sand and gravel. | Locally subject to flooding; well drained; good stability. |
| Woodsfield: WtB, WtC2, WtD2. | Fair in upper 1 to 2 feet; poor below 2 feet; clayey material. | Moderate | Good | Not suited | Fair to poor: over clayey material in lower part of subsoil. | Poor: clay shale. | Plastic clay in subsoil; high shrink-swell potential; cuts are erodible; 3 to 6 feet to shale; possible slippage. |
| *Woolper: WxB, WyC.<br>For Sees part of WyC, see the Sees series. | Poor: loamy to clayey material; some areas subject to flooding. | Moderate to high. | Fair: limited suitable topsoil. | Not suited | Poor: loamy to clayey material. | Poor: clayey material. | Subject to cracking and possible slippage; locally subject to flooding; some steep slopes. |
| *Zanesville: ZnB, ZnB2, ZnC, ZnC2, ZnD2, ZoB, ZoB2, ZoC, ZoC2, ZoD2.<br>For Woodsfield part of ZoB through ZoD2, see the Woodsfield series. | Poor: seasonally wet. | High | Good to a depth of 12 inches. | Not suited | Fair to poor: loamy material. | Fair to poor: loamy material. | Subject to seepage on fragipan, bedrock below depth of 3½ feet; cuts are erodible; some moderately steep slopes. |

[1] Also applies to low dikes and levees.

*interpretations*—Continued

| Soil features affecting—Continued | | | | | | |
|---|---|---|---|---|---|---|
| Pipeline construction and maintenance | Farm ponds | | Agricultural drainage | Sprinkler irrigation | Terraces and diversions | Waterways |
| | Reservoir area | Embankment [1] | | | | |
| Bedrock below depth of 3½ to 6 feet; high shrink-swell potential; possible slippage. | Bedrock below depth of 3½ to 6 feet; high shrink-swell potential, possible seepage. | Fair to poor stability and compaction characteristics; subject to cracking; high compressibility; low permeability. | Not needed; well drained. | Some very steep slopes; erosion hazard; high available moisture capacity. | Some slopes too steep for terraces; erosion hazard. | Some steep to very steep slopes; erosion hazard. |
| 3½ to 5 feet deep to shale; some steep to very steep slopes; good stability. | Excessive rate of seepage; 3½ to 5 feet to siltstone and shale. | Fair stability and compaction characteristics; susceptible to piping; 3½ to 5 feet to siltstone and shale. | Not needed; well drained. | 3½ to 5 feet deep to bedrock; low to medium available moisture capacity; erosion hazard on slopes. | Some slopes too steep for terraces; 3½ to 5 feet deep to bedrock; cut channels are droughty. | Erosion hazard on slopes; cut channels are droughty; 3½ to 5 feet deep to bedrock. |
| Deep, well drained; locally subject to flooding. | Pervious substratum below depth of 7 feet; moderate rate of seepage in upper 7 feet. | Fair stability and compaction characteristics; medium compressibility; moderate permeability; susceptible to piping. | Not needed; well drained. | High available moisture capacity; rapid infiltration; erodible on slopes. | Some short slopes; subject to erosion. | WrC2 erodible. |
| Plastic clay in subsoil; high shrink-swell potential; 3 to 6 feet to shale; possible slippage. | Slow rate of seepage; shale at depth of 3 to 6 feet. | Fair to poor stability and compaction characteristics; high compressibility; low permeability; subject to cracking. | Not needed; well drained. | Moderate permeability in upper 2 feet; rapid infiltration rate; erodible on slopes. | Some slopes too steep for terraces; erosion hazard; cut channels are clayey. | Erosion hazard; channels clayey in places. |
| Subject to cracking and possible slippage; locally subject to flooding; steep slopes. | Slow rate of seepage; locally subject to flooding. | Fair to poor stability and compaction characteristics; medium to high compressibility; subject to cracking; low permeability. | Not needed; well drained. | Moderately slow permeability; rapid infiltration rate; high available moisture capacity. | Erosion hazard; rapid surface runoff. | Erosion hazard; rapid surface runoff. |
| Subject to seepage on fragipan; bedrock below depth of 3½ feet; seasonally wet. | Seepage may occur through cracks in underlying bedrock. | Fair stability and compaction characteristics; medium compressibility; medium to low permeability; susceptible to piping. | Not generally needed; fragipan below depth of 20 inches; slow permeability. | Medium available moisture capacity; erosion hazard on slopes; moderate infiltration. | Seepage in channels; erodible on slopes. | Seepage in channels; erodible on slopes. |

*Figure 10.*—At the left is a No. 4 sieve, in the center is a No. 10 sieve, and at the right a No. 200 sieve. The soil material in the No. 4 sieve is more than 4.7 millimeters in diameter; that in the No. 10 sieve is more than 2.0 millimeters in diameter; and that in the No. 200 sieve is more than 0.074 millimeter in diameter.

ity in a fragipan is rated at a lower figure than is normal for the given texture. This is a result of increased bulk density in this layer, which greatly reduces the penetration of plant roots. Thus, some of the water stored is not available to plant roots.

REACTION.—The pH ranges given in this column represent a summary of the many field pH determinations taken during the survey on each of the soils in the county. See "Reaction" in the Glossary for definition.

SHRINK-SWELL POTENTIAL.—This indicates the volume change to be expected of the soil material with changes in moisture content. The soil materials that are rated high have serious limitations for engineering uses, such as highway locations and backfill for building foundations.

CORROSION POTENTIAL.—The corrosion potential indicated for uncoated steel is based on soil texture, soil drainage, and total acidity. Electrical resistivity is not considered in this rating. The corrosion potential for concrete is based on soil texture and pH values. The rating given is for an average concrete mixture. The ratings do not apply to concrete mixed specifically for corrosion resistance.

### *Engineering interpretations*

Table 6 lists the soils in the county and describes and rates selected characteristics of these soils that affect their use for engineering purposes. The interpretations in the table are based on soil test data in table 4, on the estimate of properties in table 5, and on field experience. Explanations of the column headings in table 6 are given in the following paragraphs.

SUITABILITY FOR WINTER GRADING.—The features considered are those that affect the ease with which the soil can be moved by construction equipment. Because of wetness, plasticity, or susceptibility to frost action, many of the soils are not adapted to grading during some of the winter season. Such soils are rated as poor.

SUSCEPTIBILITY TO FROST ACTION.—Silty and fine sandy soils that are wet most of the winter and have a readily available source of water are most susceptible to frost action. Such soils are rated high.

SUITABILITY AS A SOURCE OF TOPSOIL.—The thickness, texture, and inherent fertility of the surface layer determine the suitability of the soil for use as a topdressing for roadbanks and embankments to promote the growth of vegetation. Only the surface layer of the soil is considered in this rating, except as otherwise noted.

SUITABILITY AS A SOURCE OF SAND AND GRAVEL.—The soil is rated as a possible source of sand and gravel for construction purposes. It should not be assumed that because a soil is rated good, all areas of the soil can be used for commercial development for sand or gravel. A soil rated good has better possibilities for sand or gravel than soils rated poor or fair.

SUITABILITY AS A SOURCE OF ROADFILL.—Well-graded, coarse-grained material or mixtures of clay and coarse-grained material are very desirable for roadfill; plastic clayey soils, poorly graded silty soils, and organic soils are low in stability and are undesirable for roadfill. This column rates the upper 2 to 3 feet (solum) and underlying substratum as a source of roadfill material.

HIGHWAY LOCATION.—Features that adversely affect highway location are shallowness to rock, high water table, steep slopes, slippage, and flood hazard.

PIPELINE CONSTRUCTION AND MAINTENANCE.—Features that affect pipelines are depth to hard bedrock, soil stability, and natural drainage. Corrosion potential is rated in table 5.

FARM PONDS.—Under the "Reservoir area" subheading, the primary consideration is the soil's susceptibility to seepage, but shallowness to bedrock and susceptibility to

overflow on flood plains also are noted. Under the "Embankment" subheading, the soil is rated according to its stability and permeability when used in the construction of pond embankment. The permeability noted in this column is for the soil material when compacted at optimum moisture. The information in this column is also pertinent to dikes and levees.

AGRICULTURAL DRAINAGE.—The soil features considered are natural drainage, permeability, and the height of the water table.

SPRINKLER IRRIGATION.—The relative ease with which water normally infiltrates into, percolates through, and drains from the soil, and the available moisture capacity of the soil as well as other features also are noted.

TERRACES AND DIVERSIONS.—The slope and erodibility of the soil are the main considerations. Other soil features considered are depth to bedrock and the presence of a seasonal high water table. Highly erodible soils require special care in the construction of diversions.

WATERWAYS.—The slope and erodibility of the soil are the main considerations. Depth to rock and a high water table are noted where applicable.

Many soils are susceptible to slippage, but the most susceptible are the Brooke, Guernsey, Sees, Upshur, and Vandalia soils. Also subject to slippage, but to a lesser degree, are soils of the Keene, Latham, Westmore, Woodsfield, and Woolper series. Slippage of these soils is a very severe hazard to structures, houses, pipelines, and roads (fig. 11). The hazard of slippage is generally greatest on the steeper soils.

Steep slopes prevalent throughout the county pose a special problem to the design of structures in relation to the control of surface runoff and erosion. The hazard of erosion on soils that are steep is very severe in construction areas. Flooding is a severe hazard to structures located on flood plains in the county, especially in the valley of the Ohio River.

## Soils and Land Use Planning

Monroe County is still essentially a rural county, but the expansion of nonfarm uses of the soils can, in a short period of time, remove many acres from farm use. Freeways and super highways can displace up to about 50 acres per mile. Shopping centers can easily replace 50 to 100 acres of farmland. These uses permanently remove soils from farming.

Community planners and industrial users of land generally look for areas where the soil is suitable and where costs of development are low. Table 7 provides information on the properties of the soils and their effects on selected nonfarm uses of the land. This information can be useful as a tool or guide for overall land use planning.

*Figure 11.*—Slippage on Guernsey-Westmore loams, 18 to 35 percent slopes, moderately eroded. Among the engineering uses for which slippage is a serious hazard are buildings, roads, and pipelines.

TABLE 7.—*Degree and kind of*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in referring to other series that appear

| Soil series and map symbols | Farms (cultivated crops) | Disposal of sewage effluent | Sewage lagoons | Building sites (3 stories or less) [1] | Lawns, landscape plantings, and golf fairways |
|---|---|---|---|---|---|
| Ashton: AsA | Slight | Severe: subject to flooding. | Severe: subject to flooding. | Severe: subject to flooding. | Moderate: subject to flooding. |
| Brooke: BwD2, BwE2 | Severe: slope; erosion hazard. | Severe: slow permeability; slope; bedrock at a depth of 1½ to 3½ feet. | Severe: slope | Severe: slope; possible slippage; bedrock at a depth of 1½ to 3½ feet. | Severe: slope |
| Captina: | | | | | |
| CaB | Slight | Severe: slow permeability. | Moderate: slope. | Moderate: seasonally high water table. | Moderate: seasonally high water table. |
| CaC2 | Moderate: slope; erosion hazard. | Severe: slow permeability. | Severe: slope | Moderate: slope; seasonally high water table. | Moderate: seasonally high water table; slope. |
| CaD2 | Severe: slope; erosion hazard. | Severe: slope; slow permeability. | Severe: slope | Severe: slope | Severe: slope |
| Chagrin: Cg | Slight | Severe: subject to flooding. | Severe: subject to flooding. | Severe: subject to flooding. | Moderate: subject to flooding. |
| Conotton: | | | | | |
| CoA | Moderate: drought hazard. | Slight: possible pollution of water supplies. | Severe: permeable substratum. | Slight | Moderate: drought hazard. |
| CoD | Moderate: slope; erosion hazard. | Severe: slope | Severe: permeable substratum; slope. | Severe: slope | Severe: slope; drought hazard. |
| Coolville-Rarden: | | | | | |
| CrC2 For both parts. | Moderate: slope; erosion hazard. | Severe: slow permeability. | Severe: slope | Moderate: slope; high shrink-swell potential; seasonally high water table. | Moderate: slope; seasonally high water table. |
| *CrD2 For Rarden part of this unit, see RcD2 in the Rarden series. | Severe: slope; erosion hazard. | Severe: slope; slow permeability. | Severe: slope | Severe: slope; high shrink-swell potential. | Severe: slope |
| Dekalb: | | | | | |
| DkC2 | Moderate: slope; erosion hazard. | Severe: depth to rock is 2 to 3½ feet. | Severe: slope; depth to rock is 2 to 3½ feet. | Severe: depth to rock is 2 to 3½ feet. | Moderate: drought hazard. |
| DkD2, DkE2 | Severe: slope; erosion hazard. | Severe: slope | Severe: slope | Severe: slope | Severe: slope |
| Gilpin and Dekalb: GdE, GdG. For both parts. | Severe: slope; very stony; erosion hazard. | Severe: slope; limited depth to rock. | Severe: slope; pervious material. | Severe: slope; limited depth to bedrock. | Severe: slope |

See footnote at end of table.

*limitation for spceified land uses*

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for in the first column of this table]

| Streets and parking lots (in subdivisions) | Athletic fields and other intensive play areas | Parks and other extensive play areas | Campsites | | Sanitary land fill (trench) | Cemeteries |
|---|---|---|---|---|---|---|
| | | | For tents | For trailers | | |
| Severe: subject to flooding. | Moderate: flooding hazard which should be evaluated onsite. | Moderate: subject to flooding. | Severe: subject to flooding. | Severe: subject to flooding. | Severe: subject to flooding. | Severe: subject to flooding. |
| Severe: slope; possible slippage. | Severe: slope; slow permeability. | Severe: slope | Severe: slope; slow permeability. | Severe: slope; slow permeability. | Severe: slope; bedrock at a depth of 1½ to 3½ feet. | Severe: slope; bedrock at a depth of 1½ to 3½ feet. |
| Moderate: slope; seasonally high water table. | Severe: slow permeability. | Slight | Severe: slow permeability. | Severe: slow permeability. | Slight | Severe: slow permeability. |
| Severe: slope | Severe: slow permeability; slope. | Moderate: slope. | Severe: slow permeability. | Severe: slow permeability; slope. | Moderate: slope. | Severe: slow permeability; slope. |
| Severe: slope | Severe: slow permeability; slope. | Severe: slope | Severe: slow permeability; slope. | Severe: slow permeability; slope. | Severe: slope | Severe: slow permeability; slope. |
| Severe: subject to flooding. | Moderate: flooding hazard, which should be evaluated onsite. | Moderate: subject to flooding. | Severe: subject to flooding. | Severe: subject to flooding. | Severe: subject to flooding. | Severe: subject to flooding. |
| Slight | Moderate: gravelly surface. | Slight | Moderate: gravelly surface. | Moderate: gravelly surface. | Severe: permeable material; possible pollution of water supplies. | Moderate: gravelly surface. |
| Severe: slope | Severe: slope | Severe: slope | Severe: slope | Severe: slope | Severe: slope; permeable material. | Severe: slope. |
| Severe: slope | Severe: slow permeability; slope. | Moderate: slope. | Severe: slow permeability | Severe: slow permeability. | Moderate: slope. | Severe: slow permeability. |
| Severe: slope | Severe: slow permeability; slope. | Severe: slope | Severe: slow permeability. | Severe: slow permeability; slope. | Severe: slope | Severe: slope; slow permeability. |
| Severe: slope | Severe: slope | Moderate: slope. | Moderate: slope. | Severe: slope | Severe: depth to rock is 2 to 3½ feet. | Severe: depth to rock is 2 to 3½ feet. |
| Severe: slope | Severe: slope | Severe: slope | Severe: slope | Severe: slope | Severe: slope; depth to rock is 2 to 3½ feet. | Severe: slope; depth to rock is 2 to 3½ feet. |
| Severe: slope | Severe: slope | Severe: slope | Severe: slope | Severe: slope | Severe: slope; limited depth to rock. | Severe: slope; limited depth to rock. |

TABLE 7.—*Degree and kind of*

| Soil series and map symbols | Farms (cultivated crops) | Disposal of sewage effluent | Sewage lagoons | Building sites (3 stories or less) [1] | Lawns, landscape plantings, and golf fairways |
|---|---|---|---|---|---|
| Gilpin-Upshur: | | | | | |
| GkB2: | | | | | |
| Gilpin part | Slight | Severe: moderately deep to shale. | Severe: moderately deep to shale. | Moderate: moderately deep to shale. | Moderate: moderately deep to shale. |
| Upshur part | Moderate: erosion hazard. | Severe: slow permeability. | Moderate: slope. | Moderate: high shrink-swell potential. | Moderate: some clay textures. |
| *GkC2 | Moderate: slope; erosion hazard. | Severe: moderately deep to shale. | Severe: moderately deep to shale. | Moderate: moderately deep to shale. | Moderate: moderately deep to shale. |
| For Upshur part of this unit, see UpC2 in the Upshur series. | | | | | |
| *GkD, GkD2, GkE2, GkE3, GkG, GkG3, GlE, GlG, GnE, GnG. | Severe: slope; erosion hazard. | Severe: slope; moderately deep to rock. | Severe: slope; moderately deep to rock. | Severe: slope | Severe: slope |
| For Upshur part of these units, see UpD2 and UrC3 in the Upshur series. | | | | | |
| Gilpin-Westmoreland: | | | | | |
| GoB2: | | | | | |
| Gilpin part | Slight | Severe: moderately deep to shale. | Severe: moderately deep to shale. | Moderate: moderately deep to shale. | Moderate: moderately deep to shale. |
| Westmoreland part | Slight | Moderate: depth to shale is 3½ to 5 feet. | Moderate: slope; moderate permeability. | Slight | Slight |
| GoC2: | | | | | |
| Gilpin part | Moderate: slope; erosion hazard. | Severe: moderately deep to shale. | Severe: moderately deep to shale. | Moderate: moderately deep to shale. | Moderate: moderately deep to shale. |
| Westmoreland part | Moderate: slope; erosion hazard. | Moderate: slope; depth to shale is 3½ to 5 feet. | Severe: slope | Moderate: slope | Moderate: slope |
| GoD2, GoD3, GoE2, GoE3, GoG2, GpG: | | | | | |
| Gilpin part | Severe: slope; erosion hazard. | Severe: slope; moderately deep to rock. | Severe: slope; moderately deep to rock. | Severe: slope | Severe: slope |
| Westmoreland part | Severe: slope; erosion hazard. | Severe: slope | Severe: slope | Severe: slope | Severe: slope |
| *Guernsey-Upshur: | | | | | |
| GrC2 | Moderate: slope; erosion hazard. | Severe: slow permeability. | Severe: slope | Moderate: slope; high shrink-swell potential; moderately well drained; possible slippage. | Moderate: slope |
| For the Upshur part of this unit, see UpC2 unit in the Upshur series. | | | | | |
| GrD2, GrE2, GrG2, GsG, GuE, GuG. | Severe: slope; erosion hazard. | Severe: slope; slow permeability. | Severe: slope | Severe: slope; subject to slippage. | Severe: slope; subject to slippage. |
| For the Upshur part of these units, see UpD2 in the Upshur series. | | | | | |

See footnote at end of table.

*limitation for specified land uses*—Continued

| Streets and parking lots (in subdivisions) | Athletic fields and other intensive play areas | Parks and other extensive play areas | Campsites | | Sanitary land fill (trench) | Cemeteries |
|---|---|---|---|---|---|---|
| | | | For tents | For trailers | | |
| Moderate: slope. | Moderate: slope; moderately deep to shale. | Moderate: moderately deep to shale. | Slight | Moderate: slope. | Moderate: moderately deep to rock. | Moderate: moderately deep to rock. |
| Moderate: high shrink-swell potential. | Severe: slow permeability. | Severe: some clay textures. | Severe: some clay textures. | Severe: some clay textures. | Severe: clay textures, subject to cracking. | Severe: clay textures. |
| Severe: slope | Severe: slope | Moderate: slope; moderately deep to shale. | Moderate: slope. | Severe: slope | Moderate: slope; moderately deep to rock. | Moderate: slope; moderately deep to rock. |
| Severe: slope | Severe: slope | Severe: slope | Severe: slope | Severe: slope | Severe: slope; moderately deep to rock. | Severe: slope. |
| Moderate: slope. | Moderate: slope; moderately deep to shale. | Moderate: moderately deep to shale. | Slight | Moderate: slope. | Moderate: moderately deep to rock. | Moderate: moderately deep to rock. |
| Moderate: slope. | Moderate: slope. | Slight | Slight | Moderate: slope. | Moderate: depth to shale is 3½ to 5 feet. | Slight. |
| Severe: slope | Severe: slope | Moderate: slope; moderately deep to shale. | Moderate: slope. | Severe: slope | Moderate: slope; moderately deep to rock. | Moderate: moderately deep to rock. |
| Severe: slope | Severe: slope | Moderate: slope. | Moderate: slope. | Severe: slope | Moderate: slope; depth to shale is 3½ to 5 feet. | Moderate: slope. |
| Severe: slope | Severe: slope | Severe: slope | Severe: slope | Severe: slope | Severe: slope; moderately deep to rock. | Severe: slope. |
| Severe: slope | Severe: slope | Severe: slope | Severe: slope | Severe: slope | Severe: slope | Severe: slope. |
| Severe: slope; high shrink-swell potential; possible slippage. | Severe: slope; slow permeability. | Moderate: slope. | Severe: slow permeability. | Severe: slope; slow permeability. | Severe: clayey texture; subject to cracking and seepage. | Severe: slow permeability. |
| Severe: slope; high shrink-swell potential; subject to slippage. | Severe: slope; slow permeability; subject to slippage. | Severe: slope | Severe: slope; slow permeability. | Severe: slope; slow permeability. | Severe: slope; clayey textures. | Severe: slope; slow permeability. |

TABLE 7.—*Degree and kind of*

| Soil series and map symbols | Farms (cultivated crops) | Disposal of sewage effluent | Sewage lagoons | Building sites (3 stories or less) [1] | Lawns, landscape plantings, and golf fairways |
|---|---|---|---|---|---|
| Guernsey-Westmore: GwC2: Guernsey part | Moderate: slope; erosion hazard. | Severe: slow permeability. | Severe: slope | Moderate: slope; high shrink-swell potential; moderately well drained; possible slippage. | Moderate: slope |
| Westmore part | Moderate slope; erosion hazard. | Severe: slow permeability. | Severe: slope | Moderate: slope; high shrink-swell potential. | Moderate: slope |
| GwD2, GwE2, GwE3, GwG2: Guernsey part | Severe: slope; erosion hazard. | Severe: slope; slow permeability. | Severe: slope | Severe: slope; subject to slippage. | Severe: slope; subject to slippage. |
| Westmore part | Severe: slope; erosion hazard. | Severe: slope; slow permeability. | Severe: slope | Severe: slope | Severe: slope; erosion. |
| *Gullied land, Gilpin-Upshur material: Gy. Gullied land to variable to rate. For Gilpin part, see Gilpin part in unit GoD2, under Gilpin-Westmoreland. For Upshur part, see UrD3, under Upshur. | | | | | |
| Hackers: HcB | Slight | Severe: subject to flooding. | Severe: subject to flooding. | Severe: subject to flooding. | Severe: subject to flooding. |
| Hartshorn: He, Hr | Slight | Severe: subject to flooding. | Severe: subject to flooding. | Severe: subject to flooding. | Severe: subject to flooding. |
| Huntington: Hu | Slight | Severe: subject to flooding. | Severe: subject to flooding. | Severe: subject to flooding. | Severe: subject to flooding. |
| Keene: KeB | Slight | Severe: slow permeability. | Moderate: slope. | Moderate: moderately well drained; high shrink-swell potential. | Moderate: low fertility. |
| KeC2 | Moderate: slope; erosion hazard. | Severe: slow permeability. | Severe: slope | Moderate: slope; moderately well drained; high shrink-swell potential. | Moderate: slope; low fertility. |

See footnote at end of table.

*limitation for specified land uses*—Continued

| Streets and parking lots (in subdivisions) | Athletic fields and other intensive play areas | Parks and other extensive play areas | Campsites | | Sanitary land fill (trench) | Cemeteries |
|---|---|---|---|---|---|---|
| | | | For tents | For trailers | | |
| Severe: slope; high shrink-swell potential; possible slippage. | Severe: slope; slow permeability. | Moderate: slope. | Severe: slow permeability. | Severe: slope; slow permeability. | Severe: clayey texture; subject to cracking and seepage. | Severe: slow permeability. |
| Severe: slope. | Severe: slope; slow permeability. | Moderate: slope. | Severe: slow permeability. | Severe: slope; slow permeability. | Moderate: slope. | Severe: slow permeability. |
| Severe: slope; high shrink-swell potential; subject to slippage. | Severe: slope; slow permeability; subject to slippage. | Severe: slope. | Severe: slope; slow permeability. | Severe: slope; slow permeability. | Severe: slope; clayey textures. | Severe: slope; slow permeability. |
| Severe: slope; possible slippage. | Severe: slope; slow permeability. | Severe: slope. | Severe: slope; slow permeability. | Severe: slope; slow permeability. | Severe: slope. | Severe: slope; slow permeability. |
| Severe: subject to flooding. | Severe: flooding hazard, which should be evaluated onsite. | Moderate: subject to flooding. | Severe: subject to flooding. | Severe: subject to flooding. | Severe: subject to flooding. | Severe: subject to flooding. |
| Severe: subject to flooding. | Severe: flooding hazard, which should be evaluated onsite; Hr is somewhat poorly drained. | Moderate: subject to flooding. | Severe: subject to flooding. | Severe: subject to flooding. | Severe: subject to flooding. | Severe: subject to flooding. |
| Severe: subject to flooding. | Severe: flooding hazard, which should be evaluated onsite. | Moderate: subject to flooding. | Severe: subject to flooding. | Severe: subject to flooding. | Severe: subject to flooding. | Severe: subject to flooding. |
| Moderate: slope; high shrink-swell potential. | Severe: slow permeability. | Slight. | Severe: slow permeability. | Severe: slow permeability. | Moderate: some clayey layers; depth to shale is 3½ to 5 feet. | Severe: slow permeability. |
| Severe: slope; high shrink-swell potential. | Severe: slope; slow permeability. | Moderate: slope. | Severe: slow permeability. | Severe: slope; slow permeability. | Moderate: slope; some clayey layers; depth to shale is 3½ to 5 feet. | Severe: slow permeability. |

TABLE 7.—*Degree and kind of*

| Soil series and map symbols | Farms (cultivated crops) | Disposal of sewage effluent | Sewage lagoons | Building sites (3 stories or less) [1] | Lawns, landscape plantings, and golf fairways |
|---|---|---|---|---|---|
| *Keene-Latham: KlD2——— For Latham part of this unit, see LdE2 in the Latham series. | Severe: slope; erosion hazard. | Severe: slope; slow permeability. | Severe: slope——— | Severe: high shrink-swell potential; possible slippage. | Severe: slope——— |
| *Latham-Keene: LdE2——— For Keene part of this unit, see KlD2 in the Keene series. | Severe: slope; erosion hazard. | Severe: slope; slow permeability. | Severe: slope——— | Severe: high shrink-swell potential; subject to slippage. | Severe: slope——— |
| Lindside: Lh——— | Slight——— | Severe: subject to flooding. | Severe: subject to flooding. | Severe: subject to flooding. | Severe: subject to flooding. |
| Made land: Ma. Properties too variable for reliable evaluation. Onsite investigation required. | | | | | |
| Newark: Nn——— | Slight——— | Severe: subject to flooding. | Severe: subject to flooding. | Severe: subject to flooding. | Severe: subject to flooding. |
| *Rarden-Coolville: RcD2——— For Coolville part of this unit, see CrD2 in the Coolville series. | Severe: slope; erosion hazard. | Severe: slow permeability. | Severe: slope——— | Severe: slope; high shrink-swell potential. | Severe: slope——— |
| Sciotoville: ScB——— | Slight——— | Severe: moderately slow permeability. | Slight to moderate: moderate on slopes greater than 2 percent. | Moderate: moderately well drained. | Moderate: moderately well drained. |
| Sees-Woolper: SsD, SsE——— For both parts. | Severe: slope; erosion hazard. | Severe: slope; slow permeability. | Severe: slope——— | Severe: slope; subject to slippage. | Severe: slope——— |
| Strip mine spoils: St. Properties too variable for reliable evaluation. Onsite investigation required. | | | | | |
| Upshur: UpC2, UrC3——— | Severe: slope; erosion hazard. | Severe: slow permeability. | Severe: slope——— | Severe: high shrink-swell potential; subject to slippage. | Severe: clay textures in subsoil. |
| UpD2, UrD3——— | Severe: slope; erosion hazard. | Severe: slope; slow permeability. | Severe: slope——— | Severe: slope; high shrink-swell potential; subject to slippage. | Severe: slope; clay textures. |
| Vandalia: VaD——— | Severe: slope; erosion hazard. | Severe: slope; slow permeability. | Severe: slope——— | Severe: slope; subject to slippage. | Severe: slope——— |
| Vandalia-Sees: VdE, VsE2——— For both parts. | Severe: slope; erosion hazard. | Severe: slope; slow permeability. | Severe: slope——— | Severe: slope; subject to slippage. | Severe: slope——— |

See footnote at end of table.

*limitation for specified land uses*—Continued

| Streets and parking lots (in subdivisions) | Athletic fields and other intensive play areas | Parks and other extensive play areas | Campsites | | Sanitary land fill (trench) | Cemeteries |
|---|---|---|---|---|---|---|
| | | | For tents | For trailers | | |
| Severe: slope; high shrink-swell potential; possible slippage. | Severe: slope; slow permeability. | Severe: slope | Severe: slope; slow permeability. | Severe: slope; slow permeability. | Severe: slope | Severe: slope; slow permeability. |
| Severe: slope; high shrink-swell potential; subject to slippage. | Severe: slow permeability. | Severe: slope | Severe: slope; slow permeability. | Severe: slope; slow permeability. | Severe: slope | Severe: slope; slow permeability. |
| Severe: subject to flooding. | Severe: flooding hazard, which should be evaluated onsite. | Moderate: subject to flooding. | Severe: subject to flooding. | Severe: subject to flooding. | Severe: subject to flooding. | Severe: subject to flooding. |
| Severe: subject to flooding. | Severe: subject to flooding; somewhat poorly drained. | Moderate: subject to flooding | Severe: subject to flooding. | Severe: subject to flooding. | Severe: subject to flooding; seasonal high water table. | Severe: subject to flooding. |
| Severe: slope | Severe: slope; slow permeability. | Severe: slope | Severe: slope; slow permeability. | Severe: slope; slow permeability. | Severe: slope | Severe: slope; slow permeability. |
| Slight to moderate: moderate on slopes greater than 2 percent. | Moderate: slope; moderately slow permeability. | Slight | Moderate: moderately slow permeability. | Moderate: slope; moderately slow permeability. | Moderate: moderately well drained. | Moderate: moderately slow permeability. |
| Severe: slope; subject to slippage. | Severe: slope; slow permeability. | Severe: slope | Severe: slope; slow permeability. | Severe: slope; slow permeability. | Severe: slope; some clayey textures. | Severe: slope; slow permeability. |
| Severe: slope; high shrink-swell potential; subject to slippage. | Severe: slope; slow permeability. | Severe: clay textures. | Severe: clay textures; slow permeability. | Severe: slope; clay textures; slow permeability. | Severe: clay textures. | Severe: slope; clay textures; slow permeability. |
| Severe: slope; high shrink-swell potential; subject to slippage. | Severe: slope; slow permeability. | Severe: slope; clay texture. | Severe: slope; clay texture; slow permeability. | Severe: slope; clay texture; slow permeability. | Severe: slope; clay texture. | Severe: slope; clay textures; slow permeability. |
| Severe: slope; subject to slippage. | Severe: slope; slow permeability. | Severe: slope; clay textures in subsoil. | Severe: slope; slow permeability. | Severe: slope; slow permeability. | Severe: slope; clay textures in subsoil. | Severe: slope; slow permeability. |
| Severe: slope; subject to slippage. | Severe: slope; slow permeability. | Severe: slope; clay textures in subsoil. | Severe: slope; slow permeability. | Severe: slope; slow permeability. | Severe: slope; clay textures in subsoil. | Severe: slope; slow permeability. |

TABLE 7.—*Degree and kind of*

| Soil series and map symbols | Farms (cultivated crops) | Disposal of sewage effluent | Sewage lagoons | Building sites (3 stories or less) [1] | Lawns, landscape plantings, and golf fairways |
|---|---|---|---|---|---|
| Wellston: | | | | | |
| WhB2 | Slight | Moderate: depth to bedrock is 3½ to 5 feet. | Moderate: slope; moderate permeability. | Slight | Moderate: slope |
| WhC2 | Moderate: slope; erosion hazard. | Moderate: slope; depth to bedrock is 3½ to 5 feet. | Severe: slope | Moderate: slope | Moderate: slope |
| WhD2 | Severe: slope; erosion hazard. | Severe: slope | Severe: slope | Severe: slope | Severe: slope |
| *Westmore. See Guernsey series. | | | | | |
| *Westmoreland. See Gilpin series. | | | | | |
| Wheeling: | | | | | |
| WrA | Slight | Slight: severe if subject to flooding. | Moderate: moderate permeability; severe if subject to flooding. | Slight: severe if subject to flooding. | Slight: severe if subject to flooding. |
| WrB | Slight | Slight: severe if subject to flooding. | Moderate: slope; severe if subject to flooding. | Slight: severe if subject to flooding. | Slight: severe if subject to flooding. |
| WrC2 | Moderate: slope; erosion hazard. | Moderate: slope; severe if subject to flooding. | Severe: slope; subject to flooding. | Moderate: slope; severe if subject to flooding. | Moderate: slope; severe if subject to flooding. |
| Woodsfield: | | | | | |
| WtB | Slight | Severe: slow permeability. | Moderate: slope. | Slight: high shrink-swell potential. | Slight |
| WtC2 | Moderate: slope; erosion hazard. | Severe: slow permeability. | Severe: slope | Moderate: slope; high shrink-swell potential. | Moderate: slope. |
| WtD2 | Severe: slope; erosion hazard. | Severe: slope; permeability. | Severe: slope | Severe: slope; high shrink-swell potential; possible slippage. | Severe: slope |
| Woolper: WxB | Slight | Severe: moderately slow permeability; flooding hazard, which should be evaluated onsite. | Moderate: slope; flooding hazard, which should be evaluated onsite. | Slight: flooding hazard, which should be evaluated onsite. | Slight |

See footnote at end of table.

*limitation for specified land uses*—Continued

| Streets and parking lots (in subdivisions) | Athletic fields and other intensive play areas | Parks and other extensive play areas | Campsites | | Sanitary land fill (trench) | Cemeteries |
|---|---|---|---|---|---|---|
| | | | For tents | For trailers | | |
| Moderate: slope. | Moderate: slope. | Slight | Slight | Moderate: slope. | Moderate: depth to bedrock is 3½ to 5 feet. | Slight. |
| Severe: slope | Severe: slope | Moderate: slope. | Moderate: slope. | Severe: slope | Moderate: slope; depth to bedrock is 3½ to 5 feet. | Moderate: slope. |
| Severe: slope | Severe: slope | Severe: slope | Severe: slope | Severe: slope | Severe: slope | Severe: slope. |
| Slight: severe if subject to flooding. | Slight: severe if subject to flooding. | Slight | Slight: severe if subject to flooding. | Slight: severe if subject to flooding. | Severe: possible pollution of ground water; pervious substrata. | Slight: pervious substrata; severe if subject to flooding. |
| Moderate: slope; severe if subject to flooding. | Moderate: slope; severe if subject to flooding. | Slight | Slight: severe if subject to flooding. | Moderate: slope; severe if subject to flooding. | Severe: pervious substrata; possible pollution of ground water. | Slight: severe if subject to flooding. |
| Severe: slope; subject to flooding. | Severe: slope; subject to flooding. | Moderate: slope. | Moderate: slope; severe if subject to flooding. | Severe: slope; subject to flooding. | Severe: possible pollution of ground water; pervious substrata. | Moderate: slope; severe if subject to flooding. |
| Moderate: slope; high shrink-swell potential. | Severe: slow permeability. | Slight | Severe: slow permeability. | Severe: slow permeability. | Severe: clay texture in subsoil. | Severe: slow permeability. |
| Severe: slope; high shrink-swell potential. | Severe: slope; slow permeability. | Moderate: slope. | Severe: slow permeability. | Severe: slope; slow permeability. | Severe: clay texture in subsoil. | Severe: slow permeability. |
| Severe: slope; high shrink-swell potential; possible slippage. | Severe: slope; slow permeability. | Severe: slope | Severe: slope; slow permeability. | Severe: slope; slow permeability. | Severe: slope; clay textures in subsoil. | Severe: slope; slow permeability. |
| Moderate: slope; flooding hazard, which should be evaluated onsite. | Moderate: slope; moderately slow permeability; flooding hazard, which should be evaluated onsite. | Slight | Moderate: moderately slow permeability; flooding hazard, which should be evaluated onsite. | Moderate: slope; moderately slow permeability; flooding hazard, which should be evaluated onsite. | Slight | Slight: flooding hazard, which should be evaluated onsite. |

TABLE 7.—*Degree and kind of*

| Soil series and map symbols | Farms (cultivated crops) | Disposal of sewage effluent | Sewage lagoons | Building sites (3 stories or less) [1] | Lawns, landscape plantings, and golf fairways |
|---|---|---|---|---|---|
| Woolper and Sees: WyC—For both parts. | Moderate: slope; erosion hazard. | Severe: moderately slow permeability; flooding hazard, which should be evaluated onsite. | Severe: slope | Moderate: slope; possible slippage; flooding hazard, which should be evaluated onsite. | Moderate: slope |
| Zanesville: ZnB, ZnB2 | Slight | Severe: slow permeability. | Moderate: slope | Moderate: moderately well drained. | Moderate: moderately well drained. |
| ZnC, ZnC2 | Moderate: slope; erosion hazard. | Severe: slow permeability. | Severe: slope | Moderate: slope; moderately well drained. | Moderate: slope; moderately well drained. |
| ZnD2 | Severe: slope; erosion hazard. | Severe: slope; slow permeability. | Severe: slope | Severe: slope | Severe: slope |
| *Zanesville-Woodsfield: ZoB, ZoB2—For Woodsfield part of these units, see WtB in the Woodsfield series. | Slight | Severe: slow permeability. | Moderate: slope | Moderate: moderately well drained. | Moderate: moderately well drained. |
| ZoC, ZoC2—For Woodsfield part of these units, see WtD2 in the Woodsfield series. | Moderate: slope; erosion hazard. | Severe: slow permeability. | Severe: slope | Moderate: slope; moderately well drained. | Moderate: slope; moderately well drained. |
| ZoD2—For Woodsfield part of this unit, see WtD2 in the Woodsfield series. | Severe: slope; erosion hazard. | Severe: slope; slow permeability. | Severe: slope | Severe: slope | Severe: slope |

[1] Also applies to small industrial, institutional, and commercial structures.

*limitation for specified land uses*—Continued

| Streets and parking lots (in subdivisions) | Athletic fields and other intensive play areas | Parks and other extensive play areas | Campsites | | Sanitary land fill (trench) | Cemeteries |
|---|---|---|---|---|---|---|
| | | | For tents | For trailers | | |
| Severe: slope; possible slippage. | Severe: slope | Moderate: slope. | Moderate: moderately slow permeability; slope. | Severe: slope | Moderate: slope. | Moderate: slope. |
| Moderate: slope; moderately well drained. | Severe: slow permeability. | Slight | Severe: slow permeability. | Severe: slow permeability. | Moderate: depth to bedrock is 4 to 5½ feet; moderately well drained. | Severe: slow permeability. |
| Severe: slope | Severe: slope; slow permeability. | Moderate: slope. | Severe: slow permeability. | Severe: slope; slow permeability. | Moderate: depth to bedrock is 4 to 5½ feet; slope; moderately well drained. | Severe: slow permeability. |
| Severe: slope | Severe: slope; slow permeability. | Severe: slope | Severe: slope; slow permeability. | Severe: slope; slow permeability. | Severe: slope | Severe: slope; slow permeability. |
| Moderate: moderately well drained. | Severe: slope; moderately well drained. | Slight | Severe: slow permeability. | Severe: slow permeability. | Moderate: depth to bedrock is 4 to 5½ feet; moderately well drained. | Severe: slow permeability. |
| Severe: slope | Severe: slope; slow permeability. | Moderate: slope. | Severe: slow permeability. | Severe: slope; slow permeability. | Moderate: depth to bedrock is 4 to 5½ feet; slope; moderately well drained. | Severe: slow permeability. |
| Severe: slope | Severe: slope; slow permeability. | Severe: slope | Severe: slope; slow permeability. | Severe: slope; slow permeability. | Severe: slope | Severe: slope; slow permeability. |

Table 7 gives the estimated degree and kinds of limitations of soils for some selected land uses. Knowledgeable alternatives can be developed as a basis for long-range planning and zoning. It must be recognized that extensive manipulation of the soil will alter some of its natural properties. In areas where there have been extensive cutting and filling operations, the ratings for some uses will no longer apply.

Any one particular soil property may impose a degree of limitation for a specified land use. This same soil property can be more or less limiting when considering some other specified land use. To provide a comparative scale, the estimated degree of limitation for each soil and specified land use is given as slight, moderate, and severe. A rating of slight indicates that the soil presents no important limitation to the specified use. A rating of moderate shows that the soil presents some limitations to the specified use. These limitations need to be recognized, but they generally can be overcome. A rating of severe indicates that the soil presents serious problems to the specific use, and the problems are difficult and costly to overcome.

FARMS.—Much of the rural land in Monroe County is in farm use. In table 7 the soils have been rated for their suitability for cultivated field crops. The degree of limitation is based on the hazards to cropping, such as slope, erosion, wetness, droughtiness, and stoniness. Farming is rated on this table to aid land-use planners when they are considering farming as a sound land use.

DISPOSAL OF SEWAGE EFFLUENT.—Soil properties important to the installation and operation of septic tank disposal fields include permeability, depth to rock, slope, natural drainage (water table level), and the hazard of flooding. Permeability of each soil has been estimated and is shown in table 5. If filter fields for septic tanks are located where slopes are more than 12 percent, erosion and seepage downslope can be a problem, or the soil might become unstable when saturated. A limitation is imposed by a restrictive layer, such as solid bedrock, a dense fragipan, or a layer of clay that interferes with adequate filtration and the movement of the effluent from the soil. Some soils in the county have a gravelly and sandy substratum or are underlain by creviced bedrock through which effluent that is inadequately filtered can contaminate ground water or nearby springs, lakes, or streams. Before a septic tank system is installed, an investigation should be made at the proposed site to determine the limitations of the soil.

SEWAGE LAGOONS.—These shallow ponds are built to dispose of sewage through oxidation. They may be needed in an area if septic tanks or a central sewage system is not practical. Among the features that control the degree of limitation are the hazard of flooding, degree of slope, depth to rock, and permeability.

BUILDING SITES.—These locations are for homes of three stories or less that have a basement, but the ratings also apply to sites for small industrial, commercial, and institutional buildings. Some of the acreage taken from farming is being converted to new residential developments. These areas generally surround present urban areas. Individual houses or small groups of houses are also being built throughout the county.

Soil properties and some related site characteristics that influence the ratings include depth to bedrock, slope, natural drainage, hazard of flooding, hazard of slippage, and surface stoniness or rockiness. The method of sewage disposal is not considered in the homesite location column. Soils subject to flooding have severe limitations as sites for permanently used structures. Although flooding may be infrequent, it is costly when it does occur.

LAWNS, LANDSCAPE PLANTINGS, AND GOLF FAIRWAYS.—Some soils in the county are suitable sources of topsoil. This is noted in table 6 in the engineering section of this survey. During the process of construction, the upper foot of natural surface soil can be scalped and pushed aside into a stockpile. After grading has been completed, the natural surface soil can then be redistributed over the area. This provides a good rooting zone for lawns, flowers, shrubs, and trees. The natural surface soil in areas being developed for streets can also be preserved in a like manner and used to improve other areas where it is most needed.

Among the soil properties that determine whether a good lawn or golf fairway can be established are natural drainage, degree of slope, depth to bedrock, texture of the surface soil, stoniness and rockiness, and hazard of flooding.

STREETS AND PARKING LOTS.—The soil ratings are applicable to streets and parking lots in subdivisions that are *not* subject to continual heavy traffic. Soil characteristics that affect this use include drainage, slope, depth to rock, hazard of flooding, hazard of slippage, and stoniness or rockiness. In subdivisions, soils that have slopes over 6 percent are rated severe. Tables 3 and 4 in the engineering section give other information about the soils that are important for streets and parking lots. The degree of slope that should be designed for the side of cuts and fills depends on the erodibility of the soil and its suitability for close-growing vegetation.

The use and development of recreation areas is becoming increasingly important in Monroe County. Potentially, all the soils of the county are suitable for one or more kinds of recreational development. Soils on flood plains have excellent potential as recreation areas because they generally occur in long, winding areas along streams and adjacent scenic hills. Use of these soils for homes, highways, and most other nonfarm uses is severely limited by the hazard of flooding. In addition, construction in these areas may hold back the natural flow of floodwater. Among the recreational facilities that can be developed safely on flood plains are play areas such as ball diamonds, picnic areas, tennis courts, and others that are not subject to permanent costly damage by floodwater. Local flood frequencies and severity should be determined before recreational facilities are constructed on soils subject to flooding.

ATHLETIC FIELDS AND OTHER INTENSIVE PLAY AREAS.—These areas are fairly small tracts used for baseball, football, tennis, volleyball, badminton, and other sports. Because the areas must be nearly level, considerable shaping may be needed. Consequently, slopes greater than 2 percent are a limitation. The criteria for rating athletic fields include permeability, slope, depth to rock, natural drainage, and texture of the surface layer.

PARKS AND OTHER EXTENSIVE PLAY AREAS.—These areas can be located on many kinds of soil. Areas consisting of several different soils provide a variety of wildlife and

natural vegetation. Considered in rating the soils for picnicking, related hiking, study of nature, and similar uses are degree of slope, texture of the surface soil, natural drainage, stoniness, and hazard of flooding. Paths in picnic and play areas should be constructed and maintained in a way that helps control erosion.

CAMPSITES.—Campsites for tents should be located in areas where the landscape is attractive, where trafficability is good, and where grasses and trees grow well. Slopes of over 12 percent generally are poorly suited for tent campsites, and slopes over 6 percent are poorly suited for trailer sites. Soils that are firm when moist and nonsticky when wet are desirable. Other soil properties that influence the rating for campsites are texture of the surface layer, permeability, and stoniness.

SANITARY LAND FILL.—In considering the use of soils for sanitary land fill, the depth to underlying rock is especially important. The most favorable soils for the trench type of sanitary land fill are those underlain with unconsolidated material that is slowly permeable. Among the soil features that limit use for this purpose are shallowness to bedrock, clayey texture, excessive wetness, rapid permeability, steep slopes, and the hazard of flooding.

CEMETERIES.—Considered in rating the soils for cemeteries are depth to hard or rippable bedrock, slope, permeability, and hazard of flooding. Texture of the surface layer is important in order to maintain a good vegetative cover.

The installation and maintenance of utility lines is affected by soil properties, but this use is not rated in table 7. Depth to bedrock, natural drainage, water table characteristics, and corrosion potential are among the important properties affecting the maintenance of utilities. The corrosion potential of the soils in the county is rated in table 5. The establishment, control, and maintenance of vegetation on utility rights-of-way are also related to soil properties.

## *Descriptions of the Soils*

In this section the soils of Monroe County are described in detail. The soil series are described, and the mapping units in that series are described. Thus, to get full information on any one mapping unit, it is necessary to read both the description of that unit and the description of the soil series to which the unit belongs.

Each series description contains a short narrative of a soil profile considered representative of the series and a much more detailed description of the same profile that scientists, engineers, and others can use in making highly technical interpretations. The colors described are for moist soils, unless otherwise noted. Soil materials that have a Munsell color value of 4 or more are considered light colored; those that have a color value of less than 4 are considered dark colored. Many of the terms used in describing soil series and mapping units are defined in the Glossary, and others are defined in the section "How This Survey Was Made."

The approximate acreage and proportionate extent of the soils are shown in table 8. The "Guide to Mapping Units" lists the mapping units of the county and shows the capability unit and woodland suitability group in which each mapping unit has been placed, and the page where each is described.

Throughout much of the county, soils of more than one series are together in such intricate patterns that it is impractical to map them separately at the scale used. Also, it is generally impractical to use and manage these soils differently. The dominant soils in an area are mapped together as a soil complex. Some examples of mapping units that are soil complexes are: Gilpin-Upshur complex, 12 to 18 percent slopes, moderately eroded; Gilpin-Westmoreland silt loams, 2 to 6 percent slopes, moderately eroded; and Gilpin-Westmoreland silt loams, 12 to 18 percent slopes, moderately eroded.

In a few areas, soils of more than one series could be delineated individually, but are mapped in one unit because, for the purpose of the soil survey, there is little value in mapping them separately. These soils are mapped as undifferentiated groups. An example of a mapping unit that is an undifferentiated group is Gilpin and Dekalb very stony soils, 12 to 35 percent slopes.

### Ashton Series

The Ashton series consists of deep, nearly level, well-drained soils that have a loamy surface layer. These soils are on high bottoms along Sunfish Creek from Claington to about 3 miles above Cameron. These high bottoms range from 2 to 8 feet above the lower level flood plains. Ashton soils formed in water-deposited materials that were washed from uplands underlain mainly by limestone, siltstone, shale, and sandstone. They are subject to occasional flooding of short duration.

A representative Ashton soil that is cultivated has a dark-brown silt loam surface layer about 8 inches thick. This layer is friable and easy to work. The upper part of the subsoil, to a depth of 17 inches, is dark yellowish-brown silt loam. The middle part is brown to dark-brown silty clay loam and silt loam. Below a depth of 44 inches, the subsoil is loam to clay loam. Below the subsoil, between depths of 58 to 95 inches, is mottled brown to dark-brown loam to clay loam and dark grayish-brown sandy clay loam. Loose sand and gravel is at depths below 95 inches.

Ashton soils are generally loamy throughout, but they have a higher clay content in the subsoil than in the surface layer. Water and air readily move through the soils, but drainage is not excessive. Permeability is moderate. Most areas of Ashton soils in this county can be expected to be flooded two or three times in a 10-year period. The rooting zone is deep, and the available moisture capacity is high. Natural fertility is high, and reaction in the rooting zone is medium acid to neutral.

Ashton soils are well suited to cultivated crops and are used mostly for those crops.

Representative profile of Ashton silt loam, 0 to 3 percent slopes, in a cultivated field 1½ miles west of Cameron along Sunfish Creek:

Ap—0 to 8 inches, dark-brown (10YR 3/3) silt loam; weak, fine and medium, granular structure; friable; many roots; neutral; abrupt, smooth boundary.

TABLE 8.—*Approximate acreage and proportionate extent of the soils*

| Soil | Acres | Percent |
|---|---|---|
| Ashton silt loam, 0 to 3 percent slopes | 192 | 0. 1 |
| Brooke silty clay loam, 12 to 18 percent slopes, moderately eroded | 221 | . 1 |
| Brooke silty clay loam, 18 to 35 percent slopes, moderately eroded | 577 | . 2 |
| Captina silt loam, 2 to 6 percent slopes | 235 | . 1 |
| Captina silt loam, 6 to 12 percent slopes, moderately eroded | 588 | . 2 |
| Captina silt loam, 12 to 18 percent slopes, moderately eroded | 304 | . 1 |
| Chagrin silt loam | 6, 720 | 2. 3 |
| Conotton gravelly loam, 0 to 2 percent slopes | 108 | (1) |
| Conotton gravelly loam, 6 to 18 percent slopes | 96 | (1) |
| Coolville-Rarden silt loams, 6 to 12 percent slopes, moderately eroded | 241 | . 1 |
| Coolville-Rarden silt loams, 12 to 18 percent slopes, moderately eroded | 158 | (1) |
| Dekalb loam, 6 to 12 percent slopes, moderately eroded | 110 | (1) |
| Dekalb loam, 12 to 18 percent slopes, moderately eroded | 364 | . 1 |
| Dekalb loam, 18 to 35 percent slopes, moderately eroded | 1, 109 | . 4 |
| Gilpin and Dekalb very stony soils, 12 to 35 percent slopes | 266 | . 1 |
| Gilpin and Dekalb very stony soils, 35 to 70 percent slopes | 4, 426 | 1. 5 |
| Gilpin-Upshur complex, 2 to 6 percent slopes, moderately eroded | 282 | . 1 |
| Gilpin-Upshur complex, 6 to 12 percent slopes, moderately eroded | 3, 611 | 1. 2 |
| Gilpin-Upshur complex, 12 to 18 percent slopes | 916 | . 3 |
| Gilpin-Upshur complex, 12 to 18 percent slopes, moderately eroded | 14, 027 | 4. 8 |
| Gilpin-Upshur complex, 18 to 35 percent slopes, moderately eroded | 42, 725 | 14. 6 |
| Gilpin-Upshur complex, 18 to 35 percent slopes, severely eroded | 3, 820 | 1. 3 |
| Gilpin-Upshur complex, 35 to 70 percent slopes | 40, 938 | 14. 1 |
| Gilpin-Upshur complex, 35 to 70 percent slopes, severely eroded | 768 | . 3 |
| Gilpin-Upshur complex, steep, benched | 185 | . 1 |
| Gilpin-Upshur complex, very steep, benched | 1, 937 | . 7 |
| Gilpin-Upshur very stony complex, 12 to 35 percent slopes | 250 | . 1 |
| Gilpin-Upshur very stony complex, 35 to 70 percent slopes | 703 | . 3 |
| Gilpin-Westmoreland silt loams, 2 to 6 percent slopes, moderately eroded | 766 | . 3 |
| Gilpin-Westmoreland silt loams, 6 to 12 percent slopes, moderately eroded | 4, 858 | 1. 7 |
| Gilpin-Westmoreland silt loams, 12 to 18 percent slopes, moderately eroded | 10, 259 | 3. 5 |
| Gilpin-Westmoreland silt loams, 12 to 18 percent slopes, severely eroded | 446 | . 2 |
| Gilpin-Westmoreland silt loams, 18 to 35 percent slopes, moderately eroded | 28, 271 | 9. 7 |
| Gilpin-Westmoreland silt loams, 18 to 35 percent slopes, severely eroded | 1, 359 | . 5 |
| Gilpin-Westmoreland silt loams, 35 to 70 percent slopes, moderately eroded | 29, 449 | 10. 1 |
| Gilpin-Westmoreland silt loams, very steep, benched | 859 | . 3 |
| Guernsey-Upshur complex, 6 to 12 percent slopes, moderately eroded | 148 | (1) |
| Guernsey-Upshur complex, 12 to 18 percent slopes, moderately eroded | 913 | . 3 |
| Guernsey-Upshur complex, 18 to 35 percent slopes, moderately eroded | 3, 213 | 1. 1 |
| Guernsey-Upshur complex, 35 to 70 percent slopes, moderately eroded | 2, 428 | . 8 |
| Guernsey-Upshur complex, 18 to 70 percent slopes, landslip | 5, 323 | 1. 8 |
| Guernsey-Upshur complex, steep, benched | 245 | . 1 |
| Guernsey-Upshur complex, very steep, benched | 255 | . 1 |
| Guernsey-Westmore silt loams, 6 to 12 percent slopes, moderately eroded | 493 | . 2 |
| Guernsey-Westmore silt loams, 12 to 18 percent slopes, moderately eroded | 4, 682 | 1. 6 |
| Guernsey-Westmore silt loams, 18 to 35 percent slopes, moderately eroded | 11, 667 | 4. 0 |
| Guernsey-Westmore silt loams, 18 to 35 percent slopes, severely eroded | 422 | . 1 |
| Guernsey-Westmore silt loams, 35 to 70 percent slopes, moderately eroded | 9, 008 | 3. 1 |
| Gullied land, Gilpin-Upshur material | 354 | . 1 |
| Hackers silt loam, 3 to 8 percent slopes | 208 | . 1 |
| Hartshorn silt loam | 3, 672 | 1. 3 |
| Hartshorn silt loam, wet variant | 424 | . 2 |
| Huntington silt loam | 1, 320 | . 5 |
| Keene silt loam, 2 to 6 percent slopes | 107 | (1) |
| Keene silt loam, 6 to 12 percent slopes, moderately eroded | 552 | . 2 |
| Keene-Latham silt loams, 12 to 18 percent slopes, moderately eroded | 720 | . 3 |
| Latham-Keene silt loams, 18 to 35 percent slopes, moderately eroded | 135 | (1) |
| Lindside silt loam | 1, 618 | . 6 |
| Made land | 1, 614 | . 6 |
| Newark silt loam | 1, 106 | . 4 |
| Rarden-Coolville silt loams, 12 to 18 percent slopes, moderately eroded | 330 | . 1 |
| Sciotoville silt loam, 0 to 4 percent slopes | 324 | . 1 |
| Sees-Woolper silt loams, 12 to 18 percent slopes | 505 | . 2 |
| Sees-Woolper silt loams, 18 to 35 percent slopes | 1, 997 | . 7 |
| Strip mine spoils | 33 | (1) |
| Upshur silt loam, 6 to 12 percent slopes, moderately eroded | 301 | . 1 |
| Upshur silt loam, 12 to 18 percent slopes, moderately eroded | 244 | . 1 |
| Upshur clay, 6 to 12 percent slopes, severely eroded | 247 | . 1 |
| Upshur clay, 12 to 18 percent slopes, severely eroded | 1, 319 | . 5 |
| Vandalia silt loam, 12 to 18 percent slopes | 229 | . 1 |
| Vandalia-Sees silt loams, 18 to 35 percent slopes | 917 | . 3 |
| Vandalia-Sees very stony silt loams, 18 to 35 percent slopes, moderately eroded | 102 | (1) |
| Wellston silt loam, 2 to 6 percent slopes, moderately eroded | 351 | . 1 |
| Wellston silt loam, 6 to 12 percent slopes, moderately eroded | 2, 942 | 1. 0 |
| Wellston silt loam, 12 to 18 percent slopes, moderately eroded | 3, 745 | 1. 3 |
| Wheeling silt loam, 0 to 2 percent slopes | 530 | . 2 |
| Wheeling silt loam, 2 to 6 percent slopes | 268 | . 1 |
| Wheeling silt loam, 6 to 18 percent slopes, moderately eroded | 132 | (1) |
| Woodsfield silt loam, 2 to 6 percent slopes | 129 | (1) |
| Woodsfield silt loam, 6 to 12 percent slopes, moderately eroded | 284 | . 1 |
| Woodsfield silt loam, 12 to 18 percent slopes, moderately eroded | 167 | . 1 |
| Woolper silt loam, 2 to 6 percent slopes | 267 | . 1 |
| Woolper and Sees silt loams, 6 to 12 percent slopes | 124 | (1) |
| Zanesville silt loam, 2 to 6 percent slopes | 1, 847 | . 6 |
| Zanesville silt loam, 2 to 6 percent slopes, moderately eroded | 712 | . 2 |
| Zanesville silt loam, 6 to 12 percent slopes | 957 | . 3 |
| Zanesville silt loam, 6 to 12 percent slopes, moderately eroded | 5, 103 | 1. 8 |

See footnote at end of table.

TABLE 8.—*Approximate acreage and proportionate extent of the soils*—Continued

| Soil | Acres | Percent | Soil | Acres | Percen |
|---|---|---|---|---|---|
| Zanesville silt loam, 12 to 18 percent slopes, moderately eroded | 1, 308 | . 5 | Zanesville-Woodsfield silt loams, 12 to 18 percent slopes, moderately eroded | 6, 225 | 2. 1 |
| Zanesville-Woodsfield silt loams, 2 to 6 percent slopes | 500 | . 2 | Gravel pit | 46 | (1) |
| Zanesville-Woodsfield silt loams, 2 to 6 percent slopes, moderately eroded | 407 | . 1 | Riverwash | 18 | (1) |
| Zanesville-Woodsfield silt loams, 6 to 12 percent slopes | 537 | . 2 | Quarry | 50 | (1) |
| Zanesville-Woodsfield silt loams, 6 to 12 percent slopes, moderately eroded | 5, 075 | 1. 7 | Water | 157 | (1) |
| | | | Total | 291, 200 | 100. 0 |

[1] Less than 0.05 percent.

B21—8 to 17 inches, dark yellowish-brown (10YR 3/4) silt loam, brown to dark brown (10YR 4/3) when crushed; weak, coarse, prismatic structure parting readily to moderate, medium, angular blocky; firm; common roots; thin, continuous, dark-brown (10YR 3/3) silt-clay coatings on all ped surfaces; neutral; clear, smooth boundary.

B22t—17 to 24 inches, brown to dark-brown (10YR 4/3) light silty clay loam; moderate, medium, angular blocky structure; firm; few roots; thin, continuous, dark-brown (10YR 3/3) clay films on ped surfaces; slightly acid; clear, smooth boundary.

B23t—24 to 32 inches, brown to dark-brown (10YR 4/3) silty clay loam; moderate, medium and coarse, angular blocky structure; firm; few roots; thin, patchy, dark-brown (10YR 3/3) clay films on ped surfaces; neutral; clear, smooth boundary.

B24t—32 to 44 inches, brown to dark-brown (7.5YR 4/4) silt loam; moderate, coarse, angular blocky structure; firm; few roots; thin, patchy, brown to dark-brown (7.5YR 4/2) clay films on ped surfaces; slightly acid; clear, smooth boundary.

B3t—44 to 58 inches, brown to dark-brown (7.5YR 4/4) heavy loam to clay loam; weak, coarse, subangular blocky structure; few roots; thin, very patchy, brown to dark-brown (7.5YR 4/2) clay films on vertical ped surfaces; slightly acid; clear, smooth boundary.

C1—58 to 87 inches, brown to dark-brown (10YR 4/3) loam to clay loam; few, fine, faint, light brownish-gray (10YR 6/2) mottles; massive; friable; common, fine, black (10YR 2/1) concretions; slightly acid; clear, smooth boundary.

C2—87 to 95 inches, dark grayish-brown (10YR 4/2) sandy clay loam; common, fine, faint, light brownish-gray (10YR 6/2) mottles and few, fine, faint, light olive-brown (2.5YR 5/4) mottles; massive; friable; common, fine, black (10YR 2/1) concretions; slightly acid; clear, wavy boundary.

IIC3—95 to 100 inches, loose sand and gravel.

The solum ranges from 40 to 60 inches in thickness. Depth to loose sand and gravel is variable but generally is more than 6 feet. The A horizon ranges from very dark grayish brown (10YR 3/2) to dark brown (10YR 3/3). Moist, broken, and rubbed colors have values and chromas of less than 3.5. The color of the B horizon has a value of 3 or 4 and a chroma of 2 to 4 in hues of 10YR and 7.5YR. Low-chroma mottles are absent in the upper 36 inches. Texture of the B horizon is normally silt loam or silty clay loam (less than 30 percent clay), but it ranges to loam and clay loam. The more loamy textures are most common in the lower part of the Bt horizon. The C horizon is more variable in texture and includes fine sandy loam, sandy loam, loam, sandy clay loam, and clay loam. Reaction is generally neutral to slightly acid throughout the profile but ranges to medium acid. Small pebbles and both rounded and angular coarse fragments commonly make up about 1 to 3 percent of the solum, by volume.

Ashton soils are generally adjacent to the lighter colored, well drained Chagrin soils and the lighter colored, moderately well drained Lindside soils that occupy the lower level flood plains nearest the stream. Ashton soils normally are below the Sees and Woolper soils on foot slopes. Both Sees and Woolper soils have a higher clay content in the upper part of the Bt horizon than Ashton soils. Ashton soils are similar in many respects to the Wheeling soils on high bottoms and terraces in other parts of the county, but they typically have a darker colored surface layer, are less acid, and are less sandy and more silty than the Wheeling soils.

**Ashton silt loam, 0 to 3 percent slopes** (AsA).—Most areas of this soil range from 10 to 15 acres in size.

Included in mapping were a few spots of moderately well drained or somewhat poorly drained soils that generally occur in slight depressions or in positions where they receive runoff or underground seepage from adjacent uplands.

This soil is well suited to the use of most types of farm machinery, and the plow layer is very easy to till. For very short periods, water ponds in small depressions but does little or no harm to crops. Erosion is not a hazard.

This soil is well suited to farming. It has no limitations for intensive cropping; however, occasional flooding limits the soil for many nonfarm uses. (Capability unit I–1; woodland suitability group 1o1 on all aspects)

## Brooke Series

The Brooke series consists of well-drained, moderately deep soils that have a dark-colored surface layer and a clayey subsoil. These soils formed in material weathered from limestone and thin, interbedded layers of shale, siltstone, and sandstone. They occur throughout the county, but the largest acreage is in Seneca and western Malaga Townships where the limestone layers are especially thick and extensive. The soils are mainly on steep to very steep hillsides, but they also are on moderately steep ridgetops and knolls.

A representative Brooke soil has a dark-brown silty clay loam surface layer about 7 inches thick. This layer tends to be sticky when wet and hard when dry. The uppermost inch of the surface layer is generally very dark grayish brown. The upper part of the subsoil, to a depth of 15 inches, is dark yellowish-brown clay and silty clay. The lower part of the subsoil, to a depth of 32 inches, is dark yellowish-brown and dark-brown to brown clay. Below the subsoil is brown to dark-brown and light olive-brown, calcareous clay that contains some limestone fragments. Dark-gray, hard limestone begins at a depth of 40 inches.

Most areas of Brooke soils have been farmed intensively in the past. In most places the original silty surface soil has been eroded away, and the present surface layer is a finer textured silty clay loam. As a result, the soils have a slow infiltration rate. They crack and dry out rapidly late in summer.

Permeability is slow, and surface runoff is rapid. Erosion is a hazard if these soils are not protected. The available moisture capacity is low or medium. The soils are slightly acid to mildly alkaline. Lime is not generally needed.

Brooke soils are used mostly for pasture and long-term meadow. Good natural stands of bluegrass are common on these soils.

Representative profile of Brooke silty clay loam, 12 to 18 percent slopes, moderately eroded, in a pasture in sec. 18, Seneca Township, 0.2 mile N. of junction of County Road 2 and Township Road 2:

O1—½ inch to 0, deciduous leaf litter.

A11—0 to 1 inch, very dark grayish-brown (10YR 3/2) silty clay loam, rubbed color is dark brown (10YR 3/3), dry color is dark grayish brown (10YR 4/2); moderate, fine and medium, granular structure; friable; many fine and medium roots; neutral; abrupt, smooth boundary.

A12—1 to 7 inches, dark-brown (10YR 3/3) silty clay loam; moderate, fine, subangular blocky structure; friable; many roots; neutral; abrupt, irregular boundary.

B21t—7 to 10 inches, dark yellowish-brown (10YR 4/4) light clay; strong, fine and medium, subangular blocky structure; firm; many roots; thin, patchy, brown to dark-brown (10YR 4/3) clay films on vertical ped faces; neutral; clear, smooth boundary.

B22t—10 to 15 inches, dark yellowish-brown (10YR 4/4) silty clay; strong, fine, angular blocky structure; very firm; common roots; thin, continuous, brown to dark-brown (10YR 4/3) clay films on ped faces; neutral; clear, smooth boundary.

B23t—15 to 25 inches, dark yellowish-brown (10YR 4/4) clay; strong, fine, angular blocky structure; very firm; few roots; thin, continuous, brown to dark-brown (10YR 4/3) clay films on ped faces; neutral; clear, smooth boundary.

B3t—25 to 32 inches, dark-brown to brown (10YR 4/3) clay; moderate, fine and medium, angular blocky structure; firm; few roots; thin, continuous, brown to dark-brown (10YR 4/3) clay films on ped faces; neutral; clear, wavy boundary.

C—32 to 40 inches, mixed brown to dark-brown (7.5YR 4/2) and light olive-brown (2.5YR 5/4) clay; massive; about 20 percent, by volume, limestone fragments; mildly alkaline and calcareous; abrupt, wavy boundary.

R—40 inches +, massive, dark-gray (10YR 4/1), hard limestone.

The color of the A horizon centers on 10YR 3/2 with a range in value and chroma of 2 to 3. Color value and chroma in the B horizon are generally only one or two units higher than those of the A horizon. Thickness of the B horizon is normally about 22 to 25 inches, but it ranges from 18 to 30 inches. Texture of the B horizon is generally silty clay or clay; if a B21 or B1 horizon is present, it is commonly silty clay loam. Reaction of the solum is commonly neutral, but it ranges from slightly acid to mildly alkaline. Coarse fragments generally make up less than 15 percent of the solum. Depth to bedrock ranges from 20 to 40 inches, but in most places bedrock begins at a depth of about 36 inches.

Brooke soils are shallower to rock, less acid in the root zone, and darker colored than the adjacent Westmore and Guernsey soils. They are shallower to rock and better drained than the nearby Sees soils; they are also shallower to rock than the nearby Woolper soils. Both Brooke and Woolper soils have a dark-colored A horizon, but the upper part of the B horizon of Brooke soils is lighter colored than that of Woolper soils.

**Brooke silty clay loam, 12 to 18 percent slopes, moderately eroded** (BwD2).—This soil is on narrow ridgetops, knolls, hillsides, and benches. The ridges are smoothly rounded, and areas on hillsides are generally even and uniformly shaped. This soil has the profile described as representative for the series. Most areas have 4 to 7 inches of the original surface soil remaining. In cultivated areas the surface layer has been mixed through tillage with some of the finer textured subsoil.

Included in mapping were areas where the subsoil is as thin as 10 inches or as thick as 36 inches. A few severely eroded areas were also mapped with this soil. In these areas the surface layer is sticky, heavy clay that is hard to work and difficult to revegetate. Most of these areas have many small limestone fragments on the surface. Also mapped with this soil were a few small areas where the slope is 6 to 12 percent and some areas that are deeper than 40 inches to limestone.

This soil erodes severely if not protected. It is generally well suited to long-term meadow or pasture. Slope and slow permeability are limitations to many nonfarm uses. (Capability unit IVe–1; woodland suitability group 3c1 on all aspects)

**Brooke silty clay loam, 18 to 35 percent slopes, moderately eroded** (BwE2).—This soil occurs on hillsides and smoothly rounded knolls. Commonly, the slopes are even and uniform, but a few areas have landslips and uneven topography. In uneven areas, limy shale makes up a large part of the underlying material. From 4 to 7 inches of the original surface layer remains. This material has been mixed through tillage with some of the finer textured subsoil.

Included in mapping were areas where the subsoil is as thin as 10 inches or as thick as 36 inches. A few severely eroded areas were also mapped with this soil. In these areas the surface layer is sticky clay that is lighter in color and lower in organic-matter content than the original surface soil. Also included in mapping were some areas deeper to limestone than is typical for Brooke soils.

Slope, hazard of erosion, and slow permeability limit the use of this soil for farming or nonfarm use. (Capability unit VIe–1; woodland suitability group 3c1 on all aspects)

## Captina Series

The Captina series consists of deep soils that are light colored and moderately well drained. These soils are gently sloping to moderately steep and occupy old alluvial terraces that range from about 20 to more than 200 feet above present stream levels. The largest acreage is on stream terraces along the Little Muskingum River, Clear Fork, and Sunfish Creek. Captina soils formed in thick deposits of old alluvial material.

A representative Captina soil has a dark grayish-brown silt loam plow layer about 9 inches thick. It is friable and easily worked. The upper part of the subsoil, to a depth of 21 inches, is yellowish-brown heavy silt loam to light silty clay loam. The lower part of the subsoil, to a depth of 57 inches, is light silty clay loam and loam. It has mixed colors of yellowish brown, strong brown, brown to dark brown, and light gray. In the lower part of the subsoil is a compact, brittle fragipan that severely limits the penetration of roots, water, and air. Beneath this fragi-

pan, from a depth of 57 inches to 8 feet or more, is loamy alluvium that has dominant colors of brown and light gray.

The rooting zone is moderately deep, and the available moisture capacity is medium. A few roots penetrate downward along vertical cracks in the fragipan, but root growth generally is restricted by the fragipan. The natural supply of plant nutrients is low to medium. These soils are moderately permeable above the fragipan but are slowly permeable in the fragipan. They dry out rather slowly in the spring. During wet periods there is commonly a perched water table above the fragipan.

The acreage of these soils is used about equally for cultivated crops, hay, and pasture. Alfalfa is subject to severe winter heaving on these soils.

Representative profile of Captina silt loam, 2 to 6 percent slopes, in a cultivated field in NE¼ sec. 5, Washington Township, 1.9 miles south of junction of County Road 72 and County Road 42:

Ap1—0 to 4 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, fine, granular structure and some moderate, medium and thin, platy; friable; many roots; medium acid; abrupt, smooth boundary.

Ap2—4 to 9 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, medium, subangular blocky structure; friable; many roots; medium acid; abrupt, smooth boundary.

B1—9 to 11 inches, yellowish-brown (10YR 5/6) silt loam; moderate, fine and medium, subangular blocky structure; firm; common roots; thin, very patchy, dark-brown (10YR 3/3) silt coatings on vertical ped faces; medium acid; abrupt, smooth boundary.

B21t—11 to 21 inches, yellowish-brown (10YR 5/6) heavy silt loam to light silty clay loam; moderate, fine and medium, subangular blocky structure; firm; common roots; thin, very patchy, dark yellowish-brown (10YR 4/4) and yellowish-red (5YR 4/6) clay films on ped faces; strongly acid; clear, wavy boundary.

Bx1—21 to 25 inches, mixed yellowish-brown (10YR 5/4) and strong-brown (7.5YR 5/6) light silty clay loam; very coarse prismatic structure parting to moderate, medium, platy; very firm; few roots; thin, very patchy, brown (10YR 5/3) clay films, and thick, continuous, light-gray (10YR 7/1) silt coatings on both the vertical and horizontal ped faces; many black concretions and coatings; very strongly acid; clear, smooth boundary.

IIBx2—25 to 57 inches, mixed yellowish-brown (10YR 5/4), brown to dark-brown (7.5YR 4/4), and strong-brown (7.5YR 5/6) loam; very coarse prismatic structure parting to weak, thick, platy; very firm; thin, patchy, brown (10YR 5/3) clay films and thick, continuous, light-gray (10YR 7/1) silt coatings on both the vertical and horizontal ped faces; very strongly acid; clear, smooth boundary.

IIC—57 to 94 inches, mixed brown to dark-brown (7.5YR 4/4), strong-brown (7.5YR 5.6), brown (10YR 5/3), and light-gray (10YR 7/1) loam; massive; friable; very strongly acid.

The Ap horizon is brown (10YR 4/3) and dark grayish brown (10YR 4/3). Color of the B and Bx horizons ranges from brown (10YR 5/3) to yellowish brown (10YR 5/8) with hues of 10YR and 7.5YR. In some profiles the lower part of the B2 horizon is mottled, but 2-chroma mottles are absent in the upper 10 inches of the Bt horizon. The Bx horizons commonly are extensively mottled. Texture of the B horizon is most commonly silt loam but ranges from silty clay loam to loam. Layers of gravelly or sandy material occur in the C horizon in most places. Depth to the fragipan ranges from 10 to 30 inches, but it averages about 23 inches. Thickness of the fragipan ranges from 10 to 42 inches, but it averages about 32 inches. Total thickness of the alluvium ranges from about 4 to 12 feet. Unless the soils have been limed, reaction throughout the profile is strongly acid or very strongly acid. Concretionary material is normally lacking in the B2 horizon, but it is commonly abundant in the Bx and C horizons. Coarse fragments throughout the solum make up less than 5 percent, by volume.

Captina soils commonly are near the Wheeling and Sciotoville soils. They have a fragipan, which Wheeling soils lack. They also have a lower sand content and a lower base saturation than Wheeling soils. Captina soils differ from Sciotoville soils by having a more strongly developed fragipan and lower base saturation.

**Captina silt loam, 2 to 6 percent slopes** (CaB).—This soil is on well-defined benches above the present overflow level of streams. These benches have smooth, uniform slopes and are a prominent feature of the landscape along the streams where they occur. The largest areas of this soil are inside large bends of the streams or where the valleys are widest. A profile of this soil is described as representative for the series.

Included in mapping were a few areas of somewhat poorly drained soils where colors below the plow layer are mottled with gray. In some areas sand, gravel, or rock is beneath the fragipan. Also included were a few moderately eroded areas that have a lighter colored surface layer and a slightly lower available moisture capacity.

Most areas of this soil are used for crops. The principal crops are corn, small grains, and hay. Runoff is moderate to rapid, and the hazard of erosion is the dominant limitation to farming. Slow permeability and seasonal wetness are limitations to many nonfarm uses. (Capability unit IIe–3; woodland suitability group 2w1 on all aspects)

**Captina silt loam, 6 to 12 percent slopes, moderately eroded** (CaC2).—This soil has lost 25 to 75 percent of its original surface layer through erosion. In most areas the remaining part of this layer has been mixed through tillage with some of the lighter colored subsoil. In places the plow layer is sticky silty clay loam that is in poor tilth. This soil has a profile similar to the one described as representative for the series, but the surface layer is thinner. Natural fertility, available moisture capacity, and organic-matter content are lower in this soil than in the soil having the representative profile.

Nearly all of this soil has been cleared and cultivated. Some areas have reverted to pasture. A continuing hazard of erosion is the dominant limitation to farming. Slow permeability, seasonal wetness, and slope are limitations to many nonfarm uses. (Capability unit IIIe–2; woodland suitability group 2w1 on all aspects)

**Captina silt loam, 12 to 18 percent slopes, moderately eroded** (CaD2).—This soil is on benches above the present flood level of streams. Most commonly it is in bands below or near areas of Captina soils that are less steep. Some of the small areas of this soil are remnants of a former larger area of water-deposited material that has been worn away by erosion. Several areas of this soil are cut by deep drainageways. This soil has a profile similar to that described as representative for the series, except that the surface layer is thinner and the total thickness of the fragipan is generally less. In most areas 25 to 75 percent of the original surface layer has been removed through erosion. In a few places all of that layer has been removed, and the yellowish subsoil is exposed.

Runoff is rapid, and the hazard of erosion is severe if this soil is cultivated and not protected. The hazard of erosion is even more severe where the soil is in areas that receive additional water from adjacent higher slopes. Slope and slow permeability are limitations to many nonfarm uses. (Capability unit IVe–3; woodland suitability group 2w3 on all aspects)

## Chagrin Series

The Chagrin series consists of loamy, well-drained soils that occur on flood plains of all the major streams in the county except the Ohio River. These soils formed in material deposited by floodwaters.

A representative Chagrin soil that has been cultivated has a dark-brown silt loam plow layer about 5 inches thick. The upper part of the subsoil, to a depth of 28 inches, is brown to dark-brown silt loam. The lower part of the subsoil, to a depth of 48 inches, is dark yellowish-brown silt loam. The underlying material, to a depth of 5 or 10 feet or more, is dark yellowish-brown loamy alluvium.

Chagrin soils have a high available moisture capacity and high natural fertility. Permeability is moderate, and there are no drainage problems. Reaction is medium acid to neutral. These soils commonly do not need lime for crops such as corn, but lime is needed for legumes. Crops respond well to applications of fertilizer. Most areas of Chagrin soils are flooded one to three times a year. Flooding normally occurs in winter or early in spring.

Chagrin soils are used for many kinds of crops, including corn and soybeans, and they also are extensively used for hay and pasture.

Representative profile of Chagrin silt loam in a pasture, NW¼ sec. 21, Seneca Township, T. 7 N., R. 7 W., 1.1 miles north of junction of State Routes 78 and 379:

Ap—0 to 5 inches, brown to dark-brown (10YR 4/3) silt loam; moderate, coarse, granular structure; the upper 1½ inches has weak, thin, platy structure; friable; many roots; dark-brown (10YR 3/3) organic stains on ped faces; slightly acid; clear, smooth boundary.

B21—5 to 11 inches, brown to dark-brown (10YR 4/3) silt loam; weak, medium and fine, subangular blocky structure; friable; common roots; slightly acid; clear, smooth boundary.

B22—11 to 28 inches, brown to dark-brown (10YR 4/3) silt loam; weak, coarse and medium, subangular blocky structure; friable; common roots; slightly acid; clear, smooth boundary.

B23—28 to 48 inches, dark yellowish-brown (10YR 4/3) silt loam; weak, fine, subangular blocky structure; friable; few roots; thin, continuous, dark grayish-brown (10YR 4/2) silt coatings on ped faces; slightly acid; clear, smooth boundary.

C1—48 to 61 inches, dark yellowish-brown (10YR 3/4) loam to silt loam; few, fine, prominent, strong-brown (7.5YR 5/6) mottles; massive; friable; few roots; thin, continuous, dark grayish-brown (10YR 4/2) silt coatings on ped faces; neutral; gradual, smooth boundary. (Water table at depth of 61 inches.)

C2—61 to 120 inches, dark yellowish-brown (10YR 3/4) loam; massive; friable; neutral.

The A horizon is mainly silt loam but in places is loam. Color of the Ap horizon is dominantly dark brown (10YR 3/3) and dark yellowish brown (10YR 3/4), but it ranges to dark reddish brown (5YR 3/3 and 3/4). Crushed colors generally have values exceeding 3.5. Dominant colors to a depth of at least 30 inches are 10YR or 7.5YR in hue. Chroma is 3 or more, and value is generally 4. Some silt coatings have a chroma of 2. Mottling occurs at depths below 3 feet in many profiles. The upper part of the C horizon is commonly stratified and structureless (massive). Stratification of sediment occurs in most profiles, but the part between depths of 6 and 36 inches is dominantly silt loam and loam. Reaction in the profile ranges from medium acid to neutral. Depth to gravelly material or bedrock ranges from 2½ feet along some of the smaller streams to 10 feet or more along the larger streams.

Chagrin soils commonly are adjacent to the moderately well drained Lindside soils and the somewhat poorly drained Newark soils. They are higher in sand content and have a lighter colored plow layer than the Huntington soils on the Ohio River flood plains. They are deeper to loose sand and gravel than the Hartshorn soils that occur along the smaller streams. They differ from the Wheeling soils in that they lack a Bt horizon.

**Chagrin silt loam** (Cg).—This nearly level soil is on flood plains adjacent to all the major streams in the county, except the Ohio River. A few small areas occur along drainageways on uplands. The width of the bottom lands ranges from about 75 feet to more than one-fourth mile.

Included in mapping were small areas of moderately well drained Lindside soils and somewhat poorly drained Newark soils. The included Newark soils generally are in slight depressions, and the included Lindside soils are in narrow bands along the edge of this soil. Also included with this soil in mapping are areas with a gravelly surface layer. These are shown on the soil map by a special symbol. Chagrin soils that are more acid than typical occur in some of the smaller watersheds in the northern and central parts of the county. Chagrin soils that are redder than typical occur in some areas in the southern part of the county where Upshur soils are extensive.

Most of the acreage of this Chagrin soil is cleared and is in crops or pasture. A few areas along the smaller streams are wooded. This soil is one of the most fertile in the county. It is especially suited to corn. It has no limitations for intensive cropping, except the hazard of occasional flooding. Areas subject to more than occasional flooding are better suited to grass or trees than to cultivated crops. Flooding is a severe limitation for most nonfarm uses. (Capability unit IIw–1; woodland suitability group 1o1 on all aspects)

## Conotton Series

The Conotton series consists of gravelly, well-drained, loamy soils that formed in water-deposited sand and gravel. These soils are nearly level on terrace benches and are sloping to moderately steep on breaks between different terrace levels, mainly along the Ohio River.

A representative Conotton soil has a very dark grayish-brown gravelly loam plow layer about 10 inches thick. The subsoil, to a depth of 28 inches, is dark-brown to brown gravelly sandy loam that contains 25 percent pebbles. The underlying material, to a depth of 96 inches, is loose sand and gravel.

Conotton soils have a high content of sand and gravel throughout the profile. The available moisture capacity is low. Water moves through these soils rapidly, and nutrients are lost by leaching. The soils commonly are very strongly acid in the rooting zone, but normally they are less acid in the underlying sand and gravel. These soils are droughty and are better suited to spring crops

than to summer crops. They are well suited to early season crops because they drain readily and warm up quickly in spring. They are well suited to irrigation.

Conotton soils are well suited as sites for buildings where slope is not limiting. They are also a good source of gravel. A few areas are used for truck crops, corn, hay, and pasture.

Representative profile of Conotton gravelly loam, 0 to 2 percent slopes, in a pasture in sec. 33, Lee Township, T. 1 N., R. 3 W., 250 feet south of State Route 7:

A1—0 to 10 inches, very dark grayish-brown (10YR 3/2) gravelly loam that crushes to dark grayish brown (10YR 4/2); weak, fine, granular structure; friable; many roots; 15 percent pebbles; medium acid; clear, smooth boundary.

B2t—10 to 28 inches, dark-brown to brown (7.5YR 4/4) gravelly sandy loam; weak, fine, subangular blocky structure; friable; common roots; 25 percent pebbles; thin, patchy, dark grayish-brown (10YR 4/2) clay films bridging sand grains and on pebbles; medium acid; clear, irregular boundary.

C—28 to 96 inches, dark-brown to brown (7.5YR 4/4) loose sand and gravel.

The A horizon has values of 3 and 4 and chromas of 2 to 4. Colors of the B horizon include dark yellowish brown (10YR 4/4), yellowish-brown (10YR 5/4, 5/6), dark brown to brown (7.5YR 4/4), and strong brown (7.5YR 5/6). Dominant chroma is less than 6 in the major part of the Bt horizon. Texture of the B horizon includes gravelly fine sandy loam, gravelly sandy loam, and gravelly loam. A B1 horizon is present in some profiles. The increase in content of clay from the A horizon to the B horizon is typically about 4 percent and rarely exceeds 6 percent. Depth to loose sand or gravel ranges from 20 to 36 inches, but the average depth for the county is about 26 inches. Thickness of the Bt horizon ranges from 12 to 20 inches. Reaction of the solum ranges from medium acid to very strongly acid; pH normally increases with depth. The content of gravel ranges from 15 to 50 percent in the solum.

The Conotton soils in this county generally contain less gravel and have a thinner solum than typical Conotton soils of other survey areas. This does not greatly affect the use and management of these soils.

Conotton soils commonly occur near the well drained Wheeling soils and the moderately well drained Sciotoville soils. They are shallower to gravel and are typically higher in sand and gravel content throughout the solum than the Wheeling or Sciotoville soils. Conotton soils lack the dense, compact fragipan layer that occurs in the lower part of the subsoil of Sciotoville soils.

**Conotton gravelly loam, 0 to 2 percent slopes** (CoA).—This soil is on benches along the Ohio River. It has the profile described as representative for the series.

Included in mapping were a few small areas that lack gravel in the surface layer, and a few areas that are gently sloping.

Because this soil is nearly level, it absorbs practically all rainfall and is subject to little or no erosion. Many rounded gravel fragments are on the surface and in the soil, but generally these do not interfere with tillage. Droughtiness is the major limitation to crop growth. This soil is not subject to flooding and has few limitations for nonfarm uses. (Capability unit IIIs–1; woodland suitability group 3f1 on all aspects)

**Conotton gravelly loam, 6 to 18 percent slopes** (CoD).—This soil is in narrow bands, commonly next to gravelly escarpments. It is mainly on stream terraces along the Ohio River. A few areas are along stream terraces of Clear Fork and Rich Fork near areas of Captina soils. In these areas the soil contains less sand than in areas along the Ohio River.

Included in mapping were a few areas that lack gravel in the surface layer and upper part of the subsoil. Some short steep escarpment areas also were included. These are indicated on the soil map by a special symbol.

Most of the acreage of this soil is used for growing corn or truck crops. A few areas are in hay and pasture. Although infiltration of water is rapid, erosion is a hazard and is the dominant limitation to farming. The soil is droughty in summer. It is not subject to flooding. Slope is the dominant limitation to nonfarm uses. (Capability unit IIIe–1; woodland suitability group 3f1 on all aspects)

## Coolville Series

The Coolville series consists of deep, moderately well drained soils. These soils occupy rounded ridgetops, hillside benches, and moderately steep upper slopes. The upper layers of these soils formed in silty material (loess), and the lower part of the subsoil formed in material weathered from acid clay shale. In Monroe County, Coolville soils were not mapped separately, but they are an important component of the Coolville-Rarden and Rarden-Coolville complexes. These soils are widely scattered throughout the county, but the largest acreage is in the townships of Bethel and Washington.

A representative Coolville soil that has been cultivated has a dark yellowish-brown silt loam plow layer about 6 inches thick. The upper part of the subsoil, to a depth of 19 inches, is strong-brown, silty clay loam. The lower part of the subsoil, to a depth of 42 inches, is firm and very firm, mottled clay having colors of red, reddish brown, and yellowish brown. Beneath the subsoil is dusky-red, gray, yellowish-brown, and reddish-brown, very firm clay. Olive-gray and very dark gray clay shale bedrock is at a depth of 55 inches.

Water passes readily through the surface layer and upper part of the subsoil, but the clayey lower part of the subsoil and the substratum restrict the penetration of water and roots. Permeability is moderate above the clayey layers and is slow in them. Coolville soils commonly are wet late in spring and at times in fall. Crop growth is reduced in wet periods because of poor aeration, but artificial drainage generally is not justified, except for intensive use. Deep-rooted crops are subject to winter injury. The soils are very strongly acid to extremely acid, and they are low in natural nutrient supply. The available moisture capacity is medium.

Coolville soils are used mostly for pasture, but some areas are reverting to woodland.

Representative profile of a Coolville silt loam in an abandoned field, SE¼ sec. 17, Washington Township, approximately 200 yards southeast of junction of T–323 and T–320:

Ap1—0 to 1 inch, brown (10YR 4/3) silt loam; weak, very fine, granular structure; very friable; many roots; very strongly acid; abrupt, smooth boundary.

Ap2—1 to 6 inches, dark yellowish-brown (10YR 4/4) silt loam; weak, medium, subangular blocky structure parting readily to weak, fine, granular; friable; many roots; very strongly acid; abrupt, wavy boundary.

B1—6 to 10 inches, strong-brown (7.5YR 5/6) silty clay loam; weak, fine, subangular blocky structure; friable; common roots; thin, very patchy, brown (7.5YR 5/4) silt coatings on vertical ped faces; very strongly acid; clear, smooth boundary.

B21t—10 to 19 inches, strong-brown (7.5YR 5/6) silty clay loam; moderate, fine, subangular blocky structure; firm; common roots; thin, patchy, yellowish-brown (10YR 5/4) clay films and some silt coatings on vertical ped faces; very strongly acid; clear, smooth boundary.

IIB22t—19 to 24 inches, yellowish-red (5YR 4/6) clay; many, fine, prominent, gray to light-gray (10YR 4/3) mottles; moderate, medium, subangular blocky structure; firm; few roots; thin, patchy, grayish-brown (10YR 5/2) clay films on vertical and horizontal ped faces; very strongly acid; abrupt, wavy boundary.

IIB23t—24 to 32 inches, reddish-brown (5YR 4/3) clay; common, fine, distinct, gray to light-gray (10YR 6/1) mottles and few, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, angular blocky structure; very firm; few roots; thin, continuous, reddish-brown (5YR 4/4) clay films; extremely acid; clear, smooth boundary.

IIB31t—32 to 37 inches, reddish-brown (5YR 4/3) clay; common, fine, distinct, gray to light-gray (10YR 6/1) mottles and common, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, coarse, subangular blocky structure; very firm; thin, patchy, reddish-brown (5YR 4/4) clay films; extremely acid; clear, wavy boundary.

IIB32t—37 to 42 inches, yellowish-brown (10YR 5/6) clay; common, fine, distinct, gray (10YR 5/1) mottles and few, fine, prominent, reddish-brown (5YR 4/3) mottles; weak, coarse, subangular blocky structure; very firm; thin, patchy, reddish-brown (5YR 4/4) clay films; extremely acid; clear, wavy boundary.

IIC1—42 to 49 inches, mixed yellowish-brown (10YR 5/6), gray to light-gray (10YR 6/1), and dusky red (10R 3/4) clay; massive; very firm; extremely acid; gradual, smooth boundary.

IIC2—49 to 55 inches, mixed dusky-red (10R 3/2), gray (10YR 5/1), and reddish-brown (5YR 4/3) clay; massive; very firm; extremely acid; abrupt, smooth boundary.

R—55 inches, olive-gray (5Y 5/2) and very dark gray (5Y 3/1) clay shale.

Thickness of the solum ranges from 36 to 42 inches, and depth to bedrock is 42 to 70 inches. In cultivated areas the Ap horizon is brown (10YR 4/3), dark grayish brown (10YR 4/2), or dark yellowish brown (10YR 3/4, 4/4). In wooded areas the A1 horizon is less than 4 inches thick and is dark brown (10YR 3/2). In some areas an A2 horizon has values of 4 or 5 and chroma of 2 to 4. Matrix color of the unmottled B horizon is strong brown (7.5YR 5/6) or yellowish brown (10YR 5/6, 5/4). The B1 horizon in some areas has a texture of heavy silt loam or light silty clay loam. Colors of the upper part of the B2t horizon are variegated and mixed in reds, grays, and yellowish browns. There are low-chroma mottles within the upper 24 inches of the Bt horizon. The depth to clayey texture (IIB horizon) ranges from 15 to 30 inches. Texture of the IIB2t horizon is clay or silty clay that has a clay content of about 45 to 70 percent. The C horizon is clay or heavy clay loam and generally contains slightly more sand and less clay than the overlying horizons. Reaction is very strongly acid or extremely acid.

Keene, Latham, Rarden, Woodsfield, and Zanesville soils are nearby on the landscape. Coolville soils have redder colors in the lower part of the B horizon than Keene soils, and they are deeper to the clay B horizon than Rarden soils. They have a redder, finer textured B horizon than Zanesville soils and lack the compact fragipan that is characteristic of those soils. Coolville soils are more variegated in the lower part of the B horizon and are more acid than Woodsfield soils. They are redder in the lower part of the B horizon than Latham soils, and their solum is thicker than in Latham soils.

**Coolville-Rarden silt loams, 6 to 12 percent slopes, moderately eroded** (CrC2).—These soils are on rounded ridgetops and saddles. Most areas are about 2 to 4 acres in size, but a few are as much as 10 acres.

The Coolville soil typically makes up about 65 percent or more of this mapping unit, and the Rarden soil makes up 15 to 35 percent in most areas. The Rarden soil commonly occurs along the edges of mapped areas near slope breaks or on slight rises. It has a heavy sticky subsoil at a depth of 12 inches or less, and in some places the plow layer is sticky and hard to till. The Rarden soil commonly delays plowing and field operations because it dries out more slowly than the Coolville soil following wet periods.

Runoff is rapid, and the hazard of erosion is severe if these soils are cultivated. These soils can be farmed only if suitable conservation practices are applied. Slope and slow permeability are limitations to many nonfarm uses. (Capability unit IIIe–3, woodland suitability group 3w1 on all aspects)

**Coolville-Rarden silt loams, 12 to 18 percent slopes, moderately eroded** (CrD2).—These soils are on benches and, to a lesser extent, on knolls and saddles and at the heads of small drainageways on uplands. The areas are variable in size and shape, but commonly they are long and narrow and about 4 acres in size.

Typically, this complex is made up of about 55 percent Coolville soil, 25 percent Rarden soil, and 20 percent included soils. Although the Coolville soil is dominant in the mapping unit, the shallower and more clayey Rarden soil limits the use of these areas and the timing of field operations. The Rarden soil is slow to dry in spring and is commonly wet in fall. It is more difficult to fill and more susceptible to erosion than the Coolville soil. Included in mapping were small areas of severely eroded soils and a few small areas of Upshur soils.

The hazard of erosion is very severe if the soils are cultivated. The soils are suitable for occasional cultivation only if conservation practices are applied. Small or very narrow areas of these soils are commonly managed with generally steeper adjacent soils. Slope and slow permeability are limitations to many nonfarm uses. (Capability unit IVe–4; woodland suitability group 3w1 on all aspects)

## Dekalb Series

The Dekalb series consists of moderately deep, loamy, well-drained soils. These soils formed in residuum weathered from medium-grained to coarse-grained acid sandstone. They occur throughout the county, but the largest acreage is in the south-central part on the very steep hillsides along the Little Muskingum River. They generally occupy the upper third of steep slopes but also occur on knolls and narrow ridgetops. There are other Dekalb soils on some of the longer, steep, and commonly rocky slopes where sandstone is the dominant underlying bedrock.

A representative Dekalb soil in pasture has a thin, very dark grayish-brown loam surface layer and a brown to dark-brown loam subsurface layer. These layers have a combined thickness of about 7 inches, and they are very friable. The upper part of the subsoil, to a depth of 10 inches, is yellowish-brown loam. The lower part of the subsoil is yellowish-brown channery loam and channery sandy loam that extends to a depth of 25 inches. Fractured sandstone that has sandy loam material between

the fractures is below the subsoil. Coarse-grained acid sandstone bedrock is at a depth of 32 inches.

Dekalb soils have a low available moisture capacity. Permeability is moderately rapid, and plant nutrients are readily leached out. Unless they are limed, these soils are very strongly acid. Natural fertility is low; however, crops respond well to applications of lime and fertilizer. The soils dry out and warm up rapidly in spring, and areas that are not stony are easy to work throughout a wide range of moisture content. Dekalb soils absorb water readily and have slower runoff than most other soils in the county. Erosion can be a serious problem if the soils are not protected. These soils are used mainly for woodland and pasture.

Representative profile of a Dekalb loam in a pasture, SE¼ sec. 20, Benton Township, 700 feet west of junction of Township Road 596, on Township Road 562:

A1—0 to 2 inches, very dark grayish-brown (10YR 3/2) heavy loam; moderate, very fine, granular structure; very friable; many roots; very strongly acid; abrupt, smooth boundary.

A2—2 to 7 inches, brown to dark-brown (10YR 4/3) heavy loam; weak, coarse and medium, subangular blocky structure; very friable; common roots; very strongly acid; abrupt, irregular boundary.

B1—7 to 10 inches, yellowish-brown (10YR 5/4) loam; weak, coarse and medium, subangular blocky structure; friable; few roots; thin, patchy, brown to dark-brown (10YR 4/3) silt coatings; very strongly acid; clear, smooth boundary.

B21—10 to 20 inches, yellowish-brown (10YR 5/4) channery loam; moderate, medium and coarse, subangular blocky structure; firm; few roots; thin, patchy, brown (10YR 5/3) to dark-brown (10YR 4/3) silt coatings; strongly acid; abrupt, smooth boundary.

B22—20 to 25 inches, yellowish-brown (10YR 5/4) channery sandy loam; weak, medium, subangular blocky structure; friable; few fine roots; thin, very patchy, brown (10YR 5/3) silt coatings; common, fine, black (10YR 2/1) concretions; strongly acid; abrupt, smooth boundary.

C—25 to 32 inches, fractured, coarse-grained sandstone containing sandy loam material between the fractures.

R—32 inches, coarse-grained, acid sandstone.

Depth to bedrock ranges from 24 to 40 inches, but the average depth in this county is about 32 inches. The upper part of the solum commonly is 5 to 20 percent sandstone fragments, by volume. The lower part of the solum is skeletal. It is 30 to 50 percent fragments. The color of the Ap horizon is brown (10YR 4/3), dark grayish brown (10YR 4/2), and dark yellowish brown (10YR 4/4). Areas that have not been cultivated have A1 and A2 horizons. The A1 horizon generally is very dark grayish brown (10YR 3/2) but ranges to dark brown (10YR 3/3) and dark grayish brown (10YR 4/2). Rubbed and crushed colors generally have a value of 4. The A2 horizon is dark brown (10YR 3/3) to brown (10YR 4/2) and yellowish brown (10YR 5/4). The Ap horizon has a value of 4 or more when crushed. Color of the B2 horizon ranges through yellowish brown (10YR 5/4, 5/6) and strong brown (7.5YR 5/6). Thickness of the B horizon averages about 16 inches but ranges from 8 to 30 inches. Reaction of the solum typically is very strongly acid but in places is strongly acid.

The adjacent soils are generally the medium-textured Gilpin, Westmoreland, Wellston, and Zanesville soils and the reddish Upshur soils. Dekalb soils are higher in sand content and lower in silt and clay than all of those soils, and they lack the Bt horizon that is characteristic of those soils. Dekalb soils are better drained and lack the compact fragipan layer that is characteristic of the Zanesville soils.

**Dekalb loam, 6 to 12 percent slopes, moderately eroded** (DkC2).—This soil is on gently rounded ridgetops in small areas scattered throughout the county. Typically, the ridgetops are about 150 to 200 feet wide and have smooth, uniform slopes. Generally, these ridgetops are above steeper areas of Gilpin soils or other Dekalb soils. In most areas erosion has removed 25 to 75 percent of the original surface layer. The remaining part of the layer has been mixed through tillage with some of the lighter colored, coarser textured subsoil.

Included in mapping were areas where the plow layer is yellowish-brown sandy loam. Also included in mapping were a few small areas of Gilpin soils.

Because of moderately rapid permeability, runoff is slow and most of the rainfall is absorbed. This soil, therefore, generally contains more available moisture for crops than steeper Dekalb soils. It is suited to all the crops commonly grown in the county, but crop growth is reduced in dry years. A severe hazard of erosion is the dominant limitation for cultivated crops during prolonged or heavy rains. Slope and limited depth to bedrock are limitations for other uses. (Capability unit IIIe–1; woodland suitability group 3o1 on all aspects)

**Dekalb loam, 12 to 18 percent slopes, moderately eroded** (DkD2).—This soil is on narrow ridgetops, rounded knolls, and benches. Generally, the benches are below areas of steeper Dekalb soils. The Dekalb soil on these benches is commonly 4 to 5 feet deep to bedrock, and this is deeper than representative Dekalb soils. In most areas the original surface layer has been mixed with some of the subsoil through tillage. In a few places, the plow layer is mainly yellowish brown.

Included in mapping were areas of severely eroded soils that are lower in natural fertility, available moisture capacity, and organic-matter content than this moderately eroded soil. The plow layer in these soils is yellowish brown. Also included were a few areas that have some large stones of sandstone on the surface and in the soil.

Nearly all the acreage of this soil has been cleared and cultivated, but many areas have reverted to woodland and pasture. The soil is generally too steep for row crops. There is a very severe hazard of erosion if the soil is used for cultivated crops. Slope and limited depth to bedrock are limitations for many nonfarm uses. (Capability unit IVe–2; woodland suitability group 2r1 on north and east aspects and 3r1 on south and west aspects)

**Dekalb loam, 18 to 35 percent slopes, moderately eroded** (DkE2).—This soil is on oval or smoothly rounded knolls along drainageways and in steep, rather narrow bands around hillsides. Many of the knolls are slightly higher in elevation than the surrounding ridgetops and are a prominent feature of the landscape.

Included in mapping were some cultivated areas where as much as three-fourths of the original surface layer has been removed through erosion. Here, the present surface layer is sandy loam and the soil is lower in fertility and is more droughty than less eroded soils.

Most areas of this soil are used for hay and pasture, but a small acreage is used for small grains, and a few areas of woodland are used for woodland pasture. Cleared areas of this soil are suited to long-term hay and pasture. The operation of some kinds of farm machinery is difficult and hazardous because of slope. Generally, the soil is too steep for row crops, and erosion is the dominant limitation if cultivated crops are grown. Slope is the

dominant limitation for many nonfarm uses. (Capability unit VIe–2; woodland suitability group 2r1 on north and east aspects and 3r1 on south and west aspects)

## Gilpin Series

The Gilpin series consists of moderately deep, well-drained, loamy soils. These soils are throughout the county, mainly on narrow ridgetops, benches, and steep to very steep hillsides. They formed in materials that weathered mainly from siltstone and thin-layered shale and sandstone. Gilpin soils make up about one-fourth of the land area of Monroe County.

A representative Gilpin soil that is wooded has a very dark grayish-brown silt loam surface layer about 3 inches thick and a dark-brown to brown silt loam subsurface layer about 6 inches thick. The subsoil, to a depth of 23 inches, is yellowish-brown silt loam that is 10 to 25 percent sandstone fragments. The material below the subsoil is mostly sandstone fragments that have yellowish-brown silt loam between the fragments. Light olive-brown sandstone bedrock that contains interbedded siltstone is at a depth of 30 inches.

Gilpin soils have a moderately deep rooting zone, but their available moisture capacity is generally low because of stone fragments in the lower part of the subsoil. The soils dry out and warm up rapidly in the spring and are easily worked. Unlimed areas are extremely acid to strongly acid, and natural fertility is low. Permeability is moderate.

Gilpin soils are used mostly for pasture and woodland. A small acreage is used for crops.

Representative profile of a Gilpin silt loam in a wooded area, SW¼ sec. 29, Perry Township, T. 5 N., R. 5 W., 0.4 mile north of junction of County Road 42 and County Road 40:

O1—½ inch to 0, deciduous leaf litter.
A1—0 to 3 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, very fine, granular structure; very friable; many roots; medium acid; abrupt, wavy boundary.
A2—3 to 9 inches, dark-brown to brown (10YR 4/3) silt loam; weak, thin and medium, platy structure; friable; many roots; very strongly acid; abrupt, irregular boundary.
B21t—9 to 14 inches, yellowish-brown (10YR 5/4) silt loam; moderate, medium, subangular blocky structure; friable; few roots; approximately 10 percent coarse fragments; thin, very patchy, dark yellowish-brown (10YR 4/4) clay films and moderate, patchy, pale-brown (10YR 6/3) silt coatings on ped faces; very strongly acid; clear, smooth boundary.
B22t—14 to 23 inches, yellowish-brown (10YR 5/4) channery silt loam; moderate, medium, subangular blocky structure; firm; few roots; approximately 25 percent coarse fragments; thin, patchy, dark yellowish-brown (10YR 4/4) clay films on vertical ped faces; very strongly acid; gradual, smooth boundary.
C—23 to 30 inches, yellowish-brown (10YR 5/4) channery silt loam; massive; few roots; approximately 60 percent coarse fragments of sandstone; very strongly acid.
R—30 inches, light olive-brown (2.5Y 5/4) sandstone and interbedded siltstone.

Depth to bedrock ranges from 20 to 40 inches, but the average depth in the county is about 30 inches. Color hues of the A horizon are 10YR and 7.5YR. In undisturbed areas, color values are 2 to 4 for the A1 horizon and 4 to 6 for the A2 horizon. Value and chroma in the B horizon are 1 or more units higher than in the A horizon. Transitional layers between the A and B horizons are common. Gilpin soils are characterized by a nonskeletal B horizon of clay accumulation 9 to 20 inches thick. Texture of the B2 horizon is heavy silt loam, light silty clay loam, light silt loam marginal to heavy loam, and silty clay loam marginal to clay loam. The Bt horizon is weakly expressed. Clay films are generally thin and very patchy on ped faces and in pores, although some of the pores have a continuous coating. The size and amount of sandstone and siltstone coarse fragments normally increase with depth. The solum below the Ap horizon is strongly acid to extremely acid.

Gilpin soils commonly are near Wellston, Dekalb, Keene, Zanesville, Latham, Westmoreland, and Upshur soils. They are shallower to bedrock than Wellston and Zanesville soils and contain less sand throughout than Dekalb soils. They lack the compact fragipan that is characteristic of Zanesville soils, and they have a coarser textured B horizon than Latham, Keene, and Upshur soils. Gilpin soils are better drained than Latham soils and lack the reddish hues of the Upshur soils. The Gilpin soils have a lower base saturation than the Westmoreland soils but otherwise are similar to those soils.

**Gilpin and Dekalb very stony soils, 12 to 35 percent slopes** (GdE).—These soils are mainly in long, narrow bands around hillsides. A few areas are on long slopes that extend from the ridgetops to the valleys. Numerous stones of sandstone are on the surface and in the soil. They make up about 15 to 25 percent of the soil mass, by volume. Most of these stones are flat and more than 15 inches in size. Considerable mixing of soil material has occurred on these longer slopes as the result of downslope movement of soil material. On the lower half of slopes in areas mapped as this unit, the soils are commonly more than 40 inches deep to bedrock.

Included in mapping were areas with large boulders and areas of sandstone bedrock escarpments. Also included were a few narrow benches and small areas of Upshur soils. Some small eroded areas are shown on the soil map by a special symbol.

The use of these soils is limited by the steep to very steep slopes and the presence of stones. The soils are not strikingly different in soil properties affecting woodland use. Gilpin soils are generally dominant, but any given area of this undifferentiated group of soils may be all Gilpin soils or all Dekalb soils. Some areas, particularly those on the long, very steep slopes near the Little Muskingum River, are made up of both Gilpin and Dekalb soils, but Dekalb soils are dominant.

These soils are generally too steep and too stony for cropland or improved pasture. Some local areas on the lower slopes are suited to improved pasture. Slope is the dominant limitation for nonfarm uses. (Capability unit VIs–1; woodland suitability group 2r1 on all aspects)

**Gilpin and Dekalb very stony soils, 35 to 70 percent slopes** (GdG).—Sandstone and shale bedrock outcrops are common in areas of these soils. Gilpin soils generally are dominant, but any given area of this undifferentiated group of soils may be all Gilpin soils or all Dekalb soils. Some areas, particularly those that have long, very steep slopes near the Little Muskingum River, are made up of both Gilpin and Dekalb soils, and Dekalb soils are dominant.

Included in mapping were a few narrow benches and a few small areas of Upshur soils. Also included are some small eroded areas that are shown on the soil map by a special symbol.

These soils are too steep and too stony for most farm uses other than native pasture and woodland. Use of ma-

chinery on these slopes is extremely hazardous. The slopes and stoniness also limit the nonfarm uses of this soil. (Capability unit VIIs–1; woodland suitability group 3r2 on north and east aspects and 4r2 on south and west aspects)

**Gilpin-Upshur complex, 2 to 6 percent slopes, moderately eroded** (GkB2).—The soils in this complex are on rather broad ridgetops throughout the county. Most areas have smooth uniform slopes and are small in size.

In cultivated areas the original surface layer has been mixed with some of the subsoil through tillage. Most areas have 2 to 7 inches of the original surface layer remaining, but in a few places the reddish subsoil of the Upshur soils or the yellowish-brown subsoil of the Gilpin soils is exposed. In a few areas, mostly in woodland or near the center of ridgetops, the surface layer is more than 7 inches thick. Loss of soil material through erosion has reduced the organic-matter content, natural fertility, and the capacity to absorb moisture. Some areas that were formerly cultivated have reverted to pasture.

In a typical area, Gilpin soils make up about 50 percent of the complex, Upshur soils about 40 percent, and included soils 10 percent. A few areas, however, are nearly all Upshur soils.

Most commonly included in mapping were small areas of Woodsfield and Wellston soils.

The soils in this complex are suited to all field crops commonly grown in the county, but there is a moderate hazard of erosion if the soils are cultivated. Permeability is slow in the Upshur soils, and this is a limitation for many nonfarm uses. The depth to bedrock is a limitation for some nonfarm uses of Gilpin soils. (Capability unit IIe–1; woodland suitability group 3o1 on all aspects)

**Gilpin-Upshur complex, 6 to 12 percent slopes, moderately eroded** (GkC2).—This mapping unit occurs on rather broad, gently rounded ridgetops, in saddles, and on top of knolls. Slopes are typically smooth and uniform. Overgrazing and excessive use of these soils for clean-tilled crops has resulted in the loss of much of the original surface layer through erosion. Although most areas have 25 to 75 percent of their original surface layer remaining in small spots, the reddish or yellowish-brown subsoil is exposed in many places.

Typically, Gilpin soils make up 50 to 60 percent of the complex. Upshur soils make up only 30 to 40 percent, but they are the soils that limit use of the complex. They have a clayey subsoil, and they are slower to dry out in spring, have slower permeability and more rapid runoff, and are subject to more severe erosion than the Gilpin soils.

Included in mapping were small areas of Woodsfield, Wellston, and Coolville soils.

Practically all areas of this complex have been cleared and cultivated. Only a small acreage remains in woodland. About two-thirds of the cleared areas are in cropland, and most of the remaining acreage is in pasture. The hazard of erosion is very severe if the soils are cultivated. Surface runoff is rapid if these soils are used for cultivated crops. Limited depth to bedrock in the Gilpin soils and slow permeability and a hazard of slippage in the Upshur soils are limitations for many nonfarm uses. (Capability unit IIIe–1; woodland suitability group 3o1 on all aspects)

**Gilpin-Upshur complex, 12 to 18 percent slopes** (GkD).—This mapping unit in on narrow, rounded ridgetops, benches, and moderately steep hillsides. Slopes are typically smooth and uniform. The soils are only slightly eroded and have over 7 inches of their original surface layer remaining.

In most places Gilpin soils make up about 60 percent of the complex, and Upshur soils make up 30 percent. In any given area, however, soils of either series may make up 15 to 70 percent of the acreage. Included soils occupy the rest.

Most areas mapped as this complex include areas of a soil that is similar to Wellston soils but has redder colors in the subsoil (*16*).

Most of this complex is wooded; a small acreage is cropland and pasture. These soils are suited to occasional use for cultivated crops, but the hazard of erosion is very severe if the soils are cultivated. The Upshur part of this complex is subject to slippage. Limited depth to bedrock and slope are also limitations of this complex for nonfarm uses. (Capability unit IVe–2; woodland suitability group 2r1, on north and east aspects and 3r1 on south and west aspects)

**Gilpin-Upshur complex, 12 to 18 percent slopes, moderately eroded** (GkD2).—This mapping unit is on narrow, rounded ridgetops and in moderately steep areas on knolls, benches, and side slopes. A few areas occur around small upland drainageways near divides.

In most places Gilpin soils make up about 60 percent of the complex, and Upshur soils make up about 30 percent. In any given area, however, soils of either series may make up 15 to 70 percent of the acreage. Included soils occupy the rest.

Included in mapping were small, severely eroded areas where the plow layer is red and difficult to work. In a few places, mostly on benches or on the lower edge of areas where the complex was mapped on hillside slopes, there are inclusions of the deep, silty Wellston soils and the more mottled Rarden and Coolville soils. In addition, most areas mapped as this complex include areas of a soil that is similar to Wellston soils but has redder colors in the subsoil (*16*).

Most areas of the soils in this complex are used for pasture or cropland, and a smaller acreage is woodland that has been grazed by livestock. Poor cropping practices and overgrazing have resulted in the loss of up to 75 percent of the original surface layer.

The hazard of erosion is very severe if these soils are used for cultivated crops, but an occasional crop can be grown. The Upshur soils are subject to slippage, and this is a significant limitation for buildings, roads, pipelines, and other nonfarm uses. Slope, slow permeability in the Upshur soils, and limited depth to bedrock in the Gilpin soils are other limitations to many nonfarm uses. (Capability unit IVe–2; woodland suitability group 2r1 on north and east aspects and 3r1 on south and west aspects)

**Gilpin-Upshur complex, 18 to 35 percent slopes, moderately eroded** (GkE2).—This mapping unit is on hillsides throughout the county. It is extensive and widely distributed. Most areas are large and are on the upper and middle parts of side slopes, extending from just below the ridgetops to about midway down the slopes. A few areas occupy knolls on the hilltops. Slopes typically are

uniform, but many areas are broken by narrow benches, minor landslips, and low escarpments.

Gilpin soils make up about 50 to 70 percent of the complex, and the reddish Upshur soils about 15 to 40 percent. Upshur soils occur in narrow, alternating bands on smooth slopes, in the more concave part of mapped areas, or in less steep parts of the overall slope. Although Upshur soils generally are not dominant, they are the soils that limit use of the complex. They are slowly permeable, have very rapid runoff, and are subject to very severe erosion.

Included in mapping were small areas of Rarden, Coolville, Wellston, and Woodsfield soils. Also included were areas of a soil that is similar to Wellston soils but has redder colors in the subsoil (*16*).

Practically all areas of this complex have been cleared, but many areas are reverting to brush and woodland. About 25 percent of the acreage is cropland, and about 75 percent is pasture. Steep slopes make the operation of some kinds of machinery difficult. If good management practices are used, some of the less steep areas are suited to an occasional row crop, but most areas are better suited to long-term meadow or pasture. Slope, slow permeability, and susceptibility to slippage are limitations of the Upshur soils for nonfarm uses. Slope and limited depth to bedrock are limitations of the Gilpin soils in this complex. (Capability unit VIe–2; woodland suitability group 2r1 on north and east aspects and 3r1 on south and west aspects)

**Gilpin-Upshur complex, 18 to 35 percent slopes, severely eroded** (GkE3).—This mapping unit is on hillsides or hilltops throughout the county. Areas are typically 5 to 10 acres in size and are in bands around hillsides near slope breaks.

This mapping unit commonly consists of 50 percent or more of Upshur soils and a smaller percentage of Gilpin and other soils. These soils generally have been farmed intensively in the past. Poor cropping practices and overgrazing of pastures have resulted in the loss of most of the original surface layer and some of the subsoil. Gullies 1 to 3 feet deep occur in most areas. As a result, productivity and the available moisture capacity have been seriously reduced. Runoff is very rapid, and the soils are difficult to protect from further erosion. In places small stones are on the surface, and where the plow layer is reddish, it is sticky and hard to work.

Because of the steep to very steep slopes and the very severe hazard of erosion, these soils are not suited to cultivated crops. Generally, they are used for permanent pasture or woodland. Landslips are a hazard to buildings on the Upshur soils, and slope is a general limitation to any use. (Capability unit VIIe–1; woodland suitability group 3r1 on north and east aspects and 4r1 on south and west aspects)

**Gilpin-Upshur complex, 35 to 70 percent slopes** (GkG).—This mapping unit is on rugged hillsides throughout the county and is especially extensive in the southern and eastern parts. Areas that are 100 acres or more in size occur on the long, very steep hillsides near the Ohio River. These are the most extensive soils in woodland in the county. Although they occupy a wide variety of slope positions, they are more common on the lower half of hillsides, in coves, and along drainageways.

The Upshur soils in this complex are in narrow, horizontal bands. In most areas Gilpin soils make up about 60 percent of the complex, and Upshur soils make up 30 percent. In any given area, however, soils of either series may make up 15 to 70 percent of the acreage. Included soils occupy the rest. On some of the longer slopes and in lower slope positions, the Gilpin and Upshur soils are deeper to bedrock, contain more stone fragments, and have less distinct horizons than the Upshur and Gilpin soils described in the representative profiles. Upshur soils have affected some areas of the Gilpin soils in this mapping unit so that they are slightly redder and finer in texture than typical.

Included in mapping were some narrow, discontinuous benches in the larger areas of this complex. Also included were some landslips, stone outcrops, and rocky ledges. In addition, there are inclusions of a soil that is similar to Wellston soils but has redder colors in the subsoil (*16*).

About two-thirds of this mapping unit is wooded. The surface layer in the wooded areas generally is 5 to 8 inches thick. Most of the remaining acreage is in pasture or is reverting from pasture to woodland. Many areas of these very steep soils were formerly cultivated with horse-drawn equipment or cleared for pasture. Erosion has resulted in the loss of up to 75 percent of the original surface layer in most of these areas. Because of the very steep, rugged slopes and the very severe hazard of erosion, these soils are not suitable for use as cropland or improved pasture. They are generally suitable for woodland. Steep slopes and the hazard of landslip are limitations to other uses. (Capability unit VIIe–2; woodland suitability group 2r2 on north and east aspects and 3r2 on south and west aspects)

**Gilpin-Upshur complex, 35 to 70 percent slopes, severely eroded** (GkG3).—These very steep soils are on hillsides throughout the county. Most areas are in narrow bands that extend horizontally along the slope. They commonly receive runoff from slopes above. Some areas are on concave slopes where they receive runoff from natural drainageways. In most areas Gilpin soils make up about 60 percent of the complex, and Upshur soils make up 30 percent. In any given area, however, soils of either series may make up 10 to 70 percent of the acreage. Included soils occupy the rest.

Erosion is still active in many areas of this mapping unit. Practically all of the original surface layer has been removed by erosion. The most common cause of this erosion was cultivation of these erodible soils by horse-drawn equipment. Overgrazing was an additional cause. The surface layer ranges from yellowish-brown channery silt loam to reddish-brown clay. Most areas have occasional gullies 1 to 3 feet deep, and in some areas gullies are numerous. In gullied areas, red shale, siltstone, and sandstone bedrock are exposed. Some gullies contain lime nodules. Depth to bedrock is generally less than 3 feet. The available moisture capacity is low.

Because of very steep slopes and a very severe hazard of erosion, these soils are generally best suited to woodland. In most places tree planting is needed to furnish a good stand of adapted trees. (Capability unit VIIe–1; woodland suitability group 3r2 on north and east aspects and 4r2 on south and west aspects)

**Gilpin-Upshur complex, steep, benched** (GlE).—This mapping unit occurs throughout the county. Its overall slopes are steep to very steep (slopes range from 18 to 35 percent), but they contain a series of two or more narrow benches that are not shown on the soil map. Most of the benches are 50 to 150 feet wide, but they extend around hillsides for several hundred feet. Slopes on the benches are gently sloping to moderately steep. Seep spots are common, mostly on benches. In most areas Gilpin soils make up about 60 percent of the complex, and Upshur soils make up about 30 percent. In any given area, however, soils of either series may make up 15 to 70 percent of the acreage. The rest of it is included soils.

The benchlike topography is caused by different rates of weathering of bedrock. Most of the bedrock on the steep breaks is hard, resistant sandstone. The benches are underlain mainly by more easily weathered siltstone and shale. Gilpin soils, some areas of which have redder colors than typical, are dominant on the steeper slopes, but the benches are occupied mainly by Upshur soils. In places on the benches, there are inclusions of Coolville, Keene, Wellston, and Woodsfield soils. In addition, most areas mapped as this complex include areas of a soil that is similar to Wellston soils but has redder colors in the subsoil (*16*).

Most areas of this complex are in pasture or are wooded. The benches generally are too narrow and the intervening slopes are too steep for cultivation. A few of the wider benches can be used for an occasional row crop, but most areas are better suited to hay, permanent pasture, or woodland. Steep to very steep slopes are a dominant limitation to many nonfarm uses. (Capability unit VIe–2; woodland suitability group 2r1 on north and east aspects and 3r1 on south and west aspects)

**Gilpin-Upshur complex, very steep, benched** (GlG).—This mapping unit occurs throughout the steeper parts of the county, but the largest acreage is on the very steep side slopes near the Ohio River where slopes range from 35 to 70 percent. Overall slopes are very steep and rugged, but they are broken by two or more narrow benchlike areas not shown on the soil map. Most benches are 20 to 150 feet wide and commonly are crossed by deep drainageways. In most areas Gilpin soils make up about 60 percent of the complex, and Upshur soils make up 30 percent. In any given area, however, soils of either series may make up 15 to 70 percent of the acreage. Included soils occupy the rest. Gilpin soils are dominant on most of the steeper slopes, but Upshur soils are on most of the benches.

In a few places, mostly on benches and on the lower edge of the steep slopes, there are inclusions of the deep, silty Wellston soils. On many of the benches there are inclusions of Woodsfield soils that are deeper to the reddish clay part of the subsoil than Upshur soils. In a few places, there are seep spots, loose stones, boulders, and rock outcrops. Also, most areas mapped as this complex include areas of a soil that is similar to Wellston soils but has redder colors in the subsoil (*16*).

Some of the wider benches are suited to hay or pasture, but most of the benches are narrow and inaccessible. These soils are used mainly for woodland, but operation of equipment on these slopes is hazardous. The narrow benches aid in woodland improvement and in the harvesting of trees. Very steep slopes are a limitation for most nonfarm uses of this complex. (Capability unit VIIe–2; woodland suitability group 2r2 on north and east aspects and 3r2 on south and west aspects)

**Gilpin-Upshur very stony complex, 12 to 35 percent slopes** (GnE).—The moderately steep to very steep soils in this complex occupy benchlike areas that are generally below steeper areas of stony Gilpin-Upshur or Gilpin and Dekalb very stony soils. Most of these benches are on the upper half of hillsides. They generally are narrow with short side slopes, but they extend around hillsides for many hundreds of feet. The largest acreage of this mapping unit is near the Ohio River in Ohio Township. The soils in these areas have profiles like those described as representative for their respective series, except they have a thicker surface layer, contain more coarse fragments, and are slightly deeper to bedrock.

In most areas Gilpin soils make up about 60 percent of the complex, and Upshur soils make up 30 percent. In any given area, however, soils of either series may make up 15 to 70 percent of the acreage. Included soils occupy the rest.

There are flat and rounded stones of sandstone on the surface and in the soil. These make up about 10 to 25 percent of the soil volume. In a few places these are boulders and rock outcrops.

Stoniness is the major limitation to farm use. The stones dilute the soil mass, reduce the available moisture capacity, and interfere with the operation of machinery. The soils can be used for an occasional row crop or for improved pasture if enough of the stones are removed. Slope is the dominant limitation for nonfarm uses. (Capability unit VIs–1; woodland suitability group 3r1 on north and east aspects and 4r1 on south and west aspects)

**Gilpin-Upshur very stony complex, 35 to 70 percent slopes** (GnG).—This mapping unit is on very steep, rugged side slopes, mainly in the eastern and southern parts of the county. The largest acreage is on the long, very steep hillsides along the Ohio River and other streams. In most areas Gilpin soils make up about 60 percent of the complex, and Upshur soils make up 30 percent. In any given area, however, the soils of either series may make up 15 to 70 percent of the acreage. The rest of the acreage consists of included soils.

In most places the surface layer is 5 to 8 inches thick, but in a few areas up to 75 percent of the original surface layer has been lost through erosion. Most areas are wooded, but a few areas have been cleared and are used for pasture. Except for the very stony surface layer, soils in this complex resemble those of the Gilpin-Upshur complex, 35 to 70 percent slopes. Many stones of sandstone of varying size are on the surface and in the soil. Most of the stones are flat, but some are angular or rounded. In places there are boulders and high bedrock escarpments.

The stones, a very severe hazard of erosion, and very steep slopes limit the use of these soils to woodland. If good management is used, the soils are well suited to trees. Equipment operation on these slopes is very hazardous. Very steep slopes are a limitation to nonfarm uses of the soil. (Capability units VIIs-1; woodland suitability group 3r2 on north and east aspects and 4r2 on south and west aspects)

**Gilpin-Westmoreland silt loams, 2 to 6 percent slopes, moderately eroded** (GoB2).—This complex is on ridgetops

throughout the county. In most areas the Gilpin soil makes up 50 to 60 percent of the complex, and the Westmoreland soil makes up 20 to 30 percent. Included soils occupy the rest. The Westmoreland soil in this mapping unit has a lower sand content than the soil having the representative profile for the Westmoreland series.

Excessive use of the soils in this complex for row crops has caused 25 to 75 percent of the original surface layer to be removed through erosion. The plow layer is a mixture of the remaining original surface layer and the lighter colored subsurface layer and subsoil. Some uneroded areas were included in mapping.

Nearly all of this complex has been intensively cultivated; however, many areas are now used for pasture. Slopes do not restrict the use of most farm machinery. The hazard of erosion is the major limitation if the soils are used for cultivated crops. Limited depth to bedrock is a limitation to some nonfarm uses of these soils. (Capability unit IIe–1; woodland suitability 3o1 on all aspects)

**Gilpin-Westmoreland silt loams, 6 to 12 percent slopes, moderately eroded** (GoC2).—This complex is widely distributed on narrow, rolling ridgetops. It also occurs on a few sloping benches and side slopes. In most areas, the Gilpin soil makes up 50 to 60 percent of the complex, and the Westmoreland soil makes up 20 to 30 percent. Included soils occupy the rest. The soils in this complex have profiles that are similar to the respresentative profile of their respective series, but they have a thinner surface layer.

Included in mapping was a small acreage in the lower slope positions on side slopes where the depth to bedrock is 3 feet to more than 6 feet, a few areas that have flat or angular stones of sandstone on the surface, and some small areas that are severely eroded. On some of the wider ridgetops, there are inclusions of the deeper Wellston and Zanesville soils.

About 85 percent of this complex has been cleared and is used for crops and pasture. A severe hazard of erosion is the main limitation to farming if these soils are cultivated. Slope and limited depth to bedrock are limitations to many nonfarm uses. (Capability unit IIIe–1; woodland suitability group 3o1 on all aspects)

**Gilpin-Westmoreland silt loams, 12 to 18 percent slopes, moderately eroded** (GoD2).—This complex is widely distributed on very narrow ridgetops, on moderately steep benches, and on side slopes throughout the county. The soils have profiles that are similar to the representative profile of their respective series, but they have a thinner, lighter colored surface layer. In most areas the Gilpin soil makes up 50 to 60 percent of the complex, and the Westmoreland soil makes up 20 to 30 percent. Included soils comprise the rest.

Included in mapping were areas of soils on benches and lower slopes where depth to bedrock is 6 feet or more. Most areas contain up to 25 percent of the deeper Wellston soils. Also, in many coves and on some south-facing slopes, there are inclusions of a soil that is similar to Wellston soils but has a thicker, darker colored, less acid surface layer (*15*).

About 85 percent of this complex has been cleared and is used for crops and pasture. A very severe hazard of erosion is the major limitation to the use of these soils for row crops and small grain. Slope and limited depth to bedrock are limitations to many nonfarm uses. (Capability unit IVe–2; woodland suitability group 2r1 on north and east aspects and 3r1 on south and west aspects)

**Gilpin-Westmoreland silt loams, 12 to 18 percent slopes, severely eroded** (GoD3).—This complex occurs in small, widely scattered areas on narrow ridgetops and on moderately steep side slopes. Many areas are in narrow bands near slope breaks. In most areas the Gilpin soil makes up 50 to 60 percent of the complex, and the Westmoreland soil makes up 20 to 30 percent. The rest of the complex consists of included soils.

More than three-fourths of the original surface layer has been removed through erosion. The present surface layer is mostly yellowish-brown material from the subsoil and contains small channery fragments of sandstone. Shallow gullies less than 3 feet deep are common in a few places. Depth to bedrock is commonly 15 to 20 inches in the Gilpin soil and 30 to 40 inches in the Westmoreland soil. The available moisture capacity and overall productivity are low.

Included in mapping, in many coves and on some north-facing slopes, were areas of a soil that is similar to Wellston soils but has a thicker, darker colored, less acid surface layer (*15*).

Nearly all of this complex has been intensively cultivated or overgrazed. The soils are better suited to permanent vegetation than to row crops. Slope and shallow depth to bedrock are limitations for many nonfarm uses. Capability unit VIe–2; woodland suitability group 3r1 on north and east aspects and 4r1 on south and west aspects)

**Gilpin-Westmoreland silt loams, 18 to 35 percent slopes, moderately eroded** (GoE2).—This complex is on steep to very steep slopes, mostly in upper slope positions on hillsides and knolls. Other areas occur along small drainageways. In most areas Gilpin soil makes up 50 to 60 percent of the complex, and Westmoreland soil makes up 20 to 30 percent. The rest of the complex consists of included soils.

Included in mapping were a few areas on lower slopes where the depth to bedrock is more than 6 feet. Also included were small areas of Upshur soils. In most areas mapped as the complex, the deeper Wellston soils make up as much as 30 percent of the acreage and are in the downslope half of the areas. In addition, in many coves and on some north-facing slopes, there are inclusions of a soil that is similar to Wellston soils but has a thicker, darker colored, less acid surface layer (*15*).

Because of the slope and severe hazard of erosion, the soils in this complex are better suited to permanent vegetation than to most other uses. Where conservation practices and improved management are used, these soils can be used for an occasional row crop. Slope makes the use of some kinds of machinery difficult and hazardous and is the dominant limitation to nonfarm uses. (Capability unit VIe–2; woodland suitability group 2r1 on north and east aspects and 3r1 on south and west aspects)

**Gilpin-Westmoreland silt loams, 18 to 35 percent slopes, severely eroded** (GoE3).—The soils of this complex have been severely eroded because of intensive use. Practically all of the original surface layer and part of the subsoil have been removed through erosion. The present surface layer is yellowish brown and contains small stones of sandstone. Shallow gullies, generally less than

3 feet deep, are common in many of these areas. In a few areas, gullies are numerous.

In most areas the Gilpin soil makes up 50 to 60 percent of the complex, and the Westmoreland soil makes up 20 to 30 percent. The rest of the complex consists of included soils.

Natural fertility, available moisture capacity, and organic-matter content have been drastically reduced as a result of erosion. Depth to bedrock is commonly about 20 inches in the Gilpin soil and 30 inches or more in the Westmoreland soil.

Included in mapping, in many coves and on some north-facing slopes, were areas of a soil that is similar to Wellston soils but has a thicker, darker colored, less acid surface layer (*15*).

The steep slope and very thin surface layer limit the use of these soils to permanent pasture or woodland. Slope is the dominant limitation to most nonfarm uses. (Capability unit VIIe–1; woodland suitability group 3r1 on north and east aspects and 4r1 on south and west aspects)

**Gilpin-Westmoreland silt loams, 35 to 70 percent slopes, moderately eroded** (GoG2).—This complex is widely distributed throughout the county. It occupies very steep, rugged slopes, mainly on the upper half of hillsides. Most areas have been overgrazed or intensively cultivated and have lost most of the original surface layer. A profile of the Westmoreland soil is described as representative for the Westmoreland series.

In most areas the Gilpin soil makes up 50 to 60 percent of the complex, and the Westmoreland soil makes up 20 to 30 percent. The rest of the complex consists of included soils.

Included in mapping were areas of deeper Wellston soils that occupy up to 20 percent of most areas mapped as the complex. The Wellston soils commonly have 20 to 40 percent sandstone fragments in the subsoil. In addition, in many coves and on some north-facing slopes, there are areas of an included soil that is similar to Wellston soils but has a thicker, darker colored, less acid surface layer (*15*). Also included in mapping were some severely eroded areas.

About a fifth of the acreage of this complex is in pasture; the rest is in woodland. Steep slopes create a very severe hazard of erosion if the soils are not protected by a dense plant cover. Operation of most kinds of machinery is hazardous. These soils generally are better suited to trees or permanent pasture than to other uses. (Capability unit VIIe–2; woodland suitability group 2r2 on north and east aspects and 3r2 on south and west aspects)

**Gilpin-Westmoreland silt loams, very steep, benched** (GpG).—This complex is characterized by a wide range in slope. The dominant slopes are very steep, but they are broken by two or more intervening benches that are gently sloping to moderately steep. The benches are narrow and commonly 50 to 150 feet wide, but they extend around hillsides for several hundred feet. In most areas the Gilpin soil makes up 50 to 60 percent of the complex, and the Westmoreland soil makes up 20 to 30 percent. Included soils occupy the rest.

The Gilpin soil on the very steep side slopes is similar to the one having the profile described as representative for the series, except that it generally contains more sandstone fragments. The Gilpin soil on the benches is commonly deeper, not so well drained, and slightly finer textured than typical.

Most of the acreage of this complex is in woodland; a few of the benches are in pasture. Dominant slopes are too steep and the benches generally too narrow and inaccessible for cultivation. The benches can be used for timber harvesting and have potential for riding and hiking trails. Steep slopes are the dominant limitations to the use of this complex for both farm and nonfarm uses. (Capability unit VIIe–2; woodland suitability group 2r2 on north and east aspects and 3r2 on south and west aspects)

## Guernsey Series

The Guernsey series consists of deep, moderately well drained soils on ridgetops, hillsides, and benches. These soils formed in material weathered from layers of limestone, siltstone, sandstone, and shale. Where the soils occur on uneroded ridgetops, they generally have a silt capping (loess) up to 15 inches thick. In this county the Guernsey soils were not mapped individually, but they are the major component of the Guernsey-Upshur and Guernsey-Westmore mapping units. Guernsey soils occur throughout the county, but are most extensive in the western and, to a lesser extent, the northeastern parts of the county.

A representative Guernsey soil in pasture has a dark-brown silt loam surface layer about 9 inches thick. The upper part of the subsoil, to a depth of 20 inches, is dark yellowish-brown heavy silt loam and silty clay loam. The subsoil, to a depth of 39 inches, is dark yellowish-brown silty clay loam and clay that is mottled with olive, brown, strong brown, and reddish brown. The lower part of the subsoil, to a depth of 46 inches, is mixed dark yellowish-brown and reddish-brown clay. Below the subsoil is silty clay that has mixed colors of dark yellowish brown, yellowish brown, light olive brown, and olive gray to a depth of about 80 inches. Weathered olive siltstone is at a depth below 80 inches.

Guernsey soils are moderately permeable in the upper 15 to 30 inches of the profile but are slowly permeable in the clayey lower part of the subsoil and in the substratum. The soils have a deep rooting zone. Surface runoff is rapid, and the soils are highly erodible on all slopes if they are not protected. They have a medium to high available moisture capacity. Although they formed partly in residuum from limestone, Guernsey soils are generally medium acid to very strongly acid in the upper part and are less acid with increasing depth. On moderately steep to very steep hillsides, the soils are subject to slippage. Most landslips occur in concave, middle positions on slopes.

These soils are used mostly for hay and pasture; only a relatively small acreage is in cultivated crops. The soils are well suited to bluegrass for pasture.

Representative profile of Guernsey silt loam, 18 to 35 percent slopes, in a pasture in NE1¼ sec. 9, Seneca Township, 1.2 miles northeast of State Highway 78 on Township Road 55 (250 feet east of profile having sample No. MN–24 that is described in table 10):

Ap1—0 to 3 inches, brown to dark-brown (10YR 4/3) silt loam; moderate, fine, granular structure; friable;

many roots; dark-brown (10YR 3/3) organic stains on ped faces; medium acid; abrupt, smooth boundary.

Ap2—3 to 9 inches, brown to dark-brown (10YR 4/3) silt loam; weak, medium and fine, granular structure; friable, common roots; strongly acid; clear, smooth boundary.

B21t—9 to 13 inches, dark yellowish-brown (10YR 4/4) heavy silt loam; moderate, fine, subangular blocky structure; firm; common roots; thin, very patchy, brown to dark-brown (7.5YR 4/4) clay films on vertical ped faces; strongly acid; clear, smooth boundary.

B22t—13 to 20 inches, dark yellowish-brown (10YR 4/4) light silty clay loam; moderate, fine and medium, subangular blocky structure; firm; common roots; thin, patchy, brown to dark-brown (7.5YR 4/4) clay films on vertical ped faces; few, fine, black (10YR 2/1) concretions; strongly acid; abrupt, smooth boundary.

IIB23t—20 to 32 inches, dark yellowish-brown (10YR 4/4) heavy silty clay loam; common, fine, distinct, strong-brown (7.5YR 5/6) and olive (5Y 5/3) mottles; strong, coarse and medium, angular blocky structure; very firm; few roots; thin, patchy, yellowish-brown (10YR 5/4) clay films on vertical ped faces; few, fine, black (10YR 2/1) concretions; strongly acid; abrupt, smooth boundary.

IIB24t—32 to 39 inches, dark yellowish-brown (10YR 4/4) clay; many, fine, distinct, brown (70YR 5/3) and reddish-brown (5YR 4/3) mottles; moderate, coarse, angular blocky structure; very firm; thin, continuous, dark-brown (10YR 4/3) clay films; few, fine, black (10YR 2/1) concretions; strongly acid; abrupt, smooth boundary.

IIB3t—39 to 46 inches, mixed dark yellowish-brown (10YR 4/4), brown (10YR 5/3), and reddish-brown (5YR 4/3) clay; weak, coarse, angular blocky structure; very firm; thin, patchy, brownish-gray (2.5Y 6/2) clay films; few, fine, black (10YR 2/1) concretions; medium acid; clear, smooth boundary.

IIC—46 to 80 inches, mixed dark yellowish-brown (10YR 4/4), yellowish-brown (10YR 5/4), light olive-brown (2.5Y 5/6), and olive-gray (5Y 5/2) silty clay; massive; very firm; few, fine, black (10YR 2/1) concretions; slightly acid; abrupt, smooth boundary.

R—80 to 90 inches plus, olive (5Y 5/6) highly weathered siltstone that has dark yellowish-brown (10YR 4/4) silty clay in fractures; neutral.

Thickness of the solum ranges from 36 to 54 inches. Content of coarse fragments commonly is about 5 percent and rarely exceeds 20 percent, by volume, in the solum. In areas that have not been cultivated, the A1 horizon is 1 to 4 inches thick and very dark grayish brown (10YR 3/2), dark brown (10YR 3/3), or very dark brown (10YR 2/2). An A2 horizon, if present, is 2 to 8 inches thick and has colors with a value of 4 or 5 and chroma of 2 to 4. The Ap horizon is dark brown (10YR 3/3), dark grayish brown (10YR 4/2), or brown (10YR 4/3). A part of the upper Bt horizon, 10 inches or less in thickness, is heavy silt loam or silty clay loam containing 25 to 35 percent clay. The weighted average clay content in the upper 20 inches of the Bt horizon is 35 to 50 percent. The upper part of the Bt horizon is unmottled or has few to common mottles with chroma of 3 to 6. Dominant colors have a hue of 10 YR or 7.5YR, value of 4 or 5, and chroma of 3, 4, or 5. The reaction of the A horizon and upper part of the B horizon is typically strongly acid but ranges from very strongly acid to medium acid.

The lower part of the Bt horizon, beginning at depths ranging from 16 to 26 inches, is clay, silty clay, or heavy silty clay loam that has a clay content ranging from 35 to 55 percent. The reaction of the lower part of the Bt horizon is typically medium acid or slightly acid but, in some places, is strongly acid above a depth of 36 inches. The lower part of the Bt horizon has mottles or variegated colors with most of the matrix having a hue of 10YR or 7.5YR, but some zones have a hue of 2.5Y, 5Y, or 5YR. Value is 4 or 5, chroma ranges from 1 to 6.

The Guernsey soils in this county differ from Guernsey soils elsewhere in that they lack 2-chroma mottles in the upper 10 inches of the Bt horizon. This slight difference does not affect the use and management of these soils.

Guernsey soils are mapped in soil complexes with Westmore soils and with Upshur soils. They are commonly on hillsides above Sees and Woolper soils. Guernsey soils have a higher clay content in the upper part of the Bt horizon than Westmore soils and are not so well drained as those soils. They lack the reddish hues in the B horizon of the Upshur soils. Guernsey soils are deeper, are more acid, and have a lighter colored surface layer than Brooke soils. They are less deep to bedrock and have a lighter colored surface layer than Woolper and Sees soils on adjacent colluvial slopes. Guernsey soils are not so well drained as the Woolper soils.

**Guernsey-Upshur complex, 6 to 12 percent slopes, moderately eroded** (GrC2).—This mapping unit is on rounded ridgetops throughout the county. Most areas are about 3 or 4 acres in size. In most places Guernsey soils make up about 50 percent of the complex, and Upshur soils make up 30 percent. In any given area, however, soils of either series may make up 20 to 80 percent of the acreage. Included in mapping were a few small areas of Brooke, Westmore, and Woodsfield soils. These make up the remaining percentage of the complex. Practically all the acreage is in cropland and pasture.

Erosion has removed up to three-fourths of the original surface layer. In most places the remaining part of that layer is mixed with some of the yellowish or reddish subsoil. The present surface layer is silt loam, silty clay loam, or silty clay. Rill erosion is common in areas cultivated up and down the slope, and in a few places there are shallow gullies. Where the plow layer is silty clay, it is sticky, hard to till, and difficult to seed or vegetate, and its organic-matter content is low.

A severe hazard of erosion is the dominant limitation to cultivation. Surface runoff from these soils is rapid. Where Guernsey soils are dominant, soils of the complex can be cultivated frequently if optimum management is used. Where Upshur soils are dominant, the soils should be cultivated only occasionally. Slow permeability and slope are limitations to many nonfarm uses. (Capability unit IIIe–3; woodland suitability group 2w2 on all aspects)

**Guernsey-Upshur complex, 12 to 18 percent slopes, moderately eroded** (GrD2).—This mapping unit occupies narrow ridgetops, rounded knolls, and moderately steep benches on hillsides. In addition, a few areas are on slopes just below ridgetops. Except for a few minor landslips on some benches, slopes are smooth and suited to most kinds of farm machinery. Some of the benches are dissected by deep drainageways, and this is a limitation to their use. In most areas Guernsey soils make up about 50 percent of the complex, and Upshur soils 30 percent. In any given area, however, soils of either series may make up 20 to 80 percent of the acreage. Included soils make up the rest.

Practically all of these areas have been cleared and are now in cropland or pasture. Sheet and rill erosion have caused the loss of up to three-fourths of the original surface layer. Unprotected areas are now being damaged by erosion. In most places the plow layer contains reddish or yellowish, finer textured material from the subsoil. The plow layer is difficult to work and to protect from further erosion. A few areas, mostly in woodland, have 7 to 10 inches of the original surface layer remain-

ing. Texture of the present surface layer is silt loam, silty clay loam, or silty clay.

On most benches and some ridgetops, this mapping unit has small inclusions of Woodsfield soils. On some of the benches, there are minor landslips and seep spots that need land smoothing and random tile drainage if these areas are to be used for cropland. In some places, excessive surface runoff from higher areas is a problem.

Soils of this complex are suited to occasional cultivation or to meadow or pasture. Surface runoff is rapid, and the soils are subject to very severe erosion if they are cultivated. Slope and slow permeability are major limitations to most nonfarm uses. (Capability unit IVe–1; woodland suitability group 2w3 on all aspects)

**Guernsey-Upshur complex, 18 to 35 percent slopes, moderately eroded** (GrE2).—This mapping unit is on hillsides. The largest areas are mainly on upper slopes in the eastern part of the county and on lower slopes in the southwestern part of the county. Other areas are on hilltop knolls that stand out as prominent landmarks. Slopes on knolls and most upper slopes are typically smooth and uniform, but some areas have minor landslips and somewhat uneven landforms. In a few places there are some large stones of sandstone and limestone on the surface and in the soil.

In most areas Guernsey soils make up about 50 percent of the complex, and Upshur soils 30 percent. In any given area, however, soils of either series may make up 20 to 80 percent of the acreage. Included soils make up the rest.

Included in mapping were small areas of Brooke, Westmore, or Woodsfield soils. A few included areas are stony, and a few are severely eroded.

Most of this complex is now in pasture or cropland. Poor field layouts, wide strips, and plowing across natural waterways have contributed to the loss of up to 75 percent of the original surface layer. Overgrazing of pastures and damage by livestock in the winter have increased the soil loss. The loss of soil material has reduced the organic-matter content, natural fertility, and the available moisture capacity.

Because of the steep slopes and very severe hazard of erosion, these soils are better suited to long-term hay, pasture, or woodland than to row crops. If careful management and intensive conservation practices are used, a few of the less steep areas can be used for an occasional row crop. If optimum management is used, these soils are well suited to pasture. Slope is the dominant limitation to most nonfarm uses. (Capability unit VIe–1; woodland suitability group 2w3 on all aspects)

**Guernsey-Upshur complex, 35 to 70 percent slopes, moderately eroded** (GrG2).—This mapping unit generally is in long, narrow bands around hilltops. Slopes are generally smooth, but some areas have minor landslips and a few rock outcrops. Slips can occur in soils of either series in this unit. Water erosion has caused the loss of 25 to 75 percent of the original surface layer of these soils. In places the reddish or yellowish clayey subsoil is exposed. A few areas, mostly in protected woodland, have 7 to 10 inches of the original surface layer of silt loam remaining. Texture of the present surface layer is silt loam or silty clay loam.

Commonly, this mapping unit is about 50 percent Guernsey soils, 25 percent or more Upshur soils, and 25 percent or less inclusions of other soils.

Included in mapping were severely eroded soils that have a silty clay or clay surface layer. Also included were areas of the dark-colored Brooke soils, areas of the well-drained Westmore soils, and, on some of the lower slopes, narrow bands of the Woodsfield soils.

Because of the very steep slopes and very severe hazard of erosion, soils of this complex are better suited to permanent pasture or woodland than to other farm uses. Some of these areas have fair to good natural stands of bluegrass and white clover. Slope is the dominant limitation to any nonfarm uses. (Capability unit VIIe–2; woodland suitability group 2w4 on all aspects)

**Guernsey-Upshur complex, 18 to 70 percent slopes, landslip** (GsG).—Where these soils have slopes of less than 35 percent, they are on the upper half of hillsides in long benchlike areas that are bounded below and above by steeper slopes. Where slopes are steeper than 35 percent, the soils are in long areas near the bottom of hillsides. Most slopes are concave and are in a position to receive runoff and seepage water from the higher slopes.

Guernsey soils are dominant in this mapping unit, but their percentage varies widely. Some areas are made up almost entirely of Guernsey soils, whereas some areas are nearly all Upshur soils. Included in mapping were a few small areas of Sees and Vandalia soils on colluvial toe slopes.

Both the Guernsey and Upshur soils are commonly more than 5 feet deep to bedrock and have a high clay content in the lower part of their subsoil. Because of many old landslips, slopes are very irregular and uneven. Many areas are still subject to slippage. There are many dips, low bulges, and small soil escarpments. Considerable mixing of soil materials has occurred, and profiles are more variable in depth and texture than those described as representative for the respective series. Stones on and in the soils are oriented in all directions. In some areas the soils have moved enough through slippage that they have buried other soil profiles. Seep spots are common.

Soils of this complex are not suited to cropland because of the steep, irregular slopes and the very severe hazard of erosion. Though these areas are well suited to woodland, most of them are now in fair-quality bluegrass pasture. The rough, steep slopes make pasture improvement difficult or impossible, and the operation of machinery is hazardous. The steep slopes are a dominant limitation to other uses. (Capability unit VIIe–2; woodland suitability group 2w4 on all aspects)

**Guernsey-Upshur complex, steep, benched** (GuE).—This mapping unit occurs on hillsides mainly in the southern part of the county. The dominant overall slope is steep to very steep, but the steeper slopes are broken by two or more narrow benches. These benches range from 20 to about 200 feet in width and are sloping to moderately steep. The benches are too narrow to indicate on the soil map.

Guernsey soils are dominant in this complex and occupy most of the steeper areas. Upshur soils are most common on some benches. Guernsey or Upshur soils that are on the narrow benches commonly contain stone fragments in the profile and generally are 5 to 8 feet deep to bedrock. In most areas of this mapping unit, the surface

layer is brown silt loam about 6 inches thick, but in a few severely eroded areas, the reddish or yellowish-brown subsoil is exposed.

Included in mapping on the steeper slopes were some areas of Westmore soils. Also included were a few small areas of Sees and Vandalia soils on colluvial toe slopes.

Soils of this complex are used mainly for woodland or grazing. The benches are generally too nearly inaccessible or too narrow and the intervening slopes too steep for cultivation. Erosion and irregular, steep slopes are the major limitations to the use of these soils. (Capability unit VIe–1; woodland suitability group 2w3 on all aspects)

**Guernsey-Upshur complex, very steep, benched** (GuG).—This mapping unit is on very steep hillsides with benches that are sloping to moderately steep and range from 20 to about 150 feet in width. Guernsey soils are dominant in these areas and occupy most of the steep slopes. Upshur soils are most common on the upper slopes. Guernsey and Upshur soils that occur on benches are commonly underlain by bedrock at a depth of 5 to 8 feet. In most areas soils of the mapping unit contain 10 to 15 percent sandstone and limestone fragments.

On many of the steeper slopes, there are inclusions of the well-drained Westmore soils. On some benches, inclusions of well-drained Woodsfield soils occur. Also included are very narrow strips of Sees and Vandalia soils on colluvial toe slopes.

More than three-fourths of this complex is wooded. Overall slopes are much too steep and benches are generally too narrow or are inaccessible for cropping. Cleared benches ordinarily are productive, but they are small, hard to manage, and commonly shaded by adjacent wooded slopes. Some of these areas are suitable for limited pasture, but they will erode severely if overgrazed or cultivated. Generally, these areas are best suited to woodland. (Capability unit VIIe–2; woodland suitability group 2w4 on all aspects)

**Guernsey-Westmore silt loams, 6 to 12 percent slopes, moderately eroded** (GwC2).—This mapping unit is on gently rounded ridgetops and, in some places, on sloping benches. Most areas are less than 5 acres in size and have smooth, uniform slopes. The Guernsey soil is dominant in this mapping unit, and some areas of the complex are made up almost entirely of the Guernsey soil.

Sheet and rill erosion have removed 25 to 75 percent of the original surface layer of these soils. In most places part of the subsoil is now mixed with the remaining part of the surface layer. A few areas, mostly in woodland, have 7 inches or more of the original silt loam surface layer remaining.

These soils are suited to cultivation, but the hazard of erosion is severe if they are farmed. The small size of most areas is a limitation for farming, except where they occur within larger areas of other soils that are suitable for farming. Slope and slow permeability are limitations for practically all uses. These soils are used mostly for cropland or pasture. (Capability unit IIIe–3; woodland suitability group 2w2 on all aspects)

**Guernsey-Westmore silt loams, 12 to 18 percent slopes, moderately eroded** (GwD2).—These soils are mainly on narrow ridgetops, benches, and upper slopes. A few areas occur along small, upland drainageways. Slopes typically are smooth and uniform, although minor slips occur on some of the benches. A few areas are severely eroded.

The Guernsey soil is dominant in this complex and makes up 70 to 75 percent of a typical area. Some areas, however, consist almost entirely of the Guernsey soil.

Included in mapping were areas where sandstone and limestone are on the surface.

Most areas of this complex have been cleared and farmed or pastured. Erosion has resulted in the loss of some of the original surface layer. In most areas the remaining part of the original surface layer has been mixed with some of the lighter colored subsoil by tillage. Shallow rills and gullies have formed in places.

These soils are too steep for other than occasional cultivation. Surface runoff is rapid, and this causes a very severe hazard of erosion if these soils are cultivated. Slope and slow permeability are limitations to most nonfarm uses. (Capability unit IVe–1; woodland suitability group 2w3 on all aspects)

**Guernsey-Westmore silt loams, 18 to 35 percent slopes, moderately eroded** (GwE2).—These soils are on hillsides, on knolls, and in benchlike areas. The benches are commonly bounded above and below by steeper areas of Guernsey-Westmore, Gilpin-Westmoreland, or Gilpin-Upshur soils. Most of these areas have smooth, uniform slopes, but small slips and low escarpments are common on some hillsides.

In most areas the Guernsey soil makes up about 65 percent of the complex, and the Westmore soil 25 percent. In any given area, however, either soil may make up 20 to 80 percent of the acreage. Included soils make up the rest.

The soils in this unit are similar to these described as representative for the respective series, but their layers are thinner and the depth to bedrock is less. Most areas have 25 to 70 percent of the original surface layer remaining, but in some places the plow layer is mostly subsoil material.

Included in mapping were a few areas that have loose boulders of limestone and sandstone on the surface and in the soil. A few spots of the darker colored Brooke soils that are too small to be mapped separately were included. Where areas of this mapping unit are on the lower half of hillsides, well drained Woolper soils and moderately well drained Sees soils also were included.

Steep slopes make the use of farm equipment difficult on these soils. They create a very severe hazard of erosion and are a limitation to most uses of this complex. These soils are better suited to pasture or to long-term meadow than to cultivated crops. (Capability unit VIe–1; woodland suitability group 2w3 on all aspects)

**Guernsey-Westmore silt loams, 18 to 35 percent slopes, severely eroded** (GwE3).—These soils are mainly on hillsides, although a few areas occur on knolls. Most areas are on the upper edges of slopes near slope breaks or below areas of steeper slopes where they receive runoff. Most of these areas range from 5 to 10 acres in size.

In most areas Guernsey soil makes up about 65 percent of the complex, and Westmore soil 25 percent. In any given area, however, either soil may make up 20 to 80 percent of the acreage. Included soils make up the rest.

In the past, these soils have been overgrazed or cropped intensively. Through erosion they have lost over

75 percent of their original surface layer and, in many places, some of their subsoil. Scattered gullies 1 to 3 feet deep occur in most places.

Included in mapping were areas where gullies are numerous and where the surface layer contains many small limestone rocks. Depth to bedrock is generally less than 4 feet.

These soils are not suitable for cultivation, because of the steep slopes and very severe hazard of erosion; however, they are more suitable for grass-legume pasture and meadow than most of the other severely eroded soils mapped in the county. Steep slopes are limitations for most uses. The steep to very steep slopes and gullies are a hazard to the safe operation of farm equipment. (Capability unit VIIe–1; woodland suitability group 2w3 on all aspects)

**Guernsey-Westmore silt loams, 35 to 70 percent slopes, moderately eroded** (GwG2).—These soils are on hillsides. Most of the acreage has been overgrazed, and many areas were formerly cultivated with horse-drawn equipment. Erosion has resulted in the loss of up to 75 percent of the original surface layer. In some places the subsoil is exposed, and there are a few shallow gullies. Where these soils occupy upper slopes, the depth to bedrock is less than that described for the series. In most areas the Guernsey soil makes up about 65 percent of the complex, and the Westmore soil 25 percent. In any given area, however, either soil may make up 20 to 80 percent of the acreage. Included soils make up the rest.

Included in mapping were a few spots of darker colored Brooke soils, spots and narrow bands of the darker colored, moderately well drained Sees soils, the well drained Woolper soils, some stony areas, bedrock escarpments, and rock outcrops.

Soils of this complex are too steep for cropland. Present stands of pasture commonly are thin and weedy. In many places liming, fertilizing, reseeding, and mowing are difficult or impossible, even with special equipment.

These soils are unsuitable for cropping because of the very steep slopes and very severe hazard of erosion. The soils are well suited to woodland, but the use of most kinds of machinery on these very steep slopes is hazardous. These steep slopes are a limitation to most nonfarm uses of this soil complex. (Capability unit VIIe–2; woodland suitability group 2w4 on all aspects)

## Gullied Land

Gullied land, Gilpin-Upshur material (Gy), is in moderately steep to very steep areas on hillsides, commonly in upper or middle slope positions near slope breaks. Many areas receive runoff from the upper slopes and natural drainageways.

These areas have been so severely eroded that they have an intricate pattern of shallow and moderately deep gullies. More than half of the surface area of this mapping unit is within the gullies. Practically all of the silt loam surface layer is gone, and soil profiles have been largely destroyed, except for areas between gullies. Texture at the surface ranges from silt loam to clay, but the dominant texture is clay loam that tends to be sticky when wet and hard when dry.

Areas between the gullies commonly are about 70 percent Upshur soils and about 30 percent Gilpin and other soils. In a few places the Gilpin soils are absent, and the areas are up to 30 percent Guernsey soils. Upshur soils have affected some of the Gilpin soils, causing them to be redder than typical. Exposed in many of the deeper gullies is shale, limestone, or sandstone bedrock.

This land type is too eroded and generally too steep for cropland or improved pasture. It is better suited to trees for watershed protection. Steep slopes and a severe hazard of erosion are limitations for most nonfarm uses. (Capability unit VIIe–1; woodland suitability group 4r1 on all aspects)

## Hackers Series

The Hackers series consists of deep, well-drained, loamy soils that have a reddish-brown subsoil. These soils are gently sloping to sloping on fans where small waterways join larger ones, particularly where steep hillside drainageways empty into valley streams. These fans commonly overlie parts of larger areas of soils on bottom lands, second bottoms, and terraces. Hackers soils formed in water-deposited material washed from soils on uplands, dominantly the Upshur soils. The largest acreage is in the southern and eastern parts of the county.

A representative Hackers soil that has been cultivated has a dark-brown silt loam plow layer about 8 inches thick. The subsoil, to a depth of 11 inches, is dark yellowish-brown silt loam. Below this, to a depth of 26 inches, it is brown to dark-brown channery silt loam and reddish-brown channery clay loam. Channery fragments make up about 20 percent of the lower part of the subsoil. Below the subsoil, to a depth of 50 inches, is reddish-brown channery clay loam. This is underlain, to a depth of 96 inches, by reddish-brown silt loam and brown to dark-brown clay loam mottled with gray.

Hackers soils have a deep rooting zone and high available moisture capacity. They have moderate permeability and are strongly acid in the root zone. Hackers soils are subject to occasional flooding from the small streams that flow through or around them. Most damage from these floods results from deposition or erosion rather than from wetness. The problem is increased if the small stream channels become clogged with gravel, stones, and debris.

Hackers soils in this county are used mostly for cultivated crops and for meadow.

Representative profile of Hackers silt loam, 3 to 8 percent slopes, in a cultivated field, NW¼ sec. 18, Jackson Township, T.1N., R.4W., 2.7 miles NE. of Fly on State Route 7:

Ap—0 to 8 inches, dark-brown (10YR 3/3) silt loam; brown to dark brown (10YR 4/3) when broken and crushed; weak, fine, subangular blocky structure; friable; many roots; 5 to 10 percent coarse fragments; medium acid; abrupt, smooth boundary.

B1—8 to 11 inches, dark yellowish-brown (10YR 4/4) silt loam; weak, medium, subangular blocky structure; firm; few roots; 5 to 10 percent coarse fragments; medium acid; clear, smooth boundary.

B21t—11 to 17 inches, brown to dark-brown (7.5YR 4/4) channery heavy silt loam; moderate, medium, subangular blocky structure; firm; few roots; thin, very patchy, dark reddish-gray (5YR 4/2) clay films; few, fine, black (10YR 2/1) concretions; very strongly acid; clear, smooth boundary.

B22t—17 to 26 inches, reddish-brown (5YR 4/3) channery light clay loam; weak, medium, subangular blocky structure; firm; few roots; thin, patchy, dark reddish-gray (5YXR 4/2) clay films; many, fine, black (10YR 2/1) concretions; very strongly acid; gradual, smooth boundary.

C1—26 to 50 inches, reddish-brown (5YR 4/3) channery light clay loam; massive; few roots; many, fine, black (10YR 2/1) concretions; medium acid; gradual, smooth boundary.

C2—50 to 90 inches, reddish-brown (5YR 4/3) heavy silt loam; common, medium, prominent, light-gray to gray (10YR 6/1) mottles in lower part; massive; many, medium, black (10YR 2/1) concretions and coatings; medium acid; gradual, smooth boundary.

C3—90 to 96 inches, brown to dark-brown (7.5YR 4/4) light clay loam; common, fine, prominent, light-gray to gray (10YR 6/1) mottles; massive; many, medium, black (10YR 2/1) concretions and coatings; slightly acid.

Thickness of the solum ranges from 20 to 50 inches but averages about 30 inches. Where these soils occur in some of the narrow valleys, bedrock is commonly at a depth of about 8 to 12 feet. However, where they overlie some of the deeper bottom-land and terrace soils, along the Ohio River, for example, bedrock can be very deep. Texture of the B horizon is silt loam, clay loam, and silty clay loam. Clay loam is the most common. The content of coarse fragments varies considerably; the average is about 10 percent, by volume, for the A horizon and 20 percent for the B horizon. Hues of the B horizon center on 5YR but range to 2.5YR in the B2 horizon and to 10YR in the B1 horizon. Values and chromas are 3 and 4. Clay films in the B2 horizon are generally thin and patchy, covering less than 50 percent of the ped faces. The solum is commonly strongly acid but ranges from very strongly acid to medium acid.

The Hackers soils in this county have a darker surface horizon and more coarse fragments in the solum than Hackers soils elsewhere. They also have a slightly thinner solum than other Hackers soils. These differences, however, do not greatly influence the use and management of the soils.

Hackers soils commonly occur near or adjacent to the well-drained Vandalia and Woolper soils. They have a less clayey Bt horizon than Vandalia soils, and they have redder colors and a less clayey Bt horizon than the Woolper soils. They have redder colors than the Hartshorn soils, and they lack the sandy and gravelly substratum of those soils. The Hackers soils have a less clayey Bt horizon and redder colors than Sees soils and also are better drained.

**Hackers silt loam, 3 to 8 percent slopes** (HcB).—Most areas of this soil are 1 to 4 acres in size, but along the Ohio River some are 10 to 25 acres. Slopes are smooth and uniform or slightly convex. Included in mapping were a few areas where the soils have a channery surface layer. The fragments generally do not interfere with cultivation, but these spots are somewhat droughty during periods of limited rainfall.

Almost all areas of this soil are in cropland or pasture. The soil is well suited to all of the common crops. Surface runoff is slow, and there is only a moderate hazard of erosion. Flooding is a serious limitation to most nonfarm uses of this soil. (Capability unit IIe-2; woodland suitability group 2o1 on all aspects)

## Hartshorn Series

The Hartshorn series consists of well drained to moderately well drained soils that are shallow or moderately deep to loose sand or gravel. These soils are loamy throughout the uppermost 12 to 30 inches. They are nearly level to gently sloping and are on narrow flood plains along small streams throughout the county.

A representative Hartshorn soil that has been cultivated has a dark-brown silt loam plow layer about 6 inches thick. This layer is easily worked. The subsoil, to a depth of 19 inches, is dark yellowish-brown silt loam, gravelly silt loam, and gravelly loam. Below the subsoil, to a depth of 56 inches, is loose sand and gravel. Sandstone bedrock is at a depth of 56 inches.

Hartshorn soils are subject to occasional flooding of short duration. The floodwater is swift and commonly causes erosion. Most flooding occurs early in spring. Permeability of the Hartshorn soils is moderately rapid. The available moisture capacity is low, and the soils are droughty in dry years. Soil reaction in the rooting zone is strongly acid to medium acid.

Hartshorn soils are used mainly for pasture, but vegetables that mature early also are grown. Many of the wider areas of these soils are used for field crops. Corn and hay are the main crops.

Representative profile of Hartshorn silt loam in a meadow, SE¼ sec. 20, Wayne Township, 105 feet south of Township Road 263:

Ap—0 to 6 inches, dark-brown (10YR 3/3) silt loam; weak, fine and medium, granular structure; friable; many roots; medium acid; abrupt, smooth boundary.

B21—6 to 10 inches, dark yellowish-brown (10YR 3/4) silt loam; weak, medium, subangular blocky structure; friable; common roots; 5 percent coarse fragments; medium acid; clear, smooth boundary.

B22—10 to 15 inches, dark yellowish-brown (10YR 3/4) gravelly silt loam; weak, fine, subangular blocky structure; friable; common roots; medium acid; abrupt, smooth boundary.

B3—15 to 19 inches, dark yellowish-brown (10YR 3/4) gravelly loam; massive; friable; common roots; thin, very patchy, dark yellowish-brown (10YR 4/4) clay films on fragments and gravel; medium acid; clear, smooth boundary.

11C—19 to 56 inches, poorly sorted gravel and sand; single grain; loose; few roots; thin, very patchy clay films on a few pebbles.

R—56 inches, sandstone bedrock.

The profile above the loose sand and gravel is silt loam, loam, or heavy sandy loam, and in places it is gravelly. Depth to sand and gravel averages about 20 inches but ranges from 16 to 30 inches. Color hue of the A horizon is 10YR or 7.5YR, whereas hues of the underlying layers range from 7.5YR to 2.5Y. In the A horizon, color value is 3 or 4 and chroma is 2 or 3. The B horizon has value and chroma of 3 or 4. Content of coarse fragments in the solum averages 15 percent, by volume, but ranges from 5 to 30 percent. In unlimed areas, reaction of the solum generally is slightly acid to medium acid but ranges from strongly acid to neutral. Depth to bedrock is greater than 40 inches.

Hartshorn soils commonly occur upstream from the Chagrin soils where the flood plains are narrow. They are not so deep to coarse-textured material as the Chagrin soils. Hartshorn soils commonly are below and adjacent to the Hackers and Woolper soils on alluvial fans and are shallower to sand and gravel than those soils. They lack the reddish hues of the Hackers soils, and they have a coarser textured B horizon than Woolper soils.

**Hartshorn silt loam** (He).—This nearly level soil occurs on flood plains in the narrow valleys near the headwaters of major drainageways. These valleys are commonly 50 feet to 250 feet wide.

Included in mapping were a few small areas of soils that have a gravelly surface layer, areas where bedrock is within a depth of 40 inches, and a few wet spots. Also included were areas of Hackers and Woolper soils on small alluvial fans.

Flooding is the dominant limitation to the use of this soil for farming. Gravel in the soil does not interfere with tillage. Droughtiness is a hazard to crops, but the soil is suited to irrigation. Flooding is a serious limitation to many nonfarm uses. (Capability unit IIw–1; woodland suitability group 1o1 on all aspects)

## Hartshorn Series, Wet Variant

The Hartshorn series, wet variant, consists of somewhat poorly drained soils that are shallow to moderately deep over gravelly material. These soils formed in loamy alluvial sediment on narrow flood plains. They do not occur in sufficient acreage for the establishment of a new soil series, and therefore they are recognized as a variant of the normal Hartshorn series.

A representative Hartshorn, wet variant, soil has a dark grayish-brown silt loam plow layer about 7 inches thick. The subsoil, to a depth of 23 inches, is dark grayish-brown silt loam that contains gray and strong-brown mottles. Below the subsoil, to a depth of 32 inches, is dark grayish-brown gravelly silt loam. Light olive-brown siltstone bedrock is at a depth of 32 inches.

Hartshorn, wet variant, soils have moderately rapid permeability. They have a seasonally high water table and are subject to flooding. Available moisture capacity is low, and reaction ranges from very strongly acid to slightly acid in the root zone. Most areas of Hartshorn, wet variant, soils are used for pasture.

Representative description of Hartshorn silt loam, wet variant, in SE¼ sec. 26, Summit Township one-tenth mile west of junction of Township Roads 54 and 55, on Township Road 55:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, granular structure; friable; many roots; few, fine, black (10YR 2/1) concretions; very strongly acid; clear, smooth boundary.

B21—7 to 10 inches, dark grayish-brown (10YR 4/2) silt loam; few, fine, distinct, gray (10YR 5/1) mottles and common, fine, distinct, strong-brown (7.5YR 5/6) mottles; weak, medium, subangular blocky structure; friable; common roots; common, fine, black (10YR 2/1) concretions; strongly acid; clear, smooth boundary.

B22—10 to 15 inches, dark grayish-brown (10YR 4/2) silt loam; common, fine, distinct, gray (10YR 5/1) mottles and many, fine, distinct, strong-brown (7.5YR 5/6) mottles; weak, medium and coarse, subangular blocky structure; friable; few roots; common, fine, black (10YR 2/1) concretions; strongly acid; clear, smooth boundary.

B23—15 to 23 inches, dark grayish-brown (2.5 4/2) silt loam; many, fine, distinct, strong-brown (7.5YR 5/6) mottles; weak, medium, subangular blocky structure; friable; few roots; common, fine, black (10YR 2/1) concretions; strongly acid; abrupt, smooth boundary.

IIC1—23 to 28 inches, dark grayish-brown (10YR 4/2) gravelly silt loam; many, fine and medium, distinct, yellowish-brown (10YR 5/6) mottles; massive; friable; thin, very patchy clay films on some pebbles; few roots; common, fine and medium, black (10YR 2/1) concretions; medium acid; clear, smooth boundary.

IIC2—28 to 32 inches, dark grayish-brown (10YR 4/2) gravelly silt loam; massive; friable; thin, very patchy clay films on some pebbles; few roots; many, medium, black (10YR 2/1) coatings on surfaces of coarse fragments; slightly acid; abrupt, smooth boundary.

IIIR—32 inches +, light olive-brown (2.5Y 5/4) siltstone.

The Ap horizon has colors that range in value from 3 to 4 and in chroma from 1 to 3. In only a few places does the matrix color of the B horizon vary more than 1 unit in chroma and value from the color of the Ap horizon. Depth to low-chroma mottles ranges from 6 to 15 inches. Reaction is medium acid or slightly acid in the lower part of the profile above bedrock. Depth to the gravelly sandy loam or gravelly silt loam C horizon ranges from 16 to 30 inches. The C horizon rarely exceeds 30 inches in thickness. Depth to bedrock ranges from 30 to 60 inches. Concretions range from few to many and from fine to medium throughout the mottled zone. They also occur as thin to moderate, very patchy coatings on the surfaces of coarse fragments in the gravelly C horizon. Profile textures are mostly medium but range from moderately coarse to moderately fine.

Hartshorn, wet variant, soils are more acid and have a higher content of coarse fragments than the deeper, somewhat poorly drained Newark soils on flood plains along the major streams. They differ from the better drained normal Hartshorn soils because they are grayer and have mottles throughout the profile.

**Hartshorn silt loam, wet variant** (Hr).—This nearly level soil is on narrow flood plains, mainly in the north-central part of the county. Most of these flood plains are about 150 feet wide, and only a few are more than 300 to 400 feet wide. In the wider areas, this soil commonly occurs in bands that are near upland slopes or in slight depressions and are separated from the stream by areas of the better drained Hartshorn silt loam.

Most areas of Hartshorn silt loam, wet variant, are in pasture made up mostly of poor-quality swamp grasses, bluegrass, and white clover. In a few of these areas there are included spots of more poorly drained soils that are mottled and gray to the surface. Reeds and sedges commonly grow on these very poorly drained spots because the soils are wet most of the year.

This soil is generally shallower to loose sand and gravel than Hartshorn silt loam. Its use for farming and nonfarm use is severely limited by wetness and flooding. (Capability unit IIw–2; woodland suitability group 2w1 on all aspects)

## Huntington Series

The Huntington series consists of dark-colored, well-drained soils that are deep and loamy. These nearly level soils formed in water-deposited material on the flood plains of the Ohio River.

A representative Huntington soil that is cultivated has a dark-brown silt loam plow layer about 13 inches thick. This layer is easy to work. The subsoil, to a depth of 42 inches, is dark-brown, friable silt loam. Below the subsoil, to a depth of 114 inches, is dark-brown silt loam and loam that is thinly stratified with sandy loam and loamy sand and is mottled with yellowish red. During major floods this soil is commonly covered with 1 to 5 inches of silty deposition. Recently deposited soil material is commonly dark grayish-brown silt loam that cracks upon drying.

Huntington soils are moderately permeable. They have a deep rooting zone and high available moisture capacity. Flooding is the only limitation for crops on these soils. Narrow bands of these soils, about 50 to 100 feet wide, commonly occur adjacent to the river, and are flooded several times a year. The major areas of Huntington soils are 10 to 20 feet above this level and are flooded only

about once in 3 or 4 years. Floodwaters are commonly swift on the lower levels, and some scouring occurs. During some floods, deposits 2 to 6 inches deep are laid down, especially in the higher areas. Most flooding occurs before the first of June.

Corn is the crop most commonly grown on Huntington soils, though some of the acreage is used for hay and pasture. These soils generally do not need lime, but crops respond well to applications of fertilizer. Many areas of Huntington soils are not farmed.

Representative profile of Huntington silt loam in an old field formerly cropped, SW¼ sec. 18, Jackson Township, 2.3 miles northeast of junction of State Route 8 and State Route 7:

A1—0 to 4 inches, dark grayish-brown (2.5Y 4/2) silt loam containing streaks of dark yellowish brown (10YR 3/4) and yellowish red (5YR 5/6) and patches of very dark gray (10YR 3/1); massive; extremely firm; drying and cracking has formed a polygonal pattern on the surface; polygons range from 4 to 8 inches in diameter; slightly acid; abrupt, smooth boundary. (This layer is very recent alluvium.)

Ap—4 to 13 inches, dark-brown (10YR 3/3) silt loam; moderate, fine, subangular blocky structure parting to moderate, fine, granular; friable; many roots; slightly acid; abrupt, smooth boundary.

B21—13 to 22 inches, dark-brown (10YR 3/3) silt loam; weak, coarse, angular blocky structure; firm; few roots; thin, very patchy clay films in pores; slightly acid; abrupt, smooth boundary.

B22—22 to 42 inches, dark-brown (10YR 3/3) silt loam; crushes to dark brown to brown (10YR 4/3); weak, very fine, blocky structure; friable; few roots; slightly acid; abrupt, smooth boundary.

IIC1—42 to 44 inches; dark-brown (10YR 3/3) fine sandy loam; massive; friable; few roots; slightly acid; abrupt, smooth boundary.

IIIC2—44 to 48 inches, brown to dark-brown (10YR 4/3) silt loam containing streaks of yellowish red (5YR 5/6); strong, coarse, blocky structure; very firm; few roots; slightly acid; abrupt, smooth boundary.

IVC3—48 to 69 inches, dark-brown (10YR 4/3) heavy loam; common, fine, prominent, yellowish-red (5YR 4/6) mottles; massive; few roots; slightly acid; clear, wavy boundary.

VC4—69 to 114 inches, dark-brown (10YR 3/3) heavy silt loam stratified with several thin layers of sandy loam and loamy sand; slightly acid.

Although stratification can occur in any profile, the upper 36 inches is dominantly medium textured. Textures are silt loam, light silty clay loam, and heavy loam. Colors to a depth of 12 inches or more include very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3). The underlying horizons, to a depth of 30 inches or more, have chroma of 2 or more and value of 4 or less in a hue of 10YR or 7.5YR. Mottling occurs at depths below 3 to 5 feet in most profiles. The B horizon generally has a weak or moderate, subangular blocky or angular blocky structure; some profiles, however, have granular or prismatic structure in the B horizon. Reaction is slightly acid or medium acid. Depth to gravelly material or bedrock ranges from 6 to more than 12 feet.

Huntington soils generally are near or adjacent to the moderately well drained Lindside soils that also are on flood plains and the more acid Wheeling soils that are on low terraces. Compared to the Chagrin soils that occur on flood plains along the smaller streams, Huntington soils contain more silt and less sand. Huntington soils typically have a darker surface layer than Lindside, Wheeling, and Chagrin soils.

**Huntington silt loam** (Hu).—This soil occupies long, narrow areas that are parallel to the Ohio River.

Included in mapping were a few areas where the plow layer contains more sand than normal and has a gritty feel. Also included, along shallow surface drains and in low areas, were narrow bands or small spots of the wetter Lindside or Newark soils.

Flooding is the only limitation to use of this soil. Because of flooding, lower areas of this soil require a careful choice of crops and time of planting. Scouring is likely to occur in the low areas. (Capability unit IIw–1; woodland suitability group 1o1 on all aspects)

## Keene Series

The Keene series consists of deep soils that are moderately well drained. The surface layer and the upper part of the subsoil formed in silty material, at least partly loess. The clayey lower part of the subsoil formed in material weathered from acid shale and siltstone. Keene soils are mainly gently sloping to moderately steep and are on ridgetops and in benchlike areas on hillsides. They occur throughout the county, but the largest acreage is in the north-central and south-central parts. In Monroe County the Keene soils were mapped individually and as components of Latham-Keene and Keene-Latham complexes.

A representative Keene soil that is cultivated has a brown to dark-brown silt loam surface layer about 7 inches thick. This layer is easy to work. The upper part of the subsoil, to a depth of 24 inches, is yellowish-brown silty clay loam. It is faintly mottled at a depth below 19 inches. The lower part of the subsoil, to a depth of 35 inches, is very firm, yellowish-brown silty clay and mixed strong-brown, yellowish-brown, and light brownish-gray clay. To a depth of 48 inches, it is very firm, mixed light olive-brown, strong-brown, and grayish-brown clay. The substratum, to a depth of 56 inches, is fractured, olive-brown siltstone that has light olive-brown and light brownish-gray heavy silty clay loam material within the fractures. Acid olive-brown siltstone is at a depth of 56 inches.

Keene soils have a moderately deep rooting zone above the dense clayey lower part of the subsoil in most places. Within this rooting zone the available moisture capacity is medium. Permeability in the upper part of the subsoil is moderate, but it is slow in the clayey lower part. In wet periods there is a perched water table above the clayey layers, and this zone is saturated with water in winter and early in spring.

Keene soils dry out and warm up more slowly in spring than more porous, medium-textured soils. Stands of alfalfa are weakened and crop growth is reduced in wet years because of poor aeration in the subsoil; however, complete drainage systems generally are not justified except where the soils are farmed intensively. Seep spots on benches may need artificial drainage if the areas are used for crops. If they have not been limed or fertilized recently, the soils are strongly acid to very strongly acid and are low in natural nutrient content.

Most of the acreage of Keene soils has been cleared and farmed. The soils are most commonly used for hay and pasture.

Representative profile of Keene silt loam, 2 to 6 percent slopes, in NE¼ sec. 27, Green Township, ¼ mile northeast of junction of Township Road 8 and County Road 9A:

Ap—0 to 7 inches, brown to dark-brown (10YR 4/3) silt loam; weak, fine, granular structure; friable; many roots; very strongly acid; abrupt, wavy boundary.

B1t—7 to 10 inches, yellowish-brown (10YR 5/6) light silty clay loam; weak, fine, subangular blocky structure; friable; common roots; thin, very patchy, strong-brown (7.5YR 5/6) clay films on vertical ped faces; very strongly acid; clear, smooth boundary.

B21t—10 to 19 inches, yellowish-brown (10YR 5/6) silty clay loam; few, fine, faint, light brownish-gray (10YR 6/2) mottles; moderate, fine and medium, subangular blocky structure; firm; few roots; thin, patchy, strong-brown (7.5YR 5/6) clay films on vertical ped faces; very strongly acid; clear, smooth boundary.

B22t—19 to 24 inches, yellowish-brown (10YR 5/6) silty clay loam; few, fine, faint, light brownish-gray (10YR 6/2) and strong-brown (7.5YR 5/8) mottles; moderate, medium, prismatic structure parting to moderate, fine and medium, subangular blocky; firm; few roots; thin, patchy, yellowish-brown (10YR 5/4) clay films on vertical ped faces; thin, continuous, light-gray (10YR 7/1) silt coatings on prism faces; few, fine, black (10YR 2/1) concretions; very strongly acid; clear, smooth boundary.

IIB23t—24 to 30 inches, yellowish-brown (10YR 5/6) silty clay; many, fine, prominent, light brownish-gray (2.5Y 6/2) mottles; moderate and weak, medium, subangular blocky structure; very firm; few roots; medium, patchy, light-gray (10YR 7/1) clay films and thin, patchy, grayish-brown (10YR 5/2) silt coatings on ped faces; few, fine, black (10YR 2/1) concretions; very strongly acid; clear, smooth boundary.

IIB24t—30 to 35 inches, mixed strong-brown (7.5YR 5/6), yellowish-brown (10YR 5/6), and light brownish-gray (2.5Y 6/2) clay containing few fine streaks of yellowish red (5YR 4/6); weak, medium, subangular blocky structure; very firm; few roots; medium, patchy, light-gray (10YR 7/1) clay films on vertical ped faces; few, fine, black (10YR 2/1) concretions; very strongly acid; clear, smooth boundary.

IIB3t—35 to 48 inches, mixed light olive-brown (2.5Y 5/6), strong brown (7.5YR 5/6), and grayish-brown (2.5Y 5/2) clay; weak, medium and coarse, blocky structure; very firm; few roots; thick light-gray (10YR 7/1) clay films on vertical ped faces; small coarse fragments, about 5 percent by volume; many, fine and medium, black (10YR 2/1) concretions and coatings on pebbles; very strongly acid; gradual boundary.

IIIC—48 to 56 inches, light olive-brown (2.5Y 5/4) and light brownish-gray (2.5Y 6/2) heavy silty clay loam soil material in highly fractured olive-brown (2.5Y 4/4) siltstone; massive; common, fine, black (10YR 2/1) concretions; very strongly acid; abrupt, irregular boundary.

R—56 inches, olive-brown (2.5Y 4/4) acid siltstone.

Thickness of the solum ranges from 24 to 54 inches. Depth to bedrock ranges from 40 to 64 inches, but the average depth is about 48 inches. Depth to mottling ranges from 15 to 30 inches. The most common colors in the Ap horizon are dark grayish brown (10YR 4/2), brown (10YR 4/3), and dark yellowish brown (10YR 4/4). Matrix colors of the B horizon are yellowish brown (10YR 5/6 or 5/4), strong brown (7.5YR 5/6), and light olive brown (2.5Y 5/6). Color of mottles in the B horizon ranges from 7.5YR to 5Y in hue. Low-chroma mottling occurs at a depth between 10 and 20 inches below the upper boundary of the Bt horizon. Texture in the upper part of the B horizon includes heavy silt loam, silty clay loam, and clay loam. The lower part of the IIB2 horizon is clay or silty clay. Texture of the IIB3t and C horizons includes clay, clay loam, and silty clay loam. Fine textures normally occur within 6 inches below the upper boundary of the mottled zone. Reaction in the profile is mainly very strongly acid or strongly acid. Content of coarse fragments in the solum rarely exceeds 10 percent, by volume.

Keene soils generally occur near Coolville, Latham, Rarden, Zanesville, Gilpin, Wellston, and Woodsfield soils. They lack the variegated reddish hues in the B horizon that are common to the Coolville and Rarden soils. Depth from the surface to the clayey B horizon is greater in Keene soils than in Latham and Rarden soils. Keene soils are finer textured in the lower part of the B horizon than Zanesville, Gilpin, and Wellston soils, and they lack the well-developed fragipan of the Zanesville soils. In contrast to the Keene soils, Gilpin and Wellston soils are better drained and free of mottling in their solum. Compared to Woodsfield soils, Keene soils have a more acid substratum and lack red colors in the lower part of their B horizon.

**Keene silt loam, 2 to 6 percent slopes** (KeB).—This gently sloping soil occupies benches on hillsides and gently rounded ridgetops having smooth, even slopes. A profile of this soil is described as representative for the series. Many areas of this soil are only 2 or 3 acres in size. The surface layer generally is 7 inches or more thick and free of coarse fragments.

In a few included areas, erosion has removed 25 to 75 percent of the original surface layer. Where these areas have been cultivated, the present plow layer contains some of the lighter colored, finer textured subsoil and is harder to till and to protect from further erosion than the original surface layer. Small wet spots are also included. These are common in the areas that are on benches.

The hazard of erosion is moderate if this soil is cultivated. Slopes are favorable for the use of all types of farm equipment. Many areas are too small to be managed separately and are commonly managed with adjacent soils. Slow permeability is a limitation to many nonfarm uses of this soil. (Capability unit IIe–3; woodland suitability group 2w2 on all aspects)

**Keene silt loam, 6 to 12 percent slopes, moderately eroded** (KeC2).—This soil is mainly on rounded ridgetops and in saddles. A few areas are on benches around hillsides and in some of the more gently rolling areas near broad upland divides. Slopes are smooth and uniform and are well suited to machinery.

Nearly all areas of this soil have been cleared and farmed. Because of erosion, material from the upper part of the subsoil has been worked into the surface layer by plowing, and the organic-matter content, natural fertility, and capacity to absorb moisture have been reduced.

Included in mapping in a few places were shallow rills and gullies, and a few included areas are almost entirely Latham soils. Also included were a few areas where erosion has not been active and some areas that are severely eroded. Most uneroded areas are in woodland and have 7 inches or more of original surface layer remaining.

This soil is suited to all of the commonly grown crops, but there is a severe hazard of erosion in cultivated areas. Slope and slow permeability are limitations to many nonfarm uses. (Capability unit IIIe–3; woodland suitability group 2w2 on all aspects)

**Keene-Latham silt loams, 12 to 18 percent slopes, moderately eroded** (KlD2).—These soils are on upper side slopes just below ridge crests, on benches, and on short slopes around the heads of drainageways. Most benches are less than 300 feet wide, but they extend laterally around the hillsides for many hundreds of feet. The dominant Keene soil makes up 60 to 70 percent of the complex, and the Latham soil 30 to 40 percent.

Included in mapping were a few areas where the subsoil is exposed in shallow gullies. Also included were seep spots and small landslips.

Practically all the acreage of this mapping unit has been cleared and farmed intensively. The remaining wooded areas have been grazed by livestock. In most areas the original surface layer has been mixed with some of the subsoil by plowing.

The hazard of erosion is very severe in cultivated areas. When these soils are used for crops, artificial drainage of seep spots aids tillage and operation of machinery. Slope and slow permeability are limitations of these soils for many nonfarm uses. (Capability unit IVe-4; woodland suitability group 2w3 on all aspects)

## Latham Series

The Latham series consists of deep, moderately steep to very steep, moderately well drained soils that formed in materials weathered from acid clay shale. These soils are on ridgetops, benches, knolls, and steep bands around hillsides. They are in small scattered areas, mainly in the northern and central parts of the county. Latham soils were not mapped separately in Monroe County but were mapped in a soil complex with Keene soils.

A representative Latham soil that has been cultivated has a dark-brown silt loam surface layer about 6 inches thick. The upper part of the subsoil, to a depth of 12 inches, is yellowish-brown silty clay loam. The lower part, to a depth of 31 inches, is strong-brown and mottled yellowish-brown clay. Below the subsoil, to a depth of 43 inches, is a seam of black, partly weathered coal. This is underlain by light olive-gray clay. Siltstone bedrock is at a depth of 56 inches.

Latham soils are moderately permeable in the surface layer but are slowly to very slowly permeable in the lower part of the subsoil and in the substratum. They have a medium to low available moisture capacity because the acid clay subsoil interferes with normal root development. Only a few crop roots penetrate to a depth below 30 inches. Unless recently limed, Latham soils are very strongly acid. A perched seasonal water table and the danger of frost heaving limit the choice of crops to those that will tolerate wetness and resist frost action. Latham soils are slow to dry out and warm up in spring and are often wet in fall. Surface runoff is rapid, and these soils are subject to very severe erosion if they are not protected.

Most areas of Latham soils have been cultivated in the past, but only a small acreage is now cropland. Most areas are in pasture or are idle.

Representative profile of a Latham silt loam, in NW¼ sec. 3, Franklin Township, 2 miles southwest of junction of State Route 145 and County Road 70:

O2—½ inch to 0, very dark brown (10YR 2/2) mat of leaves and roots.

Ap—0 to 6 inches, brown (10YR 4/3) heavy silt loam; weak, fine, granular structure; friable; many roots; very strong acid; abrupt, smooth boundary.

B1t—6 to 8 inches, yellowish-brown (10YR 5/6) silty clay loam; weak, fine, subangular blocky structure; firm; many roots; thin, very patchy, yellowish-brown (10YR 5/4) clay films on vertical faces of peds; very strongly acid; abrupt, smooth boundary.

B21t—8 to 12 inches, yellowish-brown (10YR 5/6) heavy silty clay loam; moderate, medium, subangular blocky structure; firm; common roots; thin, very patchy, yellowish-brown (10YR 5/4) clay films on ped faces; very strongly acid; clear, smooth boundary.

B22t—12 to 16 inches, strong-brown (7.5YR 5/6) clay; few, fine, gray to light-gray (5Y 6/1) mottles; weak, medium, subangular blocky structure; firm; few roots; about 5 percent, by volume, small shale fragments; thin, very patchy, dark yellowish-brown (10YR 4/4) clay films on ped faces; thin, very patchy, yellowish-brown (10YR 5/4) silt coatings; very strongly acid; abrupt, wavy boundary.

B23t—16 to 24 inches, yellowish-brown (10YR 5/4) clay; common, fine, gray to light-gray (5Y 6/1) mottles and few, fine, yellowish-red (5YR 5/6) mottles; weak, very coarse, subangular blocky structure; very firm; few roots; thin, patchy, dark yellowish-brown (10YR 4/4) clay films on ped faces; very strongly acid; abrupt, smooth boundary.

B24t—24 to 31 inches, yellowish-brown (10YR 5/6) clay; many mottles of medium gray to light gray (5Y 6/1) and brownish yellow (10YR 6/6); weak, very coarse, subangular blocky structure; very firm; few roots; thin, patchy, dark yellowish-brown (10YR 4/4) clay films on ped faces; very strongly acid; abrupt, wavy boundary.

IIC1—31 to 43 inches, black (10YR 2/1) partly weathered coal seam; strongly acid.

IIIC2—43 to 56 inches, gray to light olive-gray (5Y 6/2) mottled clay; massive; very firm; about 2 percent, by volume, small shale fragments; strongly acid.

IVR—56 inches, siltstone bedrock.

Thickness of the solum ranges from 24 to 42 inches, and depth to bedrock is about 3½ to 5 feet. Color of the Ap horizon is normally brown (10YR 4/3), dark grayish brown (10YR 4/2), or dark yellowish brown (10YR 3/4). Matrix colors of the upper part of the B horizon have a value of 5. In the lower part of this horizon, value is 5 to 6 and chroma ranges from 4 to 6. Mottles with a chroma of 2 or less generally occur in the upper 10 inches of the Bt horizon or within a depth of 18 inches. Textures of the B1t and B21t horizons include silty clay loam, clay, silty clay, and, less commonly, clay loam. Texture of the lower B2t horizons is typically clay or silty clay. Fine textures occur in the upper 15 inches of the profile. Textures in the C horizon include silty clay loam, clay loam, and clay. Coarse fragments of shale and siltstone are common, but their content in the solum rarely exceeds 10 percent, by volume. Some of the profiles of the steeper soils commonly contain sandstone fragments. Reaction in the solum is very strongly acid to extremely acid.

Latham soils are shallower to the clayey B horizon than the moderately well drained Keene soils. Among the other nearby soils are the Gilpin, Upshur, Coolville, and Rarden. Latham soils have a finer textured B horizon than Gilpin soils. They lack the reddish colors of the Upshur soils and the variegated red and gray colors in the B horizon of the Coolville and Rarden soils. Latham soils also are shallower to the clayey B horizon than Coolville soils.

**Latham-Keene silt loams, 18 to 35 percent slopes, moderately eroded** (LdE2).—These soils generally are in narrow bands around hillsides. Most slopes are smoothly uniform, but a few areas have irregular slopes resulting from soil slippage. Seep spots are common inclusions in some areas.

The Latham soil is dominant and makes up about 60 percent of a typical area mapped as this complex. Areas in which slippage has occurred are nearly all of Latham soil. The Keene soil makes up about 30 percent of a typical area and generally is on the upper edges of the benches. Coarse fragments commonly make up 5 to 10 percent, by volume, of the Keene soil. Small areas of included soils occupy the remaining 10 percent of a typical area.

In most areas the major soils in this complex have a brown or dark yellowish-brown silt loam plow layer that contains some subsoil material. A few areas of severely eroded soils are included. In these severely eroded soils, the present surface layer is generally sticky, yellowish-brown silty clay loam that is low in fertility and difficult to protect from further erosion. In places there are shallow to moderately deep gullies. Included in mapping were a few areas with slopes of slightly less than 18 percent.

Steep to very steep, commonly irregular slopes make the operation of most kinds of machinery difficult and cause a very severe hazard of erosion. These soils are commonly used for pasture or trees. The steep slopes are a limitation for most nonfarm uses of the soils. (Capability unit VIe–1; woodland suitability group 3c1 on north and east aspects and 4c1 on south and west aspects)

## Lindside Series

The Lindside series consists of deep, medium-textured, moderately well drained soils. These soils formed in recent water-deposited material. They are nearly level to gently sloping and are on flood plains and along smaller upland drainageways throughout the county.

A representative Lindside soil that has been cultivated has a dark-brown silt loam plow layer about 7 inches thick. The upper part of the subsoil, to a depth of 15 inches, is brown to dark-brown, friable silt loam. The lower part, to a depth of 48 inches, is yellowish-brown and brown silt loam and loam mottled with light brownish gray, grayish brown, and yellowish red. The underlying material, to a depth of 72 inches, is dark-gray silt loam. Below this, to a depth of 100 inches, it is stratified silt and sand.

Lindside soils have moderate permeability. Most areas of these soils are in slight depressions, and they receive excess runoff or seepage water from adjacent slopes. They are subject to occasional flooding, especially late in winter and early in spring, and surface drainage is needed in many areas. Generally, however, the drainage problem is not great enough to justify tiling. These soils dry out slowly in spring. Available moisture capacity is high, and the rooting zone is deep. Soil reaction in the rooting zone is medium acid to neutral.

Lindside soils are used mostly for pasture, but a small acreage is in corn and hay. The soils are well suited to row crops that can be planted after the danger of flooding is past. Alfalfa stands are difficult to maintain in long rotations because of poor aeration in the lower part of the subsoil.

Representative profile of Lindside silt loam in a pasture, SE¼ sec. 6, Seneca Township, 0.2 mile west of junction of County Road 39 and State Route 379:

Ap—0 to 7 inches, dark-brown (10YR 4/3) silt loam; weak, fine and medium, subangular blocky structure, the uppermost half inch has moderate, fine, granular structure; friable; many roots; dark-brown (10YR 3/3) organic stains on ped faces; neutral; clear, smooth boundary.

B21—7 to 15 inches, brown to dark-brown (10YR 4/3) silt loam; weak, fine, subangular blocky structure; friable, common roots; neutral; clear, smooth boundary.

B22—15 to 21 inches, yellowish-brown (10YR 5/4) silt loam; common, fine, distinct, light brownish-gray (10YR 6/2) mottles; weak, fine, subangular blocky structure; common roots; friable; common, fine, distinct, black (10YR 2/1) concretions; cracks 6 to 12 inches apart and coated with brown (10YR 5/3) silty material extend to a depth of 28 inches; neutral; clear, smooth boundary.

B23—21 to 28 inches, brown (10YR 5/3) silt loam; common, fine, distinct, grayish-brown (10YR 5/2) mottles; weak, fine, subangular blocky structure; friable; few roots; many, fine, black (10YR 2/1), exterior concretions and yellowish-red (5YR 4/6) interior concretions; neutral; clear, smooth boundary.

B24—28 to 48 inches, brown (10YR 5/3) loam to light silt loam; many, medium, prominent, yellowish-red (5YR 5/6) mottles and brown to dark-brown (7.5YR 4/4) mottles; weak, fine, subangular blocky structure; friable; few roots; many, fine, black concretions; neutral; abrupt, smooth boundary.

C1g—48 to 72 inches, dark-gray (5Y 4/1) silt loam; few, fine, prominent, yellowish-red (5YR 4/6) mottles; massive; friable; black concretions in upper part; neutral; clear, wavy boundary.

C2—72 to 100 inches, stratified silt and sand layers.

The Ap horizon has colors of brown to dark brown (10YR 3/3 or 4/3, or 7.5YR 3/2), very dark grayish brown (10YR 3/2), or dark yellowish brown (10YR 3/4). Crushed colors have values greater than 3.5. The unmottled part of the B horizon generally has value and chroma of 3 or 4, although value can range to 5. Hue is commonly 10YR but ranges to 5YR. The 5YR colors occur in those areas of the county where the Upshur soils are dominant. Dominant colors in the mottled part of the B horizon include brown, grayish brown, dark grayish brown, gray, dark gray, and yellowish brown (10YR 5/4). Mottles with chroma of 2 or less generally are at a depth between 15 to 20 inches. The B horizon is dominantly medium textured and generally is silt loam, but thin strata of loam, light silty clay loam, or heavy fine sandy loam occur in most profiles. Reaction ranges from medium acid to neutral. Depth to loose sand and gravel ranges from 3 feet along some of the small streams to 10 feet or more along the larger streams including the Ohio River.

Lindside soils in Monroe County have a slightly higher sand content than typical Lindside soils elsewhere, but this difference does not alter their use or behavior.

Lindside soils are the moderately well drained member of a drainage sequence of soils that includes the well-drained Chagrin and Huntington soils and the somewhat poorly drained Newark soils. Lindside soils have mottling at depths between 15 and 30 inches that is lacking in the Huntington and Chagrin soils. Typically, Lindside soils have a lighter colored surface layer than Huntington soils and are better drained than the Newark soils. Immediately below the plow layer, Lindside soils are brown, but Newark soils are a mixture of gray and brown.

**Lindside silt loam** (lh)—This nearly level soil is on flood plains of all the major streams in the county, including the Ohio River. A few small areas occur along upland drainageways. Width of the bottom land on which this soil occurs ranges from about 150 feet to more than one-fourth mile in some places. Slopes range from 0 to 3 percent. On many of the wider bottoms, this soil is in the intermediate areas between the stream and the foot of the steeper toe slopes. The Chagrin or Huntington soils are adjacent to the stream, and the wetter Newark soils are adjacent to the toe slopes.

Included in mapping were a few small areas of Newark soils. On some of the narrower flood plains in the central and eastern parts of the county, there are inclusions of a soil that is strongly acid. In a few areas the plow layer is loam.

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The major limitations of this soil for farm and nonfarm uses are occasional flooding and moderate wetness. (Capability unit IIw–1; woodland suitability group 2w1 on all aspects)

## Made Land

Three major kinds of Made land (Ma) occur in Monroe County. The most common kind is filled-in areas where a soil has been covered by other materials. These areas contain a mixture of soil materials. Normally, the surface layer has not been replaced.

Another kind of Made land is the borrow area. In these areas most of the original soil material has been removed. Subsoil, substratum, and bedrock are exposed. These areas generally are not suitable for farming.

The third major kind of Made land consists of areas where the land surface has been graded and smoothed. The original surface layer generally has not been replaced. Soil material has been moved about to provide building areas for towns, industrial plants, airports, highways, and homesites. The texture, color, structure, acidity, and fertility of soil material vary widely.

Most areas of Made land have value as building sites or for other engineering uses. Onsite investigation is generally necessary to evaluate these areas for specific uses. (Capability unit not assigned; woodland suitability group not assigned)

## Newark Series

The Newark series consists of deep, somewhat poorly drained, loamy soils that formed in water-deposited material. These nearly level soils occur on flood plains along most of the major streams but are most common in the northwestern and north-central parts of the county.

A representative Newark soil has a dark grayish-brown silt loam plow layer about 7 inches thick. The subsoil extends to a depth of 26 inches; it is dark grayish-brown silt loam mottled with strong brown. Below the subsoil, to a depth of 38 inches, is dark grayish-brown silt loam mottled with strong brown and grayish brown. Below this, to a depth of 90 inches or more, is mottled, dark-gray and dark grayish-brown silt loam and silty clay loam.

Wetness is a limitation on Newark soils. In most places the upper 3 feet of the profile is saturated for several weeks of each year, and the layers below a depth of 3 feet are saturated much of the time. The soils are also subject to flooding. Most areas are flooded one to three times per year. Runoff is slow, and water stands on the surface for short periods of time. Permeability is moderately slow in the lower layers. The seasonally high water table prevents good subsoil aeration. The effective rooting zone is generally less than 3 feet. The available moisture capacity is high. The soils are medium acid to mildly alkaline.

Newark soils are used mainly for pasture and, to a lesser extent, for corn and meadow. They can be farmed earlier in spring if they are artificially drained, and they are well suited to summer row crops if drained. Diversion terraces that intercept water from adjacent slopes are beneficial in some areas.

Representative profile of Newark silt loam in a pasture, SE¼, sec. 21, Seneca Township, 0.2 mile east of junction of State Route 379 and State Route 78:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, granular structure; friable; many roots; neutral; abrupt, smooth boundary.

B21g—7 to 13 inches, dark grayish-brown (2.5Y 4/2) silt loam; common, fine, distinct, strong-brown (7.5YR 5/6) mottles; weak, medium, subangular blocky structure; friable; common roots; common, fine, black (10YR 2/1) concretions; neutral; clear, smooth, boundary.

B22g—13 to 26 inches, dark grayish-brown (2.5Y 4/2) silt loam; many, fine, distinct, strong-brown (7.5YR 5/6) mottles; medium and coarse subangular blocky structure; friable; few roots; many, fine, black (10YR 2/1) concretions; neutral; gradual, smooth boundary.

C1g—26 to 38 inches, dark grayish-brown (2.5Y 4/2) silt loam; few, fine, distinct, strong-brown (7.5YR 5/6) mottles and common, fine, distinct, grayish-brown (2.5Y 5/2) mottles; massive; friable; common, fine, black (10YR 2/1) concretions; neutral; clear, smooth boundary.

C2g—38 to 60 inches, dark-gray (5Y 4/1) heavy silt loam to light silty clay loam; many, medium, distinct, dark grayish-brown (2.5Y 4/2) mottles; massive; friable; common, fine, black (10YR 2/1) concretions; neutral; clear, smooth boundary.

C3g—60 to 90 inches, dark grayish-brown (10YR 4/2) silty clay loam; common, fine, distinct, gray (10YR 5/1) mottles; massive; friable; common, fine, black (10YR 2/1) concretions and very dark grayish-brown (10YR 3/2) concretions; neutral.

Stratification of the sediment is common; however, medium textures are most common in the profile. Silt loam is the dominant texture; loam, silty clay loam, clay loam, or sandy loam occur less frequently. Colors of the Ap horizon include dark brown to brown (10YR 4/3) or dark grayish brown (10YR 4/2). Matrix colors in the C horizon have hues of 10YR to 5Y, values from 4 to 6, and chromas from 1 to 3. Depth to bedrock generally is more than 5 feet. Structure throughout is generally weak but can range to moderate in those profiles where older horizons are evident but have been buried beneath 1½ to 3 feet of deposition. Reaction is generally slightly acid to neutral but ranges from medium acid to mildly alkaline. Depth to loose sand and gravel commonly ranges from 3 feet to more than 10 feet.

Newark soils generally are near or adjacent to the moderately well drained Lindside and the well drained Chagrin and Huntington soils. They are more poorly drained than all of those soils. They contain less sand than Chagrin soils, and they are lighter colored than Huntington soils. Newark soils lack the gravelly C horizon of the Hartshorn, wet variant, soils.

**Newark silt loam** (Nn).—This nearly level to slightly depressional soil is on flood plains. The largest acreage is in the northwestern part of the county along Wills Creek. The soil occurs most commonly in areas that are 2 to 4 acres in size and are surrounded by or are adjacent to better drained soils on the flood plains. Typically, it occurs along the edge of the flood plains and receives runoff and seepage water from adjacent upland slopes.

Included in mapping were a few areas of poorly drained soils. These grayer, wetter soils generally are covered with swamp grasses and sedges, and commonly are in small depressions or in long narrow bands along the edge of this Newark soil. Some small spots of better drained soils also were included. A few areas have a dark-colored surface layer.

Nearly all areas of this soil have been cleared and are in pasture or crops. Wetness and flooding are the major

hazards to any use. (Capability unit IIw–2; woodland suitability group 2w1 on all aspects)

## Rarden Series

The Rarden series consists of soils that are moderately well drained and moderately deep to deep over shale. These soils formed in material weathered from acid clay shale. They are gently sloping to moderately steep, are on ridgetops and benches around hillsides, and are in small scattered areas throughout the county. In Monroe County the Rarden soils were mapped only in a soil complex with the Coolville soils.

A representative Rarden soil that has been cultivated has a brown silt loam plow layer about 6 inches thick. This layer is friable but slightly sticky. The upper part of the subsoil, to a depth of 11 inches, is strong-brown silty clay loam and light clay. The lower part, to a depth of 42 inches, is red and dark-red, plastic clay that has mottles of gray, red, and yellowish brown. Below the subsoil, to a depth of 54 inches, is dark reddish-brown and yellowish-brown silty clay loam. Yellowish-brown siltstone bedrock is at a depth of 54 inches.

Permeability is slow, and surface runoff is rapid. These soils are subject to severe erosion if they are not protected. The fine-textured lower part of the subsoil limits air and water movement and rooting development. These soils have a medium to low available moisture capacity and a moderately deep rooting zone. They are very strongly acid or extremely acid unless limed. Rarden soils are used mostly for pasture, but a large acreage is no longer farmed.

Representative profile of Rarden silt loam, SE¼ sec. 17, Washington Township, approximately 200 yards southeast of junction of Township Roads 323 and 320:

Ap1—0 to 1 inch, dark grayish-brown (10YR 4/2) heavy silt loam; weak, fine, granular structure; friable; many roots; very strongly acid; abrupt, wavy boundary.

Ap2—1 to 6 inches, brown (10YR 4/3) silt loam; weak, medium, subangular blocky structure parting to weak, fine, granular; friable; many roots; extremely acid; abrupt, smooth boundary.

B1t—6 to 8 inches, strong-brown (7.5YR 5/6) heavy silty clay loam; weak, fine, subangular blocky structure; firm; common roots; thin, very patchy (7.5YR 5/4) clay films on vertical and horizontal ped faces; extremely acid; clear, wavy boundary.

B21t—8 to 11 inches, strong-brown (7.5YR 5/6) clay; moderate, fine, angular blocky structure; firm; common roots; thin, patchy, brown (7.5YR 5/4) clay films on vertical and horizontal ped faces; extremely acid; clear, wavy boundary.

IIB22t—11 to 27 inches, red (2.5YR 4/6) clay; many, fine, prominent, gray to light-gray (10YR 6/1) mottles and few, fine, distinct, yellowish-brown (10YR 5/4) mottles; weak, medium, angular blocky structure; very firm, plastic and sticky when wet; few roots; thin, patchy clay films; extremely acid; clear, smooth boundary.

IIB23t—27 to 35 inches, dark-red (2.5YR 3/6) clay; common, fine, distinct, red (2.5YR 5/8) and gray (10YR 5/1) mottles; weak, medium, subangular blocky structure; very firm, plastic and sticky when wet; few roots; extremely acid; clear, smooth boundary.

IIB3t—35 to 42 inches, dark-red (2.5YR 3/6) clay; common, fine, distinct, gray (10YR 5/1) mottles; weak, coarse, subangular blocky structure; very firm, sticky and plastic when wet; few roots; thin, patchy clay films; extremely acid; gradual, smooth boundary.

IIC1—42 to 50 inches, dark reddish-brown (2.5YR 3/4) heavy silty clay loam; massive; very firm; extremely acid; clear, smooth boundary.

IIC2—50 to 54 inches, yellowish-brown (10YR 5/4) light silty clay loam; massive; very firm; very strongly acid; abrupt, smooth boundary.

R—54 inches, yellowish-brown (10YR 5/4) siltstone.

Color of the Ap horizon is generally dark grayish brown (10YR 4/2) or dark brown (10YR 4/3). Texture of the A horizon is silty clay loam in eroded areas. The B1t horizon is predominantly silty clay loam but in places is light clay or silty clay. In the Bt horizon, hue of the matrix centers on 2.5YR but ranges from 10R to 7.5YR. The 7.5YR hue is limited to the B1t horizon or, in a few places, the B3t horizon. Fine textures prevail throughout the B2 and B3t horizons; the clay content generally is greater than 50 percent. The depth to the C horizon generally is less than 40 inches. Hard shale or siltstone is at a depth of 40 to 60 inches. Reaction throughout the profile is very strongly acid or extremely acid.

Rarden soils are shallower to a B horizon of clay than Coolville and Keene soils. They have a more reddish, variegated B horizon than Keene and Latham soils. They are more mottled, have a more variegated B horizon, and are more acid than Upshur and Woodsfield soils. Rarden soils are clayey at shallower depths than Woodsfield soils.

**Rarden-Coolville silt loams, 12 to 18 percent slopes, moderately eroded** (RcD2).—These soils are on narrow, rounded ridgetops, in moderately steep areas on benches, on side slopes just below ridge crests and knolls, and in areas around the heads of small upland drainageways. The benchlike areas are narrow, commonly are only 150 to 200 feet wide, and in many places are bounded above and below by steeper areas of Gilpin-Upshur soils. The Rarden soil commonly makes up about 60 percent of this complex, the Coolville soil about 35 percent, and included soils about 5 percent.

Row cropping and overgrazing have caused the loss of 25 to 75 percent of the original surface layer. The remaining material from this layer has been mixed with some of the lighter colored subsoil by plowing. The present surface layer is sticky and is hard to protect from further erosion.

Included in mapping were a few areas of soils on narrow ridgetops that are severely eroded. In these areas the present surface layer is sticky, yellowish-brown or reddish-brown clay. Rills and shallow gullies occur in a few places.

The soils of this complex are poorly suited to row crops because they are in small, narrow areas, are moderately steep, and are subject to very severe erosion. Slope and slow to very slow permeability are limitations to most nonfarm uses. (Capability unit IVe–4; woodland suitability group 3c1 on north and east aspects and 4c1 on south and west aspects)

## Sciotoville Series

The Sciotoville series consists of deep, moderately well drained soils that formed in old alluvial material. These soils are mainly on high stream terraces along the Ohio River. They also occupy lower terraces along the Ohio River, the Little Muskingum River, Sunfish Creek, and some of the smaller streams in the county.

A representative Sciotoville soil has a dark-brown silt loam surface layer about 6 inches thick. This layer is easy to work. The upper part of the subsoil, to a depth

of 15 inches, is brown to dark-brown silt loam. Below this, to a depth of 30 inches, the subsoil is dark yellowish-brown loam. The lower part of the subsoil, between depths of 30 and 55 inches, is a very firm, compact fragipan of dark yellowish-brown loam. Below the fragipan, the substratum consists of layers of sandy loam and loam. Gravel and sand are at a depth below 7 feet.

The fragipan restricts the movement of air and water and the growth of roots. Because it is at a depth of 26 to 45 inches, however, it does not interfere with the use of Sciotoville soils for most crops commonly grown. The fragipan is at the greater depths in areas on low terraces along the Little Muskingum River and other small streams. These soils have a medium nutrient supply and medium available moisture capacity. Unless limed recently, they are very strongly acid to medium acid.

Most areas of Sciotoville soils are cropland; corn is the principal crop.

Representative profile of Sciotoville silt loam 0 to 4 percent slopes, in a meadow in NE¼ sec. 33, Jackson Township, 1.5 miles southwest of junction of State Route 8 and State Route 7:

Ap—0 to 6 inches, dark-brown (10YR 4/3) light silt loam; moderate, fine, granular structure in upper 2 inches, weak, fine, subangular blocky structure in lower 4 inches; friable; many roots; dark-brown (10YR 3/3) organic stains on ped faces; strongly acid; abrupt, irregular boundary.

A&B—6 to 9 inches, brown to dark-brown (10YR 4/3) light silt loam; weak, medium, subangular blocky structure; friable; common roots; thin, continuous, dark-brown (10YR 3/3) silt coatings on ped faces; strongly acid; clear, smooth boundary.

B1—9 to 15 inches, brown to dark-brown (10YR 4/3) light silt loam; weak, medium, subangular blocky structure; friable; common roots; thin, continuous, dark-yellowish-brown (10YR 3/4) silt coatings on ped faces; strongly acid; clear, smooth boundary.

B2t—15 to 30 inches, dark yellowish-brown (10YR 4/4) loam; many, fine, faint, dark grayish-brown (10YR 4/2) mottles and few, fine, distinct, yellowish-brown (10YR 5/8) mottles; moderate, medium and coarse, subangular blocky structure; firm; few roots; thin, very patchy, dark grayish-brown (10YR 4/2) clay films on ped faces and in pores; few, fine, black (10YR 2/1) concretions; strongly acid; clear, wavy boundary.

Bx—30 to 55 inches, dark yellowish-brown (10YR 4/4) loam; common, medium, faint, grayish-brown (10YR 5/2) mottles and many, fine, distinct, strong-brown (7.5YR 5/8) mottles; weak, coarse, prismatic structure parting to weak, thick, platy; very firm; few roots along prism faces; thin, very patchy, dark grayish-brown (10YR 4/2) clay films on vertical and horizontal ped faces; thin to medium, continuous, grayish-brown (10YR 5/2) silt coatings on prism faces; few, fine, black (10YR 2/1) concretions; strongly acid; gradual, smooth boundary.

C1—55 to 67 inches, light olive-brown (2.5Y 5/4) sandy loam; many, fine, prominent, yellowish-red (5YR 5/8) mottles and common, medium, distinct, grayish-brown (10YR 5/2) mottles; massive; firm; few, fine, black (10YR 2/1) concretions; strongly acid; gradual, wavy boundary.

C2—67 to 75 inches, olive (5Y 4/3) sandy loam; many, medium, distinct, gray (5Y 5/1) mottles and common, fine, prominent, yellowish-red (5YR 5/6) mottles; massive; firm; medium acid; gradual, wavy boundary.

C3—75 to 94 inches, mixed yellowish-brown (10YR 5/4), gray (5Y 5/1), and olive (5Y 4/3) loam; massive; firm; slightly acid.

Thickness of the solum, including the fragipan, averages 65 inches but ranges from 48 to 84 inches. The depth to underlying sand and gravel varies widely. The average depth is 8 feet, but depth ranges from 7 feet to more than 10 feet. Color of the Ap horizon is typically dark brown (10YR 3/3) but also includes very dark grayish brown (10YR 3/2) and dark yellowish brown (10YR 3/4). Broken and rubbed colors have values ranging from 3 to 4. Areas that have textures coarser than silt loam are designated by a special symbol on the soil map. Colors of the B horizon generally are dark yellowish brown (10YR 4/4) but range to brown and dark brown (10YR 4/3) and yellowish brown (10YR 5/4, 5/6) Hues range to 7.5YR. Texture of the upper part of the B horizon includes silt loam, light silty clay loam, and loam. The Bx horizon is loam, silt loam, or light silty clay loam. Depth to the mottled horizons ranges from 15 to 24 inches. The C horizon is typically coarser textured than the B horizon and includes sandy loam and loamy sand textures. Reaction in the solum ranges from strongly acid to very strongly acid. Reaction in the substratum becomes less acid with depth.

Sciotoville soils commonly are near or adjacent to the Wheeling, Conotton, and Captina soils. They are slightly coarser textured and have a weaker, less compact fragipan than the Captina soils. They contain less gravel in the solum and are deeper to loose sand and gravel than the Conotton soils. Wheeling and Conotton soils are better drained than the Sciotoville soils and do not have the fragipan.

**Sciotoville silt loam, 0 to 4 percent slopes** (ScB).—This soil occupies terraces along the Ohio River and Little Muskingum River, and to a minor extent, along Sunfish Creek and other streams. Where the soil is on high terraces, the more gravelly Conotton soils are on adjacent steeper slopes. On the lower terraces, this soil is commonly separated from the main stream by bands of the better drained Wheeling, Huntington, and Chagrin soils.

On the high terraces, the hard, compact fragipan starts at a depth of 26 to 36 inches. On the lower terraces, depth to the pan ranges from 36 to 45 inches. This depth is greater than normal for typical Sciotoville soils.

Included in mapping were a few areas of soils that are moderately well drained or well drained and lack a fragipan in the subsoil. Also included were a few spots and narrow bands of somewhat poorly drained soils that are mottled and gray below the plow layer. These wetter soils commonly receive runoff or seepage water from adjacent steeper slopes.

Where this soil is on the higher terraces along the Ohio River, it is above the mark of the highest flood levels. The lower terraces, however, are subject to occasional flooding. All of the lower areas were flooded in 1913, 1937, and 1948, and many areas were flooded in 1918, 1936, and 1964. The frequency of flooding along the other streams is variable, but the average is once in about 4 to 5 years. Most floods are of short duration. They occur mainly in winter and early in spring and cause little damage to summer-grown crops.

Most areas of this soil are cultivated; a few areas are in pasture. This soil has few limitations for intensive cropping, except for slight seasonal wetness and occasional flooding on the lower terraces. The compact pan layer in the subsoil restricts the growth of deep-rooted crops, such as alfalfa. Most lower areas of this soil have limitations for some nonfarm uses because of the hazard of flooding and the moderately slow permeability. (Capability unit IIe–3; woodland suitability group 2w1 on all aspects)

## Sees Series

The Sees series consists of deep, moderately well drained soils that have formed in colluvium. The colluvium is mostly a mixture of soil materials that weathered from stratified layers of limestone, siltstone, shale, and sandstone. These soils occur throughout the county, but the largest acreage is in the northwestern and eastern parts. The soils are on base slopes or lower benchlike areas below very steep areas of Guernsey-Westmore, Guernsey-Upshur, Gilpin-Upshur, or Brooke soils. Slopes range from 6 to 35 percent. Sees soils were not mapped separately in Monroe County but were mapped in an undifferentiated group with Woolper soils and in complexes with Vandalia and Woolper soils.

A representative Sees soil has a very dark grayish-brown silt loam plow layer about 9 inches thick. The upper part of the subsoil, to a depth of 18 inches, is dark-brown to brown silty clay loam. The lower part, to a depth of 40 inches, is dark yellowish-brown silty clay loam and silty clay. It has mottles of grayish brown, light olive brown, and yellowish brown. The substratum, to a depth of 70 inches, is silty clay with mixed colors of yellowish brown, dark brown and grayish brown. The entire profile contains less than 15 percent coarse fragments, by volume. The most common fragments are sandstone and siltstone.

Sees soils have a deep rooting zone and a medium to high available moisture capacity. They are moderately permeable in the surface layer and have moderately slow to slow permeability in the subsoil and substratum. Generally, these soils are wet in winter and spring and are slow to dry out. They receive runoff and seepage water from high adjacent areas. Sees soils are unstable and are subject to soil slippage and cracking. Reaction is strongly acid to neutral.

Sees soils are used mostly for pasture or meadow. Generally, they are too steep for cultivated crops.

Representative profile of a Sees silt loam in SW¼ sec. 25, Salem Township, T. 3 N., R. 3 W., 1 mile west of Clarington and 150 feet west of State Route 78:

Ap—0 to 9 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, fine, subangular blocky structure; friable; many roots; slightly acid; abrupt, smooth boundary.

B1t—9 to 12 inches, dark-brown to brown (10YR 4/3) light silty clay loam; weak, fine, subangular blocky structure; firm; common roots; thin, very patchy, dark yellowish-brown (10YR 3/4) clay films on vertical ped faces; medium acid; clear, smooth boundary.

B21t—12 to 18 inches, dark-brown to brown (7.5YR 4/4) silty clay loam; moderate, medium, subangular blocky structure; firm; few roots; thin, patchy, dark-brown (10YR 4/3) clay films on vertical ped faces; medium acid; clear, smooth boundary.

B22t—18 to 22 inches, dark yellowish-brown (10YR 3/4) silty clay loam; few, fine, faint, grayish-brown (10YR 5/2) mottles; moderate, medium, subangular blocky structure; firm; few roots; thin, patchy, dark-brown (7.5YR 4/2) clay films on vertical ped faces; few, fine, distinct, black (10YR 2/1) concretions; slightly acid; clear, smooth boundary.

B23t—22 to 30 inches, dark yellowish-brown (10YR 3/4) heavy silty clay loam; common, fine, faint, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/4) mottles; moderate, medium, subangular blocky structure; firm; few roots; thin, patchy, dark-brown (7.5YR 4/2) clay films on vertical ped faces; common, fine, distinct, black (10YR 2/1) concretions; slightly acid; clear, smooth boundary.

B3t—30 to 40 inches, dark yellowish-brown (10YR 3/4) light silty clay; many, fine, distinct, grayish-brown (2.5Y 5/2), light olive-brown (2.5Y 5/4), and yellowish-brown (10YR 5/6) mottles; weak, coarse, subangular blocky structure; firm; few roots; thin, patchy, dark-brown (7.5YR 4/2) clay films on vertical ped faces; many, fine, distinct, black (10YR 2/1) concretions; slightly acid; gradual, smooth boundary.

C—40 to 70 inches, mixed yellowish-brown (10YR 5/4), (10YR 5/6), dark-brown (7.5YR 4/4), and grayish-brown (2.5Y 5/2) silty clay; massive; firm; many, fine and medium, distinct, black (10YR 2/1) concretions; neutral.

Thickness of the solum ranges from 24 to 50 inches but, in most places, is about 40 inches. Depth to bedrock ranges from 6 to over 20 feet. Color value of the Ap horizon centers on 3 but ranges to 2. Chroma ranges from 1 to 3. Chroma in the B horizon is mainly 3 or 4; value is 3 to 6. Hue of the matrix is mostly 10YR but ranges from 7.5YR to 2.5Y. Silty clay loam, silty clay, clay, or clay loam are the dominant textures in the B horizon. The B1t horizon is normally silty clay loam, and the B2t and B3t horizons are heavy silty clay loam, silty clay, or clay. The B3t horizon is clay loam in some places. Reaction in the solum ranges from medium acid to neutral. The higher pH values generally occur in the lower part of the B horizon and in the C horizon. Depth to the mottled B2t horizon ranges from 15 to 25 inches. Within the mottled zone, dark concretions are few to many. In the upper part of the profile, coarse fragments generally make up less than 15 percent, by volume, of the soil mass.

Sees, Vandalia, Hackers, and Woolper soils are in similar positions on the landscape. Sees soils lack the reddish colors that are common to Vandalia and Hackers soils. They are slightly less acid and have a darker colored surface layer than Vandalia soils. They contain more clay and are not so coarse textured as the Hackers soils. Sees soils are not so well drained as Woolper soils and have dark colors to a lesser depth in the upper part of the profile.

**Sees-Woolper silt loams, 12 to 18 percent slopes** (SsD).—These soils are on hillsides, in benchlike areas, or on foot slopes. Characteristically, they are below very steep soils on uplands that are influenced by limestone. Typically, the complex is about 60 percent Sees soil, 30 percent Woolper soil, and 10 percent included soils. Slopes generally are slightly uneven and cut diagonally by small drainageways. Landslips occur in a few places.

Soil material from upslope has accumulated in the areas of this mapping unit. The surface layer, and commonly the upper part of the subsoil, are dark colored. In most places the surface layer of the Sees soil is more than 7 inches thick; the Woolper soil has dark colors to a depth of more than 10 inches.

These soils are well suited to pasture and are suited to all crops that can tolerate the slight wetness of the Sees soil. The hazard of erosion is very severe if the soils are cultivated. Natural drainageways and uneven slopes interfere with contour stripcropping and the use of these soils for row crops. Slope and the danger of soil slippage are limitations for many nonfarm uses. (Capability unit IVe–1; woodland suitability group 2w3 on all aspects)

**Sees-Woolper silt loams, 18 to 35 percent slopes** (SsE).—These soils are on foot slopes and in benchlike areas below long, very steep hillsides. The benches generally are long and narrow and are commonly bounded by steeper slopes below. Although most slopes are fairly uniform, some areas have minor landslips or are dissected by drainageways or ravines. In a few areas, large sand-

stone and limestone boulders are on the surface and in the soil. The largest areas of this mapping unit are along the Ohio River, Sunfish Creek, and Opossum Creek. Typically, this complex is about 60 percent Sees soil, 30 percent Woolper soil, and 10 percent included soils.

These soils are only slightly eroded and have up to 10 inches or more of the original dark-colored surface layer remaining. The Woolper soil has an especially thick, dark-colored surface layer. Landslips are common in some places, and these are shown on the soil map by a special symbol.

Many areas of these soils were cropped in the past, but the largest acreage is now in permanent pasture and woodland. Most areas have fair to good stands of bluegrass pasture. Some of the more even slopes can be used for long-term meadow. The seasonal wetness of the Sees soil restricts the growth of small-grain cover crops and makes it difficult to maintain stands of deep-rooted grasses and legumes. The hazard of erosion is severe if a thick plant cover is not maintained. Steep slopes and soil slippage are limitations of these soils for nonfarm uses. (Capability unit VIe–1; woodland suitability group 2w3 on all aspects)

## Strip Mine Spoils

Strip mine spoils (St) is a land type that occupies only 31 acres in the county and is in the southwestern part. The areas are 5 to 10 acres in size and range from gently sloping to steep. On the upslope side is a high wall or rock escarpment. Below the high wall, the spoil material has been graded to gently sloping or sloping. Below the graded areas, slopes are moderately steep to very steep and are very uneven.

Strip mine spoils are masses of soil material and rock fragments. The soil material is clayey and friable to firm. Most areas contain limestone fragments and are sufficiently nonacid to support some plant growth. (Capability unit VIIe–2; woodland suitability group not assigned)

## Upshur Series

The Upshur series consists of well-drained, deep soils that have a medium-textured surface layer and a reddish-brown to red, clayey subsoil underlain by red clay shale. These soils, mapped alone, are gently sloping to moderately steep and are on ridgetops, upper slopes, and benches throughout the county. They also occur extensively as components of the Gilpin-Upshur and Guernsey-Upshur complexes. In some of these complexes, the Upshur soils are steep to very steep. Upshur soils are especially extensive in the southeastern quarter of the county.

A representative Upshur soil in woodland has a silt loam surface layer about 5 inches thick. This layer is brown to dark brown in the upper part and brown to dark brown and dark reddish brown in the lower part. The subsoil, to a depth of about 26 inches, is dark reddish-brown silty clay and clay that is sticky and plastic when wet. Below the subsoil, to a depth of 46 inches, is dark reddish-brown silty clay and mixed dark reddish-brown and reddish-brown channery silty clay loam. Dusky-red shale bedrock is at a depth of about 46 inches.

Upshur soils have slow permeability. Their available moisture capacity is medium, and the rooting zone is mostly moderately deep. Generally, unlimed areas are very strongly acid in the rooting zone. Runoff is medium to rapid, and the hazard of erosion is severe if these soils are cultivated and not protected. Most areas have been cleared, but the soils dry out slowly and crack, and the clayey soil makes tillage difficult. Careful management is needed. Unimproved roads on Upshur soils are soft and very poor when wet, and in spring they are often impassable. Where these soils are steep, they are unstable and subject to landslips.

Upshur soils are used mainly for hayland, and some areas are wooded. Many areas formerly farmed are severely eroded and are now in permanent vegetation.

Representative profile of Upshur silt loam, 6 to 12 percent slopes, moderately eroded, in a wooded area, NW¼ sec. 11, Benton Township, 0.8 mile south of the junction of Township Road 816 and County Road 58 (see table 10 for laboratory data):

Ap1—0 to 2 inches, brown to dark-brown (7.5YR 4/4) silt loam; moderate, fine and medium, granular structure; friable; many roots; about 5 percent coarse fragments; extremely acid; abrupt, irregular boundary.

Ap2—2 to 5 inches, mixed brown to dark-brown (7.5YR 4/4) and dark reddish-brown (2.5YR 3/4) silt loam; moderate, fine, subangular blocky structure; firm; many roots; about 5 percent coarse fragments; very strongly acid; abrupt, smooth boundary.

B21t—5 to 10 inches; dark reddish-brown (2.5YR 3/4) silty clay; moderate, fine and medium, angular blocky structure; very firm; common roots; about 5 percent coarse fragments; thin, patchy, reddish-brown (5YR 4/3) clay films on ped faces and in pores; very strongly acid; clear, smooth boundary.

B22t—10 to 17 inches; dark reddish-brown (2.5YR 3/4) clay; moderate, medium and coarse, angular blocky structure; very firm; few roots; about 5 percent coarse fragments; thin, patchy, reddish-brown (5YR 4/4) clay films on ped faces and in pores; extremely acid; clear, smooth boundary.

B3t—17 to 26 inches; dark reddish-brown (2.5YR 3/4) clay; weak, coarse, angular blocky structure; very firm; few roots; about 5 percent coarse fragments; thin, patchy, reddish-brown (5YR 4/4) clay films on ped faces and in pores; extremely acid; clear, smooth boundary.

C1—26 to 35 inches, dark reddish-brown (5YR 3/4) silty clay; massive; very firm; few roots; about 10 percent coarse fragments; very strongly acid; clear, smooth boundary.

C2—35 to 46 inches, mixed dark reddish-brown (5YR 3/4) and reddish-brown (5YR 5/4) channery silty clay loam; common, medium, light olive-brown (2.5YR 5/4) and dark-gray (10YR 4/1) mottles; massive; very firm; few roots; about 40 percent coarse fragments; medium acid; clear, smooth boundary.

R—46 inches, dusky-red (10YR 3/4) shale; neutral reaction.

Thickness of the solum ranges from about 26 to 44 inches. Shale bedrock is at a depth of 40 to about 60 inches. Texture of the A horizon is silt loam or clay, but silt loam is the most extensive. The horizon is clay in severely eroded areas. Some profiles are loamy to a depth of 12 inches. Color hue of the B2t horizon is mainly 2.5YR or 10YR but ranges to 5YR. Where the soil is unlimed, reaction in the solum ranges from extremely acid to medium acid. The substratum is generally high in exchangeable bases. Content of coarse fragments ranges from 0 to 15 percent, by volume, in the solum.

Upshur soils are shallower to reddish clay and have a thinner silt mantle than Woodsfield soils. They lack variegated red, gray, and yellowish-brown subsoil colors that are characteristic of Rarden soils, and typically they are less

acid than Rarden soils, particularly in the lower part of the subsoil and substratum. Upshur soils have reddish colors in contrast to the Latham and Guernsey soils. Upshur soils are shallower to bedrock than the Vandalia soils on colluvial footslopes and have a redder and finer textured B horizon than Gilpin or Wellston soils.

**Upshur silt loam, 6 to 12 percent slopes, moderately eroded** (UpC2).—This soil is mainly on rounded ridgetops throughout the county. Most of these areas are small and have smooth, even slopes. A profile of this soil is described as representative for the series.

Included in mapping were a few areas of soils that are severely eroded. In these areas the surface layer is silty clay loam or clay that makes tillage difficult. These severely eroded spots are lower in fertility and available moisture capacity than less eroded areas. Also included were a few spots of wet soils.

Practically all areas of this soil are used for cropland and pasture. Small areas are used for woodland. The soil has slopes that are favorable for limited cultivation, but normally it is in small areas. The hazard of erosion is very severe if this soil is cultivated. Slow permeability and the hazard of slippage are limitations to many nonfarm uses. (Capability unit IVe–4; woodland suitability group 3c1 on all aspects)

**Upshur silt loam, 12 to 18 percent slopes, moderately eroded** (UpD2).—This soil is on narrow ridgetops and a few benches throughout the county. Most areas are small and have smooth, uniform slopes. The benches on which this soil occurs are generally long and narrow.

Included in mapping were a few spots of severely eroded soils. In these spots the reddish, finer textured part of the subsoil is exposed at the surface. This exposed part of the subsoil is lower in natural fertility and available moisture capacity than the original surface soil, and it is difficult to protect from further erosion. Also included were a few wet spots.

Almost all areas of this soil are used for crops and pasture. The soil is not suitable for cultivation because of moderately steep slopes, rapid runoff, and a severe hazard of erosion. It is commonly managed with adjacent soils because of the small size and the shape of its areas. Slope, slow permeability, and danger of slippage are major limitations of this soil for nonfarm uses. (Capability unit VIe–1; woodland suitability group 3c1 on north and east aspects and 4c1 on south and west aspects)

**Upshur clay, 6 to 12 percent slopes, severely eroded** (UrC3).—This soil is in small areas on rounded ridgetops throughout the county. Commonly, it is on rather narrow ridge crests and around the edge of broader ridgetops near slope breaks. Gilpin, Woodsfield, and Zanesville soils are the most common soils nearby.

Because of intensive use and less than optimum management, this soil has been severely eroded. It has lost over 75 percent of the original surface layer and, in most places, part of the subsoil. Shallow gullies are common. The present plow layer, which is mostly subsoil material, is sticky when wet, hard when dry, and difficult to protect from further erosion. The organic-matter content and available water capacity are low or very low. The use of this soil for farming is limited by the small size of the areas and the high susceptibility of the soil to further erosion. Slope, slow permeability, and the hazard of soil slippage are limitations of this soil to many nonfarm uses. (Capability unit IVe–4; woodland suitability group 3c1 on all aspects)

**Upshur clay, 12 to 18 percent slopes, severely eroded** (UrD3).—This soil occupies narrow, rounded ridgetops and a few areas mainly on upper slopes and benches. Most areas are small.

Intensive use has resulted in severe erosion of this soil. Most of the original surface layer and part of the subsoil have been lost. Shallow gullies, 1 to 2 feet deep, are present in most areas. Some of the gullies cannot be crossed readily by machinery, but most can be filled in by plowing. The clayey plow layer is sticky when wet and hard when dry. The organic-matter content, natural fertility, and available moisture capacity are low.

A few areas mapped as this soil are as much as 50 percent inclusions of the browner, less acid Guernsey soils. The Guernsey soils can be identified by the yellowish-brown or olive-brown clayey part of the subsoil exposed at the surface or in the gullies.

This Upshur soil is not suitable for crops, because of moderately steep slopes and the severe hazard of erosion. Slope, slow permeability, and the hazard of soil slippage are limitations to nonfarm uses of this soil. (Capability unit VIe–1; woodland suitability group 3c1 on north and east aspects and 4c1 on south and west aspects)

## Vandalia Series

The Vandalia series consists of deep, well-drained soils that formed in thick deposits of colluvium that have been moved downslope by gravity and water. These soils are moderately steep to very steep and are on colluvial foot slopes and benches at the base of very steep hillsides. Gilpin and Upshur soils generally are on the hillsides above these soils. Vandalia soils are mostly in the eastern third of the county. They are most extensive on the foot slopes along the Ohio River and its small tributaries below the city of Hannibal.

A representative Vandalia soil has a dark-brown silt loam plow layer about 8 inches thick. The upper part of the subsoil, to a depth of 17 inches, is brown silty clay loam. The lower part, to a depth of 44 inches, is reddish-brown clay. Below the subsoil, to a depth of 70 inches, is mixed dark reddish-brown and reddish-brown clay. Fragments of sandstone and siltstone and small chips of shale make up about 5 to 15 percent of the profile.

Vandalia soils have a deep rooting zone. The available moisture capacity is medium to high. Permeability is moderate in the surface layer, moderately slow in the upper part of the subsoil, and slow in the lower part of the subsoil and in the substratum. The soils generally are wet in winter and early in spring and are slow to dry out in spring. They are in areas that receive runoff and seepage water from higher adjacent soils. A severe hazard of erosion is caused by steep slopes and rapid surface runoff. Vandalia soils are unstable and are subject to slippage and cracking. They are used mostly for pasture and meadow.

Representative profile of Vandalia silt loam, 12 to 18 percent slopes, in a pasture, NE¼ sec. 13, Jackson Township, 3 miles southwest of Sardis on State Route 7:

Ap—0 to 8 inches, dark-brown (10YR 3/3) silt loam; moderate, very fine, subangular blocky structure; friable; many roots; strongly acid; abrupt, smooth boundary.

B21t—8 to 17 inches, brown (7.5YR 4/4) heavy silty clay loam; moderate, fine, subangular blocky structure; firm; common roots; thin, patchy, dark-brown (7.5YR 4/4) clay films on vertical ped faces; common, fine, black (10YR 2/1) concretions; strongly acid; clear, smooth boundary.

B22t—17 to 30 inches, reddish-brown (5YR 4/3) light clay; moderate, medium, angular blocky structure; firm; few roots; medium, continuous, reddish-brown (5YR 4/3) clay films on vertical ped faces; common, fine, black (10YR 2/1) concretions; very strongly acid; gradual, smooth boundary.

B3t—30 to 44 inches, reddish-brown (5YR 4/4) clay; weak, coarse, subangular blocky structure; firm; few roots; thick, patchy, reddish-brown (5YR 4/3) clay films on vertical ped faces; common, fine, black (10YR 2/1) concretions; very strongly acid; gradual, smooth boundary.

C—44 to 70 inches, mixed dark reddish-brown (5YR 3/4) and reddish-brown (5YR 4/4) clay; massive; common, partly weathered, light olive-brown (2.5Y 5/6) and light brownish-gray (2.5Y 6/2) siltstone fragments; thick, reddish-brown (5YR 4/3) clay films on upper surfaces of coarse fragments; many, fine, black (10YR 2/1) concretions; strongly acid in upper part, becoming slightly acid with depth.

Depth to the R layer ranges from 6 feet to more than 20 feet, and thickness of the solum ranges from 30 to 48 inches. The Ap horizon has moist and rubbed colors of dark brown (10YR 3/3) or dark brown (7.5YR 3/2). Where an A1 horizon is present, its colors include those of the Ap horizon but also range to very dark grayish brown (10YR 3/2). The upper part of the B horizon has a hue of 7.5YR or 5YR, value of 3 or 4, and chroma of 4 to 6. Texture of the Bt horizon includes heavy silty clay loam, silty clay, clay, and heavy clay loam. The B1t horizon, if present, is silty clay loam or heavy silt loam. Clay or silty clay textures are more common than silty clay loam or clay loam in the B2t horizon and B3t horizon. Silty clay loam is restricted mainly to the B21t horizon and B3t horizon. Clay loam, if present, generally is in the B3t horizon. The weighted average clay content of the B2t horizon ranges from 40 to 50 percent. Clay films around peds generally are thin and very patchy in the B1t horizon but ranges from thin to thick and from patchy to continuous in the B2t horizon. Dark concretions are few to many. Structure ranges from weak to moderate. Throughout the solum, coarse fragments are normally less than 15 percent of the volume. Reaction ranges from very strongly acid to slightly acid. The soils are less acid in the lower part of the solum and the substratum.

The Vandalia soils in Monroe County have a darker colored surface than Vandalia soils in other survey areas. This slight difference does not greatly affect the use and management of the soils.

Vandalia soils are redder and are more acid than the well drained Woolper soils and the moderately well drained Sees soils that also are on colluvial foot slopes. Vandalia soils are finer textured throughout than the Hackers soils that are commonly on nearby alluvial fans and colluvial foot slopes. They are much deeper to bedrock than Upshur soils.

**Vandalia silt loam, 12 to 18 percent slopes** (VaD).—This soil is on lower slopes and benches. The benchlike areas, normally bounded above and below by steeper wooded soils, run laterally around hillsides. Slopes are generally slightly uneven but are not a limitation to the use of most kinds of farm machinery. A profile of this soil is described as representative for the series.

A few small spots of the wetter Sees soils were included in mapping. Sees soils are most likely to be near seep spots, in small drainageways, or on the more concave parts of the slopes. Loose stones and boulders occur in a few places.

This soil is suited to hay and pasture crops. It also is suited to an occasional row crop, but the hazard of erosion is severe in cultivated areas. Slope is a dominant limitation of this soil for many nonfarm uses. (Capability unit IVe–1; woodland suitability group 2c2 on all aspects)

**Vandalia-Sees silt loams, 18 to 35 percent slopes** (VdE).—These soils are on foot slopes and in benchlike areas. They are on the lower half of hillsides and most commonly occur between the steep rugged side slopes and the valley floors. The benchlike areas, bounded above and below by steeper slopes, run laterally around hillsides. Slopes typically are somewhat uneven. They are smooth and uniform in only a few places.

Most areas of this complex are made up almost entirely of the Vandalia soil. In a few areas, the moderately well drained, dark-colored Sees soil occupies 25 to 40 percent of the acreage. However, the percentage of each soil in mapped areas can range from 20 to 80 percent.

Included in mapping were a few small seep spots and a few areas with loose stones and boulders on the surface. Small areas of landslips are shown on the soil map by a special symbol.

These soils are too steep for row crops, but they are suited to permanent meadow, pasture, and woodland. The hazard of erosion is severe in cultivated areas. Steep slopes and the danger of soil slippage are the dominant limitations for nonfarm uses. (Capability unit VIe–1; woodland suitability group 2c2 on all aspects)

**Vandalia-Sees very stony silt loams, 18 to 35 percent slopes, moderately eroded** (VsE2).—These soils generally are downslope from very steep, stony Gilpin and Upshur soils. In most places their surface layer is dark silt loam only 4 to 7 inches thick. In the more eroded areas, however, this layer is sticky, reddish-brown or brown silty clay loam that is difficult to protect from further erosion.

The Vandalia soil generally is dominant in the complex. A typical area is 65 percent Vandalia soil, 25 percent Sees soil, and 10 percent other soils. A few areas of the complex consist almost entirely of the Vandalia soil.

Included in mapping were a few areas where the surface layer is thicker than 7 inches. Also included were areas in which there are some stones of sandstone, and commonly a few stones of limestone, on the surface and in the soil. Most of the loose stones are 6 to 18 inches in diameter and 5 to 30 feet apart. A few seep spots and landslips occur. In places there are large boulders and rock outcrops.

Because of stones and steep slopes, soils of this complex are not suited to crops. In addition, although the dark-colored Sees soil is not dominant in most places, it limits use because it is wet during wet periods of the year. Nevertheless, most areas of the complex have been cleared for pasture. Stones interfere with the use of farm machinery to the extent that pasture improvement is difficult. The soils can be used for permanent pasture, but erosion is a severe hazard if a thick plant cover is not maintained. Slope is the chief limitation to nonfarm uses of the soils. (Capability unit VIs–1; woodland suitability group 2c2 on all aspects)

## Wellston Series

The Wellston series consists of deep, well-drained soils on uplands. These soils formed in loamy material that

overlies acid sandstone, siltstone, or shale bedrock. They are mainly on ridgetops and, to a lesser extent, on sloping to moderately steep hillsides and benches. They occur throughout the county but are most extensive in the northern and central parts.

A representative Wellston soil in a wooded area has a dark grayish-brown silt loam surface layer 9 inches thick. The subsurface layer, to a depth of 12 inches, is dark-gray silt loam. The subsoil, to a depth of 38 inches, is yellowish-brown silt loam. Below the subsoil there is fractured sandstone and siltstone that contains yellowish-brown silt loam soil material in the fractures. Sandstone bedrock is at a depth of 45 inches.

Wellston soils are moderately permeable. The available moisture capacity is medium. The main rooting zone is moderately deep, but some roots penetrate to depths greater than 40 inches. Unlimed areas of Wellston soils are very strongly acid.

Wellston soils are used mostly for crops and pasture, but a small acreage is wooded.

Representative profile of Wellston silt loam in a wooded area, SE¼ sec. 10, Wayne Township, 1.45 miles south of junction of Township Road 102 and County Road 45:

O1—½ inch to 0, deciduous leaf litter.
A11—0 to 1 inch, very dark grayish-brown (10YR 3/2) silt loam; moderate, fine, granular structure; friable; many roots; neutral; abrupt, smooth boundary.
A12—1 to 9 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, subangular blocky structure; friable; many roots; dark-brown (10YR 3/3) organic stains on ped faces; neutral; abrupt, wavy boundary.
A2—9 to 12 inches, dark-gray (10YR 4/1) silt loam; weak, fine and medium, subangular blocky structure; firm; many roots; medium acid; clear, smooth boundary.
B21t—12 to 18 inches, yellowish-brown (10YR 5/6) silt loam; moderate, fine and medium, subangular blocky structure; firm; common roots; thin, very patchy, brown to dark-brown (7.5YR 4/4) clay films; few, fine, black (10YR 2/1) concretions; very strongly acid; clear, smooth boundary.
B22t—18 to 26 inches, yellowish-brown (10YR 5/6) heavy silt loam; moderate, medium, subangular blocky structure; firm; few roots; thin, patchy, brown to dark-brown (7.5YR 4/4) clay films; few, fine, black (10YR 2/1) concretions; very strongly acid; clear, smooth boundary.
B23t—26 to 33 inches, yellowish-brown (10YR 5/6) heavy silt loam; moderate, medium, subangular blocky structure; firm; few roots; thin, patchy, brown to dark-brown (7.5YR 4/4) clay films; few, fine, black (10YR 2/1) concretions; very strongly acid; clear, smooth boundary.
B3t—33 to 38 inches, yellowish-brown (10YR 5/6) silt loam; weak, medium, subangular blocky structure; firm; few roots; thin, very patchy, brown to dark-brown (7.5YR 4/4) clay films; few, fine, black (10YR 2/1) concretions; very strongly acid; clear, smooth boundary.
C—38 to 45 inches, fractured siltstone and sandstone containing yellowish-brown (10YR 5/6) silt loam soil material within the fractures.
R—45 inches, sandstone bedrock.

Thickness of the solum ranges from about 2½ feet to 4 feet. Depth to bedrock ranges from 3½ feet to 5 feet, but the average depth is about 42 inches. These soils are characterized by a B horizon of illuvial clay accumulation more than 18 inches thick. Profiles on ridgetops generally have a smooth, silty upper solum suggestive of a loess mantle. Content of coarse material in the solum ranges from 2 to about 30 percent, by volume. The average content is about 5 percent. Hues of the entire profile are dominantly 10YR and 7.5YR. An A11 horizon up to 4 inches thick is common in heavily wooded areas. The colors are dark brown (10YR 3/3) or very grayish brown (10YR 3/2). The Ap horizon has a color value of 4 or 5 and chroma of 2 or 3. Color value is 4 or 5 in the B horizons. Chroma is 3 or 4 in the B1 horizon and is 4 through 6 in the B2 horizon. Where the soil has not been cultivated, it has both an A1 and an A2 horizon. Texture of the B2 horizon is dominantly heavy silt loam but is less commonly a light silty clay loam marginal to clay loam. The reaction of the B horizon is from strongly acid to extremely acid.

Wellston soils are deeper than Gilpin soils and lack the subsoil fragipan of the Zanesville soils. Wellston soils lack the fine-textured, plastic, lower part of the subsoil that is characteristic of the Keene soils. They contain more silt and clay and less sand than the coarser textured Dekalb soils. Wellston soils are coarser textured and less red throughout than Upshur soils. They differ from Westmoreland soils by having a lower sand content in the upper 20 inches of the Bt horizon.

**Wellston silt loam, 2 to 6 percent slopes, moderately eroded** (WhB2).—This soil is on broad ridgetops that have medium surface runoff. Slopes are typically smooth and uniform and grade to nearly level toward the center of these areas. Most areas of this soil are about 3 to 6 acres in size.

Sheet and rill erosion has occurred in most areas, and the original surface layer has been mixed with material from the upper part of the subsoil through tillage. Most areas have 25 to 75 percent of the original surface layer remaining, but in a few included areas the plow layer is mostly yellowish-brown subsoil material. In a few areas, mostly wooded, more than 7 inches of the original surface layer remains. A few areas mapped as this soil include spots of the moderately well-drained Zanesville soils.

Nearly all areas of this soil are used for crops. The soil is well suited to all the crops commonly grown in the county, but the hazard of erosion is moderate in cultivated areas. Bedrock within 5 feet of the surface is a limitation to some nonfarm uses of the soil. (Capability unit IIe–1; woodland suitability group 2o1 on all aspects)

**Wellston silt loam, 6 to 12 percent slopes, moderately eroded** (WhC2).—This soil is mainly on gently rounded ridgetops throughout the county. Surface runoff is rapid, and intensive cropping or overgrazing has resulted in the loss of 25 to 75 percent of the original surface layer. In most cultivated areas, the remaining surface layer has been mixed with the upper part of the subsoil. In areas that have been cultivated up and down the slopes, sheet and rill erosion along wheel tracks are common. A few areas, mostly in woodland, have 7 inches or more of their original surface layer remaining. Included in mapping, mostly near the center of the ridgetops, were small spots of Zanesville soils, some wet spots, and areas of clayey soils.

About 80 percent of the acreage of this soil is cropland and pasture. Most of the remaining acreage is wooded. This soil is well suited to the crops commonly grown in the county, but the hazard of erosion is severe in cultivated areas. Slope and limited depth to bedrock are limitations to some nonfarm uses. (Capability unit IIIe–1; woodland suitability group 2o1 on all aspects)

**Wellston silt loam, 12 to 18 percent slopes, moderately eroded** (WhD2).—This soil generally occurs in the more gently rolling uplands near drainage divides. Other areas

are in bands just below ridgetops that have slightly concave slopes, on benches, and on some of the longer middle and lower slopes.

Rill and sheet erosion have removed some of the original surface layer. As a result, the fertility, organic-matter content, and capacity to absorb moisture have been reduced. In most areas of this soil, 2 to 7 inches of the original surface layer remains, but in other areas the yellowish-brown part of the subsoil is exposed. Where this soil occurs in protected woodland, 7 inches or more of the original surface layer remains. Included in mapping were small spots or narrow bands of the shallower Gilpin soils. The Gilpin soils generally are along the upper edge of these areas or on the most convex part of the slope near the slope breaks.

Nearly all the acreage of this soil has been cleared and cultivated in the past. About half of it is now in pasture, and the rest is about equally divided between cropland and woodland. This soil is suited to crops, but the hazard of erosion is severe in cultivated areas. Slope is the dominant limitation to many nonfarm uses. (Capability unit IVe–2; woodland suitability group 2r1 on north and east aspects and 3r1 on south and west aspects)

## Westmore Series

The Westmore series consists of deep, well-drained soils that developed in mixed material weathered from limestone, siltstone, sandstone, and shale. In Monroe County these soils were mapped only in soil complexes with the Guernsey soils. They are sloping to very steep and are on ridgetops and hillsides throughout the county. The largest acreage is in the western third of the county, but a significant acreage also occurs on ridgetops and on the lower half of slopes in the northeastern part of the county.

A representative Westmore soil has a dark-brown silt loam plow layer about 6 inches thick. The subsoil extends to a depth of 51 inches and is yellowish-brown silty clay loam. There are a few sandstone fragments in the lower part. Below the subsoil, to a depth of 68 inches, is clay having mixed colors of grayish brown, dusky red, yellowish brown, dark yellowish brown, light olive brown, and dark gray. Limestone bedrock is at a depth of about 68 inches.

Westmore soils are mostly moderately permeable in the upper 2 to 3 feet of the profile, but they have moderately slow and slow permeability in the lower part of the subsoil and in the substratum. The available moisture capacity is high. If these soils have not been recently limed, they are slightly acid to very strongly acid in the rooting zone.

Westmore soils are used mainly for pasture and hay. They are well suited to permanent pasture and alfalfa-grass mixtures. The less steep areas are suited to all the crops commonly grown in the county.

Representative profile of a Westmore silt loam having slopes of 18 to 35 percent, in a pasture in sec. 23, Seneca Township, 0.5 mile west of State Route 379 on Township Road 23:

Ap—0 to 6 inches, dark-brown (10YR 4/3) silt loam; weak, fine, granular structure and some weak, medium, platy; friable; many roots; strongly acid; abrupt, smooth boundary.

B1t—6 to 9 inches, dark yellowish-brown (10YR 4/4) heavy silt loam; weak, medium, subangular blocky structure; common roots; thin, very patchy, dark yellowish-brown (10YR 4/4) clay films on vertical ped faces; medium acid; clear, smooth boundary.

B21t—9 to 23 inches, yellowish-brown (10YR 5/4) silty clay loam; moderate, fine and medium, angular blocky structure; firm; common roots; thin, patchy, dark yellowish-brown (10YR 4/4) clay films on vertical ped faces; medium acid; gradual, smooth boundary.

B22t—23 to 44 inches, yellowish-brown (10YR 5/6) heavy silty clay loam; moderate, medium, subangular blocky structure; firm; few roots; thin, patchy, yellowish-brown (10YR 5/4) clay films on vertical ped faces; strongly acid; clear, smooth boundary.

B3t—44 to 51 inches, yellowish-brown (10YR 5/4) heavy silty clay loam; weak, coarse, subangular blocky structure; firm; thin, patchy, dark yellowish-brown (10YR 4/4) clay films on vertical ped faces; many, fine, black (10YR 2/1) concretions; strongly acid; clear, smooth boundary.

IIC1—51 to 54 inches, grayish-brown (10YR 5/2) clay; common, fine, distinct, yellowish-brown (10YR 5/6) and reddish-gray (5YR 5/2) mottles; massive; firm; strongly acid; clear, smooth boundary.

IIC2—54 to 58 inches, mixed dusky-red (10R 3/2), dark yellowish-brown (10YR 4/4), yellowish-brown (10YR 5/6), and dark-gray (N 4/0) clay; massive; very firm; strongly acid; clear, smooth boundary.

IIC3—58 to 65 inches, light olive-brown (2.5Y 5/4) and dark yellowish-brown (10YR 4/4) clay; massive; very firm; slightly acid; clear, smooth boundary.

IIIC4—65 to 68 inches, dusky-red (10R 3/2) clay; massive; very firm; mildly alkaline; abrupt, smooth boundary.

R—68 inches, limestone bedrock.

Thickness of the solum ranges from 40 to 54 inches. Depth to bedrock is greater than 48 inches and normally less than 72 inches. Colors of the Ap horizon are predominantly dark grayish brown (10YR 4/2) or dark brown to brown (10YR 4/3). In the B horizon, matrix colors range from 7.5YR to 2.5Y in hue but center on 10YR, value is 4 to 5, and chroma ranges from 3 to 6. Textures in the Bt horizons are silt loam, silty clay loam, silty clay, clay, and clay loam. Silty clay loam is the most common, silt loam is limited to the upper part of the Bt horizon, and clay loam is restricted mainly to the B3t horizon. Silty clay or clay, or both, occur in about 50 percent of the profiles in Monroe County, but the clay content rarely exceeds 50 percent. The clayey textures generally are confined to depths below 36 inches or to the C horizon. The upper 20 inches of the Bt horizon has a weighted average clay content of 28 to 35 percent. Reaction of the solum ranges from slightly acid to very strongly acid. Content of coarse fragments in the solum rarely exceeds 25 percent, by volume; normally, it is about 5 percent. Dark concretions range from few to many in the lower part of the solum and in the substratum. They commonly occur as moderate to thick, patchy coatings on the fractured coarse fragments in the lower part of the substratum.

Westmore soils commonly are on hillsides and ridgetops with Guernsey soils and in some places near the Brooke soils. They are above colluvial foot slopes occupied by Sees and Woolper soils. Westmore soils are better drained and have less clay in the upper part of the subsoil than Guernsey soils. They are thicker, are more acid, and have a lighter colored surface layer than Brooke soils. They are shallower to bedrock and have a lighter colored surface layer than Sees and Woolper soils. Also, they are better drained than Sees soils.

## Westmoreland Series

The Westmoreland series consists of deep, well-drained, loamy soils that formed in materials weathered mainly from siltstone and thin-layered shale and sandstone.

These soils are on narrow ridgetops, benches, and steep to very steep hillsides. They were not mapped separately in Monroe County, but were mapped in complexes with Gilpin soils.

A representative Westmoreland soil in a wooded area has a dark-brown silt loam surface layer about 2 inches thick and a brown silt loam subsurface layer about 4 inches thick. The upper part of the subsoil, to a depth of 20 inches, is dark-brown silt loam. The lower part, to a depth of 38 inches, is dark-brown channery silt loam. Below the subsoil, to a depth of 56 inches, is dark-brown very channery silt loam. Sandstone bedrock is at a depth of 56 inches.

Westmoreland soils have a deep rooting zone, but their available moisture capacity generally is only medium because of coarse fragments in the lower layers. Permeability is moderate. The soils dry out and warm up rapidly in spring and are easy to work. Reaction in the rooting zone is very strongly acid or strongly acid.

Westmoreland soils are used mostly for pasture and woodland, but some areas are cultivated.

Representative profile of a Westmoreland silt loam in an area of Gilpin-Westmoreland silt loams, 35 to 70 percent slopes, in a wooded area in SE¼ sec. 22, Wayne Township, 4.1 miles west and 1.6 miles south of Woodsfield:

A1—0 to 2 inches, dark-brown (10YR 3/3) silt loam; weak, fine, granular structure; friable; many roots; 10 percent coarse material between 2 millimeters and 1 inch in size; strongly acid; abrupt, smooth boundary.

A2—2 to 6 inches, brown (10YR 5/3) silt loam; weak, medium, subangular blocky structure parting to weak, fine, crumb structure; friable; common roots; 10 percent coarse material between 2 millimeters and 1½ inches in size; strongly acid; clear, smooth boundary.

B1—6 to 9 inches, dark-brown (7.5YR 4/4) silt loam; weak, fine, subangular blocky structure; friable; common roots; 10 percent coarse material between 2 millimeters and 1 inch in size; very patchy, thin clay films on the ped surfaces; strongly acid; clear, smooth boundary.

B21t—9 to 14 inches, dark-brown (7.5YR 4/4) heavy silt loam; moderate, fine and medium, subangular blocky structure; firm; common roots; 10 percent coarse material between 2 millimeters and 1 inch in size; patchy, medium clay films on ped surfaces; very strongly acid; gradual, smooth boundary.

B22t—14 to 20 inches, dark-brown (7.5YR 4/4) silt loam; moderate, fine and medium, subangular blocky structure; firm; common roots; 20 percent coarse material between 2 millimeters and 1 inch in size; patchy, medium clay films on ped surfaces; strongly acid; gradual, smooth boundary.

B23t—20 to 26 inches, dark-brown (7.5YR 4/4) channery silt loam; moderate, fine and medium, subangular blocky structure; firm; common roots; 20 percent coarse material between 2 millimeters and 5 inches in size; patchy, medium clay films on ped surfaces; strongly acid; gradual, smooth boundary.

B24t—26 to 32 inches, dark-brown (7.5YR 4/4) channery silt loam; weak, fine and medium, subangular blocky structure; firm; common roots; 30 percent coarse material between 2 millimeters and 1 inch in size; patchy, thin clay films on ped surfaces; strongly acid; gradual, smooth boundary.

B25t—32 to 38 inches, dark-brown (7.5YR 4/4) channery silt loam; weak, fine and medium, subangular blocky structure; firm; common roots; 40 percent coarse material between one-fourth inch and 6 inches in size; patchy, thin clay films on ped surfaces; strongly acid; gradual, smooth boundary.

C1—38 to 44 inches, dark-brown (7.5YR 4/4) very channery silt loam; many, fine, distinct, brown (10YR 5/3) mottles; weak, fine and medium, subangular blocky structure; firm; few roots; 70 percent coarse material between one-half inch and 10 inches in size; strongly acid; gradual, smooth boundary.

C2—44 to 56 inches, dark-brown (7.5YR 4/4) very channery silt loam; massive; firm; few roots; 80 percent coarse material between one-half inch and 10 inches in size; strongly acid; gradual, smooth boundary.

R—56 inches, sandstone bedrock.

Thickness of the solum ranges from 20 to 40 inches. Depth to bedrock is more than 40 inches. A thin, dark-colored (10YR 3/3) A1 horizon and a thin A2 horizon (10YR 5/3) are present in undisturbed areas. Colors of the Ap horizon range from grayish brown (10YR 5/2) to dark brown (10YR 3/3). The Bt horizon ranges in color from dark brown (7.5YR 4/4) to yellowish brown (10YR 5/6). Weighted average clay content in the Bt horizon is about 18 to 25 percent. Sand content in the upper part of the Bt horizon is typically 15 to 25 percent. The content of coarse fragments increases with depth throughout the profile.

Westmoreland soils commonly are near or adjacent to Gilpin, Wellston, and Dekalb soils. They have a higher base saturation than Gilpin soils and are deeper to bedrock. They are very similar to Wellston soils but differ by having a higher sand content in the Bt horizon. They are more silty, less sandy, and deeper than the Dekalb soils.

## Wheeling Series

The Wheeling series consists of deep, nearly level to sloping, well-drained, loamy soils that formed in alluvial material on stream terraces. These soils are along the Ohio River and the Little Muskingum River, and to a lesser extent, along some of the smaller streams of the county.

A representative Wheeling soil in a cultivated area has a dark-brown silt loam plow layer about 8 inches thick. This layer is easy to work. The subsoil extends to a depth of 62 inches and is dark yellowish brown. It is mainly silty clay loam to a depth of 32 inches and silt loam below 32 inches. Below the subsoil, to a depth of 9 feet or more, there is dark yellowish-brown loam mottled with light brownish gray.

Wheeling soils are moderately permeable and absorb water readily. Surface runoff is slow to moderately rapid, depending on slope. Wheeling soils have a deep rooting zone and high available moisture capacity. They are medium acid to very strongly acid unless they have been recently limed.

The Wheeling soils in higher positions on terraces along the Ohio River are above the highest flood levels. Those in lower positions along the Ohio River are flooded for short periods of time by unusually high floods. Most of these lower areas were flooded in 1913, 1917, 1918, 1936, 1937, and 1948. A few areas along the Ohio River have been flooded more frequently than this. Wheeling soils that occupy terraces along the Little Muskingum River generally are flooded three or four times in a 10-year period. These infrequent floods are of short duration and do little if any crop damage.

Wheeling soils are used mainly for crops. They are well suited to all of the crops commonly grown in the county.

Representative profile of Wheeling silt loam, 0 to 2 percent slopes, in a meadow, NE¼ sec. 34, Perry Township, about 7 miles south of Woodsfield and about 475 feet southeast of County Road 42:

Ap—0 to 8 inches, dark-brown (10YR 4/3) silt loam; weak, fine, granular structure; friable; many roots; dark yellowish-brown (10YR 3/4) organic stains on ped faces; slightly acid; abrupt, smooth boundary.

B1—8 to 10 inches, dark yellowish-brown (10YR 4/4) silt loam; weak, medium, subangular blocky structure; friable; common roots; thin, patchy, dark-brown to brown (10YR 4/3) silt coatings on ped faces; medium acid; clear, smooth boundary.

B21t—10 to 16 inches, dark yellowish-brown (10YR 4/4) silty clay loam; moderate, medium, subangular blocky structure; firm; common roots; thin, very patchy, dark-brown (7.5YR 4/4) clay films on vertical ped faces; very strongly acid; clear, smooth boundary.

B22t—16 to 32 inches, dark yellowish-brown (10YR 4/4) silty clay loam; moderate, coarse, angular blocky structure; firm; few roots; thin, patchy, dark-brown (7.5YR 4/4) clay films on ped faces; moderate, continuous clay films in pores; very strongly acid; clear, smooth boundary.

B23t—32 to 43 inches, dark yellowish-brown (10YR 4/4) silt loam; weak, medium, prismatic structure parting to moderate, coarse, angular blocky; firm; few roots; thin, patchy, dark-brown (7.5YR 4/4) clay films on ped faces; moderate, continuous clay films in pores; very strongly acid; clear, smooth boundary.

B24t—43 to 62 inches, dark yellowish-brown (10YR 4/4) silt loam; weak, coarse, angular and subangular blocky structure; firm; few roots; thin, patchy, dark-brown (7.5YR 4/4) clay films on ped faces; moderate, continuous clay films in pores; very strongly acid; clear, smooth boundary.

C—62 to 110 inches, dark yellowish-brown (10YR 4/4) loam; common, fine, distinct, light brownish-gray (10YR 6/2) mottles; massive; few, fine, distinct, black (10YR 2/1) exterior concretions and dark-red (2.5YR 3/6) interior concretions; strongly acid.

Color of the Ap horizon includes dark brown (10YR 3/3), brown (10YR 4/3), and dark yellowish brown (10YR 3/4). Crushed colors have values of 4 or more. The B horizon colors include dark yellowish brown (10YR 4/4), yellowish brown (10YR 5/4), and brown (10YR 4/3, 7.5YR 4/4). Texture of the B horizon includes loam, silt loam, and silty clay loam. Weighted average clay content of the B horizon ranges from 22 to 35 percent. The C horizon textures are the same as in the B horizon, but sandy loam and fine sandy loam are also included. Loose sand and gravel underlies most profiles at depths ranging from 7 to 12 feet. In unlimed areas, reaction ranges from medium acid to very strongly acid. A Bt horizon is present but is weakly expressed. Clay films are thin and generally cover about 25 percent of ped faces. The increase in clay content for the Bt horizon as compared with the Ap horizon ranges from 4 to 8 percent. Content of coarse fragments in the solum is less than 5 percent, by volume. One or more horizons that are 50 inches or more below the top of the Bt horizon have base saturation that ranges from 35 to 60 percent.

The Wheeling soils in Monroe County are deeper to loose sand and gravel than typical Wheeling soils in other survey areas. This difference does not affect the use and behavior of the soils.

Wheeling soils are near or adjacent to the Sciotoville soils that also occupy terraces. They are better drained and lack the fragipan that is characteristic of Captina and Sciotoville soils. They are more acid than the Chagrin and Huntington soils that are on flood plains, and they have an illuvial B horizon that is lacking in those soils. In addition, Wheeling soils typically are lighter colored than Huntington soils. They are typically lighter colored and contain more sand in the upper part of the B horizon than the Ashton soils, which are mainly on terraces along Sunfish Creek. Wheeling soils are much deeper and less gravelly than the Conotton soils.

**Wheeling silt loam, 0 to 2 percent slopes** (WrA).—This soil is mainly on low terraces along the Little Muskingum River and its tributaries. A small acreage occurs along the Ohio River. This soil has the profile described as representative for the series. Most areas are 5 to 30 acres in size or are adjacent to large areas of nearly level Chagrin or Huntington soils on flood plains. Thus, this Wheeling soil is readily accessible and easily farmed. The long, narrow shape of most areas is an aid to farming. Included in mapping were some areas of wetter soils.

All areas of this soil are cleared. Most of them are used for crops and pasture, but a few along the Ohio River are idle. This soil is very well suited to farming. It has no serious limitations for intensive cropping, but flooding is a limitation to all uses in areas subject to flooding. (Capability unit I–1; woodland suitability group 1o1 on all aspects)

**Wheeling silt loam, 2 to 6 percent slopes** (WrB).—This soil is on low stream terraces. Most areas are about 3 to 5 acres in size, but a few areas along the Ohio River are as large as 20 acres. A few areas are on alluvial fans. This soil is generally near or adjacent to Huntington, Chagrin, and Lindside soils on the lower flood plains.

Most areas of this soil are used for cropland. If managed properly, the soil is well suited to farming. There is a moderate hazard of erosion in cultivated areas, and flooding is a limitation to most nonfarm uses in areas subject to flooding. (Capability unit IIe–2; woodland suitability group 1o1 on all aspects)

**Wheeling silt loam, 6 to 18 percent slopes, moderately eroded** (WrC2).—This soil is on low stream terraces. It is mostly in long, narrow areas about 3 to 6 acres in size. They are mainly on breaks between less sloping Wheeling soils and the adjacent, lower lying Huntington, Chagrin, or Lindside soils.

Sheet and rill erosion have occurred in most areas of this soil, but these eroded areas generally have good tilth and are easy to till. The present surface layer is mostly material from the original one, but this has been mixed with some of the subsoil. In a few places the plow layer is mainly dark yellowish-brown material that formerly was subsoil.

Included in mapping were a few areas of moderately steep soils and areas of soils that are slightly higher in sand and gravel content, particularly in the surface layer. A few small areas of more poorly drained soils also were included.

Most areas of this soil are used for crops. If managed properly, the soil is well suited to farming, but the hazard of erosion is severe in cultivated areas. Slope and the hazard of flooding are limitations to most nonfarm uses. (Capability unit IIIe–4; woodland suitability group 1o1 on all aspects)

## Woodsfield Series

The Woodsfield series consists of deep, well-drained soils. The upper layers of these soils formed in silty loess; the lower layers formed in material weathered from reddish clay shale. These soils are gently sloping to moderately steep and are on ridgetops, side slopes,

and benches throughout the county. In this county they were mapped individually and in complexes with Zanesville soils.

A representative Woodsfield soil in a cultivated area has a dark grayish-brown silt loam plow layer about 7 inches thick. This layer is easy to till. The upper part of the subsoil, to a depth of 20 inches, is mainly brown silty clay loam. The lower part, to a depth of 50 inches, is dark-red heavy silty clay loam, dark reddish-brown and yellowish-red silty clay, and reddish-brown clay. Below the subsoil, to a depth of 56 inches, is yellowish-brown silty clay loam with mottles of light olive brown and light gray. Bedrock is at a depth of 56 inches.

Woodsfield soils have a medium available moisture capacity. Their upper layers are moderately permeable, but the reddish, clayey lower part of the subsoil is slowly permeable. During wet periods a perched water table is present for short periods. If not protected, these soils are subject to severe erosion. Where they have not been limed recently, they are medium acid to very strongly acid.

Woodsfield soils are used mostly for cultivated crops and meadow.

Representative profile of Woodsfield silt loam, 6 to 12 percent slopes, moderately eroded, in a cultivated field, NW¼ sec. 17, Adams Township, 0.7 mile north of junction of Township Roads 36 and 378:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, granular structure; friable; many roots; neutral; abrupt, smooth boundary.

B1—7 to 10 inches, strong-brown (7.5YR 5/6) heavy silt loam; weak, medium, subangular blocky structure; friable; common roots; thin, very patchy, brown (10YR 4/3) silt coatings and thin, very patchy, yellowish-brown (10YR 5/6) clay films on ped faces and in pores; slightly acid; clear, smooth boundary.

B21t—10 to 15 inches, brown (7.5YR 5/4) light silty clay loam; moderate, medium, subangular blocky structure; firm; common roots; thin, very patchy, reddish-brown (5YR 5/4) clay films on vertical ped faces and in pores; very strongly acid; clear, smooth boundary.

B22t—15 to 20 inches, brown (7.5YR 5/4) silty clay loam; moderate, medium, subangular blocky structure; firm; common roots; thin, patchy, reddish-brown (5YR 5/4) clay films on both vertical and horizontal ped faces and in pores; very strongly acid; clear, smooth boundary.

B23t—20 to 24 inches, dark-red (2.5YR 3/6) heavy silty clay loam; moderate, medium, subangular blocky structure; firm; few roots; thin, patchy, reddish-brown (2.5YR 4/4) clay films and thin, patchy, reddish-brown (5YR 5/4) silt coatings on vertical and horizontal ped faces and in pores; strongly acid; abrupt, wavy boundary.

IIB24t—24 to 42 inches, dark reddish-brown (2.5YR 3/4) silty clay; moderate, coarse, angular blocky structure; very firm; few roots; thin, continuous, dark reddish-brown (2.5YR 3/4) clay films and thin, very patchy (less than 5 percent), reddish-brown (5YR 5/4) silt coatings on vertical and horizontal ped faces and in pores; slickensides or pressure faces are common; medium acid; abrupt, smooth boundary.

IIB31t—42 to 48 inches, yellowish-red (5YR 5/6) silty clay; weak, coarse and medium, angular blocky structure; firm; few roots; thin, continuous, reddish-brown (5YR 5/4) clay films on vertical and horizontal ped faces; few pinkish-gray (5YR 6/2) streaks in root channels; medium acid; abrupt, smooth boundary.

IIB32t—48 to 50 inches, reddish-brown (2.5YR 4/4) clay; weak, coarse and medium, angular blocky structure; very firm; few roots; thin, continuous, reddish-brown (2.5YR 4/4) clay films on vertical and horizontal ped faces; medium acid; abrupt, smooth boundary.

IIIC—50 to 56 inches, yellowish-brown (10YR 5/6) light silty clay loam; common, fine, distinct, light olive-brown (2.5Y 5/6) mottles and many, fine, prominent, light-gray (2.5Y 7/2) mottles; massive; very firm, medium acid; abrupt, smooth boundary.

IVR—56 inches, sandstone bedrock.

Thickness of the solum ranges from 40 to 60 inches. Depth to bedrock ranges from 40 to 66 inches. The color of the Ap horizon is dark grayish brown (10YR 4/2) or brown (10YR 4/3). Where an A1 horizon is present, it is 1 to 4 inches thick and is very dark grayish brown (10YR 3/2), dark brown (10YR 3/3), or very dark brown (10YR 2/2). The A2 horizon, if present, is 2 to 8 inches thick and has colors with a value of 4 or 5 and a chroma of 2, 3, or 4. The B1 horizon is 2 to 6 inches, is slightly finer in texture than the A horizon, and has a few, thin clay films as well as silt coatings. The upper part of the Bt horizon is 15 inches thick or less; it is heavy silt loam or silty clay loam that is 24 to 35 percent clay. Clay films are evident. Silt coatings are present in places. This part of the Bt horizon is generally unmottled but in places has a few to common mottles with chroma of 3 or higher. It has a hue of 5YR, 7.5YR, or 10YR; value of 4 or 5; and chroma of 4, 5, 6, or 8.

The reddish lower part of the Bt horizon, at depths ranging from 15 to 30 inches, is heavy silty clay, silty clay, or clay. Its clay content ranges from 35 to 60 percent. Pressure faces, clay films, and silt coatings are common. Silt coatings have a hue of 10YR, 2.5Y, or 5Y. Dominant chroma is less than 6 throughout the major part of the Bt horizon, and chroma of 2 or less does not occur within the upper 10 inches of the Bt horizon. The Bt horizon ranges from 32 to 50 inches in thickness. Unless limed, the solum is medium acid to very strongly acid. Reaction in the substratum is more variable, but base saturation is more than 35 percent. Weighted average clay content of the upper 20 inches of the Bt horizon ranges from 35 to 44 percent. The average is 38 percent. Oxide concretions are common throughout the lower part of the solum and the C horizon. Content of coarse material in the solum ranges from 0 to 10 percent; this material is mostly channery fragments of shale or sandstone.

Woodsfield soils have a thicker silt mantle and are thicker to a B horizon of clay than Upshur soils. They are less acid in the lower part of the subsoil and in the substratum than Coolville and Keene soils. Also, they have redder hues than Keene soils and lack the variegated red, gray, and yellowish-brown colors that are characteristic of the Coolville and Rarden soils. Woodsfield soils are redder and finer textured in the lower part of the B horizon than Zanesville and Wellston soils, and they lack the fragipan of Zanesville soils.

**Woodsfield silt loam, 2 to 6 percent slopes** (WfB).—This soil is on ridgetops that are gently rounded and smoothly uniform. Its profile generally has a slightly darker colored and thicker surface layer than that described as representative for the series. In a few areas, 25 to 75 percent of the original surface layer has been removed by sheet erosion. In these eroded areas, the remaining part of this layer has been mixed with subsoil material and the plow layer is yellowish-brown or brown heavy silt loam.

Included in mapping were a few small spots of the wetter Zanesville soils. The lower part of the subsoil of the Zanesville inclusions contains a fragipan that restricts the movement of air and water and limits root penetration.

Almost all areas of this soil are cleared and in crops and pasture. The soil is well suited to crops. It is easily managed and well suited to the use of farm machinery. The hazard of erosion is moderate in cultivated areas. Slow permeability is the dominant limitation to some

nonfarm uses. (Capability unit IIe–3; woodland suitability group 2o1 on all aspects)

**Woodsfield silt loam, 6 to 12 percent slopes, moderately eroded** (WtC2).—This soil is on smoothly rounded ridgetops. Sheet and rill erosion have resulted in the loss of up to 75 percent of the original surface layer. In most areas the remaining part of this layer, 2 to 7 inches thick, has been mixed with some of the lighter colored subsoil through tillage. In a few areas, mostly wooded, the original surface layer is 7 to 10 inches thick. A profile of this soil is described as representative for the series.

This soil is suited to all the crops commonly grown in the county. The hazard of erosion is severe in cultivated areas. Slope and slow permeability are major limitations to some nonfarm uses. (Capability unit IIIe–3; woodland suitability group 2o1 on all aspects)

**Woodsfield silt loam, 12 to 18 percent slopes, moderately eroded** (WtD2).—This soil commonly is on benches in long, narrow areas. Most benches are only 150 to 400 feet wide, but many of them extend around hillsides for many hundreds of feet. Other areas are on upper slopes near ridgetops and around small drainageways near upland divides. Slopes are generally smooth and uniform, but some benches are cut by drainageways that are inaccessible to machinery.

Included in mapping, mostly on benches, were areas of soils that are more than 7 feet deep to bedrock and have some channery fragments of sandstone in the solum.

Most areas of this soil are in cropland and pasture. Runoff is rapid, and the hazard of erosion is severe in unprotected areas. Slope is the dominant limitation to many nonfarm uses of this soil. (Capability unit IVe–3; woodland suitability group 2r1 on north and east aspects and 3r1 on south and west aspects)

## Woolper Series

The Woolper series consists of deep, dark-colored soils that are well drained. These soils are on alluvial fans and on colluvial foot slopes.

Woolper soils on alluvial fans are gently sloping and occur throughout the county. These fans are small and lie at the mouth of waterways where a small waterway joins a larger one. Here, soil material was washed from the adjacent uplands that are underlain by limestone, siltstone, shale, and sandstone bedrock. Limy material is dominant. Woolper soils on alluvial fans are subject to infrequent flooding.

In the eastern and northwestern parts of the county, Woolper soils are sloping to very steep and are on colluvial foot slopes and benches below very steep hillsides. Here, the soils formed in deep deposits of soil material that was moved down from higher adjacent slopes. Limy material is dominant. In these areas the Woolper soils occur with the moderately well drained Sees soils, and soils of the two series are intermingled in such intricate, irregular patterns that they could not be accurately separated on the soil map. They were, therefore, mapped together in complexes and in an undifferentiated group.

A representative Woolper soil on an alluvial fan in a meadow has a dark-brown silt loam plow layer about 7 inches thick. The upper part of the subsoil, to a depth of 18 inches, is dark-brown, friable silty clay loam. The lower part, to a depth of 54 inches, is mostly dark yellowish-brown, firm silty clay loam. Below the subsoil, to a depth of 64 inches, is firm, dark yellowish-brown silty clay loam. A representative Woolper soil on a colluvial foot slope is similar to the one in the foregoing description, except that there is less coarse material in the upper part of the profile. The soil on the foot slope also contains more clay, particularly in the lower part of the subsoil and in the substratum.

Woolper soils have a deep rooting zone and a medium to high available moisture capacity. They are moderately permeable in the surface layer, but permeability is moderately slow in the subsoil and substratum. These soils are normally in slightly convex, well-drained positions, and drainage generally is not a problem. Slippage occurs in some areas on colluvial foot slopes, and soil cracking is also common in these soils.

Representative profile of a Woolper silt loam in a field on an alluvial fan, SW¼ sec. 17, Washington Township, 2 miles west of Graysville along Straight Fork:

Ap—0 to 7 inches, dark-brown (10YR 3/3) heavy silt loam; weak, fine and medium, granular structure; friable; many roots; neutral; abrupt, smooth boundary.

B1t—7 to 11 inches, dark-brown (10YR 3/3) silty clay loam; weak, fine and very fine, subangular blocky structure; friable; common roots; thin, patchy, dark grayish-brown (10YR 4/2) clay films; neutral; clear, smooth boundary.

B21t—11 to 18 inches, dark-brown (10YR 3/3) heavy silty clay loam; moderate, fine and medium, subangular blocky structure; friable; common roots; medium, continuous, dark grayish-brown (10YR 4/2) clay films; neutral; clear, smooth boundary.

B22t—18 to 28 inches, dark yellowish-brown (10YR 3/4) heavy silty clay loam, crushes to brown (10YR 4/3); moderate, fine and medium, subangular blocky structure; firm; few roots; medium, continuous, dark grayish-brown (10YR 4/2) clay films; slightly acid; clear, smooth boundary.

B23t—28 to 35 inches, dark-brown (10YR 3/3) silty clay loam, crushes to brown (10YR 4/3); moderate, fine and medium, subangular blocky structure; firm; few roots; medium, patchy, dark grayish-brown (10YR 4/2) clay films; slightly acid; clear, smooth boundary.

B31t—35 to 44 inches, dark yellowish-brown (10YR 3/4) silty clay loam, crushes to brown (10YR 4/3); weak, medium, subangular blocky structure; firm; few roots; moderate, very patchy, dark grayish-brown (10YR 4/2) clay films; slightly acid; clear, smooth boundary.

B32t—44 to 54 inches, dark yellowish-brown (10YR 4/4) heavy silty clay loam; weak, medium, subangular blocky structure; firm; few roots; slightly acid; clear, smooth boundary.

C—54 to 64 inches, dark yellowish-brown (10YR 3/4) heavy silty clay loam; massive; firm; few roots; neutral.

The solum ranges from 30 to 60 inches in thickness. The thicker areas generally are on alluvial fans. Depth to bedrock ranges from 6 to more than 20 feet. Matrix colors in the Ap horizon are mainly 10YR in hue but range to 7.5YR. Except in a few eroded areas, color values are 3 or less when crushed. Colors of the B horizon normally have values of 3 to 5. Higher values are commonly in the lower part. Chroma is 3 or 4. Textures in the B horizon most commonly are heavy silty clay loam and clay. Silty clay and clay loam textures occur less frequently. The B2 horizon ranges from 35 to 55 percent clay. The content of coarse material ranges from 5 to 40 percent but averages about 10 percent. A wide variation in color is present in the substratum. Low-chroma mottles are included. Gravelly subsoil layers and thin strain of sand and gravel commonly occur on alluvial fans. Profiles on foot slopes commonly contain channery fragments of lime-

stone, sandstone, and siltstone that are oriented in all directions. Reaction in the solum is mostly slightly acid but is neutral in places.

The Woolper soils are better drained, have dark colors to greater depths in the upper part of the profile, and commonly have slightly less clay in the B horizon than the Sees soils. They are less acid and lack the reddish colors of the Vandalia and Hackers soils. They are deeper to bedrock than Brooke soils and have a finer textured B horizon than Hartshorn soils.

**Woolper silt loam, 2 to 6 percent slopes** (WxB).—This soil is in fan-shaped areas adjacent to small streams. Most areas are 1 to 4 acres in size. Slopes are smooth, uniform, or slightly convex. The largest acreage of this soil is in the western half of the county.

Included in mapping were a few small spots and narrow bands of soils that have a very channery or gravelly surface layer. These inclusions typically are near the present course of the small stream running through these areas and are the result of flooding. Cultivation is made more difficult by the presence of gravel and fragments. In a few areas there is faint mottling in the lower part of the subsoil.

This soil is well suited to all crops commonly grown in the county. Runoff is slow. Most of the rainfall enters the soil and is available to plants. Erosion is a moderate hazard if this soil is cultivated, and the soil is subject to infrequent flooding. Much of the flooding is the result of shallow, crooked, or clogged stream channels. Flooding is a serious limitation to nonfarm uses of this soil. (Capability unit IIe–2; woodland suitability group 2c1 on all aspects)

**Woolper and Sees silt loams, 6 to 12 percent slopes** (WyC).—These are very deep soils on alluvial fans and colluvial foot slopes. They have a clayey subsoil. Areas of the mapping unit on alluvial fans are nearly all Woolper soil, whereas those on colluvial foot slopes generally consist of about 45 percent Woolper soil, 45 percent Sees soil, and 10 percent other soils. Slopes are smooth and uniform and are suitable for all types of farm machinery. The small size of the individual areas is commonly a limitation to their use.

Areas of the mapping unit on alluvial fans are more suited to crops or as structure sites than the same soils on colluvial foot slopes. The use of the soils on colluvial foot slopes is controlled by the moderately well drained Sees soil, which is slow to dry out in spring. The Sees soil occurs mainly in the more concave-shaped areas of this mapping unit where there are seep spots.

This mapping unit is well suited to hay and pasture. It is also suited to row crops, but the hazard of erosion is severe in cultivated areas. Slopes and moderately slow to slow permeability is a limitation for many nonfarm uses. (Capability unit IIIe–4; woodland suitability group 2c1 on all aspects.)

## Zanesville Series

The Zanesville series consists of deep, moderately well drained, gently sloping to moderately steep soils. Most areas of these soils are on broad, gently rounded ridgetops, in benchlike areas between steeper slopes, and in broad, rolling areas near upland divides. These soils formed partly in loess and partly in material weathered from siltstone and shale beneath the loess. Zanesville soils are extensive throughout the county but are most common in the north-central and south-central parts.

A representative Zanesville soil in a cultivated area has a brown silt loam plow layer about 7 inches thick. This layer is easy to till. The upper part of the subsoil, to a depth of 13 inches, is strong-brown heavy silt loam. Below this, to a depth of 25 inches, is yellowish-brown light silty clay loam and heavy silt loam mottled with pale brown. The lower part of the subsoil, at depths between 25 and 40 inches, is a dense, yellowish-brown fragipan that is silt loam, silty clay loam, and clay loam in texture and that restricts the movement of air and water and hinders root penetration. It is distinctly mottled with gray and light brownish gray. Below the fragipan is yellowish-brown, very channery heavy silt loam mottled with grayish colors. Siltstone bedrock occurs at a depth of 55 inches.

Zanesville soils have only a medium available moisture capacity because of the restrictive fragipan. They are moderately permeable above the fragipan but are slowly permeable in it. Reaction is very strongly acid to strongly acid. A perched water table is above the fragipan late in winter and early in spring. In these areas the soils are saturated in wet periods, but they later dry out.

Artificial drainage is not normally needed except in special cases, such as urban use or where high-value crops are grown. Tiling is helpful in some areas, however, to dry the soil quickly so that machinery can be used early in spring or late in fall.

Most of the acreage of Zanesville soils is used for crops, a small acreage is in pasture, and a few areas are wooded or idle. These soils are suited to most crops, but stands of deep-rooted perennial crops, such as alfalfa, are hard to maintain.

Representative profile of Zanesville silt loam, 2 to 6 percent slopes, moderately eroded, in NE¼ sec. 26, Wayne Township, T. 6 N., R. 6 W., 300 feet southeast of farm pond, near center of wide ridgetop:

Ap—0 to 7 inches, brown (10YR 4/3) silt loam; moderate, medium, subangular blocky structure parting to weak, fine, granular; friable; very strongly acid; abrupt, clear boundary.

B1—7 to 13 inches, strong-brown (7.5YR 5/6) heavy silt loam; moderate, medium, subangular blocky structure; firm; thin, very patchy clay films; very acid; clear, smooth boundary.

B21t—13 to 18 inches, strong-brown (7.5YR 5/6) silty clay loam; moderate, medium, subangular blocky structure; firm; thin, patchy, dark-brown (7.5YR 4/4) clay films; strongly acid; clear, smooth boundary.

B22t—18 to 21 inches, yellowish-brown (10YR 5/6) light silty clay loam; many, medium, distinct, pale-brown (10YR 6/3) mottles; moderate, medium, angular blocky structure; firm; thin, patchy, dark-brown (7.5YR 4/4) clay films; strongly acid; clear, smooth boundary.

B23t—21 to 25 inches, yellowish-brown (10YR 5/6) heavy silt loam; many, medium and coarse, distinct, pale-brown (10YR 6/3) mottles; weak, fine and medium, subangular blocky structure; friable; thin, patchy, dark-brown (7.5YR 4/4) clay films; few black (10YR 2/1) iron or manganese coatings; very strongly acid; clear, smooth boundary.

IIBx1—25 to 30 inches, yellowish-brown (10YR 5/6) heavy silt loam; many, medium and coarse, distinct, light brownish-gray (10YR 6/2) mottles; weak, coarse, prismatic structure that parts to moderate, thick, platy; very hard when dry, firm when moist; thin,

very patchy, light brownish-gray (10YR 6/2) clay films; thick, continuous, light-gray (10YR 7/2) silty coatings on the prism faces; very strongly acid; clear, smooth boundary.

IIBx2—30 to 35 inches, yellowish-brown (10YR 5/6) light silty clay loam; many, medium, distinct, light brownish-gray (10YR 6/2) and gray (10YR 6/1) mottles; weak, coarse, prismatic structure that parts to moderate, thick, platy; very firm; thin, very patchy, light brownish-gray (10YR 6/2) clay films; thick, continuous, light-gray (10YR 7/2) silt coatings on the prism faces; very strongly acid; clear, smooth boundary.

IIBx3—35 to 40 inches, yellowish-brown (10YR 5/6) light clay loam; many, medium, distinct, light brownish-gray (10YR 6/2) and gray (10YR 6/1) mottles; weak, coarse, prismatic structure that parts to moderate, thick, platy; very firm; thin, very patchy, gray (10YR 6/1) clay films on ped faces; very strongly acid; clear, smooth boundary.

IIC1—40 to 50 inches, yellowish-brown (10YR 5/6) very channery heavy silt loam; many, medium, distinct, gray (10YR 6/1) and light brownish-gray (10YR 6/2) mottles; massive; very firm; 50 percent of matrix is fragments of yellowish-brown (10YR 5/6) siltstone or fine-grained sandstone; very strongly acid; clear, smooth boundary.

IIC2—50 to 55 inches, yellowish-brown (10YR 5/6) very channery heavy silt loam; few, medium, distinct, gray (10YR 6/1) and light brownish-gray (10YR 6/2) mottles; massive; very firm; 25 to 50 percent fragments of yellowish-brown (10YR 5/6) siltstone or fine-grained sandstone; strongly acid; clear, smooth boundary.

R—55 inches, siltstone bedrock.

Texture of the B horizon is generally heavy silt loam or light silty clay loam; loam and clay loam, if present, are only at depths below 30 inches. Depth to the fragipan ranges from 20 to 30 inches. Thickness of the fragipan averages 24 inches but ranges from 12 to 40 inches. Mottling generally occurs in the Bt horizon immediately above the fragipan. The B horizon has matrix colors of yellowish brown (10YR 5/6, 5/4) and strong brown (7.5YR 5/6). Depth to bedrock ranges from 4 to 5½ feet. Reaction in unlimed areas is strongly acid to very strongly acid.

Zanesville soils generally are near Wellston, Gilpin, and Woodsfield soils, all of which lack a fragipan in their subsoil. Zanesville soils are not so well drained as Wellston and Gilpin soils and are deeper to bedrock than Gilpin soils. They lack the reddish, fine-textured lower part of the subsoil that is characteristic of Woodsfield soils. They are more shallow to bedrock than Captina soils that occupy stream terraces. Zanesville soils differ from Coolville soils by having a fragipan. They are deeper than Dekalb soils and are not so well drained as those soils.

**Zanesville silt loam, 2 to 6 percent slopes** (ZnB).—This soil is on ridgetops throughout the county. The ridgetops are generally broad and have smooth, uniform slopes that are nearly level toward the center. The dark-brown to brown silt loam surface layer is 8 to 10 inches thick, and this is thicker than the one in the profile described as representative for the series. This soil has a well-developed, compact fragipan.

Included in mapping were a few spots of somewhat poorly drained soils. These wetter soils generally have slopes of 0 to 2 percent and commonly are near the center of the larger, less sloping areas of this soil. Other common inclusions are areas of Keene or Coolville soils where slopes are slightly over 6 percent.

Most areas of this Zanesville soil have been cleared and are used for cropland. The remaining acreage is mostly wooded. The use of this soil for farming is limited by a slight limitation of wetness and a moderate hazard of erosion. Slow permeability is a limitation for some nonfarm uses. (Capability unit IIe–3; woodland suitability group 2w1 on all aspects)

**Zanesville silt loam, 2 to 6 percent slopes, moderately eroded** (ZnB2).—This soil is on ridgetops throughout the county. Most areas are about 3 or 4 acres in size and have smooth, uniform slopes. A profile of this soil is described as representative for the series. The soil has a well-developed, dense fragipan in the subsoil. In most areas this soil has been cultivated intensively and has lost from 25 to 75 percent of the original surface layer through erosion. Rill erosion in wheel tracks is common in areas that have been cultivated up and down the slopes. Organic-matter content in the plow layer is lower than in the original surface layer. The soil is more subject to surface crusting than uneroded Zanesville soils.

In a few places, mostly near the center of large areas of this soil, small spots of nearly level, somewhat poorly drained soils were included in mapping. Other common inclusions are small areas of Keene and Coolville soils.

Most areas of this soil have been cleared and are used for crops, mainly corn and hay. A hazard of erosion is the dominant limitation to farming on this soil. Slow permeability is the dominant limitation to many nonfarm uses. (Capability unit IIe–3; woodland suitability group 2w1 on all aspects)

**Zanesville silt loam, 6 to 12 percent slopes** (ZnC).—This soil is on gently rounded ridgetops and, to a lesser extent, on benches and on short slopes around hillsides. The soil is especially extensive in the north-central part of the county where ridgetops are wide and uniform. The surface layer is more than 7 inches thick and is slightly thicker than the one in the profile described as representative for the series. This soil has a fragipan that is less dense and less well developed than the pan in the less steep Zanesville soils.

Included in mapping were narrow bands of the shallower Gilpin soils, which generally are around the edge of ridgetops near slope breaks. Also included were small areas of Keene and Coolville soils.

Most areas of this soil are wooded; a smaller acreage is mostly in pasture and cropland. This soil has favorable slopes for farming and is suited to cultivated crops. Erosion is the major limitation in cultivated areas. Slope and slow permeability are limitations for many nonfarm uses. (Capability unit IIIe–2; woodland suitability group 2w1 on all aspects)

**Zanesville silt loam, 6 to 12 percent slopes, moderately eroded** (ZnC2).—This soil is on gently rounded ridgetops, on benches, and in a few areas on hillsides. It occurs throughout the county but typically is in areas where the ridgetops are broader and more uniform. Intensive use of this soil for crops has resulted in the loss of surface soil through erosion. The plow layer is lighter colored and lower in organic-matter content and plant nutrients than the original surface layer. Rill erosion in wheel tracks is common in areas that have not been cultivated on the contour. As a result of erosion, this soil is more droughty and more likely to crust than uneroded Zanesville soils.

Most areas mapped as this soil include narrow bands of the more shallow Gilpin soils, mostly around the edge of ridgetops near the slope breaks. Some areas have in-

clusions of either Coolville, Keene, or Rarden soils. Also included are some small areas of severely eroded soils.

This soil is suited to farming, but the hazard of erosion is severe if the soil is cultivated and not protected. Small areas or narrow ridgetops are commonly managed with adjacent soils. Slope and slow permeability are limitations for many nonfarm uses. (Capability unit IIIe–2; woodland suitability group 2w1 on all aspects)

**Zanesville silt loam, 12 to 18 percent slopes, moderately eroded** (ZnD2).—This soil is on benches and side slopes throughout the county. The largest areas are near upland divides where the landscape is gently rolling. Many areas of this soil have smooth, uniform slopes. The soil has a profile similar to that described as representative for the series, but in some areas the fragipan is less compact and not so well developed.

This soil has lost from 25 to 75 percent of its original surface layer through erosion. As a result, the natural fertility, organic-matter content, and capacity to absorb moisture have been reduced. Erosion generally has been the result of poor cultivation practices and overgrazing of the pastures.

Included in mapping were a few spots of the more shallow Gilpin, Keene, Coolville, or Latham soils.

This soil is subject to very severe erosion if it is cultivated and not managed properly. Surface runoff is rapid. Smaller areas and areas not needed for row crops are well suited to long-term hay and pasture. Slope is the dominant limitation to nonfarm uses of this soil. (Capability unit IVe–3; woodland suitability group 2w3 on all aspects)

**Zanesville-Woodsfield silt loams, 2 to 6 percent slopes** (ZoB).—This mapping unit is on broad, gently sloping ridgetops. The largest acreage is in the more gently rolling north-central and central parts of the county. Slopes are smooth and uniform. Only slight erosion has occurred on these soils, and 7 to 10 inches of the original surface layer remains.

In most places the Zanesville soil makes up about 55 percent of the complex and the Woodsfield soil 30 percent. Included in mapping were a few spots of Coolville and Upshur soils, and these make up the remaining 15 percent. Seep spots occur in some areas.

Most areas of this complex have been cleared and are in crops or pasture. Only a small acreage is in woodland. Surface runoff is medium, and much of the rainfall is absorbed. The hazard of erosion is moderate if these soils are cultivated, and wetness is a slight limitation, particularly in spring. Slow permeability is the dominant limitation to nonfarm uses of these soils. (Capability unit IIe–3; woodland suitability group 2w1 on all aspects)

**Zanesville-Woodsfield silt loams, 2 to 6 percent slopes, moderately eroded** (ZoB2).—This mapping unit is on ridgetops throughout the county. Most areas are only 3 or 4 acres in size, and the ridgetops generally are only 200 or 300 feet wide. In most areas the original surface layer has been mixed with some of the subsoil through tillage.

In most places the Zanesville soil makes up about 55 percent of the complex, the Woodsfield soil about 30 percent, and included soils 15 percent.

Included in mapping were a few areas where the yellowish-brown subsoil is exposed. The present surface layer in these areas is more sticky and more cloddy than in less eroded areas. Also included were a few spots of Coolville and Upshur soils. Seep spots occur in some areas.

Nearly all areas of this complex have been cleared and cultivated. Many of these areas have reverted to pasture. Slopes are suitable for farming, but there is a moderate hazard of erosion if cultivated crops are grown. Slow permeability is the dominant limitation of this soil to most nonfarm uses. (Capability unit IIe–3; woodland suitability group 2w1 on all aspects)

**Zanesville-Woodsfield silt loams, 6 to 12 percent slopes** (ZoC).—This mapping unit generally is on broad, gently rounded ridgetops and in sloping areas near drainage divides. A smaller acreage occupies some of the sloping benches and lower slopes. Slopes are typically smooth and uniform. The soils are only slightly eroded and have 7 to 10 inches of their original surface layer remaining.

In most areas the Zanesville soil makes up about 55 percent of the complex, the Woodsfield soil 30 percent, and included soils 15 percent. A few small spots of Wellston and Coolville soils were included in mapping.

About half the acreage of this complex has been cleared and is used for crops and pasture. The remaining acreage is mostly wooded. The soils are suited to all the crops commonly grown in the county, but the hazard of erosion is severe if the soils are cultivated. Runoff is rapid. Slope and slow permeability are limitations for many nonfarm uses. (Capability unit IIIe–2; woodland suitability group 2w1 on all aspects)

**Zanesville-Woodsfield silt loams, 6 to 12 percent slopes, moderately eroded** (ZoC2).—This mapping unit is on rounded ridgetops and in a few sloping areas around small drainageways near upland divides. The soils occur throughout the county. Intensive grazing and cultivation have resulted in the loss of 25 to 75 percent of the original surface layer. In most places the remaining surface layer has been mixed with the finer textured upper part of the subsoil through tillage.

In most areas the Zanesville soil makes up about 55 percent of the complex, the Woodsfield soil 30 percent, and inclusions 15 percent.

Included in mapping were small spots of Wellston soils and Coolville soils. Also included were some areas of very severely eroded soils.

Nearly all of this complex has been cleared. Only a small acreage remains in woodland. The soils are suited to farming, but there is a severe hazard of erosion if they are cultivated. Slope and slow permeability are limitations for most nonfarm uses. (Capability unit IIIe–2; woodland suitability group 2w1 on all aspects)

**Zanesville-Woodsfield silt loams, 12 to 18 percent slopes, moderately eroded** (ZoD2).—This mapping unit generally is in long, benchlike areas around hillsides that are generally bounded above and below by steeper soils. Other areas are around small upland drainageways and on slopes below ridgetops near drainage divides. Slopes typically are smooth and uniform. Small landslips occur in a few places. Where the soils are on hillside benches, their surface layer generally contains some sandstone fragments. Some of the benches are cut by drainageways uncrossable by farm machinery.

In most areas the Zanesville soil makse up about 55 percent of the complex, the Woodsfield soil 30 percent,

and included soils 15 percent. Included in mapping were narrow bands of the shallower Gilpin soils around the edge of some mapped areas.

Overgrazing or excessive use for crops has caused the loss of surface soil from the soils in this complex. Most areas have 25 to 75 percent of the original surface layer remaining, but in small spots the subsoil is exposed. Rill and sheet erosion is common in areas that have been cultivated up and down the slope, and shallow gullies have formed in some places. A few areas, mostly wooded, have over 7 to 10 inches of the surface layer remaining.

Most areas of this complex have been cleared and are used for hay and pasture. Much rainfall runs off these moderately steep soils. Areas on hillside benches receive additional runoff from upslope. Unprotected areas are subject to damage by erosion. The hazard of erosion is severe in cultivated areas. Slope is the dominant limitation to most nonfarm uses of this soil. (Capability unit IVe–3; woodland suitability group 2wl on all aspects)

# *Formation and Classification of the Soils*

This section discusses the factors of soil formation and the processes of soil formation, particularly as they apply to the soils in Monroe County. Next, the soils in the county are classified by higher categories. The last part of the section shows laboratory data for selected soils.

## Factors of Soil Formation

Parent material, climate, living organisms, time, and topography are the five factors in soil formation. Climate and living organisms have an effect on parent materials that is modified by time and topography. The relative importance of each factor differs from place to place. In some areas one factor dominates and is responsible for most of a soil's properties. Normally, however, the interaction of all five factors determines what kind of soil develops in any given place.

### *Parent material*

Parent material is the unconsolidated mass from which the soil has formed. In Monroe County these materials can be divided into four groups: residual materials, which have developed in place by weathering of the underlying bedrock; colluvial materials, which have weathered from bedrock strata located at higher elevations and have been transported by water and gravity to the lower base slopes; alluvial materials deposited along streams; and a silt mantle deposited in place by wind action.

Most soils in the county formed in residual materials that were derived from material weathered from two or more different kinds of rock strata. The reasons for this are that the bedrock strata are nearly horizontal and the strata vary in horizontal thickness and generally are not consistent over any given large area. Consequently, several different rock strata are exposed on the dissected landscape within short distances laterally. Thus, the soils occurring on the sloping landscape normally contain layers that formed in mixed residuum.

Gray sandstone, siltstone, acid gray shale, and red shale, some of which contain limy material, are the dominant kinds of bedrock in the county. The Gilpin, Westmoreland, Wellston, and Zanesville soils occur where stratified siltstone and sandstone bedrock is dominant. Upshur and Woodsfield soils occur where the underlying bedrock is mainly red clay shale. A complex pattern is common for these soils on sloping landscapes.

Limestone is extensive in the northwestern part of the county and on the lower slopes in the western and northeastern parts; much of it is interbedded with shale and siltstone. Limestone outcrops occur in only a few places in other parts of the county, mainly on ridgetops and knolls. The extensive Guernsey and Westmore soils formed in residuum derived from interbedded limestone, acid and alkaline shale, and siltsone. The Brooke soils occur where the residuum was derived essentially from limestone.

Dekalb soils formed in residuum that weathered mainly from medium- to coarse-grained sandstone. These soils are extensive on the upper steeper slopes in the south-central part of the county.

The clayey Keene and Latham soils formed in residuum from acid gray clay shale. Coolville and Rarden soils have variegated red and gray colors and a clayey subsoil that were inherited from weathered clayey shale.

Colluvial deposits of various thickness are at the foot of steep slopes. These deposits consist of sediment washed or rolled downslope from the soils and weathering bedrock above. They are mixtures of materials found on the slope above them. Sees, Vandalia, and Woolper soils formed on such deposits. Woolper soils also occur on alluvial fans that are at the mouth of small waterways that fan out on larger bottom-land areas.

Alluvial materials have been laid down by water in the many valleys throughout the county. These deposits are dominantly silts and sands that contain smaller amounts of clay; some areas are gravelly. Hartshorn, wet variant, soils are in small valleys; Chagrin, Lindside, and Newark soils are along the larger or secondary streams; and the Huntington soils are along the Ohio River. Ashton soils occur along Sunfish Creek. They are on low terraces where flooding occurs but is infrequent. Wheeling and Sciotoville soils occur elsewhere in the county in the same position in the landscape. Soils on the higher terraces that are well above flooding are the Captina and Conotton soils and some Wheeling and Sciotoville soils. With the general exception of Captina soils, these soils on the higher terraces that occur along the Ohio River are underlain by glaciofluvial deposits of sand and gravel. This sediment is presumably of the Wisconsin Glacial Age. It is of mixed mineralogy and contains small amounts of carbonates.

The surface layer and upper horizons of many of the soils in the county formed in a thin mantle of silt. This mantle is commonly 15 to 25 inches thick in the Zanesville soils, 15 to 30 inches thick in the Woodsfield soils, and 8 to 15 inches thick in many of the other soils.

### *Climate*

The present climate of Monroe County is of the humid, temperate, continental type. The effects of such a climate can be observed in the soils. Rainfall and temperature have been conducive to plant growth, and, as a result,

all of the soils have a surface layer that contains measurable amounts of organic matter. The frequency of rainfall has been favorable for the movement of clay from the surface layer to the subsoil. The Guernsey and Woodsfield are among the soils that have clay films in the subsoil that are evidence of such movement. The structure in most of the soils is, at least partly, the result of freezing and thawing.

In an area the size of a county, climate is fairly uniform. Consequently, its effects on the local differences observed in soils is minor. Differences in soils within the county are determined more by differences in parent material, relief or topography, and time rather than by differences in climate. Locally, there can be significant differences in climate, but these are generally the result of differences in topography.

Additional information about the climate is given in the section "General Nature of the County."

### *Living organisms*

Living organisms are active in the soil-forming process. Hardwood forest has been the dominant vegetation in Monroe County, and most of the soils on uplands, such as Coolville, Gilpin, Wellston, and Zanesville, have characteristics of soils that formed under hardwood trees. These soils have a light-colored surface and subsurface layers. The Ashton, Brooke, Woolper, and Sees soils have a dark-colored surface layer. This is due to a higher organic-matter content, commonly 4 to 7 percent for uneroded areas. High lime content and moderately fine texture appear to be important factors that lead to this higher accumulation of organic matter.

Some of the native hardwood trees are deep rooted. They take up minerals from lower horizons in the soil and later deposit these minerals on the soil surface, mainly in leaf litter. Evidence of this can be observed in the county for such trees as tulip-poplar and basswood. These trees mine nutrients (bases) from the soil and return them to the surface in leaves and other litter. The soil reaction of the A1 horizon is commonly slightly acid to neutral where tulip-poplar trees are growing, even on acid soils, such as Gilpin and Wellston.

Insects, worms, tree roots, and small animals make the soil more permeable by making channels to great depths. Soil mixing is also a product of their activities. Man is altering the course of soil development. He has changed the vegetation and the drainage pattern in many places, and he changes the chemical regime by liming and fertilizing.

### *Time*

The length of time that parent material has been in place and exposed to the active forces of living organisms and climate is an important factor in soil formation. The soils in Monroe County have been forming for varying lengths of time. Soils on the flood plains are still being affected by periodic flooding. As a result, their formation is periodically interrupted. They have, however, formed a surface layer of organic-matter accumulation, and their subsoil shows evidence of alteration of the original material. Examples of these soils are Chagrin, Hartshorn, Huntington, Lindside, and Newark.

Many of the soils in the county are steep to very steep. On some of these soils, soil material is being removed by geologic erosion before it has time to develop into a deep soil with distinct horizons. These soils do not have some of the characteristics of soils on more stable topography, but they are in equilibrium with their environment. Examples of such soils are Dekalb and Gilpin. The Bt horizons in these soils are either weakly expressed or not expressed at all.

Ashton, Conotton, Hackers, Sciotoville, Sees, Wheeling, Woolper, and Vandalia soils are on colluvial toe slopes or on alluvial fans or terraces that are not subject to frequent flooding. Soil formation in these areas is subject to some additions of soil material or physical alteration, and this tends to interrupt the development of these soils.

In contrast, soils on wide, flat ridgetops and high terraces are examples of more strongly weathered soils. Here the soil-forming processes have had opportunity to produce distinct changes in the original parent material. Truncation of the soils by geological erosion has been slow, and soil formation has proceeded with a few or no interruptions. Captina, Woodsfield, and Zanesville soils are examples of those that have characteristics produced by long periods of essentially uninterrupted soil formation. These characteristics include deep leaching of carbonates and formation of thick, well-defined Bt horizons.

### *Topography*

Relief of the land has a major influence on soil-forming processes. It affects the rate of surface drainage, the movement of water through the soil, and the local climate. The soils having steep slopes normally have greater surface runoff, less infiltration of water, and a higher rate of erosion than soils of lesser slope. Consequently, many steeper soils have relatively thinner profiles and show horizons that are less developed than less sloping soils. An example of this is the contrast between Gilpin and Wellston soils. The Gilpin soils are more extensive where slopes are steeper.

Topography has directly affected the microclimate. The soils having slopes that face south or southwest are drier and less productive than those that face north and northeast. The direction of the slopes affects the action of the prevailing winds and the intensity of the sun rays, and these forces affect the evapotranspiration rate, the breakdown of organic matter, and kind and rate of vegetative growth. Gilpin soils that are on the drier aspects are less productive, have slightly less organic matter in the surface layer, and generally have different kinds of vegetation growing on them than Gilpin soils on the north aspects.

## Processes of Soil Formation

The factors of soil formation discussed previously largely control or influence four soil-forming processes: additions, losses, transfers, and alterations. Some of the processes promote differences within a soil, whereas others retard or preclude differences.

Additions to soils include additions of organic matter to the surface layer, additions of bases in the organic matter and in ground water, deposition of silt by runoff water from sloping areas at higher elevations, and the addition of bases contained in lime and fertilizer. The dark-colored surface layer of Ashton, Woolper, and other

soils is evidence of the addition of organic matter. All the soils have had at least a thin layer of organic accumulation, but in some places cultivation has largely destroyed this identity. To some extent, plant nutrients are recycled from soil to plants and back to soil in the form of litter or organic materials. This occurs in all of the soils in the county. Chagrin, Hartshorn, Huntington, Lindside, Newark, and other soils periodically receive additions of soil material from flooding. Additions of lime and fertilizer to cultivated areas counteract, or exceed, losses of plant nutrients that normally occur.

Losses in soils occur as removal of bases by leaching, removal of plant nutrients by crops, and actual loss of soil by erosion. One of the most significant losses in Monroe County soils involves the leaching of carbonates. In soils of the uplands, such as those of the Guernsey series, carbonates have been removed to a depth of 40 to 50 inches. Other minerals in the soil break down and are lost by leaching but at a slower rate than the carbonates. The alteration of other minerals produces free iron oxides. These cause fairly bright reddish or brownish colors in soils such as Rarden and Upshur. The mottling observed in all but the well-drained soils is caused by reduction and resegregation of the iron oxides as a result of excess water or slowly permeable soil horizons.

The most significant transfers in the soils of Monroe County involve transfers of colloidal material from the surface layer to lower horizons. The fine clays are suspended in percolating water moving downward from the surface layer. Seasonal drying or precipitation causes the fine clays to be deposited on the soil surfaces in cracks or root channels. Clay films of this nature are present in Captina, Woodsfield, and Zanesville soils. Various sesquioxides are also transferred from the surface to lower horizons of most of the soils.

Transformation within the zone of weathering involves the transformation of primary minerals such as feldspars and biotite. Most important of the transformations involves the formation of silicate clay minerals. Illite and vermiculite are two of the most common clay minerals in the soils of Monroe County. Kaolinite clay is an indicator of fairly intense weathering and occurs in minor amounts in most of the soils in the county.

## Classification of the Soils

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (*3*) and later revised (*12*, *10*). The system currently used was adopted for general use by the National Cooperative Soil Survey in 1965 and supplemented in March 1967 and September 1968 (*14*). This system is under continual study, and readers interested in the development of the system should refer to the latest literature available.

The current system of classification defines classes in terms of observable or measurable properties of soils (*14*). It has six categories. Beginning with the most inclusive, the categories are the order, suborder, the great group, the subgroup, the family, and the series.

In table 9 the soil series of Monroe County are placed in some of the categories of the current system. The placement of some soil series, particularly in families, may change as more precise information becomes available.

The six categories of the current system are described briefly in the following paragraphs.

ORDER.—Soils are grouped into orders according to properties that seem to have resulted from the same processes acting to about the same degree on the parent material. Ten soil orders are recognized in the current system: Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Alfisols, Spodosols, Ultisols, Oxisols, Histosols. The properties used to differentiate the soil orders are those that tend to give broad climatic groupings of soils. Two exceptions, Entisols and Histosols, occur in many different climates. Four of the six orders occur in this county: Inceptisols, Mollisols, Alfisols, and Ultisols.

Inceptisols occur on young land surfaces. This order is represented in Monroe County by soils of the Chagrin, Dekalb, Hartshorn, wet variant, and Lindside series.

Mollisols have a thick, dark-colored surface layer, moderate to strong structure, and base saturation of more than 50 percent. This order is represented by soils of the Huntington series.

Alfisols have a clay-enriched B horizon and a base saturation of more than 35 percent. This order is represented by soils of the Ashton, Brooke, Conotton, Guernsey, Hackers, Keene, Sciotoville, Sees, Upshur, Vandalia, Wellston, Westmore, Westmoreland, Wheeling, Woodsfield, and Zanesville series.

Ultisols are soils that have a clay-enriched B horizon but are low in base saturation. This order is represented by the Captina, Coolville, Gilpin, Latham, and Rarden series.

SUBORDER.—Each order is divided into suborders, primarily on the basis of soil characteristics that seem to produce classes that have the greatest genetic similarity. The soil properties used are mainly those that reflect the presence or absence of waterlogging or differences in climate or vegetation. The climatic range of the suborders is narrower than that of the orders.

GREAT GROUP.—Each suborder is divided into great groups on the basis of uniformity in the kinds and sequence of major horizons and soil features. The horizons considered are those in which clay, iron, or humus has accumulated and those that have pans that interfere with the penetration of roots or the movement of water. Among the features considered are the self-mulching properties of clays, soil temperature, and chemical composition (mainly calcium, magnesium, sodium, and potassium). The great group is not shown in table 9, because the name of the great group is the same as the last word in the name of the subgroup.

SUBGROUP.—Each great group is divided into subgroups, one representing the central (typic) segment of the group, and other groups, called intergrades, that have properties of one great group and also one or more properties of another group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside the range of any other great group, suborder, or order.

FAMILY.—Families are established within a subgroup primarily on the basis of properties that affect the growth of plants or the behavior of soils when used

TABLE 9.—*Soil series classified by higher categories*

| Soil series | Family | Subgroup | Order |
|---|---|---|---|
| Ashton | Fine-silty, mixed, mesic | Mollic Hapludalfs | Alfisols. |
| Brooke | Fine, mixed, mesic | Mollic Hapludalfs | Alfisols. |
| Captina | Fine-silty, mixed, mesic | Typic Fragiudults | Ultisols. |
| Chagrin [1] | Fine-loamy, mixed, mesic | Dystric Fluventic Eutrochrepts | Inceptisols. |
| Conotton [1] | Loamy-skeletal, mixed, mesic | Typic Hapludalfs | Alfisols. |
| Coolville | Clayey, mixed, mesic | Aquic Hapludults | Ultisols. |
| Dekalb | Loamy-skeletal, mixed, mesic | Typic Dystrochrepts | Inceptisols. |
| Gilpin | Fine-loamy, mixed, mesic | Typic Hapludults | Ultisols. |
| Guernsey [1] | Fine, mixed, mesic | Aquic Hapludalfs | Alfisols. |
| Hackers [1] | Fine-loamy, mixed, mesic | Typic Hapludalfs | Alfisols. |
| Hartshorn | Fine-loamy, sandy, or sandy-skeletal, mixed, mesic | Dystric Fluventic Eutrochrepts | Inceptisols. |
| Hartshorn, wet variant. | Fine-loamy over sandy or sandy-skeletal, mixed, mesic | Typic Haplaquepts | Inceptisols. |
| Huntington | Fine-silty, mixed, mesic | Fluventic Hapludolls | Mollisols. |
| Keene | Fine-silty, mixed, mesic | Aquic Hapludalfs | Alfisols. |
| Latham | Clayey, mixed, mesic | Aquic Hapludults | Ultisols. |
| Lindside [1] | Fine-silty, mixed, mesic | Fluvaquentic Eutrochrepts | Inceptisols. |
| Newark | Fine-silty, nonacid, mixed, mesic | Aeric Fluvaquents | Entisols. |
| Rarden | Clayey, mixed, mesic | Aquic Hapludults | Ultisols. |
| Sciotoville | Fine-loamy, mixed, mesic | Aquic Fragiudalfs | Alfisols. |
| Sees | Fine, mixed, mesic | Aquollic Hapludalfs | Alfisols. |
| Upshur | Fine, mixed, mesic | Typic Hapludalfs | Alfisols. |
| Vandalia [1] | Fine, mixed, mesic | Typic Hapludalfs | Alfisols. |
| Wellston | Fine-silty, mixed, mesic | Ultic Hapludalfs | Alfisols. |
| Westmore | Fine-silty, mixed, mesic | Typic Hapludalfs | Alfisols. |
| Westmoreland | Fine-loamy, mixed, mesic | Ultic Hapludalfs | Alfisols. |
| Wheeling | Fine-loamy, mixed, mesic | Ultic Hapludalfs | Alfisols. |
| Woodsfield | Fine, mixed, mesic | Typic Hapludalfs | Alfisols. |
| Woolper | Fine, mixed, mesic | Typic Argiudolls | Mollisols. |
| Zanesville | Fine-silty, mixed, mesic | Typic Fragiudalfs | Alfisols. |

[1] In this county these soils are taxadjuncts to the series for which they are named. *Chagrin soils* have a thin, darker colored A horizon than defined for the series. *Conotton soils* have a thinner solum than defined for the series. *Guernsey soils* lack the 2-chroma mottles in the upper 20 inches of the Bt horizon that are defined for the series. *Hackers soils* have a darker colored surface horizon and more coarse fragments in the solum than defined for the series. *Lindside soils* have a higher content of sand than defined for the series. *Vandalia soils* have a darker colored surface horizon than defined for the series.

for engineering purposes. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence.

SERIES.—The series is a group of soils that have major horizons that, except for texture of the surface layer, are similar in important characteristics and in arrangement of the profile.

## Laboratory Data

Profiles of six of the major soil series in Monroe County were sampled in the field for characterization analysis. One sample was taken for laboratory analysis from each of the representative horizons or layers in each soil. The analysis was made by the Ohio Agricultural Research and Development Center, Columbus, Ohio. Data from the laboratory analysis are given in table 10. A detailed description of each soil sampled is given either in the section "Description of the Soils" or in this section. The profile descriptions given in this section represent part of the range of the series, but are not as representative of the series in the county as the profile described in the series description. It should be noted that the descriptions are the field descriptions and vary from the data presented in table 10. The following paragraphs outline some of the procedures used to obtain the data presented in table 10.

Particle size was obtained by the pipette method outlined by Steele and Bradfield (*11*) but using hexametaphosphate as the dispersing agent and a 10-gram soil sample. All pH measurements were made by using a 1:1 soil-water ratio. The percentage of organic matter was determined by the wet oxidation procedures (*7*). Exchangeable calcium and magnesium were determined by the EDTA method (*4*). Potassium was determined by flame photometry. Exchangeable hydrogen, which also includes titratable aluminum, was determined by the triethanolamine method (*7*), and cation exchange capacity by the summation of exchangeable cations. Calcium carbonate equivalent was determined titrimetrically by the procedure of Hutchison and MacLennan (*8*).

In addition to the data given in table 10, the results of mechanical analysis are available for soils in the following series: Ashton, Brooke, Conotton, Coolville, Dekalb, Guernsey, Hartshorn, Huntington, Keene, Latham, Lindside, Newark, Rarden, Sciotoville, Westmore, Woodsfield, and Woolper. These data are on file at the Ohio Agricultural Research and Development Center in Columbus, Ohio; at the Ohio Department of Natural Resources, Division of Lands and Soil; and at the State office of the Soil Conservation Service.

TABLE 10.—*Physical and*

[Analyses made by the Ohio Agricultural Research and Development Center,

| Soil, sample number, and location | Horizon | Depth from surface | Particle-size distribution | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Very coarse sand (1 to 2 mm.) | Coarse sand (0.5 to 1 mm.) | Medium sand (0.25 to 0.5 mm.) | Fine sand (0.1 to 0.25 mm.) | Very fine sand (0.05 to 0.1 mm.) | Total sand (0.05 to 2 mm.) |
| | | *In.* | *Pct.* | *Pct.* | *Pct.* | *Pct.* | *Pct.* | *Pct.* |
| Dekalb loam: MN–W25. | A1 | 0–1½ | 1.5 | 3.7 | 6.1 | 24.8 | 13.0 | 49.1 |
| 1.5 miles W. and 0.25 mile N. of | A2 | 1½–5½ | 3.0 | 4.8 | 4.7 | 24.3 | 12.0 | 48.8 |
| Woodsfield, sec. 6, Center Town- | B1 | 5½–8 | 2.5 | 4.2 | 5.7 | 24.1 | 12.3 | 37.8 |
| ship. | B21 | 8–14 | 2.5 | 5.2 | 5.8 | 22.3 | 11.3 | 47.1 |
| | B22 | 14–20 | 3.6 | 7.9 | 6.3 | 21.3 | 10.1 | 49.2 |
| | B23 | 20–26 | 2.9 | 9.8 | 7.3 | 21.6 | 9.4 | 51.0 |
| | B3 | 26–31 | 3.7 | 8.7 | 7.5 | 20.4 | 8.8 | 49.1 |
| Gilpin silt loam: MN–10. | Ap | 0–3 | 3.1 | 1.4 | 1.3 | 3.3 | 4.6 | 13.7 |
| 5.9 miles W. and 3.9 miles S. of Woods- | Ap | 3–7 | 1.1 | 1.3 | 1.1 | 3.3 | 4.0 | 10.8 |
| field, sec. 26, Wayne Township. | B11t | 7–10 | .3 | 1.0 | 1.1 | 4.1 | 5.5 | 12.0 |
| | B12t | 10–13 | .4 | 1.7 | 2.0 | 6.4 | 6.4 | 16.9 |
| | B21t | 13–17 | .2 | 1.7 | 2.4 | 7.8 | 7.1 | 19.2 |
| | B22t | 17–22 | .4 | 1.3 | 1.6 | 6.9 | 11.7 | 21.9 |
| | B23t | 22–26 | .5 | 1.6 | 1.4 | 6.2 | 18.4 | 28.1 |
| | B3 | 26–29 | .6 | 1.9 | 1.9 | 9.1 | 20.0 | 33.5 |
| Guernsey silt loam: MN–24. | Ap1 | 0–2 | 1.2 | 1.9 | 1.2 | 3.5 | 3.3 | 11.1 |
| 250 feet W. of a point on Township | Ap2 | 2–6 | 1.8 | 2.2 | 1.2 | 3.4 | 3.3 | 11.9 |
| Road that is 1.2 miles NE. of State | B2t | 6–13 | .8 | 1.1 | .7 | 1.6 | 1.8 | 6.0 |
| Route 78, NW¼ sec. 9, Seneca | B2t | 13–20 | .7 | 1.2 | .7 | 1.6 | 1.9 | 6.1 |
| Township. | B3t | 20–25 | .1 | .4 | .3 | .9 | 1.4 | 3.1 |
| | C1 | 25–32 | ---------- | .2 | .2 | .7 | 1.2 | 2.3 |
| | C2 | 32–39 | .2 | .9 | .6 | 1.0 | .8 | 3.5 |
| | C3 | 39–49 | .4 | 1.5 | .8 | 1.0 | 1.4 | 5.1 |
| | C4 | 49–51 | .3 | 1.2 | 2.0 | 2.8 | 2.1 | 8.4 |
| | C5 | 51–60 | ---------- | .2 | .2 | .8 | 1.9 | 3.1 |
| Upshur silt loam: MN–48. | Ap1 | 0–1½ | 1.9 | 1.3 | .6 | 1.0 | 1.5 | 6.3 |
| 0.8 mile S. of junction of T–816 and | Ap2 | 1½–5 | 1.3 | .7 | .5 | .7 | 1.2 | 4.4 |
| County Road 58, NW¼ sec. 11, | B21t | 5–10 | .3 | .2 | .2 | .4 | .8 | 1.9 |
| Benton Township (representative | B22t | 10–17 | .2 | .1 | .1 | .3 | .8 | 1.5 |
| profile). | B3t | 17–26 | .1 | .1 | .7 | .4 | 1.1 | 2.4 |
| | C1 | 26–35 | ---------- | .1 | .2 | .7 | 1.4 | 2.4 |
| | C2 | 35–46 | ---------- | .1 | .2 | 2.7 | 5.5 | 8.5 |
| Westmoreland silt loam: MN–W6. | A1 | 0–2 | 3.0 | 2.1 | 1.6 | 3.1 | 2.7 | 12.5 |
| 4.1 miles W. and 1.6 miles S. of Woods- | A2 | 2–6 | 2.9 | 2.8 | 1.7 | 3.6 | 4.9 | 15.9 |
| field, SE¼ sec. 22, Wayne Township | B1 | 6–9 | 2.1 | 2.9 | 1.6 | 5.7 | 4.7 | 15.0 |
| (representative profile). | B21t | 9–14 | 1.9 | 3.0 | 1.5 | 2.9 | 4.4 | 13.7 |
| | B22t | 14–20 | 1.5 | 2.9 | 1.4 | 2.8 | 4.1 | 12.7 |
| | B23t | 20–26 | 2.0 | 3.1 | 1.4 | 2.8 | 4.1 | 13.4 |
| | B24t | 26–32 | 2.6 | 3.5 | 1.5 | 3.0 | 3.7 | 14.3 |
| | B25t | 32–38 | 2.4 | 3.1 | 1.7 | 3.6 | 4.6 | 15.4 |
| | C1 | 38–44 | 2.3 | 4.0 | 3.5 | 7.5 | 6.2 | 23.5 |
| | C2 | 44–56 | 2.4 | 5.4 | 4.1 | 8.4 | 6.4 | 26.7 |
| Woodsfield silt loam: MN–5. | Ap | 0–6 | .8 | .7 | .5 | 1.1 | 1.7 | 4.8 |
| 1.9 miles S. and 6.2 miles W. of | B1 | 6–13 | .2 | .6 | .3 | .6 | 1.1 | 2.8 |
| Woodsfield, sec. 34, Wayne Town- | B21t | 13–17 | .1 | .3 | .3 | 1.2 | 1.6 | 3.5 |
| ship. | B22t | 17–20 | .2 | .3 | .3 | 2.6 | 2.6 | 2.6 |
| | B3-C1 | 20–26 | .3 | .4 | .3 | 2.6 | 2.7 | 6.3 |
| | C1 | 26–33 | .2 | .5 | .4 | 1.1 | .3 | 2.5 |
| | C2 | 33–39 | .1 | .5 | .4 | 1.0 | 1.4 | 3.4 |
| | C3 | 39–49 | ---------- | 1.1 | 1.1 | 4.0 | 8.3 | 14.5 |
| | C4 | 49–58 | .4 | 1.0 | .7 | 1.6 | 4.8 | 8.5 |

*chemical data for selected soils*

Columbus, Ohio. Dashes indicate that no determination was made]

| Particle-size distribution—Continued | | | pH, 1:1 ($H_2O$) | Organic matter | Exchangeable cations (milliequivalents per 100 grams of soil) | | | | | | Base saturation |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Silt (0.002 to 0.05 mm.) | Clay (less than 0.002 mm.) | Fine clay (less than 0.0002 mm.) | | | H | Ca | Mg | K | Sum of exchangeable cations | Sum of bases | |
| *Pct.* | *Pct.* | *Pct.* | | *Pct.* | | | | | | | *Pct.* |
| 38.1 | 12.8 | 3.4 | 4.3 | 5.7 | 13.3 | 1.6 | 0.7 | 0.33 | 15.9 | 2.6 | 16 |
| 37.1 | 14.1 | 1.0 | 4.2 | 2.3 | 9.9 | .3 | .4 | .20 | 10.8 | .9 | 8 |
| 37.8 | 13.4 | .6 | 4.2 | 1.8 | 9.6 | .2 | .3 | .10 | 10.2 | .6 | 6 |
| 39.5 | 13.4 | .9 | 4.3 | .9 | 8.6 | .2 | .3 | .10 | 9.2 | .6 | 7 |
| 38.4 | 12.4 | .9 | 4.4 | .5 | 7.5 | .3 | .4 | .13 | 8.3 | .8 | 10 |
| 38.0 | 11.0 | .9 | 4.5 | .4 | 7.7 | .4 | .5 | .10 | 8.7 | 1.0 | 11 |
| 38.0 | 12.9 | 1.0 | 4.6 | ---- | 7.4 | 1.4 | .9 | .15 | 9.9 | 2.5 | 25 |
| 69.3 | 17.0 | 3.1 | 6.3 | 3.0 | 4.9 | 6.8 | 1.9 | .41 | 14.0 | 9.1 | 65 |
| 71.3 | 17.9 | 3.3 | 5.7 | 1.7 | 6.8 | 3.5 | 1.3 | .20 | 11.8 | 5.0 | 42 |
| 64.8 | 23.2 | 5.3 | 5.1 | 1.1 | 7.7 | 2.7 | .9 | .24 | 11.5 | 3.8 | 33 |
| 58.8 | 24.3 | 5.6 | 5.1 | .7 | 8.6 | 2.6 | .8 | .23 | 12.2 | 3.6 | 30 |
| 56.7 | 24.1 | 6.2 | 4.9 | .7 | 9.4 | 2.2 | .9 | .27 | 12.8 | 3.4 | 27 |
| 54.1 | 24.0 | 6.2 | 4.8 | ---- | 10.0 | 2.3 | 1.1 | .30 | 13.7 | 3.7 | 22 |
| 53.7 | 18.2 | 4.2 | 4.7 | ---- | 10.4 | 2.0 | 1.2 | .20 | 13.8 | 3.4 | 25 |
| 48.5 | 18.0 | 4.5 | 4.7 | ---- | 10.4 | 1.7 | 1.6 | .21 | 13.9 | 3.5 | 25 |
| 55.8 | 33.1 | 13.4 | 6.3 | 6.9 | 8.3 | 18.6 | 1.6 | .51 | 29.0 | 20.7 | 71 |
| 59.6 | 28.5 | 5.6 | 6.2 | 2.1 | 7.4 | 14.0 | 1.3 | .31 | 23.0 | 15.6 | 68 |
| 51.3 | 42.7 | 12.9 | 6.3 | .6 | 6.5 | 17.9 | 1.6 | .43 | 26.4 | 19.9 | 75 |
| 47.7 | 46.2 | 15.6 | 6.4 | .4 | 6.5 | 19.8 | 1.7 | .49 | 28.5 | 22.0 | 77 |
| 37.9 | 59.0 | 25.6 | 5.7 | .3 | 10.9 | 25.3 | 3.2 | .64 | 40.0 | 29.1 | 72 |
| 51.9 | 45.8 | 18.4 | 4.4 | ---- | 13.0 | 18.0 | 2.4 | .59 | 34.0 | 21.0 | 62 |
| 64.6 | 31.9 | 11.8 | 4.5 | ---- | 7.4 | 14.3 | 1.8 | .46 | 27.0 | 16.6 | 61 |
| 58.6 | 36.3 | 12.5 | 4.9 | ---- | 7.7 | 21.2 | 2.1 | .50 | 31.5 | 23.8 | 75 |
| 47.1 | 44.5 | 18.5 | 5.4 | ---- | 10.5 | 22.0 | 2.2 | .56 | 35.3 | 24.8 | 70 |
| 44.6 | 52.3 | 18.4 | 6.8 | ---- | 5.8 | 35.0 | 2.4 | .48 | 43.7 | 37.9 | 87 |
| 70.9 | 22.8 | 5.9 | 4.4 | 2.5 | 12.1 | 3.1 | 1.7 | .36 | 17.3 | 5.2 | 30 |
| 72.5 | 23.1 | 5.4 | 4.5 | 2.2 | 11.4 | 2.7 | 1.6 | .31 | 16.0 | 4.6 | 29 |
| 46.3 | 51.8 | 24.7 | 4.5 | .5 | 15.4 | 6.9 | 4.6 | .49 | 27.4 | 12.0 | 44 |
| 37.7 | 60.8 | 31.9 | 4.2 | .5 | 17.2 | 9.3 | 7.2 | .59 | 34.3 | 17.1 | 50 |
| 38.2 | 59.4 | 25.7 | 4.4 | .4 | 13.4 | 12.8 | 9.6 | .69 | 36.5 | 23.1 | 63 |
| 54.9 | 42.7 | 12.8 | 4.5 | ---- | 9.6 | 14.4 | 10.7 | .66 | 35.4 | 25.8 | 73 |
| 57.4 | 34.1 | 6.8 | 6.0 | ---- | 4.5 | 16.6 | 11.2 | .69 | 33.0 | 28.5 | 86 |
| 65.8 | 21.7 | 5.9 | 6.0 | 6.4 | 8.1 | 11.7 | 2.5 | .51 | 22.8 | 14.7 | 64 |
| 65.2 | 18.9 | 2.3 | 5.2 | 2.8 | 9.2 | 5.3 | 1.4 | .41 | 16.3 | 7.1 | 44 |
| 64.3 | 20.7 | 3.3 | 5.1 | 1.7 | 9.2 | 4.0 | 1.1 | .26 | 14.6 | 5.4 | 37 |
| 62.6 | 23.7 | 5.2 | 4.9 | .6 | 7.4 | 3.4 | 1.0 | .18 | 12.0 | 4.6 | 38 |
| 62.7 | 24.6 | 6.1 | 4.9 | ---- | 7.3 | 3.1 | 1.0 | .26 | 11.7 | 4.4 | 38 |
| 62.5 | 24.1 | 5.7 | 4.9 | ---- | 7.2 | 3.2 | 1.4 | .20 | 12.0 | 4.8 | 40 |
| 60.7 | 25.0 | 6.1 | 5.0 | ---- | 7.8 | 3.6 | 1.4 | .20 | 13.0 | 5.2 | 40 |
| 60.2 | 24.4 | 6.3 | 5.0 | ---- | 6.2 | 3.9 | 1.8 | .20 | 12.1 | 5.9 | 49 |
| 56.2 | 20.3 | 5.5 | 4.9 | ---- | 6.9 | 4.5 | 1.9 | .20 | 13.5 | 6.6 | 49 |
| 55.0 | 18.3 | 4.3 | 4.9 | ---- | 6.6 | 4.3 | 1.8 | .20 | 12.9 | 6.3 | 49 |
| 75.9 | 19.3 | 4.2 | 6.3 | 1.5 | 3.7 | 6.0 | 1.4 | .18 | 11.3 | 7.6 | 67 |
| 63.6 | 33.6 | 12.7 | 4.8 | .7 | 10.9 | 3.8 | 1.8 | .30 | 16.8 | 5.0 | 35 |
| 59.6 | 36.9 | 14.7 | 4.8 | .3 | 12.0 | 4.1 | 2.9 | .28 | 19.3 | 7.3 | 38 |
| 52.7 | 41.3 | 17.3 | 4.8 | ---- | 10.8 | 5.7 | 4.0 | .33 | 20.8 | 10.0 | 48 |
| 43.2 | 50.5 | 20.1 | 4.7 | ---- | 13.2 | 7.6 | 5.2 | .33 | 26.3 | 13.1 | 50 |
| 40.9 | 56.6 | 24.3 | 4.8 | ---- | 11.3 | 11.9 | 7.8 | .41 | 31.4 | 20.1 | 64 |
| 29.8 | 66.8 | 24.6 | 5.1 | ---- | 7.7 | 17.2 | 10.3 | .49 | 35.7 | 28.0 | 78 |
| 51.0 | 34.5 | 7.6 | 7.2 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| 55.1 | 36.4 | 6.1 | 7.7 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |

DEKALB SERIES

Typical profile of Dekalb loam (MN–W25), 1.5 miles west and 0.25 mile north of Woodsfield, sec. 6; Center Township.

A1—0 to 1½ inches, dark grayish-brown (10YR 4/2) loam; moderate, fine, granular structure; friable; many roots; 35 percent coarse material less than 1 inch in diameter; 60 percent of surface covered with flaggy sandstones less than 16 inches in diameter; pH 5.2; wavy boundary.

A2—1½ to 5½ inches, yellowish-brown (10YR 5/4) loam; weak, fine, granular structure and some platiness; friable; many roots; 40 percent coarse material less than 2 inches in diameter; pH 5.2; clear, smooth boundary.

B1—5½ to 8 inches, yellowish-brown (10Y 5/4) loam; weak, fine, subangular blocky structure; friable; many roots; 40 percent coarse material less than 3 inches in diameter; pH 5.2; clear, smooth boundary.

B21—8 to 14 inches, yellowish-brown (10YR 5/6) loam; light yellowish brown (10YR 6/4) when dry; moderate, fine, subangular blocky structure; firm; common roots; 50 percent coarse material less than 3 inches in diameter; about 30 percent of soil peds covered with white (10YR 8/2) siltlike coatings; pH 5.2; gradual, smooth boundary.

B22—14 to 20 inches, yellowish-brown (10YR 5/6) loam; light yellowish brown (10YR 6/4) when dry; weak, fine, subangular blocky structure; firm; common roots; 50 percent coarse material less than 3 inches in diameter; white (10YR 8/2) siltlike coatings cover about 30 percent of ped surfaces; pH 4.8; gradual, smooth boundary.

B23—20 to 26 inches, yellowish-brown (10YR 5/6) loam; light yellowish brown (10YR 6/4) when dry; weak, fine, subangular blocky structure; firm; common roots; 60 percent coarse material less than 3 inches in diameter; white (10YR 8/2) siltlike coatings cover about 30 percent of the ped surfaces; pH 4.8; gradual, smooth boundary.

B3—26 to 31 inches, yellowish-brown (10YR 5/4) loam; light yellowish brown (10YR 6/4) when dry; weak, fine, subangular blocky structure; firm; common roots; 75 percent coarse material less than 4 inches in diameter; white (10YR 8/2) siltlike coatings cover about 30 percent of ped surfaces; pH 5.0; clear, smooth boundary.

C&R—31 to 56 inches, fractured shale and sandstone make up 85 to 95 percent of the volume; shale is dark reddish brown (5YR 3/4); soil material and roots have penetrated the fractures.

GILPIN SERIES

Typical profile of Gilpin silt loam (MN–10), 5.9 miles west and 3.9 miles south of Woodsfield in sec. 26; Wayne Township.

Ap1—0 to 3 inches, dark-brown (10YR 4/3) silt loam; strong, fine and medium, platy structure (uppermost inch is somewhat granular); friable when moist, slightly hard when dry; many roots; pH 6.8; abrupt, smooth boundary.

Ap2—3 to 7 inches, dark-brown (10YR 4/3) silt loam; somewhat massive in place, parting to weak, medium, subangular blocky structure; firm when moist, hard when dry; many roots; pH 6.2; abrupt, smooth boundary.

B11—7 to 10 inches, dark yellowish-brown (10YR 4/4) grading toward dark-brown (7.5YR 4/4) heavy silt loam; moderate, fine, subangular blocky structure; firm; common roots; pH 5.2; clear, smooth boundary.

B12—10 to 13 inches, dark yellowish-brown (10YR 4/4) heavy silt loam; moderate, fine, subangular blocky structure; firm; common roots; pH 5.2; clear, smooth boundary.

B21t—13 to 17 inches, dark-brown (7.5YR 4/4) silty clay loam; moderate, medium, subangular blocky structure; fine; common roots; very patchy, thin clay films on ped faces; few coarse-grained sandstone fragments between depths of 13 and 26 inches; pH 5.2; clear, smooth boundary.

B22t—17 to 22 inches, dark-brown (7.5YR 4/4) light silty clay loam; moderate, medium, subangular blocky structure; firm; common roots; pH 5.2; clear, smooth boundary.

B23—22 to 26 inches, yellowish-brown (10YR 5/4) heavy loam; moderate, fine and medium, subangular blocky structure; firm; common roots; pH 5.2; clear, smooth boundary.

B3&R—26 to 29 inches, yellowish-brown (10YR 5/4) silt loam material in fractures between light olive-brown (2.5Y 5/4), fine-grained sandstone fragments; massive in place; friable; few roots; pH 5.2; clear, smooth boundary.

R—29 inches, unweathered sandstone; not sampled.

WOODSFIELD SERIES

Typical profile of Woodsfield silt loam (MN–5), 1.9 miles south and 6.2 miles west of Woodsfield, sec. 34; Wayne Township.

Ap—0 to 6 inches, dark-brown (10YR 4/3) silt loam mixed with some of the B1 horizon in the plow layer; somewhat massive in place, parting to weak, fine, granular and some platy structure; friable; many roots; pH 7.0; abrupt, smooth boundary.

B1—6 to 13 inches, yellowish-red (5YR 4/8) light silty clay loam; weak, fine, subangular blocky structure; friable; many roots; pH 6.6; clear, smooth boundary.

B21t—13 to 17 inches, strong-brown (7.5YR 5/6) silty clay loam; moderate, fine, subangular blocky structure; firm; common roots; clay films on ped surfaces; pH 6.6; clear, smooth boundary.

B22t—17 to 20 inches, reddish-brown (5YR 4/4) coarse clay; common, distinct, strong-brown (7.5YR 5/6) mottles; moderate, fine and medium, subangular blocky structure; firm; common roots; pH 5.6; clear, smooth boundary.

B3&C1—20 to 26 inches, weak-red (10R 4/4) clay; somewhat massive in place, breaking to weak, medium and coarse, subangular blocky structure; very firm; few roots; pH 5.6; gradual, smooth boundary.

C1—26 to 33 inches, weak-red (10R 4/4) clay; massive in place, breaking to weak, medium and coarse, subangular blocky structure; firm; pH 5.6; gradual, smooth boundary.

C2—33 to 39 inches, weak-red (10R 4/4) clay; massive; very firm; pH 6.2; clear, smooth boundary.

C3—39 to 49 inches, dusky-red (10R 3/3) clay loam; many, fine, prominent, olive (5Y 5/3) mottles; massive; very firm; pH 7.4; (bucket auger sample).

C4—49 to 58 inches, brown (10YR 5/3) clay loam; massive; extremely firm; strong effervescence with dilute hydrochloric acid; (bucket auger sample).

## *General Nature of the County*

Monroe County was formed in 1815 from parts of Belmont, Guernsey, and Washington Counties. Early settlers began moving into the county about 1791 and settled along the Ohio River in what is now Jackson Township. The early settlers cleared and farmed bottom lands first, then gradually worked back into the steeper uplands. By the year 1897, more than 75 percent of the county had been cleared and was being used mainly for pasture and cropland. The growth of the county was greatly influenced by the development of farmland, forests, and natural gas and oil.

The early settlers first used native sedgegrass and peavine as pasture and forage for livestock. They soon

cleared large tracts of forest for general farming. The production of cheese, milk, and livestock increased at a rapid pace as the land was cleared. In terms of acreage used, farming hit its peak in the late 1800's and early 1900's. In this period and in the years that followed, it was apparent that the farming methods commonly used were allowing excessive quantities of surface soil to wash from the cultivated fields each year. Active soil erosion became readily noticeable, and some of these scars are evident today. Farming methods changed with the development and use of soil and water conservation practices. Today, active soil erosion is not common in the county. This, in part, is because several thousand acres of once intensively farmed areas have been abandoned for farming and allowed to reforest naturally, or they have been replanted with trees. In 1959, according to the U.S. Bureau of the Census, Monroe County had 1,226 farms and the average size of the farm was 130.3 acres. Most farms were of the general type. A crop rotation system commonly used on these farms consists of corn, wheat or oats, and 2 or more years of grass-legume meadow.

A study conducted by the Soil Conservation Service in 1959 showed that the distribution of the 291,200 acres in Monroe County was as follows: 58,016 acres in cropland; 78,480, pasture; 128,000, forest; and 26,704 acres, miscellaneous uses.

Most of the farms in the county are general-type farms. There are also livestock farms, dairy farms, and poultry farms. A small acreage is planted to tobacco, but the main crops are corn, wheat, oats, and hay.

The three main industries in Monroe County are aluminum reduction, aluminum processing, and iron processing. Ferrous-silicon products are produced for the iron and steel industry, and silicon is produced for the aluminum and chemical industries. There are also sawmills, stave mills, a livestock market, a major gravel pit, and a limestone quarry.

There are a few acres of strip mines and some deep-shaft mining in Monroe County. The oil and gas industry is also important in the county.

There are no interstate highways in Monroe County; however, Interstate Highway 70 is 25 miles north of Woodsfield, and Interstate Highway 77 is 28 miles west. Commercial transportation is provided by barges on the Ohio River and by a railroad.

## Physiography, Relief, Geology, and Drainage

Monroe County is in the unglaciated, dissected Allegheny Plateau region of Ohio. The physiographic features have resulted largely through the processes of uplift and erosion. Most of the county has been thoroughly dissected by drainageways that have cut steep, V-shaped valleys and narrow ridgetops. In the north-central part of the county and near drainage divides, the hills are less steep and the ridgetops are wider than in the rest of the county.

The average relief of the county is about 600 feet. The highest point in the county, 1,416 feet, is in section 24 of Sunsbury Township (*18*). The normal pool level of the Ohio River at Fly is 594 feet.

The rock strata of the county are classified into the Greene and Washington Formations of the Permian System and the Monongahela and Conemaugh Formations of the Pennsylvanian System (*5*). Rock layers of the Conemaugh Formation, principally limestone, are at the lower elevations in Seneca Township. Bedrock strata of the Monongahela Formation are located at the lower elevations along Clear Fork and other major streams. This formation is capped by bedrock layers of the Washington Formation. Bedrock strata of the Greene Formation caps the ridgetops and knolls in the central and eastern parts of the county. The Greene Formation is the highest strata of consolidated bedrock in Ohio.

The northwestern part of the county is drained by Wills Creek and its tributaries. The southwestern part of the county is drained by the Little Muskingum and its tributaries, principally Clear Fork, Indian Run, Rich Fork, Straight Fork, and Witten Run. Most of the northern and eastern parts of the county are drained by Sunfish Creek and Opossum Creek.

## Water Supply

Water for industrial use and transportation is available along the Ohio River. The rest of Monroe County is well supplied with surface streams. These streams help to meet local needs but are not large enough for extensive industrial use.

The city of Woodsfield has two reservoirs for its water supply. The other towns in the county depend upon wells for their water. Wells adjacent to the Ohio River and within the influence or recharge from the river are capable of furnishing large amounts of water. More than 90 percent of the county is underlain by bedrock formations that yield little or no water. Most wells yield less than 2 gallons per minute, although a few sandstones may yield up to 5 gallons per minute.

Most farms in the county have one or more good springs suitable for livestock or domestic use. Springs are especially strong and more numerous in areas underlain mainly by limestone bedrock.

Runoff water is available if suitable ponds can be provided.

## Climate [5]

Weather data are not readily available for places within Monroe County. However, data from Senecaville, Ohio, to the west of the county, and from New Martinsville, West Virginia, to the east, are fairly representative of weather conditions in Monroe County. These data are shown in tables 11 and 12. Table 11 gives temperature and precipitation data summarized from observations made at nearby weather stations. Table 12 shows the probability of low temperatures at Senecaville Dam, Noble County, on or after given dates in spring and on or before given dates in fall.

The climate of Monroe County is classified as continental. Such a climate is characteristic of the interior of a land mass the size of North America. It is marked by large annual, daily, and day-to-day ranges in temperature. Summers are moderately warm and humid.

[5] By Marvin E. Miller, climatologist for Ohio, National Weather Service, U.S. Department of Commerce.

TABLE 11.—*Temperature and precipitation data*

[All data concerning precipitation and average monthly maximum and minimum temperatures are based on records kept at Senecaville Dam (elevation 832 feet) in Noble County, Ohio; based on records for the period 1940–65. The rest are based on an average of the data kept at Senecaville Dam and at New Martinsville (elevation 620 feet) in West Virginia; based on records for the period 1931–60]

| Month | Temperature | | | | Precipitation | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Average daily maximum | Average daily minimum | Average monthly maximum | Average monthly minimum | Average total | One year in 10 will have— | | Average snowfall | Average number of days with 1 inch or more of snow |
| | | | | | | Less than— | More than— | | |
| | °F. | °F. | °F. | °F. | In. | In. | In. | In. | |
| January | 40. 8 | 22. 0 | 61 | −3 | 2. 75 | 0. 98 | 4. 91 | 7. 7 | 3 |
| February | 42. 6 | 22. 3 | 63 | 0 | 2. 52 | 1. 11 | 4. 18 | 5. 7 | 2 |
| March | 52. 5 | 29. 7 | 74 | 10 | 3. 73 | 1. 52 | 6. 39 | 5. 2 | 2 |
| April | 64. 9 | 39. 2 | 82 | 20 | 3. 62 | 1. 93 | 5. 56 | . 8 | (1) |
| May | 75. 2 | 49. 1 | 87 | 30 | 3. 86 | 2. 10 | 5. 86 | 0 | 0 |
| June | 83. 0 | 57. 9 | 91 | 41 | 4. 78 | 2. 29 | 7. 68 | 0 | 0 |
| July | 86. 3 | 61. 7 | 93 | 47 | 4. 21 | 2. 37 | 6. 30 | 0 | 0 |
| August | 85. 2 | 59. 8 | 93 | 43 | 3. 32 | 1. 14 | 6. 00 | 0 | 0 |
| September | 79. 7 | 53. 4 | 90 | 32 | 2. 46 | . 76 | 4. 58 | 0 | 0 |
| October | 68. 5 | 41. 8 | 82 | 23 | 2. 37 | . 82 | 4. 28 | 0 | 0 |
| November | 53. 9 | 32. 4 | 73 | 12 | 2. 60 | 1. 37 | 4. 00 | 2. 9 | 1 |
| December | 42. 4 | 24. 0 | 62 | −1 | 2. 54 | . 95 | 4. 48 | 6. 4 | 2 |
| Year | 64. 6 | 41. 1 | 95 | −8 | 38. 76 | 31. 52 | 46. 49 | 28. 7 | 10 |

[1] Less than one-half day.

TABLE 12.—*Probability of low temperatures in spring and fall*

[All data from Senecaville Dam in Noble County; elevation 832 feet]

| Probability | Dates for given probability and temperature | | | | |
|---|---|---|---|---|---|
| | 16° F. or lower | 20° F. or lower | 24° F. or lower | 28° F. or lower | 32° F. or lower |
| Spring: | | | | | |
| 1 year in 10 later than | April 1 | April 14 | April 25 | May 6 | May 21 |
| 2 years in 10 later than | March 26 | April 9 | April 20 | May 2 | May 17 |
| 5 years in 10 later than | March 11 | March 29 | April 9 | April 22 | May 6 |
| Fall: | | | | | |
| 1 year in 10 earlier than | October 31 | October 24 | October 13 | September 25 | September 14 |
| 2 years in 10 earlier than | November 6 | October 29 | October 18 | October 1 | September 19 |
| 5 years in 10 earlier than | November 20 | November 11 | October 31 | October 13 | September 30 |

In an average summer the temperature reaches 90° F. or more on about 15 days. Winters are generally cold and cloudy. An average winter has 5 days when the temperature is below zero.

Because the terrain of Monroe County is rugged and hilly, the dates of selected spring and fall temperatures can vary from those dates shown in table 12. Valley locations generally have the latest freezes in spring and the earliest in fall, because on nights with clear skies and light winds, cool air flows down the slopes into the valleys. Light frost can form when the temperature is as high as 36°. This is commonly the case because most thermometers are placed about 5 feet above the ground, and the colder air sinks to ground level and is below the thermometer itself.

Characteristic of continental climates, precipitation in Monroe County varies widely from year to year. It is normally abundant and well distributed throughout the year. Fall is the driest season. Showers and thundershowers account for most of the rainfall during the growing season. Thunderstorms occur on about 45 days each year. Most of these occur between May and August. Most precipitation during winter is in the form of rain.

Except for small grains and hay, crops are generally planted during the period from late in April through May. During a 10-year period, rainfall excess of 1.2 inches can be expected nine times in April and 11 times in May. Rains of this magnitude delay field operations and may cause soil loss, for this is a time when vegetative cover is lacking.

Since 1929, moderate to severe droughts, as determined from the Palmer Drought Severity Index, have occurred in Monroe County during the growing seasons of 1930, 1931, 1932, 1934, 1936, 1953, 1954, 1962, and 1965.

The longest period of moderate to severe drought on record is 18 months (June 1930 through November 1931 and February 1953 through July 1954).

Soil moisture goes through a seasonal cycle each year that is almost independent of the amount of precipitation received. It reaches its lowest point in October and is replenished during winter and spring when precipitation exceeds water loss by evaporation. Since the water needs of all crops reach a maximum in July and August and rainfall is always insufficient to meet those needs, there is a progressive drying of all soils.

Generally, humidity rises and falls inversely with the daily temperature and is lowest in summer and highest in winter. During most summer days, afternoon relative humidity is most often in the range between 45 and 55 percent. For the year, relative humidity averages about 80 percent at 1 a.m. and 7 a.m., 55 percent at 1 p.m., and 70 percent at 7 p.m. Because of the terrain of Monroe County, heavy fog that restricts visibility to less than one-fourth mile is variable but is much more common in valleys than on ridges. It is most frequent in summer and fall. In an average year in Monroe County, there are 110 clear days (0 to 30 percent cloudiness), 103 partly cloudy days (30 to 70 percent cloudiness), and 152 cloudy days (more than 70 percent cloudiness). The prevailing wind is from the southwest, and the average windspeed is about 7 miles per hour. Damaging winds of 35 to 80 miles per hour are most often associated with migrating thunderstorms.

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## Glossary

**Alluvium.** Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

**Available water capacity** (also termed 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 capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

**Base saturation.** The degree to which material that has base-exchange properties is saturated with exchangeable cations other than hydrogen, expressed as a percentage of the cation-exchange capacity.

**Cation.** An ion carrying a positive charge of electricity. The common soil cations are calcium, magnesium, sodium, potassium, and hydrogen.

**Cation-exchange capacity.** A measure of the total amount of exchangeable cations that can be held by the soil. It is 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 its meaning.

**Channery soil.** A soil that contains thin, flat fragments of sandstone, limestone, or schist, as much as 6 inches in length along the longer axis. A single piece is called a fragment.

**Clay.** As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

**Colluvium.** Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

**Concretions.** Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

**Consistence, soil.** The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

*Loose.*—Noncoherent when dry or moist; does not hold together in a mass.

*Friable.*—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

*Firm.*—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

*Plastic.*—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

*Sticky.*—When wet, adheres to other material and tends to stretch somewhat and pull apart, rather than to pull free from other material.

*Hard.*—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

*Soft.*—When dry, breaks into powder or individual grains under very slight pressure.

*Cemented.*—Hard and brittle; little affected by moistening.

**Drainage, surface.** Runoff, or surface flow, of water from an area.

**Erosion.** The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

**First bottom.** The normal flood plain of a stream, subject to frequent or occasional flooding.

**Flood plain.** Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

**Fragipan.** A loamy, brittle, subsurface horizon that is very low in organic matter and clay but is rich in silt or very fine sand. The layer is seemingly cemented. When dry, it is hard or very hard and has a high bulk density in comparison with the horizon or horizons above it. When moist, the fragipan tends to rupture suddenly if pressure is applied, rather than to deform slowly. The layer is generally mottled, is slowly or very slowly permeable to water, and has few or many bleached fracture planes that form polygons. Fragipans are a few inches to several feet thick; they generally occur below the B horizon, 15 to 40 inches below the surface.

**Gravelly soil material.** From 15 to 50 percent of material, by volume, consists of rounded or angular rock fragments that are not prominently flattened and are up to 3 inches in diameter.

**Horizon, soil.** A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

*O horizon.*—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

*A horizon.*—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

*B horizon.*—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

*C horizon.*—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

*R layer.*—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

**Infiltration.** The downward entry of water into the immediate surface of the 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. It may be limited either by the infiltration capacity of the soil or by the rate at which water is applied to the surface soil.

**Leaching.** The removal of soluble materials from soils or other material by percolating water.

**Loess.** A fine-grained eolian deposit consisting dominantly of silt-sized particles.

**Mineral soil.** Soil composed mainly of inorganic (mineral) material and low in content of organic material. Its bulk density is greater than that of organic soils.

**Mottled.** Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of 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 these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6) inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

**Natural soil drainage.** Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

*Excessively drained* soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

*Somewhat excessively drained* soils are also very permeable and are free from mottling throughout their profile.

*Well-drained* soils are nearly free from mottling and are commonly of intermediate texture.

*Moderately well-drained* soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

*Somewhat poorly drained* soils are wet for significant periods but not all the time, and in Podzolic soils commonly have mottlings below 6 to 16 inches, in the lower A horizon and in the B and C horizons.

*Poorly drained* soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

*Very poorly drained* soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

**Munsell notation.** A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, value of 6, and a chroma of 4.

**Parent material.** The disintegrated and partly weathered rock from which soil has formed.

**Permeability.** The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are as follows: *Very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

**Profile, soil.** A vertical section of the soil through all its horizons and extending into the parent material.

**Reaction, soil.** The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid or alkaline. An acid, or "sour" soil is one that gives an acid reaction. In words, the degrees of acidity or alkalinity are expressed thus:

| | *pH* | | *pH* |
|---|---|---|---|
| Extremely acid | Below 4.5 | Neutral | 6.2 to 7.3 |
| Very strongly acid | 4.5 to 5.0 | Mildly alkaline | 7.4 to 7.8 |
| Strongly acid | 5.1 to 5.5 | Moderately alkaline | 7.9 to 8.4 |
| Medium acid | 5.6 to 6.0 | Strongly alkaline | 8.5 to 9.0 |
| Slightly acid | 6.1 to 6.5 | Very strongly alkaline | 9.1 and higher |

**Residual material.** Unconsolidated, partly weathered mineral material that accumulates over disintegrating solid rock. Residual material is not soil but is frequently the material in which a soil has formed.

**Root zone.** The part of the soil that is penetrated, or can be penetrated, by plant roots.

**Runoff** (hydraulics). The part of the precipitation upon a drainage area that is discharged from the area in stream channels. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground

before reaching surface streams is called ground-water runoff or seepage flow from ground water.

**Sand.** Individual rock or mineral fragments in soils having diameters ranging from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

**Silt.** Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

**Soil separates.** Mineral particles, less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *Very coarse sand* (2.0 to 1.0 millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10) millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.05 to 0.002 millimeter); and *clay* (less than 0.002 millimeter). The separates recognized by the International Society of Soil Science are as follows: I (2.0 to 0.2 millimeter); II (0.2 to 0.02 millimeter); III (0.2 to 0.002 millimeter); IV (less than 0.002 millimeter).

**Solum.** The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

**Stony.** Used to describe soils that contain stones in numbers that interfere with or prevent tillage.

**Stratified.** Composed of, or arranged in, strata, or layers, such as stratified alluvium. The term is confined to geological material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

**Structure, soil.** The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. 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 (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

**Subsoil.** Technically, the B horizon; roughly, the part of the solum below plow depth.

**Substratum.** Technically, the part of the soil below the solum.

**Terrace** (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

**Texture, soil.** The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportions 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."

**Tilth, soil.** The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

**Topsoil.** A presumed fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

**Upland** (geology). Land consisting of material unworked by water in recent geologic time and lying, in general, at a higher elevation than the alluvial plain or stream terrace. Land above the lowlands along rivers.

**Water table.** The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

**Weathering soil.** All physical and chemical changes produced in rocks at or near the earth's surface by atmospheric agents. These changes result in more or less complete disintegration and decomposition of the rock.